Class	Index Number	Name

ANG MO KIO SECONDARY SCHOOL
MID-YEAR EXAMINATION 2016
SECONDARY THREE EXPRESS

MATHEMATICS **4048/01**
Paper 1

Monday **09 May 2016** **2 hours**

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use highlighters, glue or correction fluid.

Answer **all** questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
Calculators should be used where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is **80**.

For Examiner's Use
80

This document consists of **16** printed pages

Mathematical Formulae

Compound interest

$$\text{Total amount} = P\left(1+\frac{r}{100}\right)^n$$

Mensuration

$$\text{Curve surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector Area} = \frac{1}{2}r^2\theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

1 (a) Calculate $\dfrac{\sqrt[3]{0.1257}-0.258^2}{1.5^{3.41}}$.

Write down the first six digits on your calculator display.

Answer (a) ____________________ [1]

(b) Write your answer to part **(a)** correct to 4 significant figures.

Answer (b) ____________________ [1]

---

2 Factorise completely $12x^2y^2-1-3x^2+4y^2$.

Answer ____________________ [2]

---

3 Cider costs p cents per litre.

Given that a barrel can contain q cm^3 of cider, find an expression, in terms of p and q, for the cost of a barrel of cider in dollars.

Answer \$ ____________________ [3]

---

4 **(a)** Given that $25^{15} \div 125 = 5^k$, find k.

Answer *(a)* $k =$ ____________________ [1]

(b) Simplify

(i) $\dfrac{x^0}{y^2} \div \dfrac{3}{y^3}$,

Answer *(b)(i)* ____________________ [2]

(ii) $2 \div \dfrac{6}{5x^{-3}}$.

Answer *(b)(ii)* ____________________ [2]

(c) Simplify $\sqrt[6]{x^7} + \dfrac{\sqrt{x^5}}{\sqrt[3]{x^4}}$, leaving your answer in radical form.

Answer *(c)* ____________________ [3]

5 Simplify $\frac{2}{(1-2x)^2}-\frac{3}{2x-1}$.

Answer ______________________ [2]

6 Written as the product of their prime factors,

$$a = 2^2 \times 5 \times 7,$$
$$b = 2 \times 3 \times 5^3,$$
$$c = 2^2 \times 3^2 \times 5^2.$$

Find

(a) the value of the square root of c,

Answer (a) ______________________ [1]

(b) the LCM of a, b and c, giving your answer as the product of its prime factors,

Answer (b) ______________________ [1]

(c) the greatest number that will divide a, b and c exactly.

Answer (c) ______________________ [1]

7 The scale of a map is 2.5 cm : 0.5 km.

(a) Write this scale in the form 1 : n.

Answer *(a)* ____________________ [1]

(b) The distance between two villages on the map is 12.5 cm.

Find the actual distance, in kilometres, between the two villages.

Answer *(b)* _______________ km [1]

(c) A reservoir has an actual area of 7.5 km^2.

Find the area, in square centimetres, of the reservoir on the map.

Answer *(c)* _______________ cm^2 [2]

---

8 **(a)** Express $x^2 - 12x + 9$ in the form $(x + a)^2 + b$.

Answer *(a)* ____________________ [1]

(b) **Hence** solve the equation $x^2 - 12x + 9 = 0$, giving your answers correct to two decimal places.

Answer *(b)* $x =$ __________ or ____________ [3]

---

9 Solve the simultaneous equations

$$5x + 6y = 9,$$
$$7y + 8x = 17.$$

Answer $x =$ ____________________

$y =$ ____________________ [3]

10 **(a)** Solve the inequality $x-2<2x+7\le\frac{3x+8}{3}$.

Answer *(a)* ______________________ [3]

(b) **Hence** write down the smallest integer value of x which satisfies $x-2<2x+7\le\frac{3x+8}{3}$.

Answer *(b)* ______________________ [1]

---

11 Operating on their own, pipe A and pipe B can fill a tanker with petrol in 5 minutes and 7 minutes respectively.

Find the time taken for the tanker to be filled by the two pipes operating together.

Answer __________ mins __________ s [3]

---

12 In a survey, a group of students were asked how many siblings they have.The number is shown in the table below.

Number of siblings	0	1	2	3	4
Number of students	24	28	$2x-3$	7	3

(a) Write down the largest possible value of x if the modal number of siblings is 1.

Answer *(a)* $x =$ ________________ [1]

(b) Write down the smallest possible value of x if the median number of siblings is 2.

Answer *(b)* $x =$ ________________ [1]

(c) Calculate the value of x if the mean number of siblings is 1.

Answer *(c)* $x =$ ________________ [2]

---

13 Solve the equation $\frac{3x-4}{3}+\frac{4}{7}=\frac{x-5}{5}$.

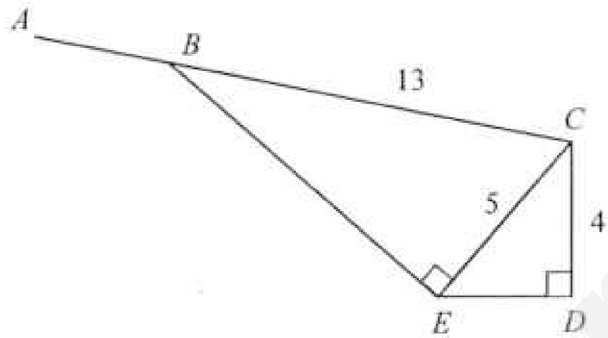
Answer $x =$ ________________ [2]

---

14 Angle $BEC = 90°$ and angle $CDE = 90°$.

CB is produced to A.

$CE = 5$ cm, $BC = 13$ cm and $DE = 3$ cm.



Write down

(a) $\sin \angle DEC$,

Answer *(a)* $\sin \angle DEC =$ ____________ [1]

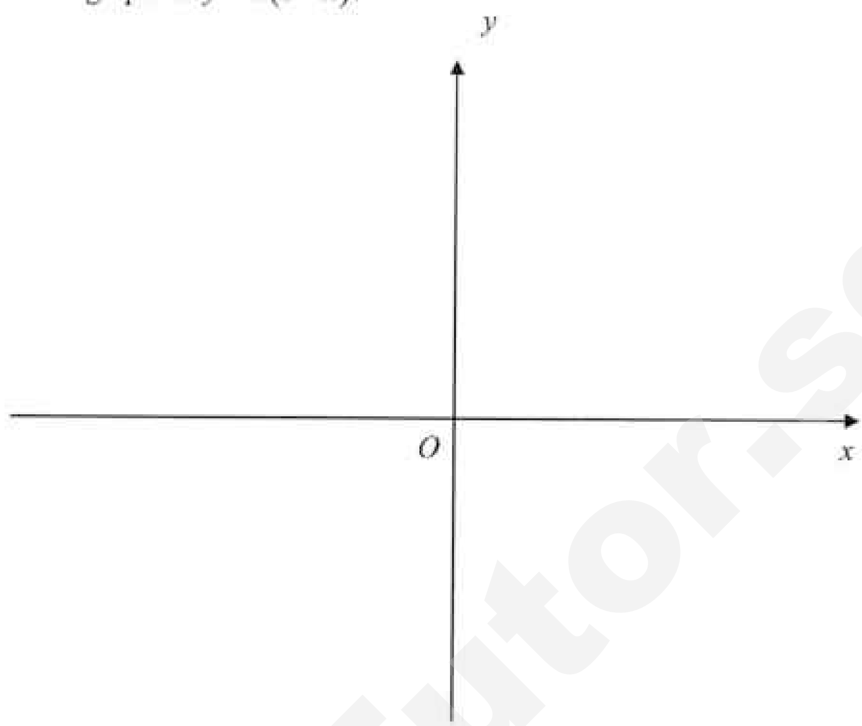
(b) $\tan \angle BCE$,

Answer *(b)* $\tan \angle BCE =$ ____________ [2]

(c) $\cos \angle ABE$.

Answer *(c)* $\cos \angle ABE =$ ____________ [1]

15 (a) (i) Sketch the graph of $y = x(6 - x)$.

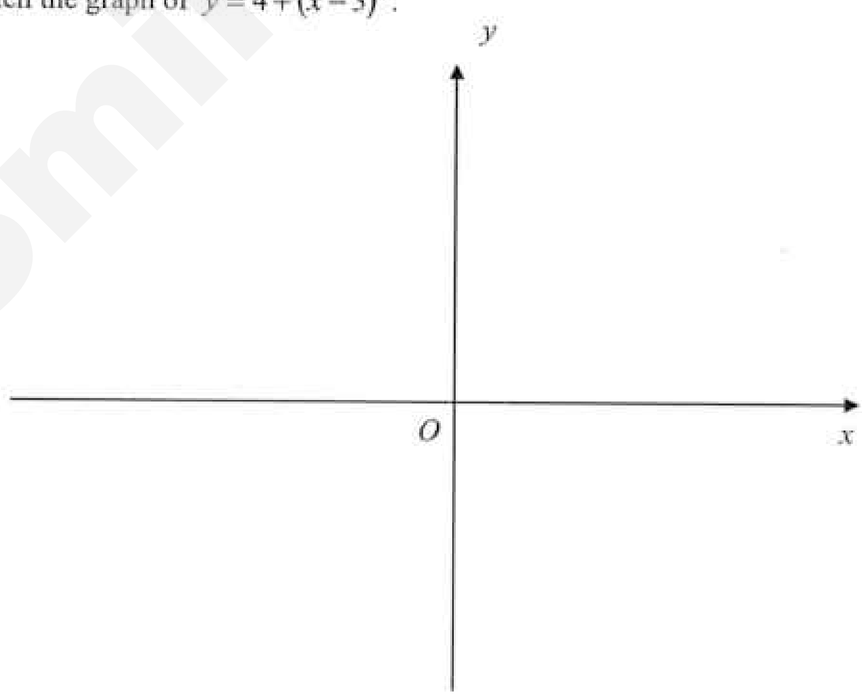


[2]

(ii) Write down the equation of the line of symmetry of $y = x(6 - x)$.

Answer *(a)(ii)* ______________________ [1]

(b) (i) Sketch the graph of $y = 4 + (x - 3)^2$.



[2]

(ii) Write down the coordinates of the minimum point of the curve.

Answer *(b)(ii)* (________ , ________) [1]

16 According to studies, the Earth has witnessed five major mass extinctions.

(a) The first major mass extinction, the End Ordovician event and the last major mass extinction, the End Cretaceous event happened 0.44 billion and 66 million years ago respectively.

Find the number of years between the two events.

Give your answer in standard form.

Answer (a) ________________ years [1]

(b) During the Cretaceous period, ammonite, a spherical organism of diameter 2.5 millimetres thrived in the ocean.

Calculate the volume of an ammonite in cubic centimetres.

Answer (b) ________________ cm^3 [2]

(c) The Cretaceous period ended when an asteroid impacted the Earth.

Given that the asteroid travelled 8325 millimetres in an hour, calculate the speed of the asteroid.

Express your answer in kilometres per second.

Answer (c) ________________ km/s [2]

17 A train departs from Moscow, Russia and arrives at Nice, France in 51 hours and 53 minutes.
When the local time in Moscow is 1.13 am, Wednesday, the local time in Nice is 11.13 pm, Tuesday.

(a) The train left Moscow at 10.13 pm, Monday local time.
What was the local time and day in Nice when it arrived?

Answer (a) ______________ , ______________ [2]

(b) The train travelled a total distance of 3281 km.
Find the average speed, in kilometres per hour, of the train.

Answer (b) ______________________ km/h [2]

18 The surface tension of a water droplet, B units, is directly proportional to the square of its radius, r cm.
The surface tension is 1 unit when the radius of the water droplet is R cm.
Find the percentage increase in the surface tension of the water droplet when the radius is $4R$ cm.

Answer ______________________ % [3]

19 Paul has a bag of marbles. He divided the marbles into three boxes, A, B and C.
The total number of marbles in box A and B as compared to the marbles in box C is in the ratio of 7 : 5, and the total number of marbles in box B and C as compared to the marbles in box A is in the ratio of 13 : 8.
Given that there are 34 marbles in box B, find the total number of marbles in the bag.

Answer __________________ marbles [3]

---

20 **(a)** Krystal bought a camera at a cost price of $1188 from the warehouse.
Given that she wants to make a 28% profit, calculate the selling price of the camera.

Answer *(a)* $ __________________ [2]

(b) Krystal also had a meal at a restaurant which amounted to $129.90 after a service charge of 10 % and a Goods and Service Tax (GST) of 7%.
Calculate the cost price of the meal **exclusive** of the service charge and GST.

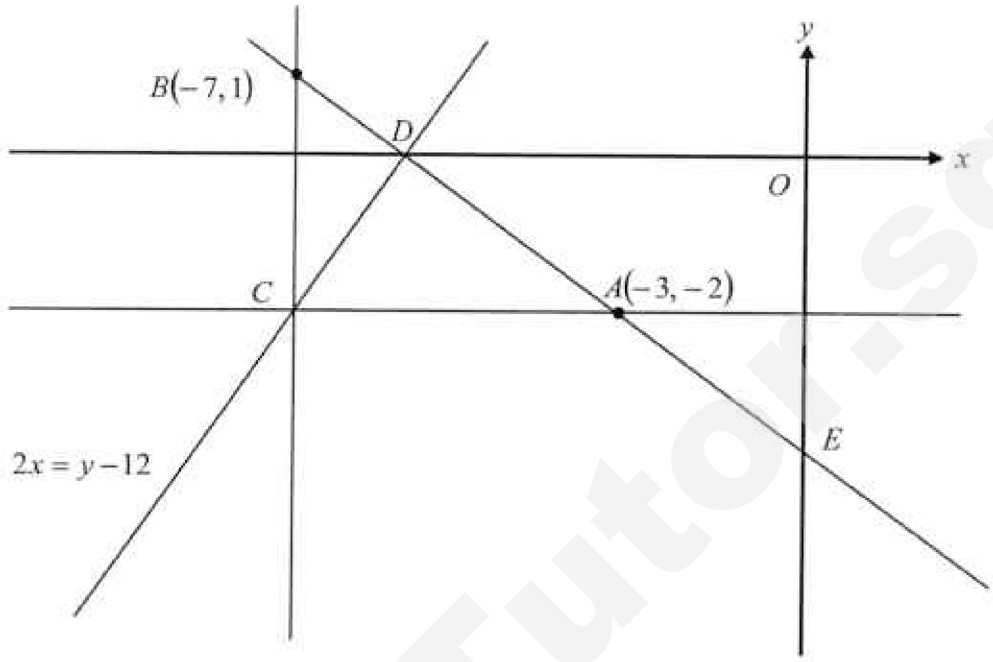
Answer *(b)* $ __________________ [2]

---

21 The line CD has an equation $2x = y - 12$ and cuts the x-axis at D.

The line AD cuts the x-axis and y-axis at D and E respectively.

Given that the line AC is parallel to the x-axis and the line BC is parallel to the y-axis, find



(a) the coordinates of C,

Answer *(a)* (________ , ________) [1]

(b) the equation of the line AC,

Answer *(b)* ________________________ [1]

(c) the coordinates of D,

Answer *(c)* (________ , ________) [1]

21(d) is on the next page

(d) the length of the line AB,

Answer *(d)* ________________ units [1]

(e) the equation of the line AB,

Answer *(e)* ______________________ [2]

(f) the coordinates of E.

Answer *(f)* (_______ , _______) [1]

END OF PAPER

Class	Index Number	Name

ANG MO KIO SECONDARY SCHOOL
MID-YEAR EXAMINATION 2016
SECONDARY THREE EXPRESS

MATHEMATICS **4048/02**
Paper 2

Friday **06 May 2016** **2 hours 30 minutes**

Additional Materials: Answer Paper

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 100.

This document consists of **12** printed pages.

Mathematical Formulae

Compound interest

$$\text{Total amount} = P\left(1+\frac{r}{100}\right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi rl$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

Answer **all** the questions.

1 **(a)** Solve the equations

(i) $3x^2 - 507 = 0$, [2]

(ii) $\dfrac{x-2}{x+3} - \dfrac{x-3}{12+4x} = 5$. [3]

(b) The equation for calculating the focal length of a lens is given by

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}.$$

(i) Find the value of f when $u = 4\times10^{-2}$ and $v = 1.2\times10^{-1}$. [1]

(ii) Express v in terms of f and u. [2]

(c) Given that $\dfrac{8m+3n}{3n-2m} = \dfrac{3}{2}$, find the value of $\dfrac{m}{n}$. [2]

(d) Given that $x - 2y = 3$ and $x^2 + 4y^2 = 1$, find the value of xy. [2]

(e) At a games carnival, the prices of tickets for adults and children are \$2.40 and \$1.60 respectively.
The number of adult tickets and children tickets sold can be represented by a and c respectively.

(i) On a particular day, the total number of adult tickets sold is 30 less than the number of children tickets sold.
Write down an equation in a and c to represent this information. [1]

(ii) If on the same day the total sales of tickets amount to \$228, write down an equation in a and c to represent this information. [1]

(iii) Solve these two equations to find the number of adult and children tickets sold on that day. [3]

2 **(a)** Simplify the following expressions, leaving your answers in positive index where necessary.

(i) $\frac{1}{9c^{-2}} \times \frac{(3d)^{-1}}{c^3}$ [2]

(ii) $\frac{5f^2g^3}{21gh} \div \frac{40f^5g^2}{7h^3}$ [2]

(b) Given that x and y are integers such that $-7 \le x < 3$ and $-2 \le y \le 3$, calculate

(i) the greatest value of $x + y$, [1]

(ii) the least value of xy, [1]

(iii) the greatest value of $x^2 - y^2$. [1]

(c) Peter can make z waffles in 1 hour. In the same amount of time, Bruce is able to make 2 more waffles than Peter. On a particular day, both Peter and Bruce made not more than 126 waffles in the span of 2 hours and 15 minutes.

(i) Using the above information, form an inequality in z, and solve it. [2]

(ii) Hence, find the maximum number of waffles that Bruce can make in 1 hour. [1]

3 Penny works in a cheesecake cafe that pays her a wage of $\$x$ per hour.
In March, her salary was \$2000.

(a) Write down an expression in terms of x, for the number of hours she worked in March. [1]

(b) From April onwards, Penny's wage was increased by \$1.50 per hour. If she also received \$2000 in April, write down an expression in terms of x, for the number of hours she worked in April. [1]

(c) If Penny worked 13 hours less in April than in March, form an equation in x and show that it reduces to

$$26x^2 + 39x - 6000 = 0.$$ [3]

(d) Solve the equation $26x^2 + 39x - 6000 = 0$, giving both answers correct to two decimal places. [3]

(e) Calculate the minimum number of hours Penny needs to work in May if she aims to earn a salary of at least \$3000. [1]

4 **(a)** Leonard deposits \$7000 in a bank that gives a compound interest of 0.8% per annum.
Calculate the total amount of money Leonard will receive after 8 years. [2]

(b) Rajesh has \$7000. He decides to open a toy shop that will cost him \$30000.
He borrows the remaining amount from a bank that charges him 2.5% simple interest per annum for 8 years.
Calculate the monthly installment that Rajesh needs to pay the bank. [3]

(c) Sheldon wants to invest €7000 in currency exchange. He decides to change his Euros (€) to Swedish Kroner (SKR). In June, he changes the money at a rate of €1 = 6.03 SKR. In July, the exchange rate changes to €1 = 5.71 SKR.
If Sheldon exchanges all his money back to Euros in July, calculate the profit that he earns in Euros. [2]

(d) Steward bought a motorcycle that cost \$7000.
The value of the motorcycle depreciated by 12% during the first year.
In the second year, the motorcycle further depreciated by 20% of its new value.
If Steward sold off his motorcycle at the end of the second year, calculate the amount of money that he lost. [2]

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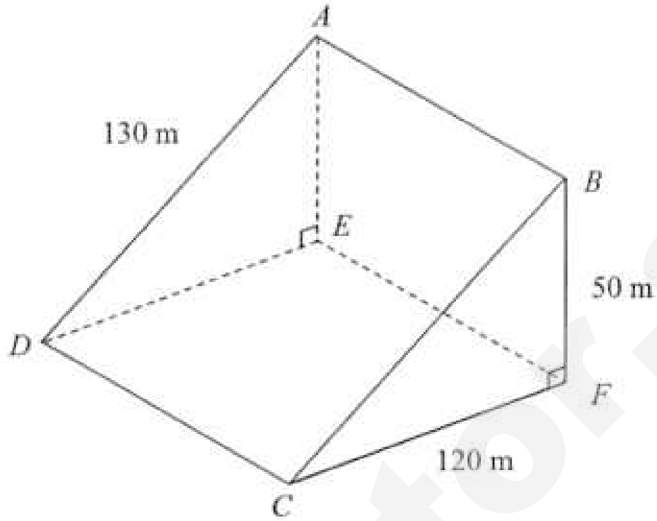
5 **(a)** The diagram shows a model of the slope of a hill. $ABCD$ is a rectangle such that $AD = 130$ m, and $CDEF$ is a square with sides 120 m. A and B are 50 m vertically above E and F respectively and $\angle AED = \angle BFC = 90°$.



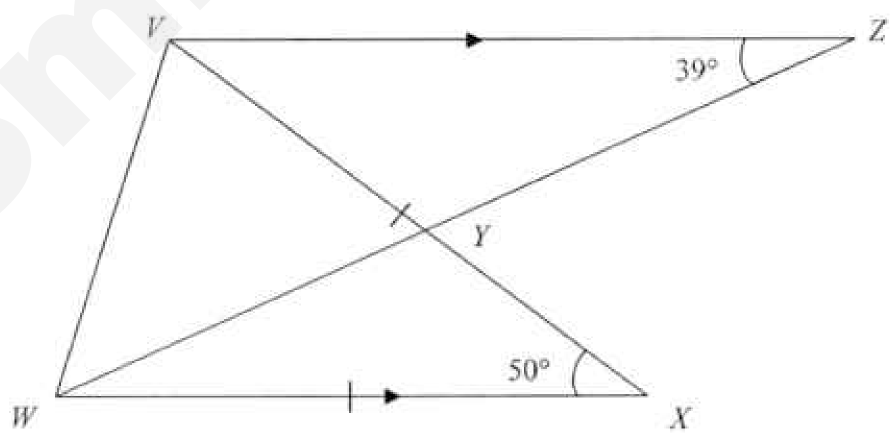
Find

(i) the length of CE, [2]

(ii) $\angle BDF$, [2]

(iii) $\angle DAF$. [3]

(b) In the diagram below, the lines WZ and VX intersect at Y. VWX is an isosceles triangle where $VX = WX$ and $\angle VXW = 50°$.

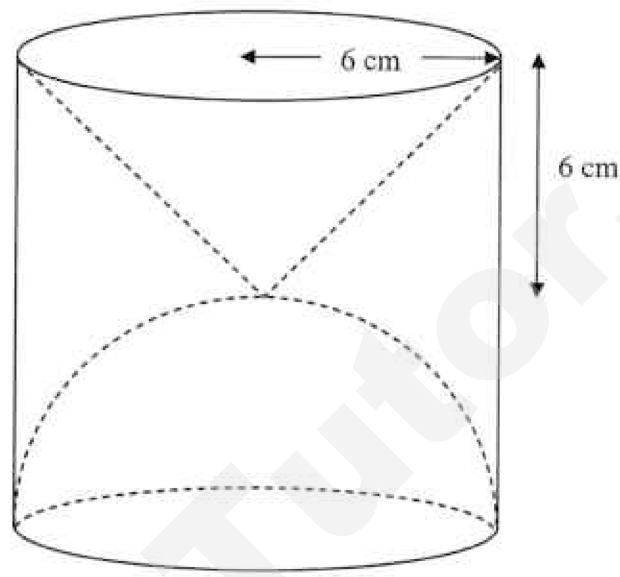


Given that VZ is parallel to WX and $\angle VZW = 39°$, find

(i) $\angle ZYX$, [2]

(ii) $\angle VWZ$. [2]

6 The diagram shows a wooden cylinder that has removed parts in the shape of a hemisphere and a cone on opposite ends.
The radius of the base of the cylinder is 6 cm.
The perpendicular height of the cone is equal to the radius of its base.



(a) Find the height of the cylinder. [1]

(b) Calculate

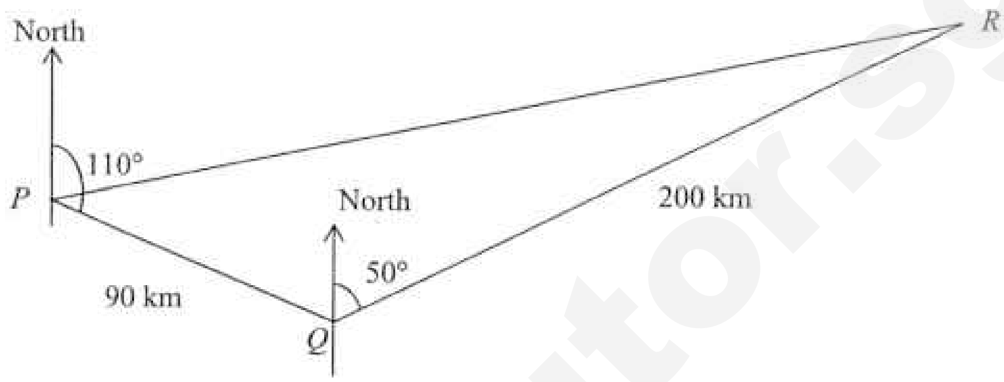
(i) the volume of the cone, [2]

(ii) the volume of the hemisphere, [2]

(iii) the volume of the solid. [2]

(c) Calculate the total surface area of the solid. [4]

7 The diagram shows three towns P, Q and R on a horizontal ground. Town Q is 200 km away from R and 90 km away from P. The bearing of town R from Q is $050°$ and the bearing of town Q from P is $110°$.



(a) **(i)** Find $\angle PQR$. [1]

(ii) **Hence**, calculate the area of ΔPQR. [2]

(b) Show that the distance between towns P and R is approximately 257 km. [3]

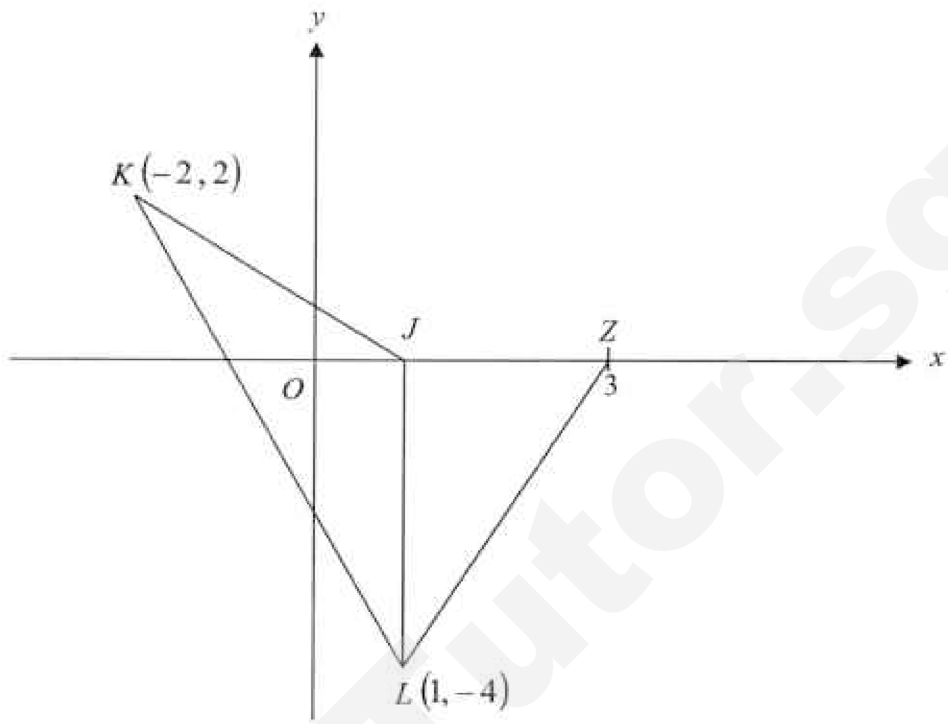
(c) Calculate the bearing of town P from town R. [3]

(d) An eagle was hovering 3 km vertically above town Q.

Calculate the greatest possible angle of depression of the eagle to a point along PR. [3]

8 JKL is a triangle where the line JL is parallel to the y-axis.

Point J lies on the x-axis, and the coordinates of L is $(1, -4)$ and K is $(-2, 2)$.



(a) **(i)** Calculate the area of ΔJKL. [1]

(ii) **Hence**, calculate the perpendicular distance from J to KL. [3]

(b) Write down the equation of line JL. [1]

(c) The line LZ meets the x-axis at $(3 \ , \ 0)$.

Given that coordinates of point X is $(6 \ , \ 6)$, prove that points L, X and Z lie on the same line. [2]

9 The figures below are formed by squares of lengths 1, 2, 3, … units. The table shows the corresponding lengths (L) and perimeter (P) of each figure (n).

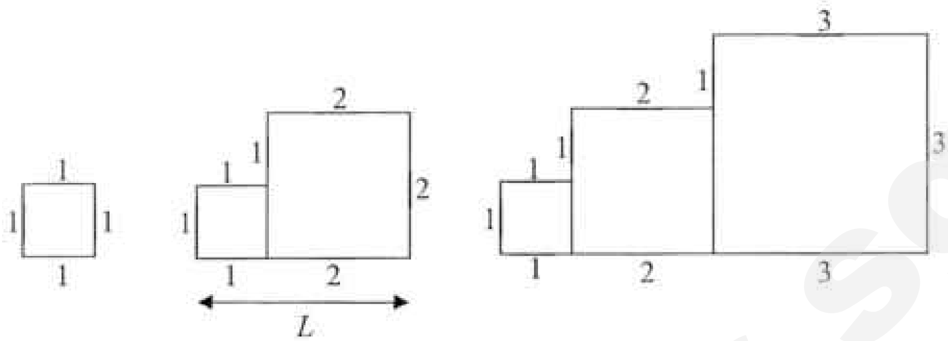


Figure 1 Figure 2 Figure 3

Figure (n)	Length (L)	Perimeter (P)
1	1	4
2	3	10
3	6	18
4	10	y
5	z	40

(a) Write down the values of y and z. [1]

(b) Express L in terms of n. [1]

(c) Show that P can be expressed as $3n + n^2$. [2]

(d) Find the area of the figure when $P = 70$ units. [2]

10 The diagram shows the relative display sizes of iPhone 6 and iPhone 6 Plus as advertised on their website. The iPhone 6 has a diagonal display size of 4.7 inches, while the iPhone 6 Plus has a diagonal display size of 5.5 inches.

iPhone 6

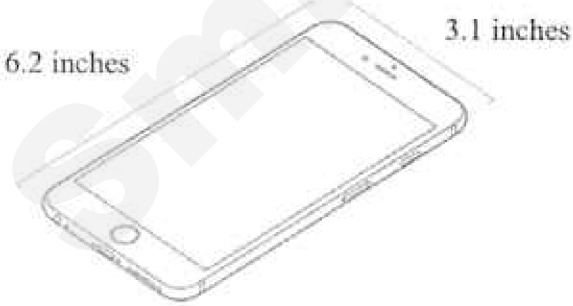
iPhone 6 Plus

(source: http://www.apple.com/sg/iphone-6s/specs/)

(a) Given that the diagonal display size of the iPhone 6 Plus in centimetres is 13.97 cm, calculate the diagonal display size of the iPhone 6 in centimetres. [2]

(b) If the length of the iPhone 6 Plus display is 4.8 inches, find the width of the iPhone 6 Plus display in inches, correct to 1 decimal place. [2]

The website also shows the dimension of the entire phone. In the diagram below, the dimensions of the iPhone 6 Plus are given as 6.2 inches by 3.1 inches. The top surface of the iPhone 6 Plus can be modelled as shown in Figure 1 below, where the corners are identical quadrants with radius 0.4 inches.



Dimensions of iPhone 6 Plus

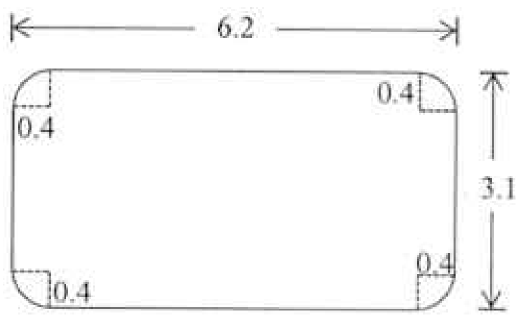


Figure 1

(source: http://www.apple.com/sg/iphone-6s/specs/)

(c) **(i)** Find the top surface area of the iPhone 6 Plus model in Figure 1, in square inches. [2]

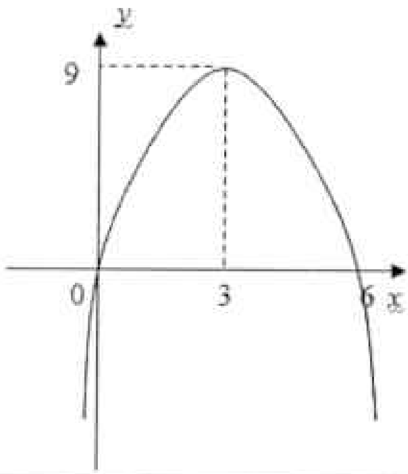
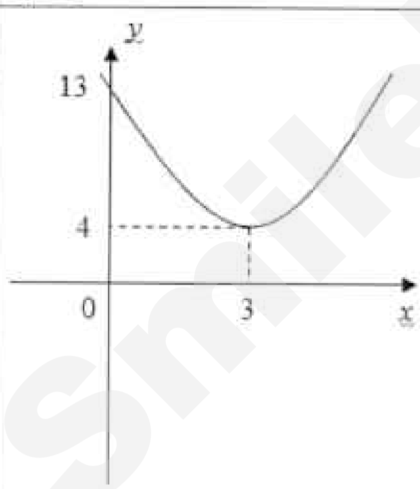
(ii) **Hence**, calculate the surface area of the iPhone 6 Plus display as a percentage of its top surface area. [2]

END OF PAPER

2016 3E E.Math Paper 1 Marking Scheme

	Solution	Mark	Remark
1(a)	$\dfrac{\sqrt[3]{0.1257}-0.258^2}{1.5^{3.41}}=0.10898$	B1	
1(b)	0.1090	B1	
2	$12x^2y^2-1-3x^2+4y^2$ $=12x^2y^2+4y^2-3x^2-1$ $=4y^2(3x^2+1)-(3x^2+1)$ $=(3x^2+1)(4y^2-1)$ $=(3x^2+1)(2y-1)(2y+1)$	 M1 A1	
3	$1000\text{ cm}^3=p$ cents $1\text{ cm}^3=\dfrac{p}{1000}$ cents $q\text{ cm}^3=\dfrac{pq}{1000}$ cents $1\text{barrel}=\$\dfrac{pq}{100000}$	 M1 M1 A1	
4(a)	$k=27$	B1	
4(b)(i)	$\dfrac{1}{y^2}\times\dfrac{y^3}{3}$ $=\dfrac{y}{3}$	M1 A1	
4(b)(ii)	$2\div\dfrac{6}{5x^{-3}}$ $=2\times\dfrac{5x^{-3}}{6}$ $=\dfrac{5}{3x^3}$ or $\dfrac{5x^{-3}}{3}$	 M1 A1	
4(c)	$\sqrt[6]{x^7}+\dfrac{\sqrt{x^5}}{\sqrt[3]{x^4}}$ $=x^{\frac{7}{6}}+x^{\frac{5}{2}-\frac{4}{3}}$ $=x^{\frac{7}{6}}+x^{\frac{7}{6}}$ $=2x^{\frac{7}{6}}$ $=2\left(\sqrt[6]{x^7}\right)$	 M1 M1 A1	
5	$\dfrac{2}{(1-2x)^2}-\dfrac{3}{2x-1}$ $=\dfrac{2}{(1-2x)^2}+\dfrac{3(1-2x)}{(1-2x)^2}$	 M1	

	$=\dfrac{5-6x}{(1-2x)^2}$	A1	
6(a)	30	B1	
6(b)	$2^2\times3^2\times5^3\times7$	B1	
6(c)	10	B1	
7(a)	20000	B1	
7(b)	2.5 km	B1	
7(c)	187.5 cm^2	B1	
8(a)	$(x-6)^2-27$	B1	
8(b)	$(x-6)^2=27$ $x=6\pm\sqrt{27}$ $x=0.80$ or 11.20	M1 A2	
9	Any suitable method $x=3$ $y=-1$	M1 A1 A1	
10(a)	$x-2<2x+7$ $2x+7\le\dfrac{3x+8}{3}$ $x>-9$ $x\le-4\dfrac{1}{3}$ $-9<x\le-4\dfrac{1}{3}$	M1 M1 A1	
10(b)	-8	B1	
11	$\dfrac{1}{5}+\dfrac{1}{7}=\dfrac{12}{35}$ $1\div\left(\dfrac{12}{35}\right)=\dfrac{35}{12}$ $\dfrac{35}{12}=2\dfrac{11}{12}$ mins $=2$ mins 55 s	M1 M1 A1	
12(a)	15	B1	
12(b)	23	B1	
12(c)	$\dfrac{4x+55}{2x+59}=1$ $x=2$	M1 A1	
13	$\dfrac{15x-20-3x+15}{15}=-\dfrac{4}{7}$ $84x=-25$ $x=-\dfrac{25}{84}$/-0.298	M1 A1	

14(a)	$\frac{4}{5}$	B1	
14(b)	$BE=\sqrt{13^2-5^2}=12$ $\tan\angle BCE=\frac{12}{5}$	M1 A1	
14(c)	$\cos\angle ABE=-\cos\angle CBE=-\frac{12}{13}$	B1	
15(a)(i)		B1 (Shape) B1 (Points)	
15(a)(ii)	$x=3$		
15(b)(i)		B1 (Shape) B1 (Points)	
15(b)(ii)	$(3,4)$	B1	
16(a)	3.74×10^8 years	B1	
16(b)	$\frac{4}{3}\pi(0.125)^3$ $=0.00818\text{ cm}^3$	M1 A1	
16(c)	$\frac{8325\times10^{-6}}{3600}$ $=2.31\times10^{-6}$ km/s	M1 A1	
17(a)	0006 / 12.06 am, Thursday	B1, B1	

17(b)	$\dfrac{3281}{51\frac{53}{60}}$ $= 63.2$ km/h	M1 A1	
18	$B = kr^2$ $1 = kR^2$ $k = \dfrac{1}{R^2}$ $B_{new} = \dfrac{1}{R^2}(4R)^2$ $B_{new} = 16$ $\dfrac{16-1}{1} \times 100\% = 15 \times 100\% = 1500\%$	M1 M1 A1	
19	$A+B : C$ $A : B+C$ $7 : 5$ $8 : 13$ $49 : 35$ $32 : 52$ $A : B : C$ $32 : 17 : 35$ 17 units = 34 marbles 84 units = 168 marbles	M1 M1 A1	
20(a)	$\dfrac{128}{100} \times 1188$ $= \$1520.64$	M1 A1	
20(b)	107% = \$129.90 100% = \$121.40 110% = \$121.40 100% = \$110.37	M1 A1	
21(a)	$(-7, -2)$	B1	
21(b)	$y = -2$	B1	
21(c)	$D(d, 0)$ $2d = -12$ $d = -6$ $D(-6, 0)$	B1	
21(d)	$\sqrt{(-3+7)^2 + (-2-1)^2}$ $= 5$ units	B1	
21(e)	Gradient $= \dfrac{-2-1}{-3+7} = -\dfrac{3}{4}$ $y = -\dfrac{3}{4}x + c$ $1 = \dfrac{21}{4} + c$	M1	

	$c=-4\frac{1}{4}$ $y=-\frac{3}{4}x-4\frac{1}{4}$	A1	
21(f)	$E\left(0,-4\frac{1}{4}\right)$	B1	

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MID YEAR EXAMINATION 2016
SECONDARY THREE EXPRESS
PAPER 2 SOLUTIONS

NO	ANSWERS	MARKS
1(ai)	$3x^2-507=0$ $x^2=169$ $x=\pm 13$	 M1 A1
1(aii)	$\frac{x-2}{x+3}-\frac{x-3}{12+4x}=5$ $\frac{x-2}{x+3}-\frac{x-3}{4(3+x)}=5$ $\frac{4(x-2)-x+3}{4(x+3)}=5$ $4(x-2)-x+3=20(x+3)$ $x=-3\frac{14}{17}$	 M1 M1 A1
1(bi)	$f=3\times 10^{-2}$ or 0.03	B1
1(bii)	$\frac{1}{f}=\frac{1}{u}+\frac{1}{v}$ $\frac{1}{v}=\frac{1}{f}-\frac{1}{u}$ $\frac{1}{v}=\frac{u-f}{uf}$ $v=\frac{uf}{u-f}$ or $v=\left(\frac{1}{f}-\frac{1}{u}\right)^{-1}$	 M1 (combining into one fraction) A1
1(c)	$\frac{8m+3n}{3n-2m}=\frac{3}{2}$ $2(8m+3n)=3(3n-2m)$ $\frac{m}{n}=\frac{3}{22}$	 M1 A1
1(d)	$(x-2y)^2=x^2-4xy+4y^2$ $(3)^2=1-4xy$ $xy=-2$	 M1 A1
1(ei)	$a+30=c$	B1
1(eii)	$2.4a+1.6c=228$	B1
1(eii)	Any Method $a=45, c=75$	M1 A1,A1

2(a)(i)	$\frac{1}{9c^{-2}} \times \frac{(3d)^{-1}}{c^3}$ $= \frac{1}{9c^{-2}} \times \frac{1}{3dc^3}$ $= \frac{1}{27cd}$	 M1 A1
2(a)(ii)	$\frac{5f^2g^3}{21gh} \div \frac{40f^5g^2}{7h^3}$ $= \frac{5f^2g^3}{21gh} \times \frac{7h^3}{40f^5g^2}$ $= \frac{h^2}{24f^3}$	 M1 A1
2(bi)	5	B1
2(bii)	-21	B1
2(biii)	49	B1
2(c)(i)	$2.25(z+z+2) \le 126$ $z \le 27$	M1 A1
2(c)(ii)	29	B1
3(a)	$\frac{2000}{x}$	B1
3(b)	$\frac{2000}{x+1.5}$	B1
3(c)	$\frac{2000}{x} - \frac{2000}{x+1.5} = 13$ $3000 = 13(x^2 + 1.5x)$ $26x^2 + 39x - 6000 = 0$	M1 M1 M1
3(d)	$x = \frac{-39 \pm \sqrt{625521}}{52}$ $x = 14.46$ or $x = -15.96$	M1 A1,A1
3(e)	188 hours	B1

4(a)	$A = 7000\left(1+\frac{0.8}{100}\right)^8$ $= \$7460.75$	M1 A1
4(b)	$\text{Total Loan} = 23000 + \frac{23000\times 2.5\times 8}{100}$ $= \$27600$ $\text{Monthly Installment} = \frac{276000}{8\times 12}$ $= \$287.50$	M1 M1 A1
4(c)	June → $€7000\times 6.03 = 42210\,\text{SKR}$ July → $42210 \div 5.71 = €7392.29$ Profit = €392.29	M1 A1
4(d)	1st year → $7000\times 0.88 = \$6160$ 2nd year → $6160\times 0.8 = \$4928$ Loss = \$2072	M1 A1
5(ai)	$CE = \sqrt{120^2+120^2}$ $=170\text{ cm}$	M1 A1
5(aii)	$\tan\angle BDF = \frac{50}{\sqrt{120^2+120^2}}$ $\angle BDF = 16.4°$	M1 A1
5(aiii)	$AF = AD = 130$ $DF = CE = \sqrt{120^2+120^2}$ $\angle DAF = \cos^{-1}\frac{130^2+130^2-\left(\sqrt{120^2+120^2}\right)^2}{2(130)(130)}$ $= 81.5°$	M1 M1 A1
5(bi)	$ZVX = 50°$ (alt angle) $\angle ZYX = 39+50 = 89°$	M1 A1
5(bii)	$\angle VWX = \frac{180-50°}{2} = 65°$ (isos triangle) $\angle ZYX = 65-39 = 26°$ (alt angle)	M1 A1

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6(a)	12 cm	B1
6(bi)	$V=\frac{1}{3}\pi(6^2)(6)$ $=226\text{cm}^3$	M1 A1
6(bii)	$V=\frac{2}{3}\pi(6^3)$ $=452\ \text{cm}^3$	M1 A1
6(biii)	$V=\pi(6^2)(12)-\frac{1}{3}\pi(6^2)(6)-\frac{2}{3}\pi(6^3)$ $=679\ \text{cm}^3$	M1 A1
6(c)	$SA=2\pi(6)(12)+2\pi(6^2)+\pi(6)\left(\sqrt{6^2+6^2}\right)$ $=839\ \text{cm}^2$	M1,M1,M1 A1
7(ai)	$\angle PQR=70+50=120°$	M1
7(aii)	$A=\frac{1}{2}(90)(200)(\sin 120)$ $=7790\ \text{cm}^2$	M1 A1
7(b)	$PR^2=200^2+90^2-2(200)(90)(\cos 120)$ $PR=257$	M2 A1
7(c)	$\frac{\sin\angle QRP}{90}=\frac{\sin 120}{257}$ $\angle QRP=17.65752082$ $bearing=17.65752082+50+180$ $=247.6°$	M1 M1 A1
7(d)	$7790=\frac{1}{2}(257)(QX)$ $QX=60.6225681\ \text{cm}^2$ $\tan\vartheta=\frac{3}{60.6225681}$ $\vartheta=2.8°$	M1 (or by using trigo ratio to find *QX*) M1 A1

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8(ai)	6 units^2	B1
8(aii)	$KL = \sqrt{3^2 + 6^2}$ $6 = \frac{1}{2} \times \sqrt{6^2 + 3^2} \times h$ $h = 1.79$ units	M1 M1 A1
8(b)	$x = 1$	B1
8(c)	Gradient of $LX = \frac{-4-6}{1-6} = 2$ Gradient of $ZX = \frac{6}{6-3} = 2$ Since Gradient of LX = Gradient of ZX, points Z, L, X lie on the same line.	M1 (either gradient) A1
9(a)	$y = 28$ $z = 15$	B1 (both)
9(b)	$L = \frac{n^2 + n}{2}$	B1
9(c)	$P = 2L + 2n$ $= n^2 + n + 2n$ $= 3n + n^2$	M1 A1
9(d)	$3n + n^2 = 70$ $3n + n^2 - 70 = 0$ or by guess and $(n+10)(n-7) = 0$ $n = 7$ check $A = 1^2 + 2^2 + \ldots + 7^2$ $= 140$ units^2	 M1 A1
10(a)	5.5" → 13.97 cm 4.7" → $\frac{13.97}{5.5} \times 4.7$ $= 11.938$ cm	 M1 A1
10(b)	Width $= \sqrt{5.5^2 - 4.8^2}$ $= 2.7$"	M1 A1

10(ci)	$A = (6.2)(3.1) - 4\left[0.4^2 - \frac{1}{4}\pi(0.4)^2\right]$ $= 19.1$ inches square	M1 (excess area) A1
10(cii)	$\% \text{ of S.A.} = \frac{(4.8)(\sqrt{5.5^2 - 4.8^2})}{19.08265482} \times 100\%$ $= 67.5\%$	M1 A1

Calculator Model:		
Class	Full Name	Index Number

bowen SECONDARY

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MID YEAR EXAMINATION 2016

O

4048/ 01

MATHEMATICS
Paper 1

1 hour 30 minutes

Secondary 3 Express
06 May 2016

INSTRUCTIONS TO CANDIDATES

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen.

Answer **all** the questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
Calculators should be used where appropriate,
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answers to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value of 3.142, unless the question requires the answer in terms of π.

At the end of the test, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is **60**.

DO NOT OPEN THIS PAPER UNTIL YOU ARE TOLD TO DO SO

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60

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This document consists of 13 printed pages, including this cover page.

Mathematical Formulae

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$$\text{Total amount} = P\left(1+\frac{r}{100}\right)^n$$

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Curved surface area of a cone $= \pi rl$

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Area of a triangle ABC $= \frac{1}{2}ab\sin C$

Arc length $= r\theta$, where θ is in radians

Sector area $= \frac{1}{2}r^2\theta$, where θ is in radians

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\Sigma fx}{\Sigma f}$$

$$\text{Standard deviation} = \sqrt{\frac{\Sigma fx^2}{\Sigma f} - \left(\frac{\Sigma fx}{\Sigma f}\right)^2}$$

Answer **all** the questions.

For Examiner's Use

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1 Simplify

(a) $5a^3 \div 7a^2b$,

Answer (a)..[1]

(b) $(2x^4)^3 \times \dfrac{1}{64x^4}$.

Answer (b)..[1]

2 Simplify the following, leaving your answers in positive index.

(a) $\left(\dfrac{3x^0y^3}{4}\right)^3 \div \left(\dfrac{3x^{-2}y^5}{2}\right)^2$,

Answer (a)..[2]

(b) $\dfrac{12c^{\frac{2}{3}}}{5a^{\frac{1}{2}}b^{-\frac{1}{3}}} \times \dfrac{3a^{\frac{3}{2}}b}{8c^{\frac{1}{3}}}$.

Answer (b)..[2]

For Examiner's Use

3 **(a)** Express 859 nanograms in grams, giving your answer in standard form.

Answer (a)................................. g [1]

(b) The diameter of a circular organism is 5 micrometres.

(i) Express 5 micrometres in metres.

(ii) Find the area, in square metres, of the circular organism, giving your answer in standard form correct to 3 significant figures.

Answer (b) (i) .... m [1]

(ii) .... m^2 [2]

4 Solve

(a) $3^{5(x-1)} = 27$.

Answer (a) x =.................................[2]

(b) $216^{x-1} = \dfrac{1}{36^{x+4}}$.

Answer (b) x = ...[2]

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5 Given that $p = 4.52 \times 10^8$ and $q = 6.12 \times 10^7$, evaluate the following, giving your answers in standard form correct to 3 significant figures.

(a) $2p - q$,

Answer (a)......................................[2]

(b) $\dfrac{5p}{2q}$.

Answer (b)......................................[2]

6 Ms Chong deposits \$42, 000 in ACBC Bank which pays an interest rate of 3% p.a compounded monthly. Calculate how much interest she can get at the end of one year.

Answer \$......................................[2]

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7 Solve the following equations, giving your answers correct to 2 decimal places.

(a) $\dfrac{2}{x+5}-\dfrac{3}{x-5}=4$,

Answer (a) $x =$…………or……………..[4]

(b) Solve $(4x-3)(3x+2)=5x+1$.

Answer (b) $x =$…………or……………..[4]

For Examiner's Use

8 **(a)** Express $y = x^2 - 6x + 2$ in the form of $y = (x-h)^2 + k$.

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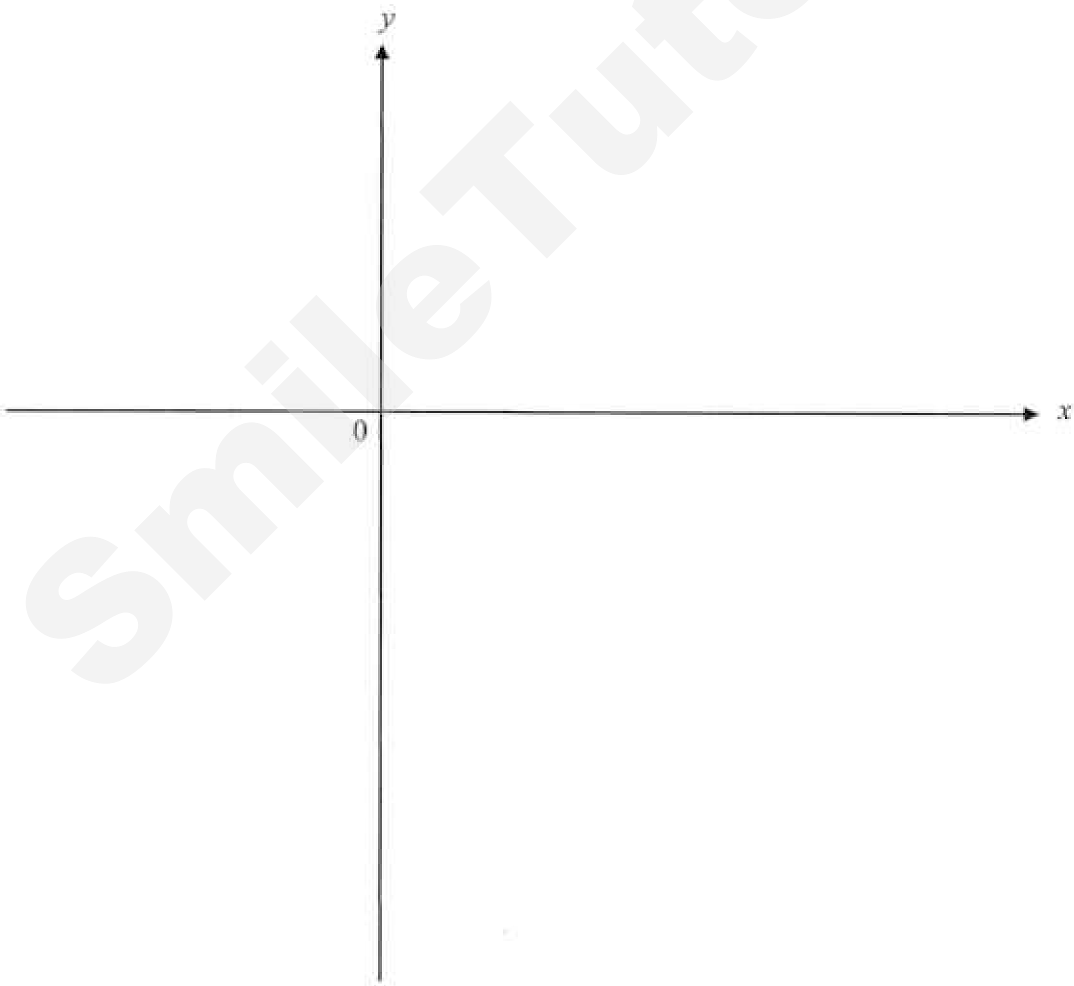
Answer (a)......................................[2]

(b) Sketch the graph of $y = x^2 - 6x + 2$ indicating clearly its intercepts with the axes and its turning point. [2]



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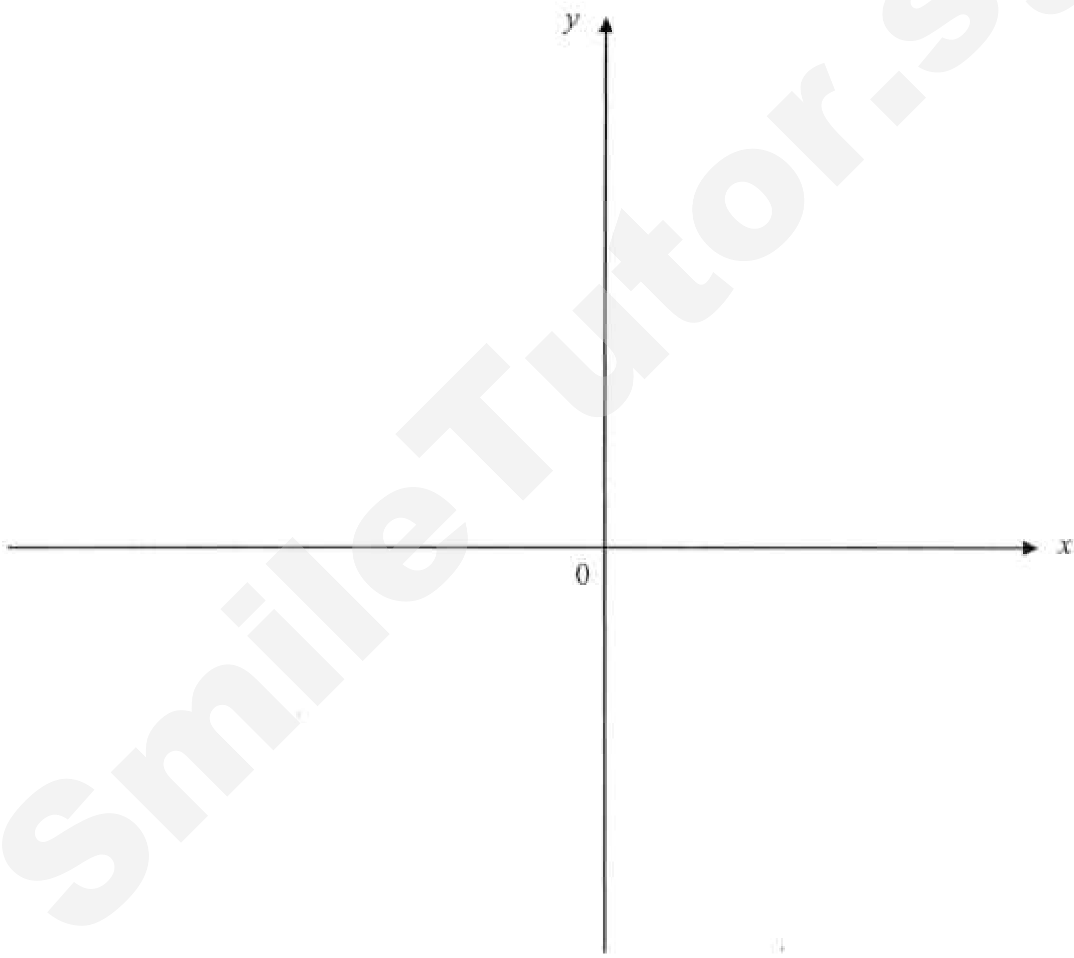
9 **(a)** Sketch the graph of $y = -x^2 - 3x + 4$ indicating clearly its intercepts with the axes and its turning point. [2]

(b) Write down the equation of the line of symmetry of the graph.



Answer (b)....................................[1]

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10 It is given that x and y are integers such that $1 \le x \le 9$ and $-3 \le y < 0$.
Find
(a) the largest possible value of $x - y$,

Answer (a) ....[1]

(b) the least possible value of $\frac{y}{x}$,

Answer (b) ....[1]

(c) the largest possible value of $\frac{1}{x^2 + y^2}$.

Answer (c) ....[1]

11 Given that $\frac{x-11}{2} < \frac{3-2x}{5} \le \frac{x+7}{3}$, find
(a) the range of values of x that satisfy the inequality and represent your solutions on a number line.
(b) the least integer value of x.
(c) the greatest prime value of x.

Answer (a) ....[4]

Number Line ____

Answer (b) ....[1]

Answer (c) ....[1]

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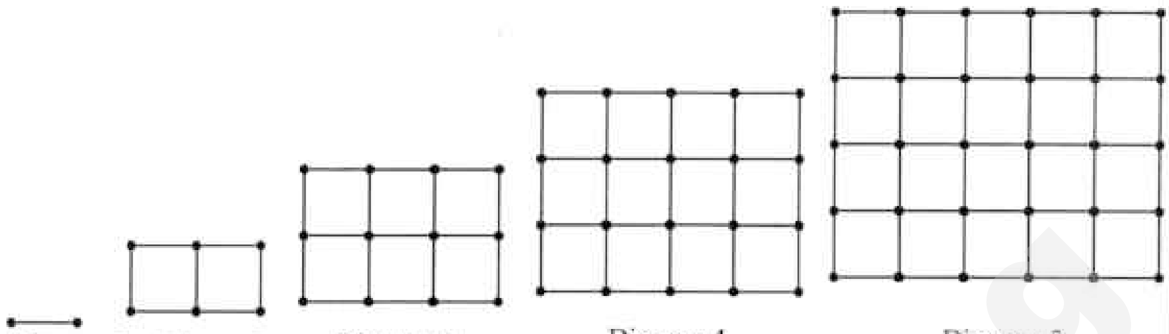
12 A sequence of 5 diagrams is shown below.



The number of dots and lines in each of the diagrams are shown in the table below.

Diagram number	1	2	3	4	5	6
Number of dots	2	6	12	20	30	p
Number of lines	1	7	17	31	49	q

(a) Find the value of p and of q.

(b) Write down an expression for the number of dots in diagram n.

(c) The number of lines in diagram n is $2n^2 - 1$.
Find the diagram number which has 287 lines.

Answer (a) p = ...[1]

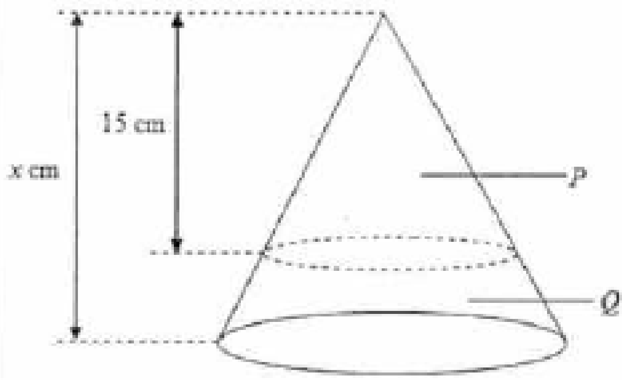
q = ...[1]

Answer (b)..[1]

Answer (c)..[2]

For Examiner's Use

13 The following diagram shows a solid cone that is cut up into 2 sections, P and Q, such that section P is a cone similar to the original cone. The curved surface area of cone P and the original cone is 160 cm^2 and 250 cm^2 respectively.



(a) If the height of cone P is 15 cm, calculate the height, x cm, of the original cone.

(b) Given that the mass of cone P is 12.8 kg, find the mass of frustum Q.

Answer (a) .... cm [2]

Answer (b) .... kg [2]

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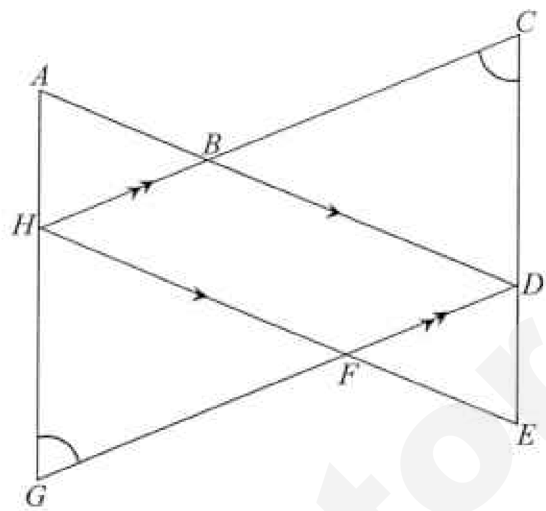
14 In the diagram below, ΔADG and ΔEHC overlap to form a parallelogram $BDFH$. Given further that $AG = EC$ and $\angle HCE = \angle DGA$, prove that ΔADG is congruent to ΔEHC. State your reasons clearly.



Answer ....

....

....

....

....[3]

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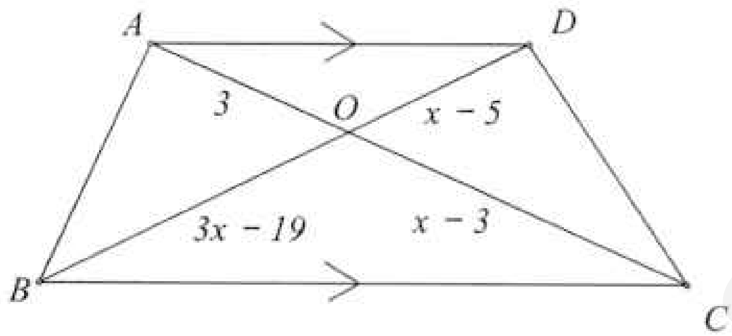
15 $ABCD$ is a trapezium in which AD is parallel to BC.
The diagonals AC and BD intersect at O.



(a) Name the triangle which is similar to ΔAOD.

Answer (a) ....[1]

(b) If $AO = 3$ cm, $BO = (3x - 19)$ cm, $CO = (x - 3)$ cm and $DO = (x - 5)$ cm, find the values of x.

Answer (b) $x =$ .... or ....[3]

END OF PAPER

Answer Key

1(a)	$\frac{5a}{7b}$	9(a)	$y=(-x+1))(x+4)$ x-intercepts at $x=-4$ and $x=1$ y-intercept = 4 Coordinates of maximum point = (-1.5, 6.25)
(b)	$\frac{x^8}{8}$	(b)	Equation of line of symmetry $x=-1.5$
2(a)	$\frac{3x^4}{16y}$	10(a)	12
(b)	$\frac{9ab^{\frac{2}{3}}c^{\frac{1}{3}}}{10}$	(b)	-3
3(a)	8.59×10^{-7} g	(c)	1
(b)(i)	$5\times10^{-6}=0.000005$ m	11(a)	$-2\frac{4}{11}\leq x<6\frac{7}{9}$
(ii)	$7.86\times10^{-11}\text{m}^2$	(b)	2
4(a)	$x=\frac{8}{5}$	(c)	5
(b)	$x=-1$	12(a)	$p=30+12=42$ $q=49+22=71$
5(a)	8.43×10^8	12(b)	Diagram 1 = 1 x 2 = 2 Diagram 2 = 2 x 3 = 6 Diagram 3 = 3 x 4 =12 Diagram n = n(n + 1) = n^2 + n
(b)	1.85×10	12(c)	n = 12
6	$1277.47	13(a)	Ratio of the length = 5 : 4 height original cone x =$18\frac{3}{4}cm$
		(b)	Ratio of the volume of original cone to the volume of cone P = 125 : 64 Mass of original cone = 25 kg Mass of the frustum = 12.2 kg
7(a)	4.21 or -4.46	14	$\angle HCE=\angle DGA$ (given) $AG=CE$ (given) $\angle CHE=\angle DGA$ (opp. $\angle$ of a parallelogram) $\Delta ADG\equiv EHC$ (AAS or SAA or ASA)
7(b)	1.05 or -0.554	15(a)	ΔCOB

8(a)	$y=(x-3)^2-7$	(b)	$\frac{3}{x-3}=\frac{x-5}{3x-19}$ $x^2-17x+72=0$ $(x-8)(x-9)=0$ $x=8$ *or* $x=9$
(b)	y-intercept = 2 x-intercepts at x=0.35, x=5.65 Coordinates of Minimum point = (3, -7)	16(a)	$x=10$
		(b)	$2x^2-7x+3=0$

Calculator Model:

Class	Full Name	Index Number

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Marking Scheme

MID YEAR EXAMINATION

2016

O

4048/ 01

MATHEMATICS **1 hour 30 minutes**
Paper 1

Secondary 3 Express
06 May 2016

INSTRUCTIONS TO CANDIDATES

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For Examiner's Use

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For Examiner's Use

1 Simplify

(a) $5a^3 \div 7a^2b$,

$$=\frac{5a^3}{7a^2b}=\frac{5a}{7b} \text{ ---------- [A1]}$$

Answer (a)......................................[1]

(b) $(2x^4)^3 \times \dfrac{1}{64x^4}$.

$$=\frac{8x^{12}}{64x^4}=\frac{1}{8}x^8 \text{ ---------- [A1]}$$

Answer (b)......................................[1]

2 Simplify the following, leaving your answers in positive index.

(a) $\left(\dfrac{3x^0y^3}{4}\right)^3 \div \left(\dfrac{3x^{-2}y^5}{2}\right)^2$,

$$=\frac{3^3x^0y^9}{4^3}\div\frac{3^2x^{-4}y^{10}}{2^2}$$

$$=\frac{3^3x^0y^9}{4^3}\times\frac{2^2}{3^2x^{-4}y^{10}} \text{ ---------- [M1]}$$

$$=\frac{3x^4y^{-1}}{4^2}=\frac{3x^4}{16y} \text{ ---------- [A1]}$$

Answer (a)......................................[2]

(b) $\dfrac{12c^{\frac{2}{3}}}{5a^{\frac{1}{2}}b^{-\frac{1}{3}}}\times\dfrac{3a^{\frac{3}{2}}b}{8c^{\frac{1}{3}}}$.

$$=\frac{9}{10}a^{\frac{3}{2}-\frac{1}{2}}b^{1+\frac{1}{3}}c^{\frac{2}{3}-\frac{1}{3}} \text{ ---------- [M1]}$$

$$=\frac{9}{10}ab^{\frac{4}{3}}c^{\frac{1}{3}} \text{ ---------- [A1]}$$

Answer (b)......................................[2]

For Examiner's Use

3 **(a)** Express 859 nanograms in grams, giving your answer in standard form.

$859\times10^{-9}=8.59\times10^{-7}$ ---------- [A]

Answer (a)................................ g [1]

(b) The diameter of a circular organism is 5 micrometres.

(i) Express 5 micrometres in metres.

(ii) Find the area, in square metres, of the circular organism, giving your answer in standard form correct to 3 significant figures.

(i) $5\times10^{-6}=0.000005m$ ---------- [A1]

(ii) Ares = $\pi r^2=3.142\times(5\times10^{-6})^2$ ----------- [M1]

$=78.55\times10^{-12}$

$=7.86\times10^{-11}$ ----------- [A1]

Answer (b) (i) .... m [1]

(ii) .... m^2 [2]

4 Solve

(a) $3^{5(x-1)}=27$,

$3^{5x-5}=3^3$ ---------- [M1]

$5x-5=3$

$x=\frac{8}{5}$ ---------- [A1]

Answer (a) x =................................[2]

(b) $216^{x-1}=\frac{1}{36^{x+4}}$.

$6^{3(x-1)}=6^{-2(x+4)}$ ---------- [M1]

$3x-3=-2x-8$

$5x=-5$

$x=-1$ ---------- [A1]

Answer (b) x = ...[2]

For Examiner's Use

5 Given that $p = 4.52 \times 10^8$ and $q = 6.12 \times 10^7$, evaluate the following. Give your answers in standard form correct to 3 significant figures.

(a) $2p - q$,

$= 2 \times 4.52 \times 10^8 - 6.12 \times 10^7$

$= 9.04 \times 10^8 - 0.612 \times 10^8$ ---------- [M1]

$= 8.428 \times 10^8$

$= 8.43 \times 10^8$ ---------- [A1]

Answer (a).......................................[2]

(b) $\dfrac{5p}{2q}$.

$= \dfrac{5 \times 4.52 \times 10^8}{2 \times 6.12 \times 10^7}$ ---------- [M1]

$= 1.8464 \times 10$

$= 1.85 \times 10$ ---------- [A1]

Answer (b).......................................[2]

6 Ms Chong deposits $42, 000 in ACBC Bank which pays an interest rate of 3% p.a compounded monthly. Calculate how much interest she can get at the end of one year.

Total amount $= \mathrm{P}\left(1 + \dfrac{r}{100}\right)^n$

$= 42000 \times (1 + \dfrac{\frac{3}{12}}{100})^{12}$ ---------- [M1]

$= 42000 \times (1 + 0.0025)^{12}$

$= \$\ 43277.47019$

Interest $= \$\ 43277.47019 - 42000$

$= \$\ 1277.47$ ----------- [A1]

Answer $.......................................[2]

For Examiner's Use

For Examiner's Use

7 Solve the following equations, giving your answers correct to 2 decimal places.

(a) $\dfrac{2}{x+5}-\dfrac{3}{x-5}=4$,

$$\frac{2(x-5)-3(x+5)}{(x+5)(x-5)}=4$$

$2x-10-3x-15=4(x^2-25)$

$4x^2+x-75=0$ ------------ [M1]

Students are expected to use the quadratic formula:

$a=4 \qquad b=1 \qquad c=-75$

$$x=\frac{-1\pm\sqrt{1^2-4(4)(-75)}}{2(4)}$$ ------------ [M1]

$x=4.2069$
$=4.21(2d.p)$ [A1]

$x=-4.4569$
$=-4.46(2d.p)$ [A1]

Answer (a) $x=$............or..................[4]

(b) Solve $(4x-3)(3x+2)=5x+1$.

$12x^2+8x-9x-6=5x+1$

$12x^2-6x-7=0$ ----------- [M1]

$a=12 \qquad b=-6 \qquad c=-7$

$$x=\frac{-(-6)\pm\sqrt{(-6)^2-4(12)(-7)}}{2(12)}$$ ------------ [M1]

$x=1.05363$
$=1.05(2d.p)$ [A1]

$x=-0.5536$
$=-0.55(2d.p)$ [A1]

Answer (b) $x=$............or..................[4]

For Examiner's Use

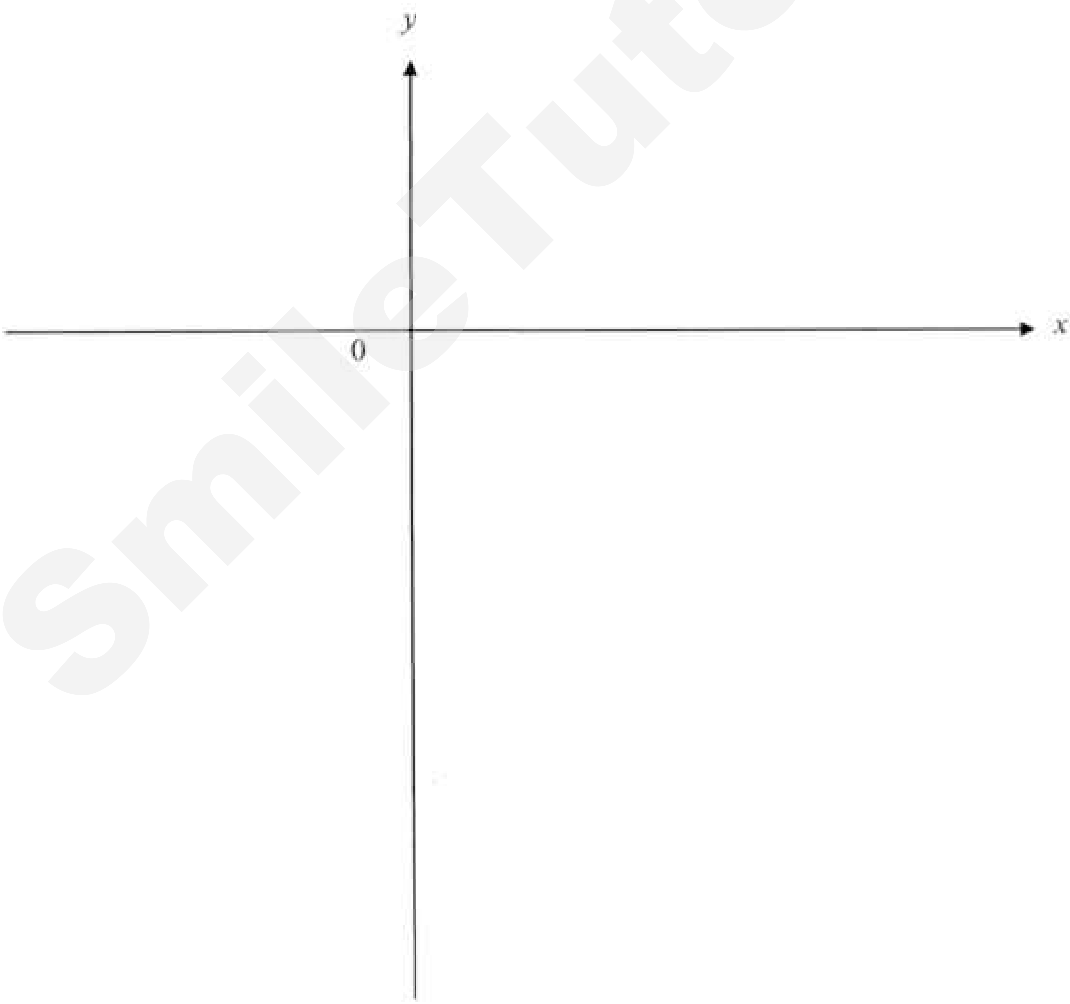
8 **(a)** Express $y = x^2 - 6x + 2$ in the form of $y = (x-h)^2 + k$.

$$y = x^2 - 6x + (\frac{-6}{2})^2 + 2 - (\frac{-6}{2})^2 \quad \text{----------- [M1]}$$
$$y = (x-3)^2 - 7 \quad \text{----------- [A1]}$$

Answer (a)...[2]

(b) Sketch the graph of $y = x^2 - 6x + 2$ indicating clearly its intercepts with the axes and its turning point. [2]

Shape of the graph [A1]
y-intercept = 2
x-intercepts at x=0.35, x=5.65
Coordinates of Minimum point = (3, -7) ----------- [A1]



For Examiner's Use

9 **(a)** Sketch the graph of $y = -x^2 - 3x + 4$ indicating clearly its intercepts with the axes and its turning point. [2]

For Examiner's Use

(b) Write down the equation of the line of symmetry of the graph.

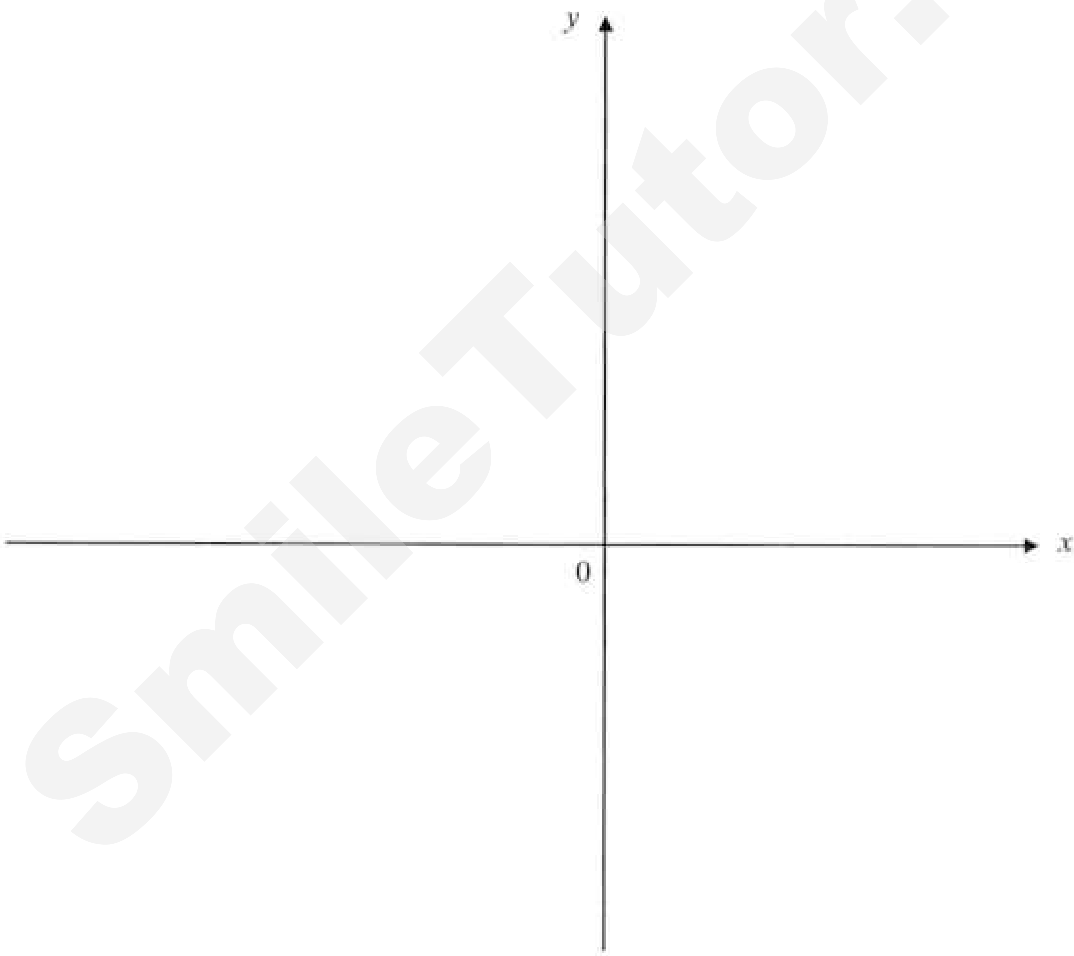
(a) $y = (-x+1)(x+4)$

Shape of graph [A1]

x-intercepts at $x = -4$ and $x = 1$

y-intercept = 4

Coordinates of maximum point = (-1.5, 6.25) ---------- [A1]



Answer (b) Equation of line of symmetry $x = -1.5$ [A1]

For Examiner's Use

10 It is given that x and y are integers such that $1 \le x \le 9$ and $-3 \le y < 0$.
Find

(a) the largest possible value of $x - y$,

$9-(-3)=12$ ---------- [A1]

Answer (a) ....[1]

(b) the least possible value of $\frac{y}{x}$,

$\frac{-3}{1}=-3$ ---------- [A1]

Answer (b) ....[1]

(c) the largest possible value of $\frac{1}{x^2+y^2}$.

$\frac{1}{1^2+0^2}=1$ ---------- [A1]

Answer (c) ....[1]

11 Given that $\frac{x-11}{2} < \frac{3-2x}{5} \le \frac{x+7}{3}$, find

(a) the range of values of x that satisfy the inequality and represent your solutions on a number line.

(b) the least integer value of x.

(c) the greatest prime value of x.

(a) $\frac{x-11}{2} < \frac{3-2x}{5}$

$5(x-11) < 2(3-2x)$

$5x-55 < 6-4x$

$9x < 61$ [M1]

$x < 6\frac{7}{9}$

$\frac{3-2x}{5} \le \frac{x+7}{3}$

$3(3-2x) \le 5(x+7)$

$9-6x \le 5x+35$

$-26 \le 11x$ [M1]

$-2\frac{4}{11} \le x$

Answer (a) $-2\frac{4}{11} \le x < 6\frac{7}{9}$ ....[A1]

Number Line ______________________________

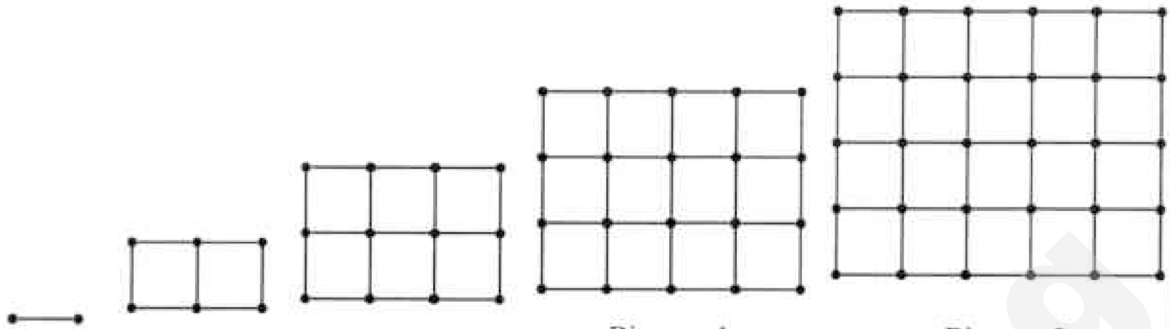
[A1]

Answer (b) ....-2....................[1]

Answer (c) ....5.....................[1]

For Examiner's Use

12 A sequence of 5 diagrams is shown below.



The number of dots and lines in each of the diagrams are shown in the table below.

Diagram number	1	2	3	4	5	6
Number of dots	2	6	12	20	30	p
Number of lines	1	7	17	31	49	q

(a) Find the value of p and of q.

(b) Write down an expression for the number of dots in diagram n.

(c) The number of lines in diagram n is $2n^2 - 1$.
Find the diagram number which has 287 lines.

(a) $p = 30 + 12 = 42$ ----------[A1]
$q = 49 + 22 = 71$ ----------[A1]

(b) Diagram 1 = 1 x 2 = 2
Diagram 2 = 2 x 3 = 6
Diagram 3 = 3 x 4 = 12
Diagram n = n(n + 1) = n^2 + n ---------- [A1]

(c)
$2n^2 - 1 = 287$
$2n^2 - 288 = 0$ ----------- [M1]
$n^2 = 144$
$n = 12$
[A1]

Answer (a) p = ...[1]

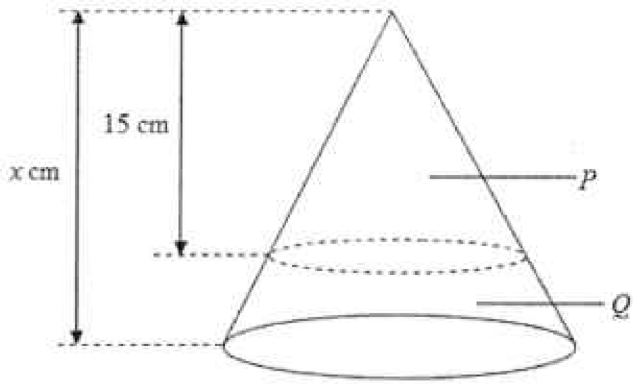
q = ...[1]

Answer (b)......................................[1]

Answer (c)......................................[2]

For Examiner's Use

13 The following diagram shows a solid cone that is cut up into 2 sections, P and Q, such that section P is a cone similar to the original cone. The curved surface area of cone P and the original cone is 160 cm^2 and 250 cm^2 respectively.



(a) If the height of cone P is 15 cm, calculate the height, x cm, of the original cone.

(b) Given that the mass of cone P is 12.8 g, find the mass of section Q.

(a) Ratio of the length $= \sqrt{\frac{250}{160}}$ ---------- [M1]

$= 5 : 4$

$\frac{x}{15} = \sqrt{\frac{250}{160}}$

$x = \frac{5}{4} \times 15$ ---------- [A1]

$x = \frac{75}{4} = 18\frac{3}{4}\,cm$

(b) Ratio of the mass of the original cone to the mass of cone P

$\frac{M_1}{M_2} = \left(\frac{5}{4}\right)^3$ ---------- [M1]

$= 125 : 64$

Mass of original cone

$= \frac{125 \times 12.8}{63} = 25kg$

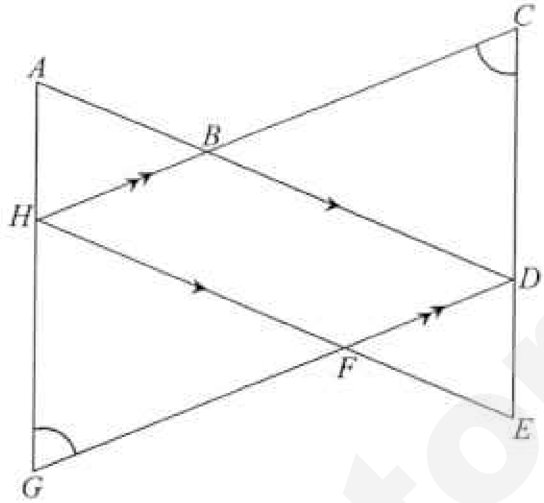
Mass of Section $Q = 25 - 12.8 = 12.2kg$ ---------- [A1]

Answer (a) .... cm [2]

Answer (c) .... kg [2]

For Examiner's Use

14 In the diagram below, ΔADG and ΔEHC overlap to form a parallelogram $BDFH$. Given further that $AG = EC$ and $\angle HCE = \angle DGA$, prove that ΔADG is congruent to ΔEHC. State your reasons clearly.



$\angle HCE = \angle DGA$ (given))

$AG = EC$ (given)) ---------- [M1]

$\angle CHE = \angle DGA$ (opp. $\angle$ s of a parallelogram) ---------- [M1]

Hence $\Delta ADG \equiv \Delta EHC$ (AAS or SAA or ASA) ---------- [A1]

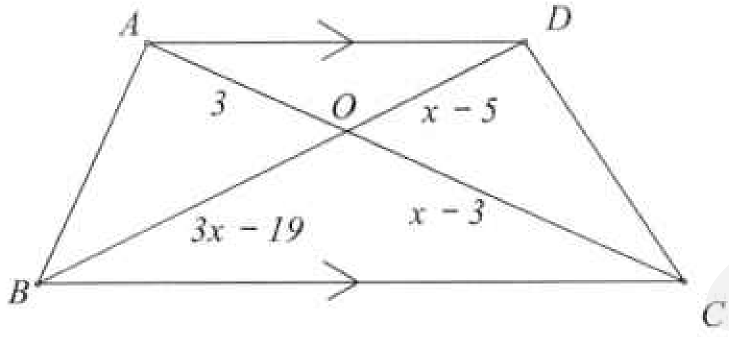
Answer ....

....

....

....[3]

15 *ABCD* is a trapezium in which *AD* is parallel to *BC*.
The diagonals *AC* and *BD* intersect at *O*.



(a) Name the triangle which is similar to ΔAOD.

Answer (a) ……… ΔCOB ……………..[1]

(b) If $AO = 3$ cm, $BO = (3x - 19)$ cm, $CO = (x - 3)$ cm and $DO = (x - 5)$ cm, find the values of x.

$$\frac{3}{x-3} = \frac{x-5}{3x-19}$$

$$x^2 - 17x + 72 = 0$$

$$(x-8)(x-9) = 0$$

$$x = 8 \text{ or } x = 9$$

Answer (b) $x =$ …………… or ……………..[3]

END OF PAPER

Answer Key

1(a)	$\frac{5a}{7b}$	9(a)	$y=(-x+1))(x+4)$ x-intercepts at $x=-4$ and $x=1$ y-intercept = 4 Coordinates of maximum point = (-1.5, 6.25)
(b)	$\frac{x^8}{8}$	(b)	Equation of line of symmetry $x=-1.5$
2(a)	$\frac{3x^4}{16y}$	10(a)	12
(b)	$\frac{9}{5}ab^{\frac{4}{3}}c^{\frac{1}{3}}$	(b)	-3
3(a)	8.59×10^{-7} g	(c)	1
(b)(i)	$5\times10^{-6}=0.000005$ m	11(a)	$-2\frac{4}{11}\le x<6\frac{7}{9}$
(ii)	$7.96\times10^{-11}\text{m}^2$	(b)	2
4(a)	$x=\frac{8}{5}$	(c)	5
(b)	$x=-1$	12(a)	$p=30+12=42$ $q=49+22=71$
5(a)	8.43×10^8	12(b)	Diagram 1 = 1 x 2 = 2 Diagram 2 = 2 x 3 = 6 Diagram 3 = 3 x 4 =12 Diagram n = n(n + 1) = n^2 + n
(b)	1.85×10	12(c)	n = 12
6	$1277.47	13(a)	Ratio of the length = 5 : 4 height original cone x =$18\frac{3}{4}cm$
		(b)	Ratio of the volume of original cone to the volume of cone P = 125 : 64 Mass of original cone = 25 kg Mass of the frustum = 12.2 kg
7(a)	4.21 or -4.46	14	$\angle HCE=\angle DGA$ (given) $AG=CE$ (given) $\angle CHE=\angle DGA$ (opp. $\angle$ of a parallelogram) $\Delta ADG\equiv EHC$ (AAS or SAA or ASA)
(b)	1.05 or -0.55		

8(a)	$y=(x-3)^2-7$	15(a)	ΔCOB
(b)	y-intercept = 2 x-intercepts at x=0.35, x=5.65 Coordinates of Minimum point = (3, -7)	(b)	$\frac{3}{x-3}=\frac{x-5}{3x-19}$ $x^2-17x+72=0$ $(x-8)(x-9)=0$ $x=8$ *or* $x=9$

Calculator Model :

Class	Full Name	Index Number

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MID YEAR EXAMINATION 2016

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4048/02

MATHEMATICS
Paper 2

Secondary 3 Express
10th May 2016 **2 hours**

Additional Materials: Writing Papers
Graph Paper (1 sheet)

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, highlighters, glue or correction fluid.

Answer **all** questions.
If working is needed for any questions it must be shown with the answer.
Omission of essential working will result in loss of marks.
Calculators should be used where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total marks for this paper is 80.

DO NOT OPEN THIS PAPER UNTIL YOU ARE TOLD TO DO SO

For Examiner's use
80

This document consists of 7 printed pages, including this cover page.

Setter: Ms Melissa Chong

Mathematical Formulae

Compound interest

$$\text{Total amount} = P\left(1 + \frac{r}{100}\right)^n$$

Mensuration

$$\text{Curve surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector Area} = \frac{1}{2}r^2\theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

Answer **all** the questions.

1 **(a)** Find the value of $\frac{\sqrt{6.43 \times 10^4 - 2.78 \times 10^{-2}}}{4.2^{\frac{2}{7}}}$, correct to 2 decimal places. [1]

(b) In Singapore, the number of HDB households in 2013 was 1.175×10^6. The average number of people living in each household was 3.47.

(i) Estimate the total number of people living in HDB households in Singapore in 2013. [1]

Leave your answer in standard form, correct to 3 significant figures.

(ii) If the number of households increases by 1.8% per year, find the total number of HDB households in Singapore in 2015. [2]

Leave your answer in standard form, correct to 3 significant figures.

(c) Simplify the following and express your answers in positive index notation.

(i) $\left(\frac{-3p^2}{2pq^0}\right)^{-2}$ [2]

(ii) $\frac{x^2}{4y} \div \frac{6x^{-3}}{y^3}$ [2]

(iii) $(2a^2b^{-\frac{2}{3}})^3 \times \sqrt[3]{8ab}$ [2]

2 **(a)** **(i)** Solve $5^{2x-3} = 1$. [1]

(ii) Given that $3^{x+3} \times (\frac{1}{9})^x = 27^4$, find the value of x. [2]

(b) It is given that $W = \frac{1}{2}m(v^2 - u^2)$.

(i) Find W when $m = 3$, $u = 4$ and $v = 10$. [1]

(ii) Express u in terms of W, m and v. [2]

(c) Factorise completely $18p^2 - 8$. [2]

3 (a) Solve the equation $\frac{3x-7}{4}+\frac{1}{x}=\frac{x}{4}$, giving your answers to 3 decimal places. [3]

(b) Given that $\frac{x+2y}{x+5y}=\frac{3}{7}$, find the value of $\frac{3y}{2x}$ [3]

(c) (i) Express x^2-7x+3 in the form $(x-a)^2+b$ by completing the square. [2]

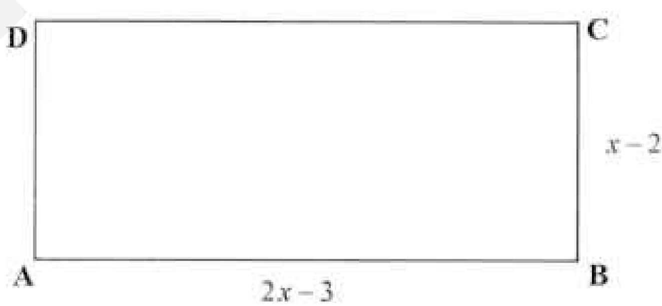
(ii) **Hence,** solve the equation $x^2-7x+3=0$, giving your answer correct to 2 decimal places. [3]

4 (a) Jonathan invested some money in a bank which pays simple interest at a rate of 4.5% per annum. He would be able to receive \$15 735.75 in total (including interest) 5 years later. How much money did Jonathan invest in the bank initially? [2]

(b) At the same time, Jonathan also invested \$8 000 in another bank that pays compound interest at a rate of 2.5% per annum compounded half-yearly. How much money will Jonathan get back at the end of 3 years? [2]

5 (a) Solve the simultaneous inequalities $3(2x-1)<2(7+5x)$ and $\frac{x-1}{3}\le\frac{x-4}{7}$. [3]

(b) The diagram shows a rectangle **ABCD** whereby its perimeter is at most 40 cm.

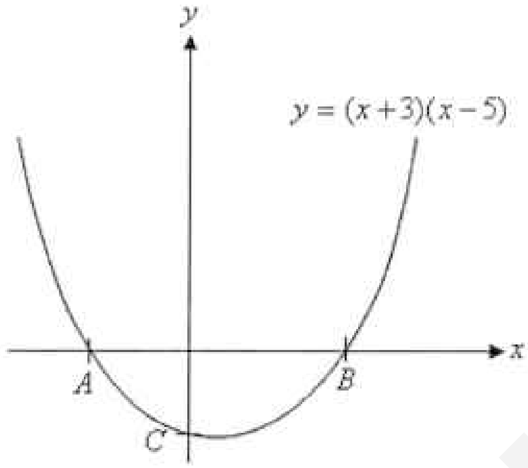


(i) Form an inequality in terms of x. [1]

(ii) Solve the inequality. [1]

(iii) Determine the greatest possible length of **AB** if x is an integer. [1]

6 The curve $y = (x+3)(x-5)$ cuts the x-axis at A and B, and the y-axis at C.



Find

(a) the coordinates of A and B, [2]

(b) the coordinates of C, [1]

(c) the equation of the line of symmetry, [1]

(d) the coordinates of the minimum point of the curve. [1]

7 Alice and Betty started cycling together for a 10 km journey at their respective constant speed.

Alice rode at a speed of x km/h, while Betty's speed was 1 km more than Alice's.

(a) Write down an expression in terms of x for the time, in hours, Alice took to complete the entire journey. [1]

(b) Write down an expression in terms of x for the time, in hours, Betty took to complete the entire journey. [1]

(c) Given that Betty finished the journey 15 minutes earlier than Alice, form an equation in x and show that it reduces to $x^2 + x - 40 = 0$. [3]

(d) Solve the equation $x^2 + x - 40 = 0$, giving both answers correct to 2 decimal places. [4]

(e) Find the time in hours and minutes, which Alice took to complete the 10 km journey. [3]

Answer the whole of this question on a sheet of graph paper.

8 The following table gives the corresponding values of x and y which are connected by the equation $y = 8 + 2x - x^2$

x	-3	-2	-1	0	1	2	3	4	5
y	-7	0	p	8	9	8	5	0	-7

(a) Find the value of p. [1]

(b) Draw the graph of $y = 8 + 2x - x^2$. [3]

Using a scale of 2 cm to represent 1 unit on the x-axis, draw a horizontal x-axis for $-3 \leq x \leq 5$ and a scale of 2 cm to represent 2 units on the y-axis, draw a vertical y-axis for $0 \leq y \leq 10$.

On your axes, plot the points given in the table and join them with a smooth curve.

(c) State the equation of the line of symmetry. [1]

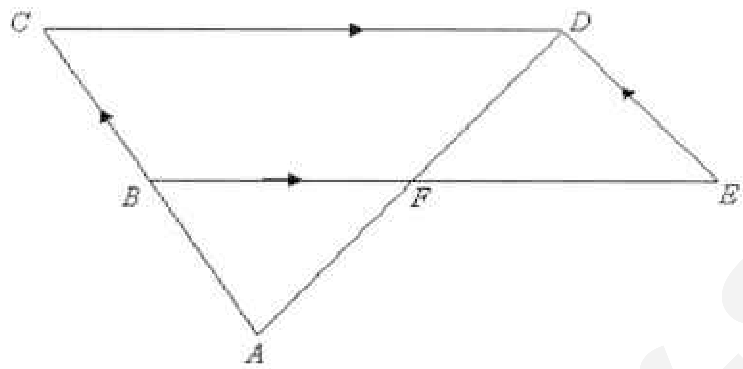
(d) For the range of $-3 \leq x \leq 5$, use your graph to

(i) solve the equation $8 + 2x - x^2 = 0$ [2]

(ii) find the values of x when $y = 2$, [2]

(iii) find solutions of the equation $4 + 2x - x^2 = 0$ by drawing a suitable straight line on the same axes as your graph. [3]

9 **(a)** In the figure below, $BCDE$ is a parallelogram. CB is extended to meet DF extended at A. B is the mid-point of AC.



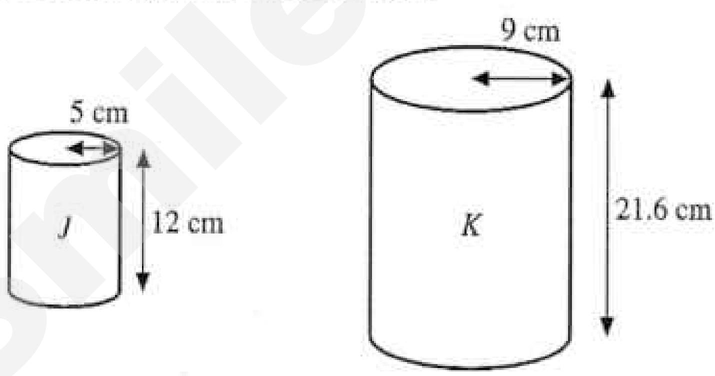
(i) Prove, stating the reasons clearly, that ΔDEF and ΔABF are congruent. [2]

(ii) Prove, stating the reasons clearly, that ΔDEF and ΔACD are similar. [2]

(iii) If $CD = 18$ cm, find FE. [2]

(iv) Given that the area of ΔDEF is 21 cm^2, find the area of the quadrilateral $BCDF$. [2]

(b) The diagram shows two geometrically similar cylinders with their dimensions. These cylinders are made with the same material.



(i) Find the ratio of the total surface area of cylinder **J** that of cylinder **K**. [1]

(ii) The cost of painting cylinder **J** is $10.45, find the cost of painting cylinder **K**. [1]

(iii) The containers are completely filled with water. Given that cylinder **K** holds 2.5 litres of water, calculate the capacity of cylinder **J**, correcting your answer to 2 decimal places. [2]

END OF PAPER 2

Answers to Sec 3 MYE Paper 2 2016				
1	(a)		168.28 [A1]	[1]
	(b)	(i)	$1.175\times10^{6}\times3.47$ $=4077250$ $=4.08\times10^{6}$ ----[$A1$]	[1]
		(ii)	$1.175\times10^{6}\times\frac{101.8}{100}$ $=1196150(2014)$ ----[$M1$] $1196150\times\frac{101.8}{100}$ $=1.22\times10^{6}(3sf)$ ----[$A1$]	[2]
	(c)	(i)	$(\frac{3p^2}{2pq^0})^{-2}$ $=(\frac{2pq^0}{3p^2})^2$ ----[$M1$] $=\frac{4}{9p^2}$ ----[$A1$]	[2]
		(ii)	$\frac{3x^2}{4y}\div\frac{6x^{-3}}{y^3}$ $=\frac{3x^2}{4y}\times\frac{y^3}{6x^{-3}}$ $=\frac{3x^2x^3y^3}{24y}$ ----[$M1$] $=\frac{x^5y^2}{8}$ ----[$A1$]	[2]
		(iii)	$(2a^2b^{-\frac{2}{3}})^3\leftarrow\sqrt[3]{8ab}$ $=(8a^6b^{-2})\leftarrow2a^{\frac{1}{3}}b^{\frac{1}{3}}$ ----[$M1$] $=16a^{\frac{19}{3}}b^{-\frac{5}{3}}$ $=\frac{16a^{\frac{19}{3}}}{b^{\frac{5}{3}}}$ ----[$A1$]	[2]
2	(a)	(i)	$5^{2x-3}=1$ $5^{2x-3}=5^0$ $2x-3=0$ $2x=3$ $x=\frac{3}{2}$ ----[$A1$]	[1]

		(ii)	$3^{x+3} \times (\frac{1}{9})^x = 27^4$ $3^{x+3} \times 3^{-2x} = 3^{12}$ ----[M1] $x+3-2x=12$ $-x=9$ $x=-9$ ----[A1]	[2]
	(b)	(i)	$W=126$	[1]
		(ii)	$W=\frac{1}{2}m(v^2-u^2).$ $2W=mv^2-mu^2$ $mu^2=mv^2-2W$ ----[M1] $u=\pm\sqrt{\frac{mv^2-2W}{m}}$ ----[A1]	[2]
	(c)		$18p^2-8$ $=2(9p^2-4)$----[M1] $=2(3p-2)(3p+2)$----[A1]	[2]
3	(a)		$\frac{3x-7}{4}+\frac{1}{x}=\frac{x}{4}$ $\frac{x(3x-7)+4}{4x}=\frac{x}{4}$ $\frac{3x^2-7x+4}{4x}=\frac{x}{4}$ $4(3x^2-7x+4)=4x^2$ $12x^2-28x+16=4x^2$ $8x^2-28x+16=0$ ----[M1] $x=\frac{28\pm\sqrt{(-28)^2-4(8)(16)}}{2(8)}$ $=\frac{28\pm\sqrt{272}}{16}$ $\therefore x=\frac{28+\sqrt{272}}{16}$ or $\frac{28-\sqrt{272}}{16}$ $=2.781$ or $0.719(3dp)$ ----[A2]	[3]
	(b)		$\frac{x+2y}{x+5y}=\frac{3}{7}$	[3]

			$7(x+2y)=3(x+5y)$ $7x+14y=3x+15y$ $4x=y$----[M1] $\frac{x}{y}=\frac{1}{4}$ $\frac{y}{x}=4$----[M1] $\frac{3y}{2x}$ $=(\frac{3}{2})4$ $=6$----[A1]	
	(c)	(i)	x^2-7x+3 $=x^2-7x+(\frac{-7}{2})^2+3-(\frac{-7}{2})^2$----[M1] $=(x-\frac{7}{2})^2-\frac{37}{4}$----[A1]	[2]
		(ii)	$(x-\frac{7}{2})^2-\frac{37}{4}=0$ $(x-\frac{7}{2})^2=\frac{37}{4}$----[M1] $x-\frac{7}{2}=\sqrt{\frac{37}{4}}\ or -\sqrt{\frac{37}{4}}$ $x=\sqrt{\frac{37}{4}}+\frac{7}{2}\ or\ -\sqrt{\frac{37}{4}}+\frac{7}{2}$ $=6.54\ or\ 0.46$----[A2]	[3]
4	(a)		$\frac{P(4.5)(5)}{100}=15735.75-P$----[M1] $P(22.5)=100(15735.75-P)$ $22.5P=1573575-100P$ $122.5P=1573575$ $P=12845.51(2dp)$----[A1]	[2]
	(b)		Amount $=8000(1+\frac{2.5/2}{100})^6$----[M1] $=8619.07(2dp)$----[A1]	[2]
5	(a)		$3(2x-1)<2(7+5x)$	[3]

			$6x-3<14+10x$ $-4x<17$ $x>-\frac{17}{4}$ $x>-4\frac{1}{4}$----[$M1$] $\frac{x-1}{3}\leq\frac{x-4}{7}$ $7x-7\leq 3x-12$ $7x-3x\leq -12+7$ $4x\leq -5$ $x\leq -\frac{5}{4}$----[$M1$] $\therefore -4\frac{1}{4}<x\leq -\frac{5}{4}$----[$A1$]	
	(b)	(i)	$2x-3+2x-3+x-2+x-2\leq 40$----[$A1$]	[1]
		(ii)	$6x-10\leq 40$ $6x\leq 50$ $x\leq\frac{50}{6}$ $x\leq 8\frac{1}{3}$----[$A1$]	[1]
		(iii)	Greatest possible $x = 8$ Greatest possible AB = 2(8)-3 = 13cm ----[A1]	[1]
6	(a)	(i)	When $y=0$, $(x+3)(x-5)=0$ $x+3=0$ *or* $x-5=0$ $x=-3$ *or* 5 $\therefore A(-3,0), B(5,0)$----[$A2$]	[2]
		(ii)	When $x=0$, $(0+3)(0-5)=y$ $y=(3)(-5)$ $=-15$ $\therefore C(0,-15)$----[$A1$]	[1]
		(iii)	$x=1$	[1]
		(iv)	x-coordinate of minimum point = 1 When $x=1$,	[1]

			$(1+3)(1-5)=y$ $y=(4)(-4)$ $=-16$ $\therefore (1,-16)----[A1]$	
7		(i)	$\frac{10}{x}h$	[1]
		(ii)	$(\frac{10}{x+1})h$	[1]
		(iii)	$\frac{10}{x+1}+\frac{1}{4}=\frac{10}{x}----[M1]$ $\frac{40+x+1}{4(x+1)}=\frac{10}{x}$ $\frac{41+x}{4x+4}=\frac{10}{x}$ $x(41+x)=10(4x+4)$ $x^2+41x=40x+40----[M1]$ $x^2+x-40=0(shown)----[A1]$	[3]
		(iv)	$x^2+x-40=0$ $x=\frac{-1\pm\sqrt{1^2-4(1)(-40)}}{2}----[M1]$ $=\frac{-1\pm\sqrt{161}}{2}----[M1]$ $=5.8442 or -6.8442$ $=5.84 or -6.84(2dp)----[A2]$	[4]
		(v)	Reject x = -6.84 Time taken by Alice $=\frac{10}{5.8442}----[M1]$ $==1.71109h----[M1]$ $=1h\ \ 43\min----[A1]$	[3]
8			refer to graph paper	

9	(a)	(i)	DE = CB (opp. sides of //gram)
			Since CB = AB (B is midpoint of AC), DE = AB.
			
			Angle DFE = Angle AFB (vert. opp. angles) 1m
			
			Angle DEF = Angle ABF (alt. angles)
			
			ΔDEF and ΔABF are congruent (ASA – 1m)
				[2]

		(ii)	Angle DEF = Angle ACD (opp. angles of //gram) Angle EDF = Angle CAD (alt. angles) 1m ΔDEF and ΔACD are similar (AAA – 1m).	[2]
		(iii)	Since ΔDEF and ΔACD are similar, $\frac{CD}{EF}=\frac{AC}{DE}=\frac{2}{1}----[M1]$ $\frac{18}{EF}=\frac{2}{1}$ $EF=9cm----[A1]$	[2]
		(iv)	$\frac{Area\ of\ DEF}{Area\ of\ ACD}=(\frac{DE}{AC})^2=(\frac{1}{2})^2$ $\frac{21}{Area\ of\ ACD}=\frac{1}{4}$ $Area\ of\ ACD=84cm^2----[M1]$ Since area of ABF = area of DEF = 21cm^2, area of BCDF = (84 – 21)cm^2- = 63 cm^2---[A1]	[2]
	(b)	(i)	25:81 ----[A1]	[1]
		(ii)	($10.45÷25)x 81 =$33.85----[A1]	[1]
		(iii)	Ratio of volume = 125:729----[M1] Capacity of cylinder J = (2.5÷729)x125 =0.43 litres of water ----[A1]	[2]

CEDAR GIRLS' SECONDARY SCHOOL
Mid-Year Examination
Secondary Three

CANDIDATE NAME

CLASS

INDEX NUMBER

MATHEMATICS

4048

Sections A and B

4 May 2016

Students are advised to spend 45 minutes on Section A and 1 hour 15 minutes on Section B.

2 hours

Section A

Candidates answer on the Question Paper.

For Examiner's Use
30

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** the questions.
If working is needed for any question, it must be shown with the answer.
Omission of essential working will result in loss of marks.
Calculators should be used where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely.
Hand in Section A and Section B separately.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for **Section A** is 30.
The total of the marks for **Section B** is 50.

Section A consists of 8 printed pages.

[Turn over

For Examiner's Use

Answer all the questions.

1 **(a)** Solve the inequalities

$$\frac{2x}{3} < \frac{x+7}{5} \le \frac{4x+5}{2} + 1.$$

Illustrate your solution on the number line below.

(b) Hence, state the smallest possible integer value of x.

Answer (a) .... [3]

(b) Smallest x = ... [1]

2 **(a)** Write down the smallest possible integer k such that $\sqrt{21600k}$ is a positive integer.

(b) 3 traffic lights along a street turn red at regular intervals of 35 seconds, 48 seconds and 1 minute 12 seconds respectively. Occasionally, all three traffic lights will turn red simultaneously. If all traffic lights turn red simultaneously at 0830 for the first time, find the next time when they turn red simultaneously again.

Answer *(a)* .... [2]

(b) .... [2]

For Examiner's Use

3 The table below shows the number of hours of exercise by a group of 90 adults in a week.

Number of hours of exercise in a week (hours)	2	3	4	5
Number of adults	22	x	20	y

(a) Given that the mean number of hours of exercise by each adult in a week is 3 hours, show that $3x + 5y = 146$.

Answer (a)

[2]

(b) Find the value of x and of y.

Answer (b) $x =$ ____________

$y =$ ____________ [2]

(c) Find the median number of hours of exercise by each adult in a week.

(c) ____________ h [1]

For Examiner's Use

4 The table shows the depth of water, h cm, when the same amount of water is poured into cylindrical containers with different base radii, r cm.

Base radius (r cm)	1	2	4	10
Depth of water (h cm)	6	1.5	0.375	0.06

(a) Explain clearly why h is inversely proportional to r^2, using the values in the table.

____

____

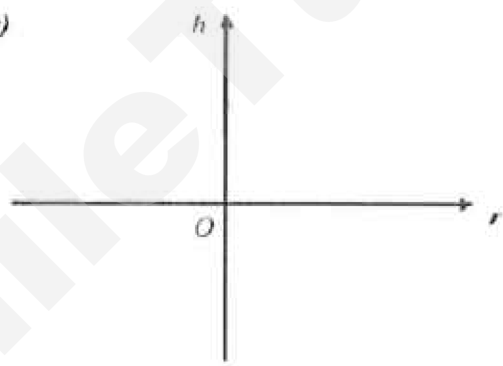
____ [1]

(b) Write down an equation connecting h and r.

(c) Sketch the graph using your answer in (b) in the diagram below.

(d) Find the base radius of the cylinder when the depth of water in the cylinder is 2.4 cm.

Answer (c)



[2]

Answer (b) and (d)

Answer *(b)* ______________ [1]

(d) Base radius = ______ cm [2]

For Examiner's Use

For Examiner's Use

5 **Diagrams I** and **II** show the graphs of $y = ka^x$ and $y = bx^m$ respectively, where k, a, b and m are constants. The point $(1, 1)$ has also been identified on **Diagram II**.
Write down a possible equation for each graph, indicating clearly the specific values of k, a, b and m.

(a)

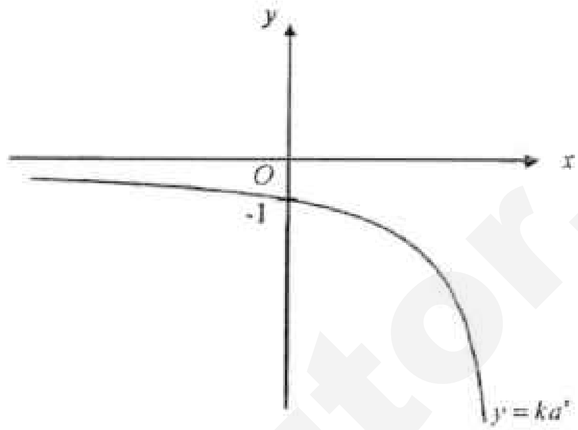


Diagram I

(b)

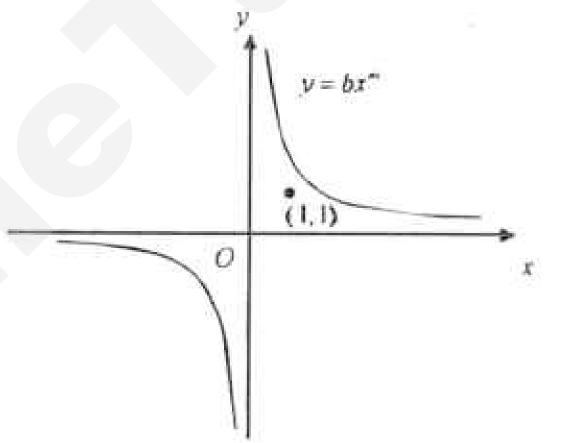


Diagram II

Answer *(a)* **Diagram I:** ____________ [1]

(b) **Diagram II:** ____________ [1]

For Examiner's Use

For Examiner's Use

6 In a quadrilateral $ABCD$, $AB = 8$ cm, $BC = 8$ cm, $\angle ABC = 122°$, $\angle BAD = 58°$ and $\angle BCD = 58°$.
The side AB has already been drawn in the answer space below.

(a) Construct quadrilateral $ABCD$ in the answer space below, showing clearly your construction arcs. [1]

(b) On the same diagram, construct using rulers and compass only,

(i) the perpendicular bisector of BC, [1]

(ii) the bisector of angle DAB. [1]

(c) The two bisectors in **(b)(i)** and **(b)(ii)** intersect at point P.
Measure the length of PB.

(d) $ABCD$ is a special quadrilateral.
State the name of this special quadrilateral.

Answer (a), (b)(i) and *(b)(ii)*

A B

Answer *(c)* $PB =$ ______________ cm [1]

(d) ______________________________ [1]

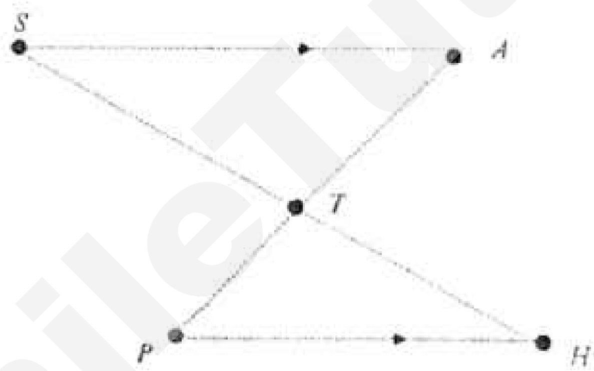
For Examiner's Use

7 The diagram shows the positions of different places located in a town. The road joining the Shopping Mall and Amusement park is parallel to the road joining the Police Station and the Hospital.
The straight road joining the Shopping Mall and the Hospital, and the straight road joining the Amusement Park and the Police Station intersect at the Town Hall.
The Town Hall is 2 km nearer to the Police Station than to the Hospital.
The Town Hall is 1 km nearer to the Hospital than to the Amusement Park.

Given that the total distance of the road from the Police Station to the Town Hall and the road from the Town Hall to the Shopping Mall is 13 km, calculate the distance of the road from the Police Station to the Town Hall.

S, A, T, P, H represent the Shopping Mall, Amusement park, Town Hall, Police Station and Hospital respectively.

(Hint: Let the distance between the Police Station and Town Hall be x km.



Answer .... [4]

End of Section A

Answer all the questions.

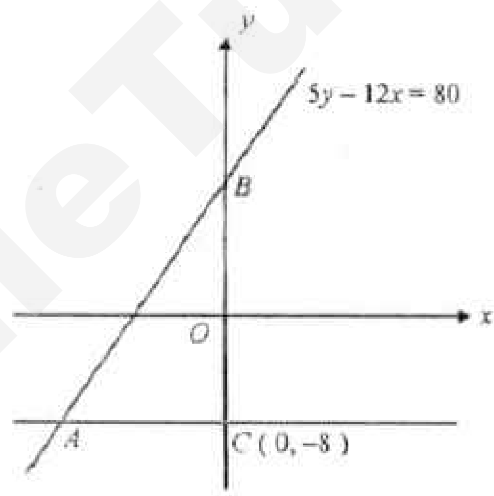
1 **(a)** Simplify $3(-2a^3b^{-2})^3 \div (\frac{3}{4}a^{-5}b^4)$, leaving your answer in positive indices. [2]

(b) Given that $2x-3=\frac{2}{y}\sqrt{y^2x^2+1}$, express y in terms of x. [3]

(c) Factorise $4t^2+14t-98$ completely. [2]

(d) Given that $2x=3y=7z$, find the ratio of $x:y:z$. [2]

2 In the diagram, C is the point $(0,-8)$ and B is a point on the y-axis.
The sloping line through B and the horizontal line through C meet at the point A.
The equation of the line AB is $5y-12x=80$.



(a) Write down the equation of line AC. [1]

(b) Find the coordinates of A and of B. [3]

(c) Find the value of the constant k if the line joining the points $(4, 6)$ and $(k+2, 2k-1)$ is parallel to AB. [3]

(d) Calculate the length of AB. [1]

(e) Calculate the perpendicular distance from C to AB. [2]

3 A man wants to deposit \$10 000 in a bank for a period of 2 years.
Bank A offers a simple interest of 1.5% per annum.
Bank B offers a compound interest of 1.4% per annum, compounded monthly.
Showing your reasoning clearly, indicate the bank that he should put his money in. [4]

4 A tank can be filled with water from tap A and tap B at constant rates.

(a) If only tap A is turned on, the tank can be filled in x minutes. What fraction of the tank can be filled by tap A alone in 1 minute? [1]

(b) If only tap B is turned on, the tank can be filled in $(x+5)$ minutes. What fraction of the tank can be filled by tap B alone in 1 minute? [1]

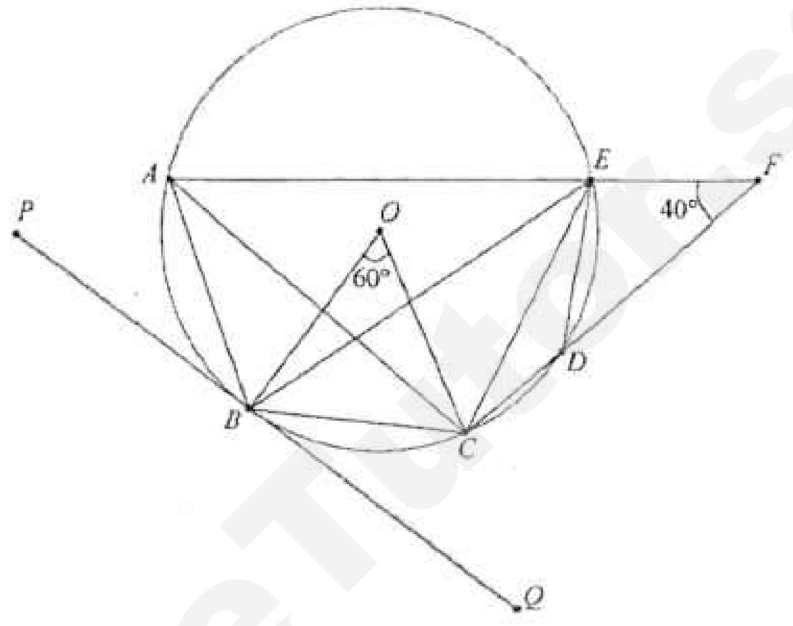
(c) If taps A and B are turned on together, the tank can be filled in 3 minutes and 15 seconds.

(i) Show that $4x^2 - 6x - 65 = 0$. [3]

(ii) Solve the equation in **(c) (i)**. [2]

(d) Hence, write down the time taken to fill the tank by turning on tap B only. Give your answer in minutes and seconds, correct to the nearest second. [2]

5 In the diagram, points A, B, C, D and E lie on a circle with centre O.
AEF and CDF are straight lines.
PBQ is a tangent to the circle at B.
Angle $AFD = 40°$, angle $BOC = 60°$ and $AC = CF$.



(a) Find, showing your reasoning clearly,

(i) angle EBC, [2]

(ii) angle CBQ, [2]

(iii) angle AED. [2]

(b) Explain why triangle DEF is isosceles. [2]

6 **Answer the whole of this question on a sheet of graph paper.**

The variables x and y are connected by the equation $y = 8x^2 + \frac{15}{x} - 7$.

Some corresponding values of x and y are given in the following table.

x	0.2	0.3	0.5	1	1.5	2	2.5	3	3.5
y	68.3	43.7	25	16	21	32.5	49	p	95.3

(a) Calculate the value of p. [1]

(b) Using a scale of 4 cm to represent 1 unit, draw a horizontal x-axis for $0 \le x \le 3.5$.
Using a scale of 1 cm to represent 5 unis, draw a vertical y-axis for $0 \le y \le 100$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]

(c) Use your graph to find the values of x when $y = 60$. [2]

(d) By drawing a tangent, find the gradient of the curve at the point where $x = 2$. [2]

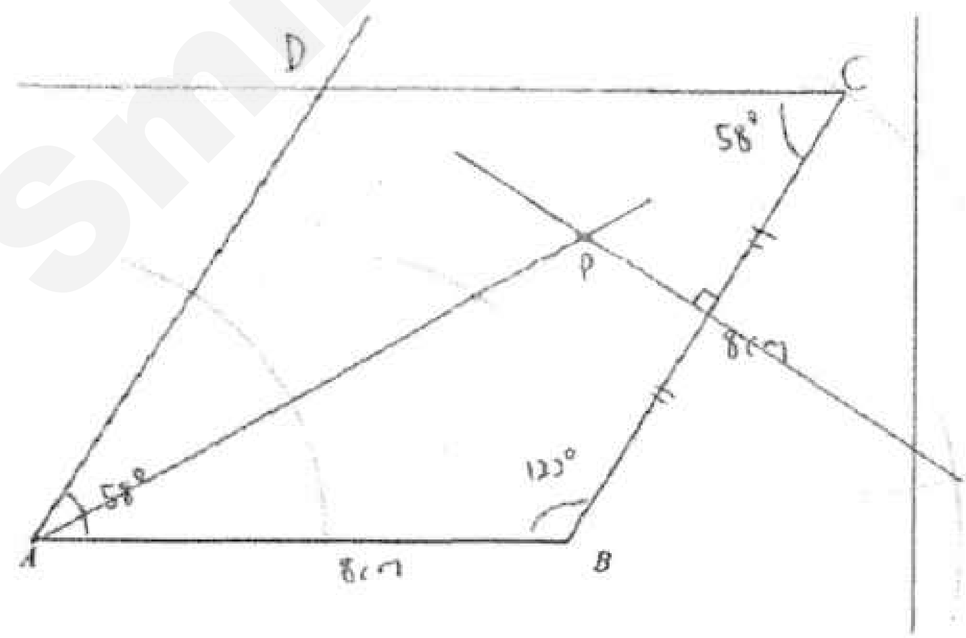
(e) By drawing a suitable straight line, use your graph to solve
$8x^3 - 12x^2 - 37x + 15 = 0$ for $0 \le x \le 3.5$. [2]

End of Section B

CEDAR GIRLS' SECONDARY SCHOOL
SECONDARY 3 MATHEMATICS
2016 Mid-Year Examination

Answer Key for Mathematics 4048			
Section A		Section A	
1(a)	$-\frac{1}{18} \le x < 3$	4(b)	$hr^2 = 6$ or $h = \frac{6}{r^2}$
1(b)	Smallest integer = 0	4(c)	Graph Sketching
2a	$k = 6$	4(d)	$r = 1.58\text{cm}$
2(b)	0954 or 9:54 am	5(a)	$y = -2^x$ $k = -1, a = 2, a > 1,$
3(a)	show that $3x + 5y = 146$	5(b)	$y = 3x^{-1}$ $b > 1, m = -1$
3(b)	$y = 1, x = 47$	6(c)	$PB = (4.6 \pm 0.1)\text{cm}$
3(c)	3 hours	6(d)	Rhombus
4(a)	Since $hr^2 = 6$, for all values in the table, h is inversely propotiond to r^2.	7	$x = 1$ or $x = 3$

Question 6(a), (b)(i) and (b)(ii)

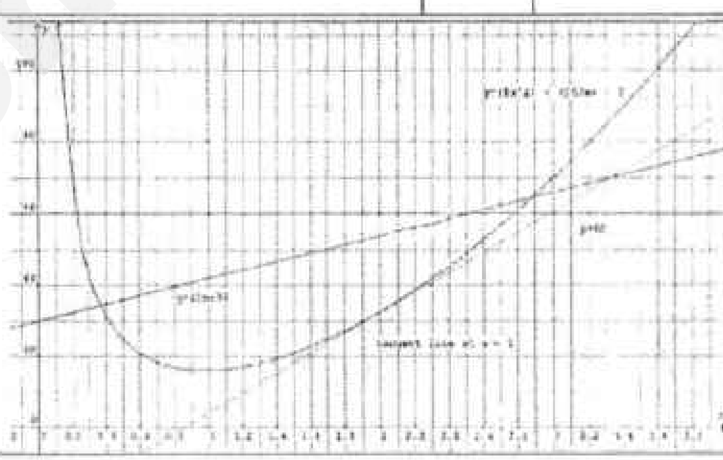


CEDAR GIRLS' SECONDARY SCHOOL
SECONDARY 3 MATHEMATICS
2016 Mid-Year Examination

Answer Key for Mathematics 4048 Section B

1a	$\frac{16a^{11}}{b^{8}}$	4b	$\frac{1}{x+5}$
1b	$y = \pm\frac{2}{\sqrt{9-12x}}$	4c(i)	To be shown
1c	$2(2t-7)(t+7)$	4c(ii)	4.85 or − 3.35
1d	$x:y:z = 21:14:6$	4c(iii)	9 mins 51 sec
2a	$y = -8$	5a(i)	40°
2b	$A = (-10, -8)$	5a(ii)	30°
2c	$k = -5.5$	5a(iii)	80°
2d	26 units	5b	$\because \angle EDF = 40° = \angle EFD$ (base $\angle$s of isosceles triangle)
2e	9.23 units	6a	$p = 70$
3	He should put his money in Bank A	6c	Draw the line $y = 60$. $x = 0.25$ or $x = 2.80$ (± 0.05)
4a	$\frac{1}{x}$	6d	Gradient = 28 (± 3)
		6e	Draw $y = 12x + 30$ $x = 0.37\ (\pm 0.1)$ or $x = 2.87\ (\pm 0.1)$

6b, 6c, 6d, 6e



Answer **all** the questions.

1 Factorise fully

(a) $(k+1)^2 - 25k^2$,

(b) $p^2q^2 - 3p^2q - 3pq^2 + pq^3$.

Answer (a) .... [2]

(b) .... [2]

---

2 Simplify

$$\frac{c^2 - 8c + 16}{c^2 - 2c} \times \frac{c-2}{c-4}$$

Answer .... [2]

---

3 One of the solution of $3x^2 + kx - 4 = 0$ is $x = 4$.
Find
(i) the value of k,
(ii) the other solution of the equation.

Answer (i)............................ [1]

(ii)............................ [1]

---

4 Express as a single fraction in its simplest form.

$$2 - \frac{m - 3n}{2n + m}$$

Answer .... [2]

5 **(a)** Given that $4^{17} \div 16 \times 2^0 = 4^k$, find the value of k.

(b) Given that $m = 4.15 \times 10^2$ and $n = 2.12 \times 10^{-4}$, evaluate $\frac{3n}{m}$, giving your answer in standard form.

Answer (a) .... [2]

(b) .... [1]

---

6 Simplify each the following, expressing your answers in **positive** index form.

(a) $\sqrt{\frac{49b^6}{a^8}} \div \frac{a^{-1}b^6}{2}$,

(b) $\frac{x^3 y^{-3}}{3z} \times \left(\frac{x}{y}\right)^{-2}$

Answer (a) .... [2]

(b) .... [2]

7 **(a)** Given that p and q are integers where $-1 \leq p \leq 4$ and $0 \leq q \leq 3$, find

(i) the least possible value of $\dfrac{2q}{p}$,

(ii) the largest possible value of $q^2 - p^2$.

Answer (a)(i) ....[1]

(ii) ....[1]

(b) Solve the inequality $11 + 2x \leq x + 3 < 20$.

Answer (b)....................................[2]

8 **(a)** Stephen borrowed a sum of $1000 from the bank. The bank charges an interest of 24% per annum compounded half yearly. Calculate the amount of money he has to return at the end of 2 years, correct to the nearest cent.

(b) Given that $m = \sqrt{\dfrac{30}{n+2}}$, calculate the value of n when $m = 2$.

Answer (a) $.. [2]

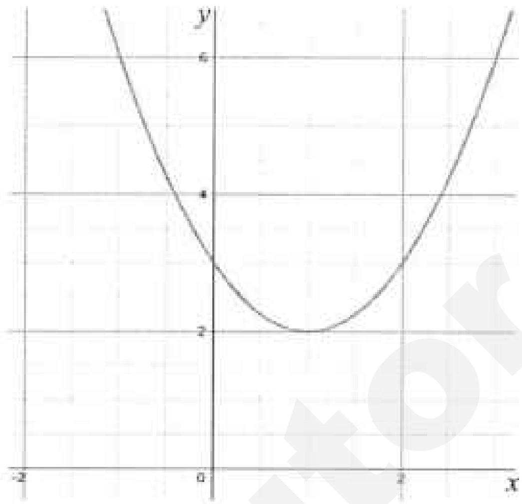
(b) .... [2]

---

9 **(a)** Solve the equation $\dfrac{2x}{x+1} = \dfrac{3}{x-2}$.

Answer (a) .... [2]

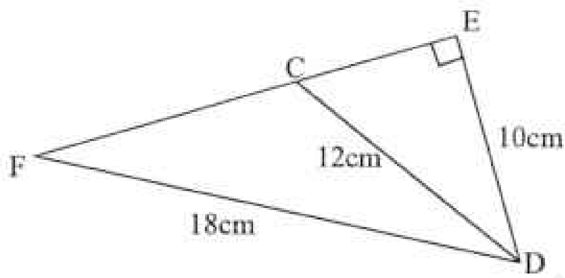
(b) A quadratic graph in the form of $y = (x+a)^2 + b$ is shown below. Determine the values of a and b, where a and b are integers.



Answer (b) …………………………………… [2]

CHIJ ST. THERESA'S CONVENT
SECONDARY THREE EXPRESS
2016 MID YEAR EXAMINATION MATHEMATICS PAPER 1

10 In ΔDEF shown below, C is a point on EF and $\angle DEF = 90°$. $DE = 10$ cm, $DF = 18$ cm and $CD = 12$ cm.



(a) Express $\sin \angle DCF$ as a fraction in its simplest form.

Answer (a) .... [1]

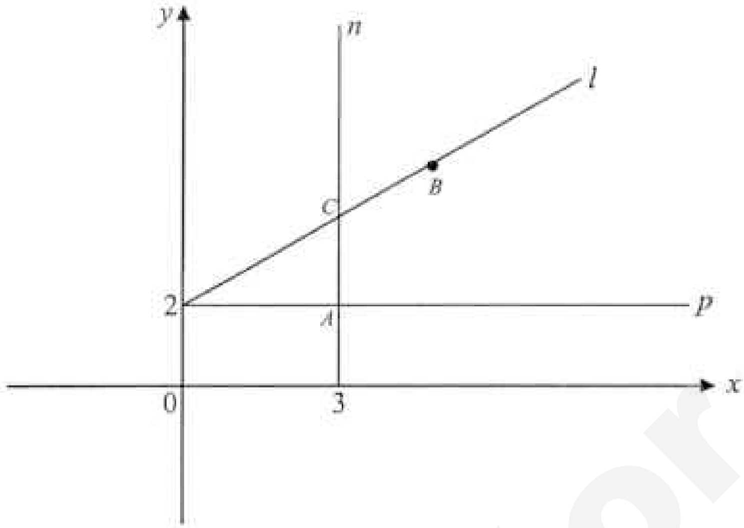
(b) Calculate $\angle EFD$.

Answer (b) .... ° [2]

(c) Calculate the length of CF.

Answer (c) ....cm [2]

11



The diagram above shows three lines n, p and l. The point B has coordinate $(4, 4)$ and C is the point of intersection of lines n and l. Lines p and n intersect at A.

(a) Write down the equation of lines n and p.

Answer (a) ....

.... [2]

(b) Hence determine the coordinates of point A

Answer (b) .... [1]

(c) Find the gradient of line l and hence write down the equation of line l.

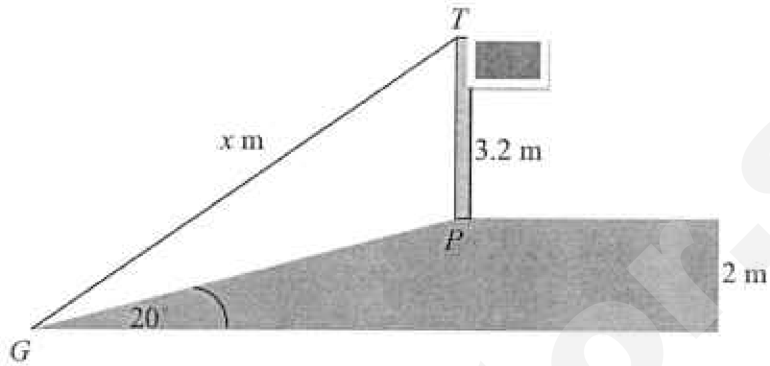
Answer (c) Gradient: .... [1]

Equation of line l: .... [1]

(d) Given that point C has coordinates (x, y), determine the values of x and y.

Answer (d) .... [2]

12 The diagram below shows a flag pole of 3.2m standing at a point P on the top of a slope which is inclined at $20°$ to the horizontal ground. The flag pole is 2m above the ground level. A x m taut rope at the top of the flag pole at point T is attached to point G at the end of the slope.



(a) Find $\angle TPG$.

Answer (a) ....° [1]

(b) Find the length of the slope GP.

Answer (b) ....m [2]

(c) Find x.

Answer (c) ....m [3]

(d) Hence, calculate the angle of elevation from point G to point T.

Answer (d) ....$^\circ$ [3]

End of paper1

Answer **all** the questions.

1 **(a)** Factorise completely $ac - 2bc + 5ak - 10bk$. [2]

(b) Express as a single fraction in its simplest form $\frac{8x+1}{(3x-1)^2} + \frac{2}{(1-3x)}$. [2]

(c) Given that $\frac{2}{p} = \sqrt{\frac{p-q}{q}}$, express q in terms of p. [3]

2 **(a)** Simplify $\frac{(2a)^3}{b^4} \div \frac{4a^{-2}}{b^2}$, leaving your answer in **positive index**. [2]

(b) Patrick went to a car showroom to buy a new car. After looking at the cars, he decided to buy a new Toyota Camry. He needs a loan of \$138 000 to buy the car.
Bank A charges an interest rate of 2.25% per annum compounded monthly.
Bank B charges a simple interest rate of 2.35% per annum.
Which bank should he borrow from if he were to take a five year loan?
Justify your answer. You must show all your working clearly. [3]

(c) Determine if 2^{5000} or 6^{2000} is greater. Explain your answer. [2]

3 **(a)** It is estimated that a female adult human body has 24 trillion red blood cells in 5000 cm^3 of blood.

(i) Express 24 trillion in standard form. [1]

(ii) Find the number of red blood cells in 1 cm^3 of blood, giving your answer in standard form. [1]

(b) The population of Singapore in the year 2015 is approximately 5.54 million. This is a growth of 1.2% from the year 2014, the slowest in more than a decade.

(i) 5.54 million can be written as $k \times 10^8$.
Find the value of k. [1]

(ii) Find the estimated population of Singapore in the year 2014, giving your answer as an ordinary number, correct to three significant figures. [1]

4 **(i)** Given that $P(1, 5)$ and $Q(-3, 0)$, find

(a) the length of the line segment PQ, giving your answer in exact form, [2]

(b) the gradient of PQ, [1]

(c) the equation of the line which is parallel to PQ and passing through the point (8, 6). [2]

(ii) If $x=1$ is the line of symmetry of triangle PQR, state the coordinates of point R. [1]

(iii) If the coordinate of S is $(7, -2)$ and $PQST$ forms a parallelogram, state the coordinates of the point T. [1]

5 **(i)** Solve the inequality $8\frac{1}{2} - x < 2x + 13 \le \frac{x+33}{2}$. [3]

(ii) Hence, write down the integral values of x that satisfy this inequality. [1]

6 Abigail has a budget of \$180 to buy lemon-honey tarts for her friends .

(a) Given that the price of each lemon-honey tart is \$$x$, write down an expression, in terms of x, for the number of lemon-honey tarts she can buy. [1]

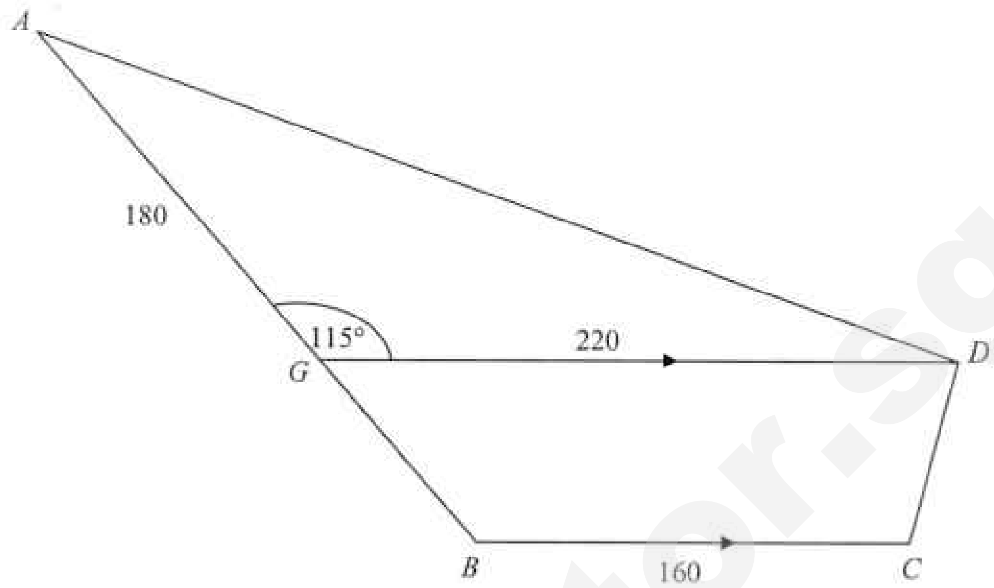
(b) At the shop, she discovers that the price of each lemon-honey tart has risen by 60 cents. Write down an expression, in terms of x, for the number of lemon-honey tarts she can buy now. [1]

(c) Due to the increase in price, Abigail could buy 4 fewer lemon-honey tarts. Write down an equation in x to represent this information, and show that it reduces to $5x^2 + 3x - 135 = 0$. [3]

(d) Solve the equation $5x^2 + 3x - 135 = 0$, giving your answers correct to two decimal places. [4]

(e) Hence, calculate the number of honey-lemon tarts she could buy before the increase in price. [1]

7



The diagram shows a park $ABCD$ in the shape of a quadrilateral on horizontal ground.
G is a point on AB such that $AG : GB = 3 : 2$ and GD is parallel to BC.
$AG = 180$ m, $GB = 220$ m, $BC = 160$ m and angle $AGD = 115°$.

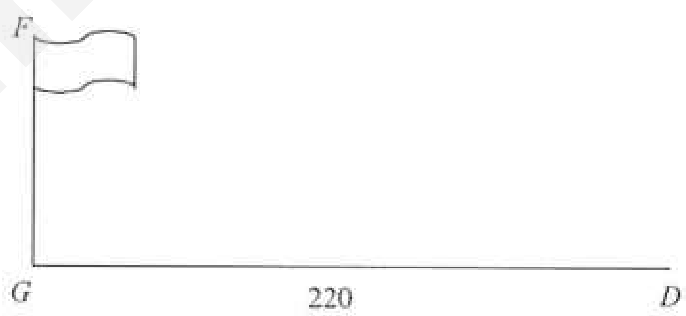
(a) Calculate

(i) AD, [3]

(ii) angle GDA, [2]

(iii) area of the park. [4]

(b) The base of a vertical flagpole, GF, is at vertex G on the park.



Given that the angle of elevation of F from D is 3.5°, find the height of the flagpole. [2]

End of Paper 2

(Have you checked your work?)

Answer **all** the questions.

1 Factorise each of the following expressions completely:

(a) $(k+1)^2 - 25k^2$,

(b) $p^2q^2 - 3p^2q - 3pq^2 + pq^3$.

(a) $(k+1)^2 - (5k)^2$

$= (k+1-5k)(k+1+5k)$ M1

$= (1-4k)(1+6k)$ A1

OR

$k^2+2k+1-25k^2$

$= -24k^2+2k+1$ M1

$= (-4k+1)(6k+1)$ A1

(b) $p^2q(q-3) - pq^2(3-q)$

$= p^2q(q-3) + pq^2(q-3)$ M1 – w

$= (p^2q + pq^2)(q-3)$

$= pq(p+q)(q-3)$ A1

Answer (a) ...... $(1-4k)(1+6k)$ ...... [2]

(b) ...... $pq(p+q)(q-3)$ ...... [2]

---

2 Simplify

$$\frac{c^2-8c+16}{c^2-2c} \times \frac{c-2}{c-4},$$

$$\frac{(c-4)^2}{c\cancel{(c-2)}} \times \frac{\cancel{c-2}}{\cancel{c-4}} = \frac{c-4}{c}$$ A1

M1

Answer ...... $\frac{c-4}{c}$ ...... [2]

3 One of the solution of $3x^2 + kx - 4 = 0$ is $x = 4$.
Find
(i) the value of k,
(ii) the other solution of the equation.

(i) $3(4)^2 - 4k - 4 = 0$

$48 - 4k - 4 = 0$

$-4k = 44$

$k = -11$ B1

(ii) $3x^2 - 11k - 4 = 0$

$(3x + 1)(x - 4) = 0$

$x = 4$ or $x = -\frac{1}{3}$ B1

Answer (i) $k = -11$ [1]

(ii) $x = -\frac{1}{3}$ [1]

4 Express as a single fraction in its simplest form.

$$2 - \frac{m - 3n}{2n + m},$$

$\frac{2(2n+m) - m + 3n}{2n+m}$ M1

$= \frac{4n + 2m - m + 3n}{2n+m}$

$= \cancel{3n+5m}\ \frac{7n+m}{2n+m}$ A1

Answer $\frac{7n+m}{2n+m}$ [2]

5 (a) Given that $4^{17} \div 16 \times 2^{0} = 4^{k}$, find the value of k.

(b) Given that $m = 4.15 \times 10^{2}$ and $n = 2.12 \times 10^{-4}$, evaluate $\frac{3n}{m}$, giving your answer in standard form.

(a) $4^{17-2} = 4^{k}$ M1 – any law of indices applied.

$k = 15$ A1

Answer (a) .... $k = 15$ .... [2]

(b) .... 1.53×10^{-6} B1 .... [1]

---

6 Simplify each the following, expressing your answers in **positive** index form.

(a) $\sqrt{\frac{49b^{6}}{a^{8}}} \div \frac{a^{-1}b^{6}}{2}$,

(b) $\frac{x^{3}y^{-3}}{3z} \times \left(\frac{x}{y}\right)^{-2}$

(a) $\frac{7b^{3}}{a^{4}} \times \underset{\text{M1}}{\frac{2}{a^{-1}b^{6}}} = \frac{14}{a^{3}b^{3}}$ A1

(b) $\frac{x^{3}y^{-3}}{3z} \times \frac{x^{-2}}{y^{-2}}$ M1

$= \frac{xy^{-1}}{3z} = \frac{x}{3yz}$ A1

Answer (a) .... $\frac{14}{a^{3}b^{3}}$ .... [2]

(b) .... $\frac{x}{3yz}$ .... [2]

7 (a) Given that p and q are integers where $-1 \le p \le 4$ and $0 \le q \le 3$, find

(i) the least possible value of $\frac{2q}{p}$,

(ii) the largest possible value of $q^2 - p^2$.

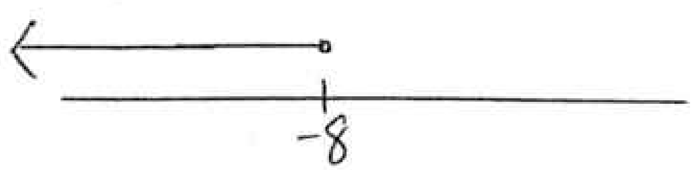
Answer (a)(i) ......-6 B1......[1]

(ii) ......9 B1......[1]

(b) Solve the inequality $11 + 2x \le x + 3 < 20$.
Show your answer on a number line.

$11+2x \le x+3$ and $x+3<20$

$x \le -8$ $\qquad$ $x<17$ B1



Answer (b)......$x \le -8$ B1......[2]

8 (a) Stephen borrowed a sum of $1000 from the bank. The bank charges an interest of 24% per annum compounded half yearly. Calculate the amount of money he has to return at the end of 2 years, correct to the nearest cent.

(b) Given that $m = \sqrt{\dfrac{30}{n+2}}$, calculate the value of n when $m = 2$.

(a) $A = 1000\left[1 + \dfrac{\frac{24}{2}}{100}\right]^4$ M1

$= \$1573.\cancel{xx}52$ A1

(b) $2 = \sqrt{\dfrac{30}{n+2}}$

$4 = \dfrac{30}{n+2}$ M1

$n+2 = \dfrac{30}{4}$

$n = \dfrac{30}{4} - 2 = 5\frac{1}{2}$ A1

Answer (a) $1573.52 [2]

(b) $5\frac{1}{2}$ or 5.5 [2]

---

9 (a) Solve the equation $\dfrac{2x}{x+1} = \dfrac{3}{x-2}$.

$2x(x-2) = 3x+3$

$2x^2 - 7x - 3 = 0$

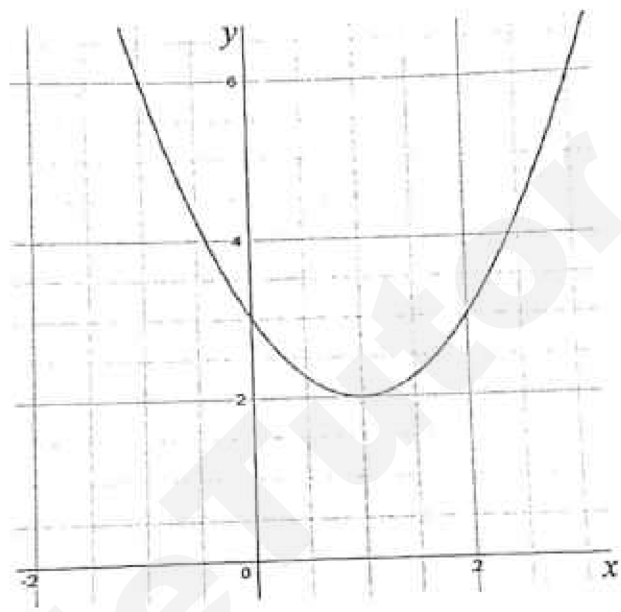
$x = \dfrac{7 \pm \sqrt{49+24}}{4}$ M1

$x = \dfrac{7+8.544}{4}$ or $x = \dfrac{7-8.544}{4}$

$= 3.89$ $= -0.386$ A1

Answer (a) $x = 3.89$ or -0.386 [2]

(b) A quadratic graph in the form of $y=(x+a)^2+b$ is shown below. Determine the values of a and b.

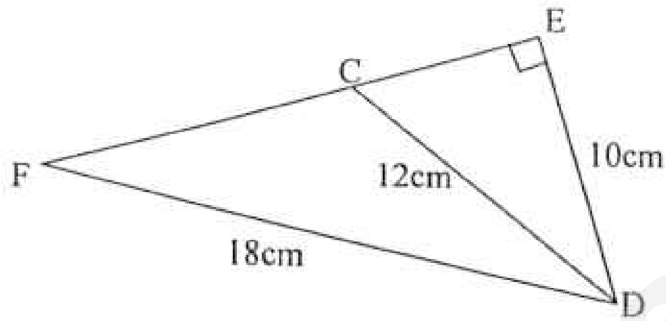


$y=(x-1)^2+2$

B1 B1

Answer (b) $a=-1$, $b=2$ [2]

10 In ΔDEF shown below, C is a point on EF and $\angle DEF = 90°$. $DE = 10$ cm, $DF = 18$ cm and $CD = 12$ cm.



(a) Express $\sin\angle DCF$ as a fraction in its simplest form.

$\frac{5}{6}$ B1

Answer (a) .... [1]

(b) Calculate $\angle EFD$.

$EF^2 = \sqrt{18^2 - 10^2}$
$= 224$
$EF = \sqrt{224}$

$\tan E\hat{F}D = \frac{10}{\sqrt{224}}$

$E\hat{F}D = \tan^{-1}\left[\frac{10}{\sqrt{224}}\right] \approx 33.7°$ M1

A1

Answer (b) 33.7 ....° [2]

(c) Calculate the length of CF.

$C\hat{D}F = 180° - 33.7° - 123.6°$
$= 22.7°$

Using sine rule, M1

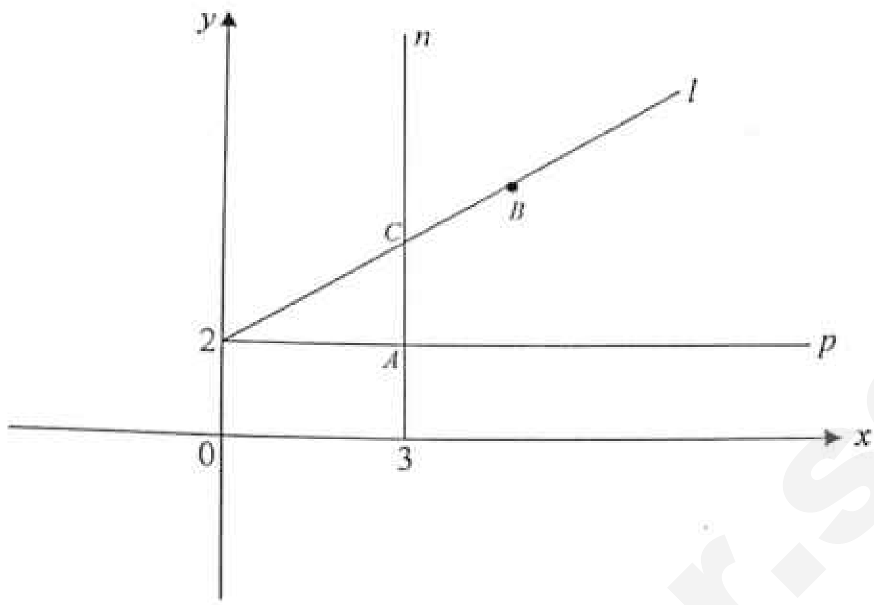
$\frac{18}{\sin D\hat{C}F} = \frac{CF}{\sin 22.7°}$ $\therefore CF \approx 8.34$ cm

OR $CF = \sqrt{18^2 - 10^2} - \sqrt{12^2 - 10^2}$ M1
$= \sqrt{224} - \sqrt{44} \approx 8.33$ cm

A1

Answer (c) 8.34 cm .... cm [2]

11



The diagram above shows three lines n, p and l. The point B has coordinate (4, 4) and C is the point of intersection of lines n and l. Lines p and n intersect at A.

(a) Write down the equation of lines n and p.

Answer (a) $x=3$ B1

$y=2$ B1 [2]

(b) Hence determine the coordinates of point A

Answer (b) $(3,2)$ B1 [1]

(c) Find the gradient of line l and hence write down the equation of line l.

Gradient $= \frac{4-2}{4-0} = \frac{2}{4} = \frac{1}{2}$.

$y = \frac{1}{2}x + c$

Sub (0,2) into eqn above,

$2 = \frac{1}{2}(0) + c \Rightarrow c = 2$.

$\therefore y = \frac{1}{2}x + 2$.

Answer (c) Gradient: $\frac{1}{2}$ B1 [1]

Equation of line l: $y = \frac{1}{2}x + 2$. B1 [1]

(d) Given that point C has coordinates (x, y), determine the values of x and y.

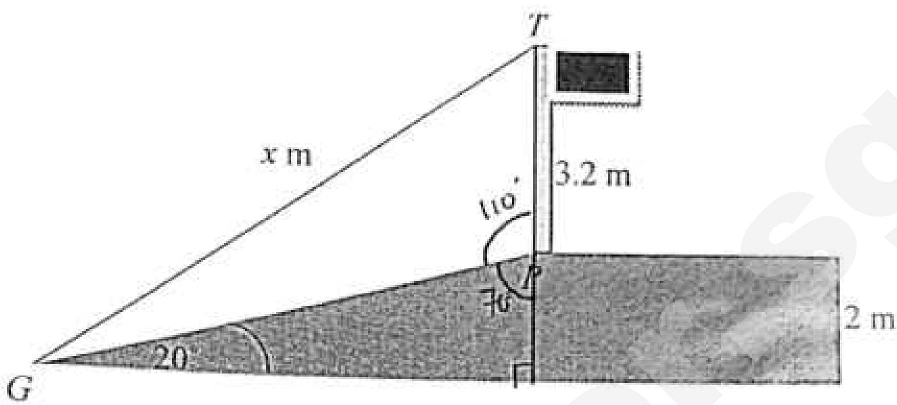
Sub $x=3$ into the eqn of line l,

$y = \frac{1}{2}(3) + 2 = 3\frac{1}{2}$.

Answer (d) $x=3$, $y=3\frac{1}{2}$ [2]

B1 B1

12 The diagram below shows a flag pole of 3.2m standing at a point P on the top of a slope which is inclined at $20°$ to the horizontal ground. The flag pole is 2m above the ground level. A x m taut rope at the top of the flag pole at point T is attached to point G at the end of the slope.



(a) Find $\angle TPG$.

Answer (a) ......110° B1...... ° [1]

(b) Find the length of the slope GP.

$\sin 20° = \frac{2}{GP}$

$\therefore GP = \frac{2}{\sin 20°} = 5.8476\text{m}$ M1

$\approx 5.85\text{m}$

Answer (b) ......5.85 A1...... m [2]

(c) Find x. Using cosine rule,

$x^2 = (3.2)^2 + (5.8476)^2 - 2(3.2)(5.8476)\cos 110^\circ$ M1

$= 57.2675$ M1

$\therefore x = \sqrt{57.2675} = 7.5675$

≈ 7.57 m A1

Answer (c) ......7.57...... m [3]

(d) Hence, calculate the angle of elevation from point G to point T.

Using sine rule,

$\frac{7.5675}{\sin 110^\circ} = \frac{3.2}{\sin T\hat{G}P}$ M1

$T\hat{G}P = \sin^{-1}\left[\frac{3.2\sin 110^\circ}{7.5675}\right]$

$\approx 23.4^\circ$

Hence $\angle$ of elevation

$= 23.4^\circ + 20^\circ$ M1

$= 43.4^\circ$

Answer (d) ......43.4 A1...... ° [3]

End of paper 1

SEC 3 EXP E-MATHS SA1 (PAPER 2)

1(a) $ac - 2bc + 5ak - 10bk = c(a-2b) + 5k(a-2b)$ [M1]

$= (a-2b)(c+5k)$ *. [A1]

1(b) $\dfrac{8x+1}{(3x-1)^2} + \dfrac{2}{1-3x} = \dfrac{8x+1}{(3x-1)^2} - \dfrac{2}{3x-1}$ [M1]

$= \dfrac{8x+1-2(3x-1)}{(3x-1)^2}$

$= \dfrac{8x+1-6x+2}{(3x-1)^2}$

$= \dfrac{2x+3}{(3x-1)^2}$ *. [A1]

* Many studs complicated the sol^n by doing this: $\dfrac{(8x+1)(1-3x)+2(3x-1)^2}{(3x-1)^2(1-3x)}$

And they did not factorise to simplify their answer at the end.

* many studs did not put this bracket.

1(c) $\dfrac{2}{p} = \sqrt{\dfrac{p-q}{q}}$

$\dfrac{4}{p^2} = \dfrac{p-q}{q}$ [M1]

$4q = p^3 - p^2q$

$4q + p^2q = p^3$

$q(4+p^2) = p^3$ [M1]

$\therefore q = \dfrac{p^3}{4+p^2}$ *. [A1]

* Many studs could only square both sides to get rid of the square root sign; and they were stuck after that.

* Many studs could not factorise to isolate q

Common mistake:

① $4q + qp^2 = p^3$

$5q = \dfrac{p^3}{p^2}$ (ERROR)

② $4q = p^3 - p^2q$

$\dfrac{4q}{q} = p^3 - p^2$

2(a) $\dfrac{(2a)^3}{b^4} \div \dfrac{4a^{-2}}{b^2} = \dfrac{[8a^3]}{b^4} \times \dfrac{b^2}{4a^{-2}}$ [M1]

$= \dfrac{2a^5}{b^2}$ * [A1]

* Common mistake:
$(2a)^3 = 6a^3$ or $2a^3$.

* Common mistake:
$\dfrac{8a^3}{b^4} \times \dfrac{b^2}{4a^{-2}}$
$= \dfrac{8a^3}{b^4} \times 4a^2 b^2$

2(b) Bank A

Compound Int $= 138000\left(1 + \dfrac{\frac{2.25}{12}}{100}\right)^{5\times12} - 138000$ [M1]

$= \$\,16415.70489$

$\approx \$\,16415.70$ * (2d.p.)

* Many studs do not know the compound int. formula & the simple int. formula.

Bank B

Simple Int $= \dfrac{138000\,(2.35)(5)}{100} = \$16215$ * [M1]

* Many studs compared total amount with simple int.

Patrick should borrow from Bank B as he will pay a lower interest. [A1]

2(c) $2^{5000} = (2^5)^{1000} = 32^{1000}$
$6^{2000} = (6^2)^{1000} = 36^{1000}$ } [M1]

Given the same indices, since $36 > 32$,
$\therefore 6^{2000}$ is greater in value. [A1]

* Many studs presented only $2^5 = 32$ and $6^2 = 36$ without taking into account the index 1000.

* Many studs claimed that 6^{2000} is bigger because it has a bigger base.

* 2^{5000} = Math error
6^{2000} = Math error
$\Rightarrow$ Neither is greater than the other.

* Common mistake:
$6^{2000} = 3(2^{2000})$

3(a)(i) 24 trillion $= 24 \times 10^{12}$

$= 2.4 \times 10^{13}$ *. [B1]

* Many studs did not recognise that trillion $= 10^{12}$

* Common mistake: 2.4^{13}.

3(a)(ii) $\dfrac{2.4 \times 10^{13}}{5000} = 4.8 \times 10^{9}$ *. [B1]

3(b)(i) 5.54 million $= 5.54 \times 10^{6}$

$= 0.0554 \times 10^{8}$

$\therefore k = 0.0554$ *. [B1]

3(b)(ii) $\dfrac{5.54 \times 10^{6}}{101.2} \times 100 = 5474308.3$

$\approx 5\,470\,000$ *. [B1]

* Common mistake:

$100\% - 1.2\% = 98.8\%$

$\therefore \dfrac{98.8}{100} \times 5540000 = 5473520$

≈ 5470000

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4(i) (a) length of PQ $= \sqrt{(1-(-3))^2+(5-0)^2}$ [M1]

$= \sqrt{41}$ #. [A1]

* Common mistake:

length $= \sqrt{(1-(-3)^2+(5-0)^2}$

* Many studs did not leave answer in exact form.

* Many studs think that writing 10 digits is leaving answer in exact form

4(i) (b) Grad of PQ $= \dfrac{5-0}{1-(-3)} = \dfrac{5}{4}$ #. [B1]

4(i) (c) $y = \frac{5}{4}x + c$

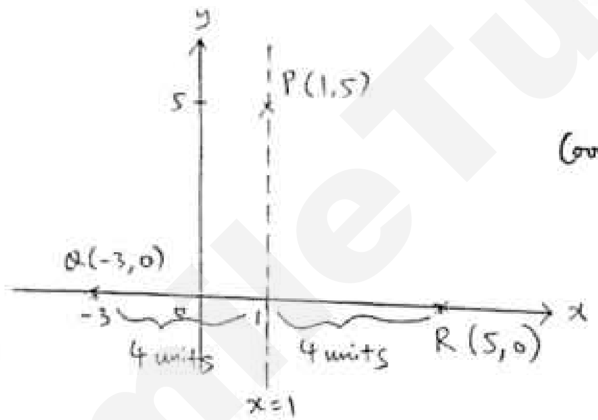
When $x = 8$, $y = 6$, we have,

$6 = \frac{5}{4}(8) + c$ [M1]

$c = -4$

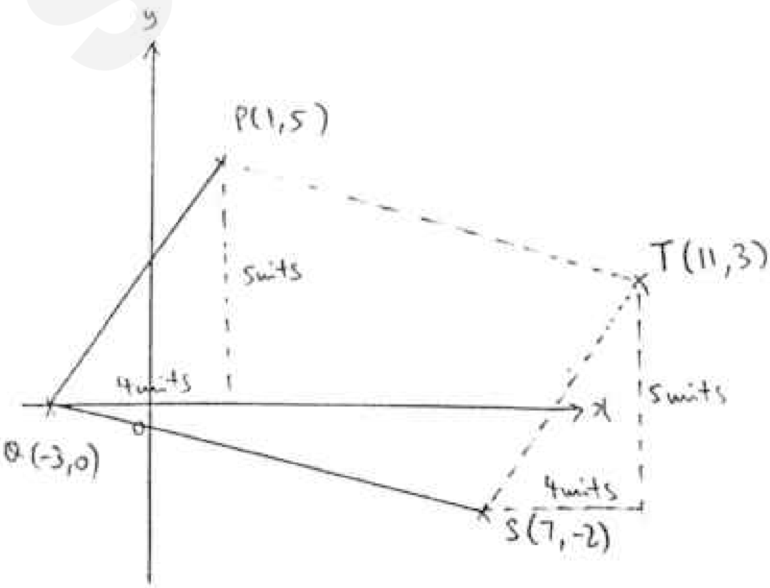
$\therefore$ eq^n of the line is $y = \frac{5}{4}x - 4$ #. [A1]

4(ii)



Coord of R = (5, 0) #. [B1]

4(iii)



Coord of T = (11, 3) # [B1]

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5 (i) $8\frac{1}{2} - x < 2x + 13 \leq \frac{x+33}{2}$

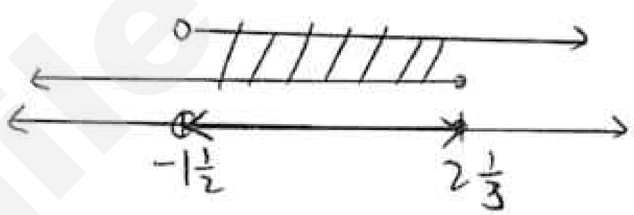
$8\frac{1}{2} - x < 2x + 13$ and $2x + 13 \leq \frac{x+33}{2}$

$17 - 2x < 4x + 26$ $\quad$ $4x + 26 \leq x + 33$

$-6x < 9$ $\quad$ $3x \leq 7$

$x > -1\frac{1}{2}$ [M1] $\quad$ $x \leq 2\frac{1}{3}$ [M1]

* Many stnds did not solve the inequality. Many left the answer $-1\frac{1}{2} < x \leq 2\frac{1}{3}$ as part (ii)'s answer.



Ans : $-1\frac{1}{2} < x \leq 2\frac{1}{3}$ #. [A1]

5 (ii) The integers are $-1, 0, 1, 2$ #. [B1]

* Many did not know that -1 and 0 are integers.

6(a) $\dfrac{180}{x}$ #. [B1]

6(b) $\dfrac{180}{x+0.6}$ #. [B1]

6(c) $\dfrac{180}{x} - \dfrac{180}{x+0.6} = 4$ [B1]

* Many studs stop at the line $4x^2+2.4x-108=0$.

$180(x+0.6) - 180x = 4x(x+0.6)$ [B1]

$180x + 108 - 180x = 4x^2 + 2.4x$

$$\left.\begin{aligned} 4x^2 + 2.4x - 108 &= 0 \\ 40x^2 + 24x - 1080 &= 0 \\ 5x^2 + 3x - 135 &= 0 \ \text{\#. (shown)} \end{aligned}\right\} \text{[B1]}$$

6(d) $5x^2+3x-135=0$

$\therefore x = \dfrac{\boxed{-3} \pm \sqrt{(3)^2-4(5)(-135)}}{\boxed{2(5)}}$ → Discriminant [B1]

[B1]

* Many studs still give this line $(x-4.90)(x+5.50)=0$.

* Many studs rejected -5.50 in part (d).

$= \dfrac{-3 \pm \sqrt{2709}}{10}$

$= 4.904805472$ or -5.504805472

≈ 4.90 # (2d.p) [B1] or -5.50 #. (2d.p) [B1]

6(e) Since money cannot be negative, $x=-5.50$ is rejected.

$\therefore$ No. of honey-lemon tarts Abigail could buy before the increase in price $= \dfrac{180}{4.904805472}$

$= 36.69870314$

≈ 36 #. [B1]

7(a)(i) $AD^2 = 180^2 + 220^2 - 2(180)(220)\cos 115^\circ$ [M1]

$\therefore AD = \sqrt{114271.3663}$ [M1]

$= 338.0404803$

$\approx 338 \text{ m}_{\#} \ (3 \text{ s.f.})$ [A1]

7(a)(ii) $\dfrac{\sin \angle GDA}{180} = \dfrac{\sin 115^\circ}{338.0404803}$

$\therefore \angle GDA = \sin^{-1}\left(\dfrac{180 \sin 115^\circ}{338.0404803}\right)$ [M1]

$= 28.8547824\,3$

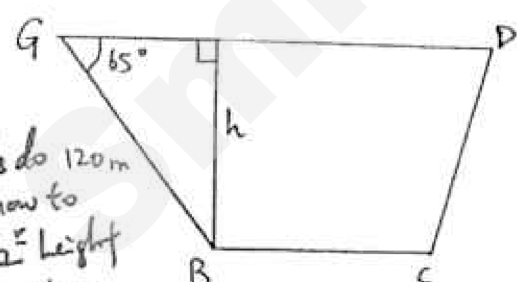
$\approx 28.9^\circ_{\#} \ (1 \text{ d.p.})$ [A1]

7(a)(iii) Area of $\triangle AGD = \frac{1}{2}(180)(220)\sin 115^\circ$ [M1]

$= 17944.89418 \text{ m}^2$

Length of $GB = \dfrac{180}{3} \times 2 = 120 \text{ m}$

Let the vertical height of the trapezium GBCD be h.



$\sin(180^\circ - 115^\circ) = \dfrac{h}{120}$

$\therefore h = 120 \sin 65^\circ$ [M1]

$= 108.7569344$

*Most studs do not know how to find the ⊥ height of the trapezium.

Area of trapezium $= \frac{1}{2}(160 + 220)(120 \sin 65^\circ)$ [M1]

$= 20663.81754 \text{ m}^2$

$\therefore$ Total area of the park $= 17944.89418 + 20663.81754$

$= 38608.71173$

$\approx 38600 \text{ m}^2_{\#} \ (3 \text{ s.f.})$ [A1]

7(b) $\tan 3.5^\circ = \dfrac{FG}{220}$

$FG = 220 \tan 3.5^\circ$ [M1]

$\approx 13.5 \text{ m}_{\#} \ (3 \text{ s.f.})$ [A1]

Name:	Register No.:	Class:

CRESCENT GIRLS' SCHOOL
SECONDARY THREE
MID-YEAR EXAMINATION 2016

MATHEMATICS

4048
6 May 2016
2 hours 30 minutes

For Section A, candidates answer on the Question Paper.
For Section B, candidates answer on the writing paper and graph paper given.

READ THESE INSTRUCTIONS FIRST

Write your name, register number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer all questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
Calculators should be used where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, submit section A and B separately.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for Section A is 40.
The total of the marks for Section B is 60.

For Examiner's Use	
Section A	40
Section B	60
Total	100

This paper (Section A + Section B) consists of 15 printed pages (inclusive of cover page) and 1 blank page.

Mathematical Formulae

Compound Interest

$$\text{Total amount} = P\left(1+\frac{r}{100}\right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard Deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

SECTION A

Answer all the questions.

1. (a) Sixty four small cubes have edges 4 cm each measured correct to the nearest 0.1 cm. These cubes fit exactly in a bigger cube. Find the
   (i) greatest length of the bigger cube

Answer (i) .... [1]

   (ii) least possible base area of the bigger cube

Answer (ii) .... [2]

(b) The mass of a DNA molecule is 2.01×10^{-19} kg. What is the mass of 15 DNA molecules in picograms? Give your answer in standard form.

Answer (b) .... picograms [1]

2. Solve the inequality $\frac{1}{3}(x+7) < \frac{1}{6}(x+22) \le x+6$ and represent the answer on the number line below.

Answer

[3]

3. (a) Express the expression $x^2 - 12x + 5$ in the form $(x-a)^2 + b$.

Answer (a) .... [2]

(b) Using your answer from part (a), solve the equation $3x^2 - 36x + 12 = 0$.

Answer (b) .... [3]

4. David has $\$P$ in a bank that pays compound interest at the rate of 2.4 % per annum compounded quarterly. If he receives a total of \$ 2500 from the bank after 3 years, find the value of P, giving your answer to the nearest whole number.

Answer $P =$ \$.................................... [2]

5. (a) A cartridge in a printer will last 30 days when an average of 70 sheets of paper are printed each day. How long will a cartridge last when the average number of sheets printed per day is increased by 30?

Answer (a) ………………………………… days [2]

(b) y is inversely proportional to d^2. Given that $y = 2$ for a certain value of d, find the value of y when this value of d is increased by 200%?

Answer (b) ………………………………… [2]

6. (a) (i) Sketch the graph $y = x^2 + 2x$ on Figure 1. [2]

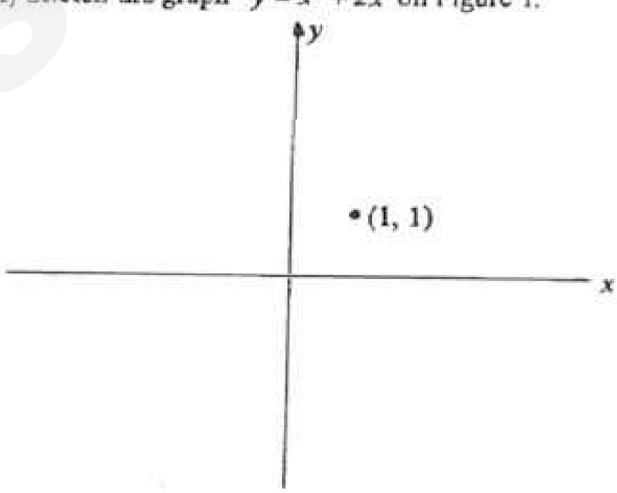


Figure 1

(ii) Sketch the graph $y = -3^x + 3$ on Figure 2. [2]

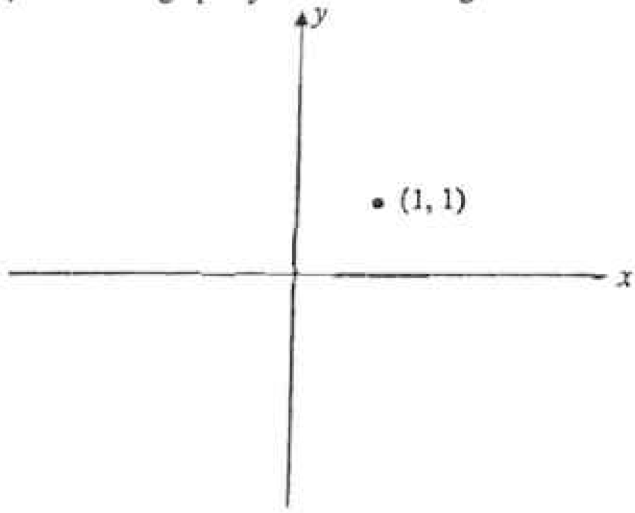
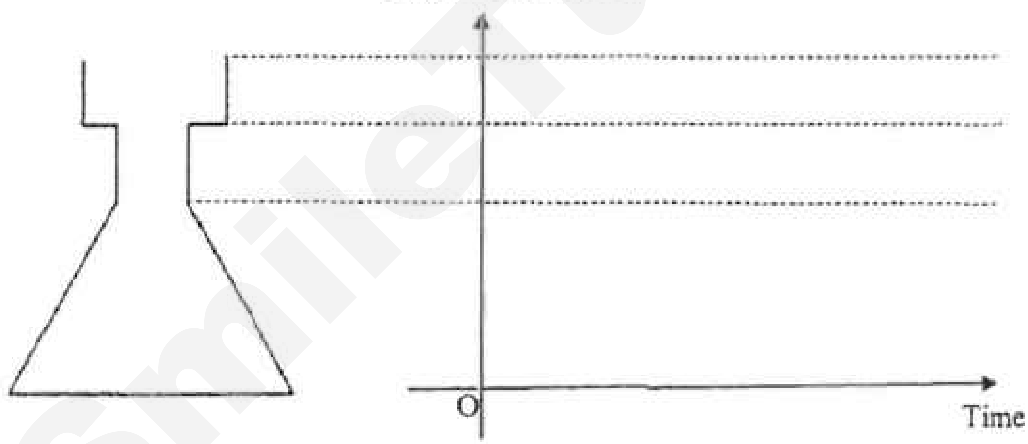
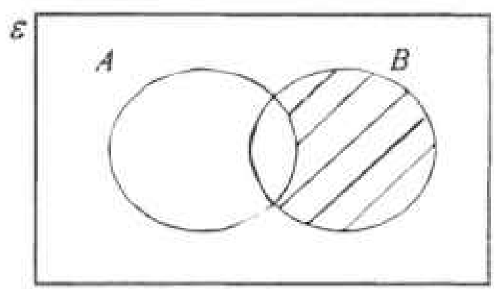


Figure 2

7. Water is poured at a constant rate into the container as shown below.
Draw on the axes provided, the change in the water level of the container over time. [2]

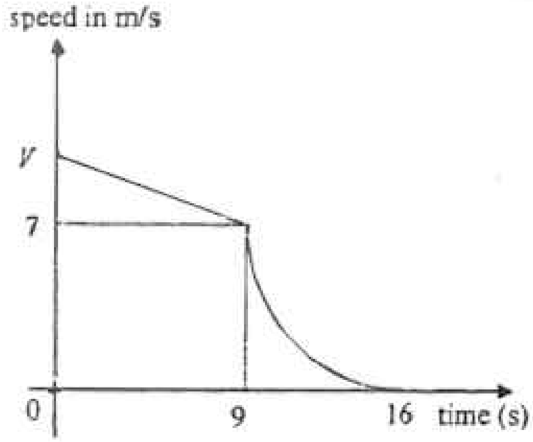


8. Express in set notation, the region shaded in the Venn diagram below.



Answer .... [1]

9.



The diagram above shows the speed-time graph of a car travelling in a straight line.

It decelerates uniformly from an initial speed V for the first nine seconds at $\frac{1}{3}$ m/s^2.

Given that its deceleration in the last seven seconds is such that the curve on the graph is a quarter of a circle, calculate

(a) the value of V,

(b) the distance travelled in the last 7 seconds,

(c) the average speed of the car for the first nine seconds.

[Take π to be $\frac{22}{7}$.]

Answer (a) .... [2]

(b) ....m [2]

(c) ....m/s [2]

10. James plans to buy either pens or bags as gifts for his friends. He has exact amount of money to buy either 15 wallets or 60 pens. If he buys an equal number of pens and wallets, how many of each can he buy with the money?

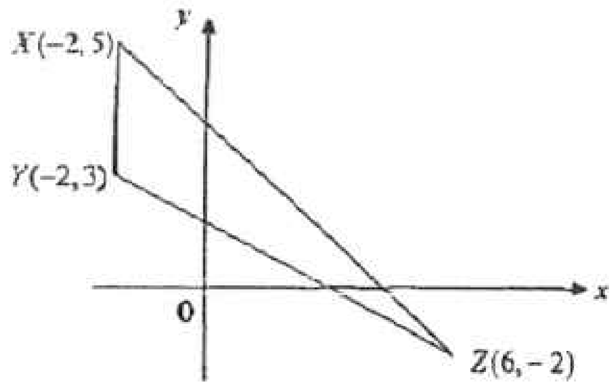
Answer (a) .... [2]

11. (a) A metal cylinder has a radius $8x^{\frac{3}{4}}$ cm and height $\frac{9}{4}x^{\frac{5}{6}}$ cm . Express the volume of the cylinder in terms of x and π.

(b) The cylinder is melted to form a hemisphere. Find the radius of the hemisphere in terms of x.

Answer (a)....................................cm³ [2]

(b)....................................cm [2]

12. 

The points X, Y and Z are $(-2, 5)$, $(-2, 3)$ and $(6, -2)$ respectively. Find the

(a) gradient of the line XZ,

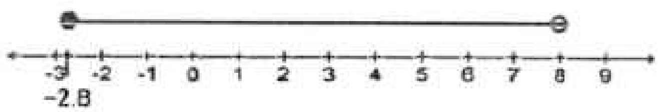
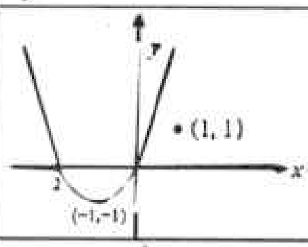
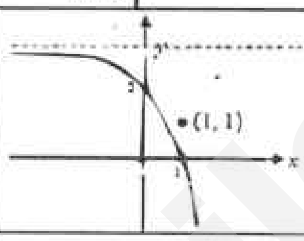
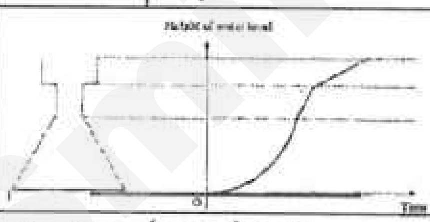
(b) $XYZA$ is a trapezium such that XY // AZ and the area of trapezium is 3 times the area of ΔXYZ find the coordinates of A.

Answer (a) .... [1]

(b) .... units^2 [2]

END OF SECTION A

Section A – Anskey

1	a i)	16.2 cm
	a ii)	249.64 cm^2
	b)	3.015×10^{-3}
2		$-2.8 \le x < 8$ 
3	a)	$(x-6)^2 - 31$
	b)	$x = 11.7$(3sf) or 0.343(3sf)
4		\$2327
5	a)	21 days
	b)	$\frac{2}{9}$
6	a)	
	b)	
7		
8		$B \cap A'$ or $(A \cap B)' \cap B$
9	a)	10 m/s
	b)	10½ m
	c)	8.5 m/s
10		12
11	a)	$144\pi x^{\frac{7}{3}}$ cm^3
	b)	$6x^{\frac{7}{9}}$ cm
12	a)	$-\frac{7}{8}$
	b)	(6, 2)

2016 CGS SEC 3 EM MYE

SECTION B

Answer all the questions.

---

1 (a) Factorise $4x^2 - 20xy + 25y^2 - 12x + 30y$. [3]

(b) Given that $x = 3$, find the values of y when $4x^2 - 20xy + 25y^2 - 12x + 30y = 0$. [2]

2 (a) Simplify $\left(\dfrac{2a^3b}{3c^{-4}}\right)^{-2} \div \dfrac{4a^{-4}}{9bc}$, leaving your answer in positive indices. [3]

(b) Solve $25^{3x-1} = 125^{1-x}$. [3]

3 A boat travelled from Sunshine Town to Moonlight City and back to Sunshine Town. It is given that the distance between Sunshine Town and Moonlight City is 80 km and the speed of the boat in still water is 25 km/h.
On that day, there is a constant current of x km/h from Sunshine Town to Moonlight City which resulted in a difference of 40 minutes of travelling time in the two journeys.

(a) Write down an expression, in terms of x, for the time taken, in hours, by the boat to travel from Sunshine Town to Moonlight City. [1]

(b) Write down an expression, in terms of x, for the time taken, in hours, by the boat to travel from Moonlight City to Sunshine Town. [1]

(c) Form an equation in x and show that it simplifies to $x^2 + 240x - 625 = 0$. [3]

(d) Solve the equation $x^2 + 240x - 625 = 0$. [2]

(e) Hence, find the time taken by the boat to travel from Moonlight City to Sunshine Town, leaving your answer in hours and minutes, correct to the nearest minute. [2]

(f) State the assumption that you made to solve this problem. [1]

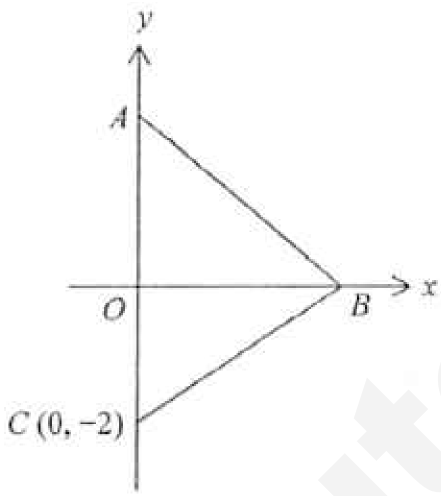
23. Find the value of $\frac{4x}{y}$, $y \neq 0$, given that $\frac{2x-3y}{x+7y} = \frac{2}{3}$.

Ans: 23 [CGS/2013/EOY/P1]

24. Given that $y = 1 + \sqrt{(3-x^2)y}$, express x in terms of y.

Ans: $x = \pm\sqrt{3 - \frac{(y-1)^2}{y}}$ [CGS/2013/EOY/P1]

4 In the diagram, C is the point $(0, -2)$, A is a point on the y-axis and B is a point on the x-axis. It is given that the length of AC is 4.5 units and BC is parallel to the line $3y-2x=5$.



Find,

(a) the coordinates of B, [2]

(b) the equation of AB, [2]

(c) the area of triangle ABC, [2]

(d) the perpendicular distance from C to AB. [3]

5 Jim has \$15000 to invest in either Bank A or Bank B. Here is some information about the investment plans offered by both banks.

<u>Bank A</u>
- 2.5% per annum compound interest, compounded yearly
- Interest will only be paid with a minimum of 5 years of investment

<u>Bank B</u>
- 2.2% per annum compound interest, compounded half yearly
- Interest will only be paid with a minimum of 5 years of investment

(a) Jim wishes to invest the money for a period of 5 years.

(i) Which bank should Jim invest in? Explain your answer. [3]

(ii) Calculate the difference in interest earned after 5 years. [2]

(b) After 3 years of investment, Jim decides to buy a car but was short of \$15000. He has two options to consider.

<u>Option 1</u>
- Withdraw his investment of \$15000 from the bank chosen in (a)(i).
- Jim will not earn any interest as he did not invest the money for a minimum of 5 years.

<u>Option 2</u>
- Continue his investment of \$15000 in the bank chosen in (a)(i).
- Borrow \$15000 from Bank C which charges 3% per annum simple interest for 2 years.

Which option should Jim choose? Explain your answer. [4]

6 **Answer the whole of this question on a sheet of graph paper.**

In 2008, a research was carried out to determine the wild cat population on Paradise Island.

The table below shows the population of cats, y, on Paradise Island, t years after 2008.

t	0	1	2	3	4	5	6	7	8
y	32	60	68	62	48	32	20	18	32

(a) Using a scale of 2cm to represent 1 year, draw a horizontal t-axis for $0 \le t \le 8$.
Using a scale of 2cm to represent 10 cats, draw a vertical y-axis for $0 \le y \le 70$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]

(b) (i) By drawing a tangent, find the gradient of the curve when $t = 3$. [2]

(ii) Using your answer to (b)(i), explain what was happening to the wild cat population when $t = 3$. [1]

(c) There were 10 wild cats on Beauty Island in 2008 and the population of the wild cats, y, increased at a uniform rate of 5 cats per year.

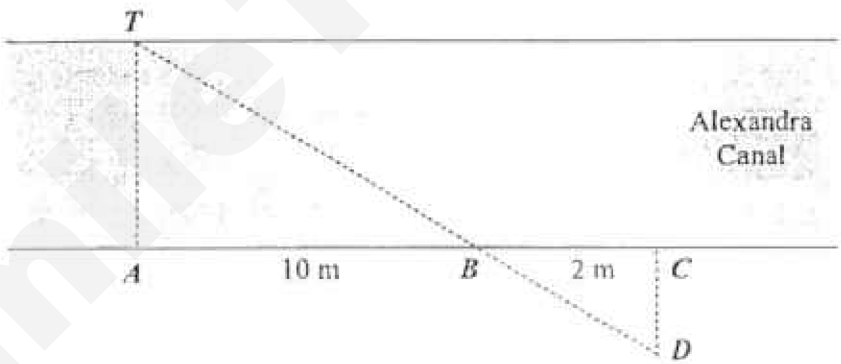
(i) Express the population of wild cats, y, on Beauty Island in terms of t, where t is the number of years after 2008. [1]

(ii) On the same axes, draw the graph of the equation in (c)(i) for $0 \le t \le 8$ and estimate the year in which the population of wild cats will be the same on both islands. [3]

(d) Jim proposes that the wild cat population on Paradise Island can be modelled by the equation $y = t^3 - 13t^2 + 40t + 32$.
Can this equation be used to predict the wild cat population on the island after 20 years? Explain your answer. [1]

7 (a) George is an engineer and he has been tasked to build a bridge across a part of the Alexandra canal. However, before he can build the bridge, he will need to determine the width of the canal.

George decides to use the following method to determine the width of the canal. He notices that there is a tree T that is located at the edge of the canal and he erects a pole at a point A directly opposite the tree. He walks along the canal and erects poles at points B and C, 10 m and 12 m away from point A respectively. At point C, George walks away from the canal in a direction perpendicular to BC until he sees that the pole at point B coincides the tree T. George then erects a pole at this point D.

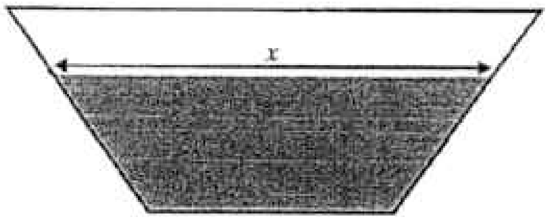


(i) Prove that triangles TAB and DCB are similar. [2]

(ii) Find the width of the canal given that the distance CD is 4.6 m. [2]

(iii) State one assumption made by George when determining the width of the canal. [1]

(b) The cross sectional area of the Alexandra canal can be modelled by a trapezium. On a rainy day, $\frac{2}{3}$ of the canal is filled with water and the width of the water surface is x m.



(i) Using the value found in (a)(ii), find the value of x. [2]

(ii) It is given that the cross sectional area of the canal is 525 m^2 and the length of the canal is 1.2 km. Find the volume of water, in m^3, in the canal on a rainy day. [3]

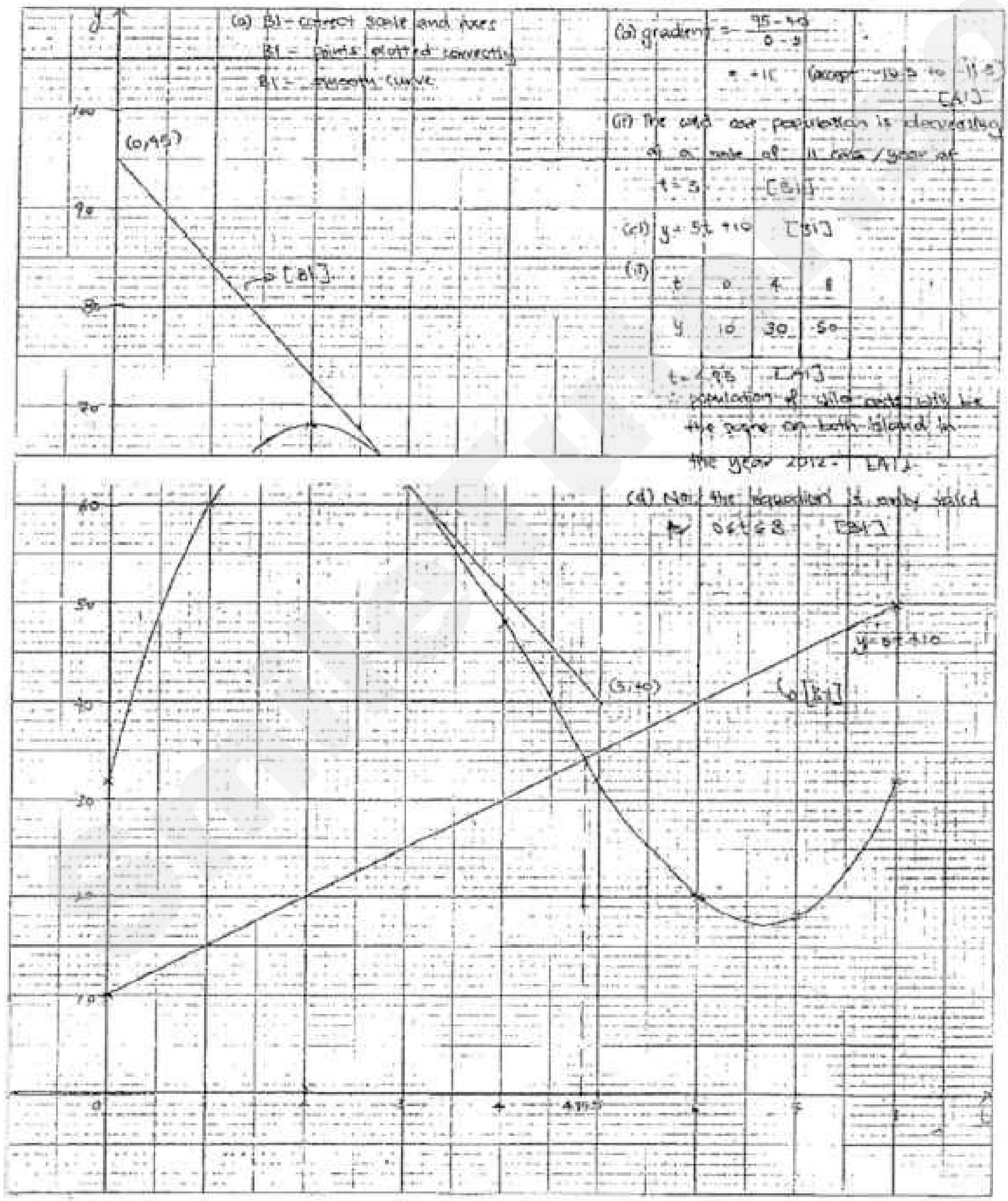
END OF SECTION B

Section B – Anskey

1	a)	$(2x-5y)(2x-5y-6)$
	b)	$y=1\frac{1}{5}$ or $y=0249.64\text{ cm}^2$
2	a)	$\frac{81}{16a^2bc^7}$
	b)	$x=\frac{5}{9}$
3	a)	$\left(\frac{80}{25+x}\right)$h
	b)	$\left(\frac{80}{25-x}\right)$h
	d)	2.58 (3sf) or -243 (3sf)
	e)	3 hours 34 minutes (nearest minute)
	f)	The boat is travelling in the same direction as the current from Sunshine Town to Moonlight City and against the current from Sunshine Town to Moonlight City.
4	a)	(3, 0)
	b)	$y=-\frac{5}{6}x+\frac{5}{2}$
	c)	6.75 units^2
	d)	3.46 (3sf)
5	a i)	Jim should invest in Bank A as he will have more money after 5 years.
	a ii)	$237.00
	b	Jim should choose Option 2 as he will earn $1071.12 after 5 years as compared to Option 1.
6		See attached
7	a ii)	23 m
	a iii)	George assumed that the width of the river is the same for this stretch of the canal.
	b i)	18.8 (3sf)
	b ii)	420000 m^3

Name: ____________ Index No.: ____________

Subject: ____________ Class: ____________ Date: ____________



(a) B1 – correct scale and axes
B1 – points plotted correctly
B1 – smooth curve

(b)(i) gradient $= \frac{95-40}{0-5}$

$= -11$ (accept -10.5 to -11.5) [A1]

(ii) The wild cat population is decreasing at a rate of 11 cats / year at $t = 5$. [B1]

(c)(i) $y = 5t + 10$ [B1]

(ii)

t	0	4	8
y	10	30	50

$t = 4.95$ [A1]

population of wild cats will be the same on both island in the year 2012. [A1]

(d) No, the equation is only valid for $0 \le t \le 8$. [B1]

Class	Index Number	Name

新加坡海星中学

MARIS STELLA HIGH SCHOOL

SEMESTRAL ASSESSMENT ONE

SECONDARY THREE

MATHEMATICS **06 May 2016**

2 hours 30 minutes

Additional Materials:
Writing paper (3 sheets)
Graph paper (1 sheet)

INSTRUCTIONS TO CANDIDATES

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use paper clips, highlighters, glue or correction fluid.

Answer all questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
You are expected to use a scientific calculator to evaluate explicit numerical expressions.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give your answer to three significant figures. Give answer in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, submit Section A and B **separately**.
The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 100.

For Examiner's Use			
	Section A	Section B	
Subtotal			
Presentation			
Unit			
Rounding off			100

This document consists of 14 printed pages.

Mathematical Formulae

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$$\text{Total amount} = p\left(1+\frac{r}{100}\right)^n$$

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$$\text{Surface area of a sphere} = 4\pi r^2$$

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$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle ABC} = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta\text{, where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta\text{, where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin c}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

SECTION A (56 MARKS)

Answer **ALL** the questions in the spaces provided.

1. Given that $-1 \le a < 3$ and $-5 \le b \le -1$, where a and b are integers, find

(a) the greatest value of ab,

Answer (*a*) .... [1]

(b) the smallest possible value of $\frac{a}{b^2}$, given that $\frac{a}{b^2}$ is a perfect cube.

Answer (*b*) .... [1]

2. Simplify $\dfrac{\left(p^{-1}q^{2}\right)^{5} \div \left(2pr^{-4}\right)}{\left(3qr\right)^{3}\left(2p^{-2}q^{3}\right)^{0}}$, leaving your answer in positive index notation.

Answer .... [3]

3. (a) Factorise $169+52q+4qr-r^2$ completely.

Answer (*a*) .... [2]

(b) Make x the subject of the equation $2x^2=\dfrac{y-x^2}{2y}+1$.

Answer (*b*) x =.......................... [3]

---

4. The curve $y=2(x+2)(x+k)$ cuts the y-axis at $(0,-8)$.

(a) Find the value of k.

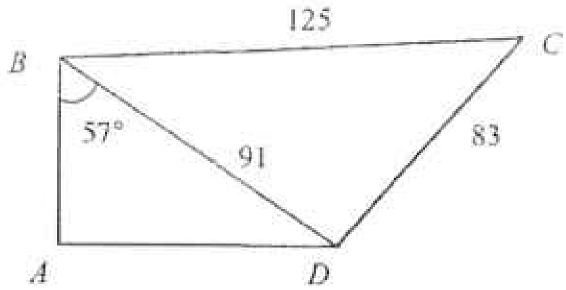
Answer (*a*) k = ... [2]

(b) Using the value of k found in part (a), find the coordinates of the points where the curve cuts the x-axis.

Answer (*b*) .... [2]

---

5. The figure below represents a plot of land $ABCD$. B is due north of A, D is due east of A. $BC = 125$ m, $CD = 83$ m and $BD = 91$ m. Angle $ABD = 57°$.



(a) Find angle BDC.

Answer (*a*) .... ° [3]

(b) Find the bearing of D from C.

Answer (*b*) .... ° [2]

6. **(a)** Solve the inequality $\frac{x-35}{3} < 5-3x \le 2(4-x)$. Represent your answer on the number line below.

Answer (*a*) .... [4]

(b) Write down the largest prime number which satisfies

$$\frac{x-35}{3} < 5-3x \le 2(4-x).$$

Answer (*b*) $x =$........................ [1]

7. A hard disk has a memory capacity of 2 terabytes.

(a) If a low-resolution photograph takes up about 250 kilobytes, how many million photographs can be stored in the hard disk?

Answer (*a*) .... million [2]

(b) If the hard disk is to store 25 video clips with capacity of 273 megabytes each, how much capacity is left in the disk? Give your answer in standard form, correct to 3 significant figures.

Answer (*b*) .... bytes [3]

8. (a) Express $\frac{5}{12x+9}-\frac{2x+1}{9-16x^2}$ as a single fraction.

Answer (*a*) .... [3]

(b) **Hence**, solve $\frac{5}{12x+9}-\frac{2x+1}{9-16x^2}=1$.

Answer (*b*) $x =$ .... or .... [3]

9. **(a)** Solve $\frac{25^x}{5} - \sqrt{\frac{1}{625}} = 0$.

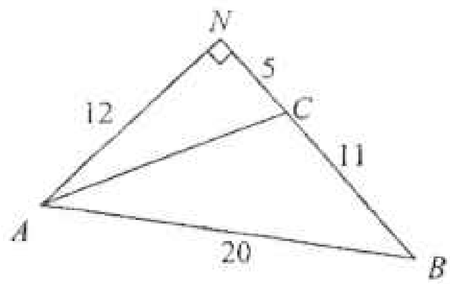
Answer (*a*) x = ... [3]

(b) Find the value of m for which $\sqrt{a^2 \sqrt{a^{\frac{1}{3}}}} = a^m$.

Answer (*b*) m = ... [3]

10. In the diagram, ABN is a right-angled triangle, and BCN is a straight line.

$AN = 12$ cm, $CN = 5$ cm, $BC = 11$ cm and $AB = 20$ cm.



Calculate

(a) the length of AC,

Answer (*a*) .... cm [1]

(b) $\cos\angle ACB$,

Answer (*b*) .... [2]

(c) angle BAC.

Answer (*c*) ....° [3]

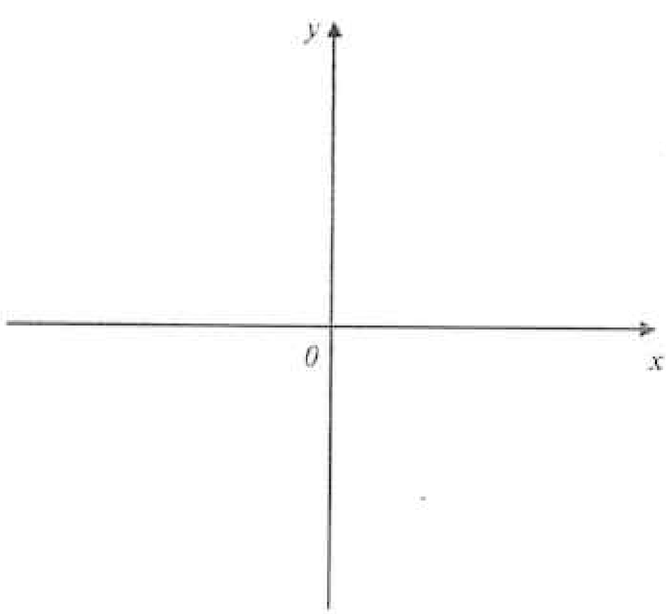
11. (a) Express $-x^2+6x-3$ in the form $-(x+b)^2+c$.

Answer (*a*) .... [3]

(b) **Hence**, solve the equation $x^2+3=6x$.

Answer (*b*) $x=$ .... or .... [3]

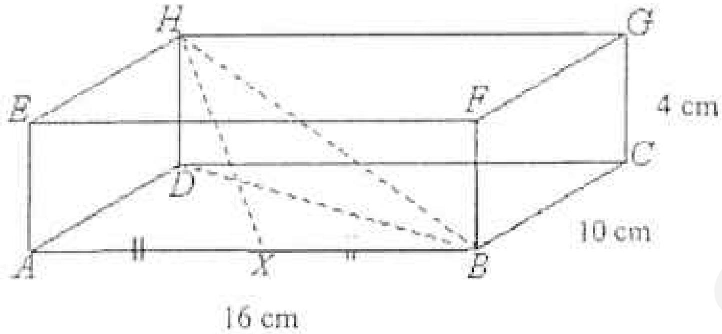
(c) Sketch the graph $y=-x^2+6x-3$ on the axes provided, labeling your turning point, x-intercepts and y-intercept clearly. [3]



END OF SECTION A

SECTION B (44 MARKS)
Answer **ALL** the questions on the writing papers provided.

12. The diagram below shows a cuboid of dimensions 16 cm by 10 cm by 4 cm. Point X lies on AB such that $AX = XB$ and angle $HBX = 33.9°$.



Calculate

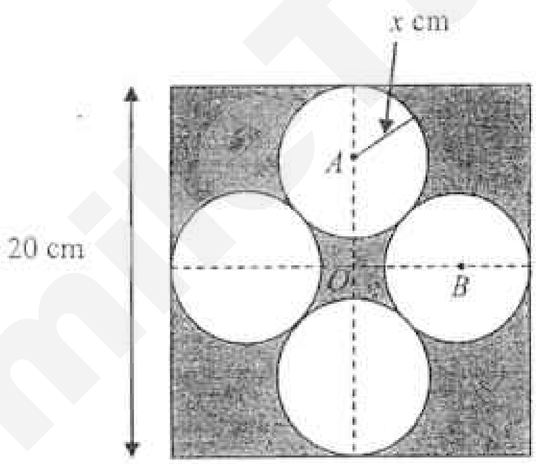
(a) the length of BH, [3]

(b) angle HBD, [2]

(c) HX, [2]

(d) angle DHX. [2]

13.



The diagram shows a square of length 20 cm. O is the intersection of the diagonals of the square. Four smaller identical circles, touching each other, with radius x cm are drawn as shown. A and B are the centres of two of the smaller circles.

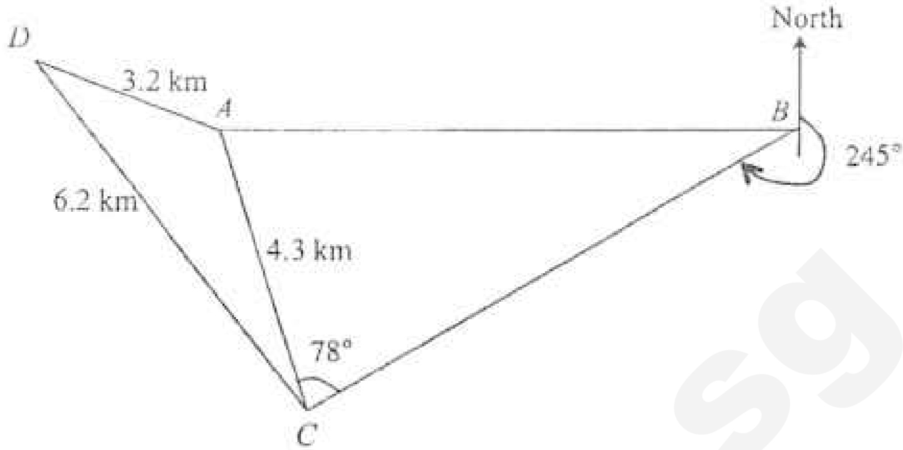
(a) Express the length of OA and of AB in terms of x. [2]

(b) Use Pythagoras' Theorem to form an equation in x and show that it can be simplified to $x^2 + 20x - 100 = 0$. [3]

(c) Solve the equation $x^2 + 20x - 100 = 0$, giving your answers correct to 2 decimal places. [3]

(d) Calculate the area of the shaded region. [2]

14.



In the diagram, A, B, C and D are four points on level ground. It is given that $AC = 4.3$ km, $AD = 3.2$ km, $CD = 6.2$ km, angle $ACB = 78°$, the bearing of C from B is $245°$ and B is due east of A. Calculate

(a) angle ACD, [3]

(b) the bearing of B from C, [2]

(c) the length of AB, [3]

(d) the area of triangle ADC. [2]

Alex walked from D to C along the path DC.

(e) He stopped at point X when he is at the shortest distance to point A. Calculate AX. [2]

(f) At point X, Alex saw a building standing vertically at point A. Given that the height of the building is 980 m tall, calculate the angle of elevation of the top of building when viewed by Alex. [2]

15. **Answer the whole of this question on a piece of graph paper.**

The variables x and y are connected by the equation $y = 2x^2 - 5x - 3$. Some corresponding values are given in the following table.

x	-2	-1	0	0.5	1	2	3	4
y	a	4	-3	-5	-6	-5	0	9

(a) Calculate the value of a. [1]

(b) Taking 2 cm to represent 1 unit on the x-axis and 2 cm to represent 5 units on the y-axis, draw the graph of $y = 2x^2 - 5x - 3$ for the range $-2 \le x \le 4$. [3]

(c) From your graph, find

(i) the value(s) of x when $y = 5$, [2]

(ii) the minimum value of y. [1]

(d) By adding suitable line(s) on the same graph paper, find

(i) the values of x for which $2x^2 - 5x - 3 = 0$, [1]

(ii) the solutions for the equation $2x^2 - 7x = 0$. [3]

END OF PAPER

Class	Index Number	Name

新加坡海星中学
MARIS STELLA HIGH SCHOOL
SEMESTRAL ASSESSMENT ONE
SECONDARY THREE

MATHEMATICS
[Solution]

06 May 2016

2 hours 30 minutes

Additional Materials:
Writing paper (3 sheets)
Graph paper (1 sheet)

INSTRUCTIONS TO CANDIDATES

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
You are expected to use a scientific calculator to evaluate explicit numerical expressions.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give your answer to three significant figures. Give answer in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, submit Section A and B **separately**.
The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 100.

For Examiner's Use			
	Section A	Section B	
Subtotal			
Presentation			
Unit			
Rounding off			100

This document consists of **14** printed pages.

Mathematical Formulae

Compound Interest

$$\text{Total amount} = p\left(1+\frac{r}{100}\right)^{n}$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle ABC} = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta\text{, where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta\text{, where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin c}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

SECTION A (56 MARKS)

Answer **ALL** the questions in the spaces provided.

1. Given that $-1 \le a < 3$ and $-5 \le b \le -1$, where a and b are integers, find

(a) the greatest value of ab,

[Solution]

the greatest possible value of $ab = (-1)(-5)$
$= 5$

Answer *(a)* ....5.......... [1]

(b) the smallest possible value of $\frac{a}{b^2}$, given that $\frac{a}{b^2}$ is a perfect cube.

[Solution]

the smallest possible value of $\frac{a}{b^2} = \frac{-1}{(-1)^2}$
$= -1$

Answer *(b)* ....-1.......... [1]

---

2. Simplify , leaving your answer in positive index notation.

[Solution]

$$\frac{\left(p^{-1}q^{2}\right)^{5} \div \left(2pr^{-4}\right)}{\left(3qr\right)^{3}\left(2p^{-2}q^{3}\right)^{0}}$$

$$= \frac{p^{-5}q^{10}}{\left(27q^{3}r^{3}\right)\left(2pr^{-4}\right)}$$

$$= \frac{q^{7}r}{54p^{6}}$$

Answer .... $\frac{q^{7}r}{54p^{6}}$ .... [3]

---

3. (a) Factorise $169+52q+4qr-r^2$ completely.

[Solution]

$169+52q+4qr-r^2$

$=169-r^2+52q+4qr$

$=(13-r)(13+r)+4q(13+r)$

$=(13+r)(13-r+4q)$

Answer $(13+r)(13-r+4q)$ .... [2]

(b) Make x the subject of the equation $2x^2=\dfrac{y-x^2}{2y}+1$.

[Solution]

$2x^2=\dfrac{y-x^2}{2y}+1$

$4x^2y=y-x^2+2y$

$4x^2y+x^2=y+2y$

$x^2(4y+1)=3y$

$x^2=\dfrac{3y}{4y+1}$

$x=\pm\sqrt{\dfrac{3y}{4y+1}}$

Answer $x=\pm\sqrt{\dfrac{3y}{4y+1}}$ .... [3]

---

4. The curve $y=2(x+2)(x+k)$ cuts the y-axis at $(0,-8)$.

(a) Find the value of k.

[Solution]

At $(0,\ -8)$,

$-8=2(0+2)(0+k)$

$4k=-8$

$k=-2$

Answer *(a)* $k=$ -2 .... [2]

(b) Using the value of k found in part (a), find the coordinates of the points where the curve cuts the x-axis.

[Solution]

When $y=0$,

$0=2(x+2)(x-2)$

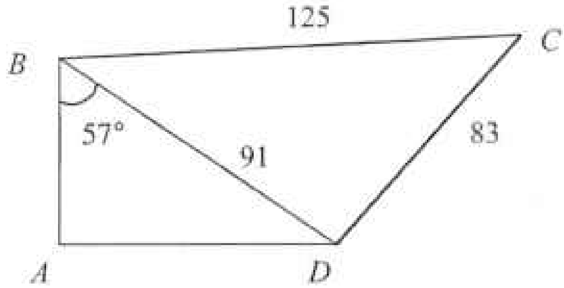
$x=-2$ or 2

$(-2,0)$ and $(2,0)$

Answer *(b)* (-2,0) and (2,0) .... [2]

---

5. The figure below represents a plot of land $ABCD$. B is due north of A, D is due east of A. $BC = 125$ m, $CD = 83$ m and $BD = 91$ m. Angle $ABD = 57°$.



(a) Find angle BDC.

[Solution]

By cosine rule,

$$125^2 = 91^2 + 83^2 - 2(91)(83)\cos\angle BDC$$

$$\cos\angle BDC = \frac{125^2 - 91^2 - 83^2}{-2(91)(83)}$$

$$\angle BDC = \cos^{-1}\left(-\frac{5}{166}\right)$$

$$\approx 91.726°$$

$$= 91.7° \text{ (to 1d.p.)}$$

Answer (a) ....91.7........ ° [3]

(b) Find the bearing of D from C.

[Solution]

Bearing from D from C

$$= (91.726° - 57°) + 180°$$

$$\approx 214.726°$$

$$= 214.7° \text{ (to 1 d.p.)}$$

Answer (b) ....214.7........ ° [2]

6. **(a)** Solve the inequality $\frac{x-35}{3} < 5 - 3x \le 2(4-x)$. Represent your answer on the number line below.

[Solution]

$\frac{x-35}{3} < 5 - 3x \le 2(4-x)$

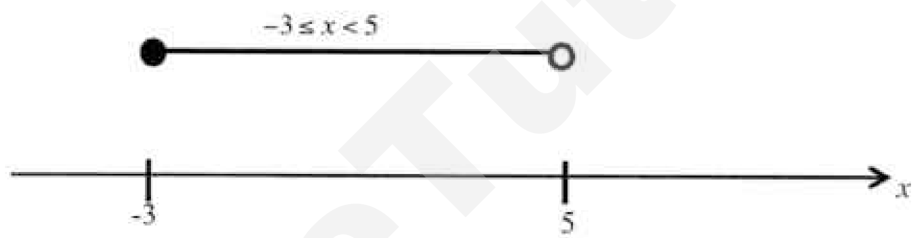
$\frac{x-35}{3} < 5 - 3x$ and $5 - 3x \le 2(4-x)$

$x - 35 < 15 - 9x$ $\quad$ $5 - 3x \le 8 - 2x$

$10x < 50$ $\quad$ $-x \le 3$

$x < 5$ $\quad$ $x \ge -3$

$\therefore -3 \le x < 5$



Answer *(a)* $-3 \le x < 5$ .... [4]

(b) Write down the largest prime number which satisfies

$$\frac{x-35}{3} < 5 - 3x \le 2(4-x).$$

Answer *(b)* $x =$ 3 .... [1]

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6

7. A hard disk has a memory capacity of 2 terabytes.

(a) If a low-resolution photograph takes up about 250 kilobytes, how many million photographs can be stored in the hard disk?

[Solution]

no. of photographs

$= \dfrac{2\times10^{12}}{250\times10^{3}}$

$= \dfrac{2\times10^{12}}{2.5\times10^{5}}$

$= 0.8\times10^{7}$

$= 8\times10^{6}$

$= 8$ million

Answer *(a)* ....8.... million [2]

(b) If the hard disk is to store 25 video clips with capacity of 273 megabytes each, how much capacity is left in the disk? Give your answer in standard form, correct to 3 significant figures.

[Solution]

capacity left

$= 2\times10^{12} - (25\times273\times10^{6})$

$= 2\times10^{12} - 6825\times10^{6}$

$= 2\times10^{12} - 6.825\times10^{9}$

$= 2000\times10^{9} - 6.825\times10^{9}$

$= 1993.175\times10^{9}$ bytes

$= 1.993175\times10^{12}$ bytes

$= 1.99\times10^{12}$ bytes (to 3 s.f.)

Answer *(b)* ....1.99×10^{12}.... bytes [3]

8. **(a)** Express $\frac{5}{12x+9}-\frac{2x+1}{9-16x^2}$ as a single fraction.

[Solution]

$$\frac{5}{12x+9}-\frac{2x+1}{9-16x^2}$$
$$=\frac{5}{3(4x+3)}-\frac{2x+1}{(3+4x)(3-4x)}$$
$$=\frac{5(3-4x)-(2x+1)(3)}{3(3+4x)(3-4x)}$$
$$=\frac{15-20x-6x-3}{3(3+4x)(3-4x)}$$
$$=\frac{-26x+12}{3(3+4x)(3-4x)}$$

Answer (a) $\frac{-26x+12}{3(3+4x)(3-4x)}$ [3]

(b) **Hence**, solve $\frac{5}{12x+9}-\frac{2x+1}{9-16x^2}=1$.

[Solution]

$$\frac{5}{12x+9}-\frac{2x+1}{9-16x^2}=1$$
$$\frac{-26x+12}{3(3+4x)(3-4x)}=1$$
$$-26x+12=3(9-16x^2)$$
$$48x^2-26x-15=0$$
$$x=\frac{-(-26)\pm\sqrt{(-26)^2-4(48)(-15)}}{2(48)}$$
$$=\frac{26\pm\sqrt{3556}}{96}$$
$x=0.892$ or $x=-0.350$ (to 3 s.f.)

Answer (b) $x=$ 0.892 or −0.350 [3]

9. **(a)** Solve $\frac{25^x}{5}-\sqrt{\frac{1}{625}}=0$.

[Solution]

$\frac{25^x}{5}-\sqrt{\frac{1}{625}}=0$

$\frac{5^{2x}}{5}-\frac{1}{25}=0$

$5^{2x-1}=5^{-2}$

By comparing indices,

$2x-1=-2$

$x=-\frac{1}{2}$

Answer (a) $x=$ $-\frac{1}{2}$ .... [3]

(b) Find the value of m for which $\sqrt{a^2\sqrt{a^{\frac{1}{3}}}}=a^m$.

[Solution]

$\sqrt{a^2\sqrt{a^{\frac{1}{3}}}}=a^m$

$\sqrt{a^2 a^{\frac{1}{6}}}=a^m$

$\sqrt{a^{\frac{13}{6}}}=a^m$

$a^{\frac{13}{12}}=a^m$

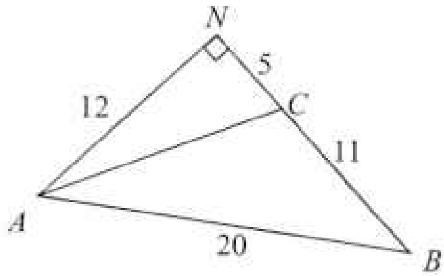
By comparing indices,

$m=1\frac{1}{12}$

Answer (b) $m=$ $1\frac{1}{12}$ .... [3]

10. In the diagram, ABN is a right-angled triangle, and BCN is a straight line.

$AN = 12$ cm, $CN = 5$ cm, $BC = 11$ cm and $AB = 20$ cm.



Calculate

(a) the length of AC,

[Solution]

By Pythagoras' Theorem,

$$AC = \sqrt{12^2 + 5^2}$$
$$= 13 \text{ cm}$$

Answer *(a)* ....13........ cm [1]

(b) $\cos\angle ACB$,

[Solution]

$$\cos\angle ACN = \frac{5}{13}$$
$$\cos\angle ACB = -\cos\angle ACN$$
$$= -\frac{5}{13}$$

Answer *(b)* .... $-\frac{5}{13}$ .... [2]

(c) angle BAC.

[Solution]

$$\frac{\sin\angle BAC}{11} = \frac{\sin\angle ACB}{20}$$

$$\sin\angle BAC = \frac{11 \times \frac{12}{13}}{20}$$
$$= \frac{33}{65}$$

$$\angle BAC = \sin^{-1}\frac{33}{65}$$
$$\approx 30.51024°$$
$$= 30.5° \text{ (to 1 d.p.)}$$

Answer *(c)* ....30.5.......° [3]

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11. (a) Express $-x^2+6x-3$ in the form $a(x+b)^2+c$.

[Solution]

$-x^2+6x-3$

$=-\left(x^2-6x\right)-3$

$=-\left(x^2-6x+\left(\frac{6}{2}\right)^2-\left(\frac{6}{2}\right)^2\right)-3$

$=-\left((x-3)^2-9\right)-3$

$=-(x-3)^2+6$

Answer (a) $-(x-3)^2+6$ [3]

(b) **Hence**, solve the equation $x^2+3=6x$.

[Solution]

$x^2+3=6x$

$-x^2+6x-3=0$

$-(x-3)^2+6=0$

$(x-3)^2=6$

$x-3=\pm\sqrt{6}$

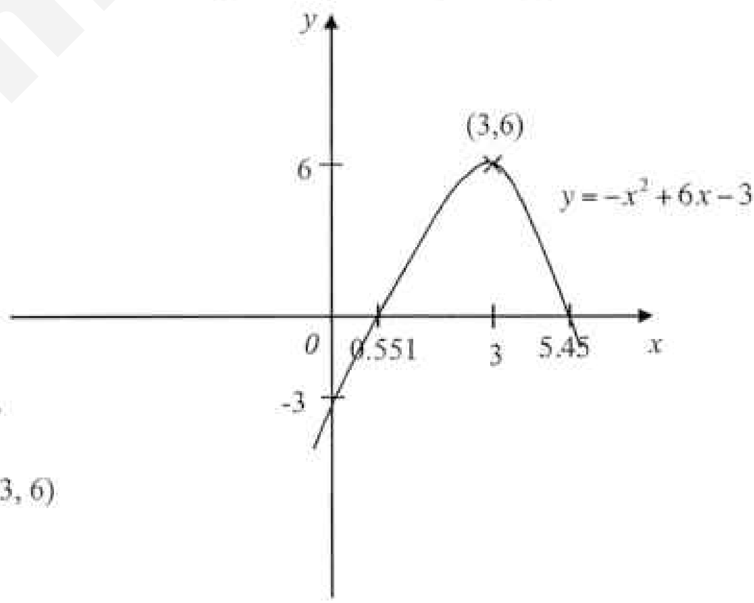
$x=3\pm\sqrt{6}$

$=0.55051$ or 5.4495

$=0.551$ or 5.45

Answer (b) $x=$ 0.551 or 5.45 [3]

(c) Sketch the graph $y=-x^2+6x-3$ on the axis provided, labeling your turning point and x-intercepts and y-intercept clearly. [3]



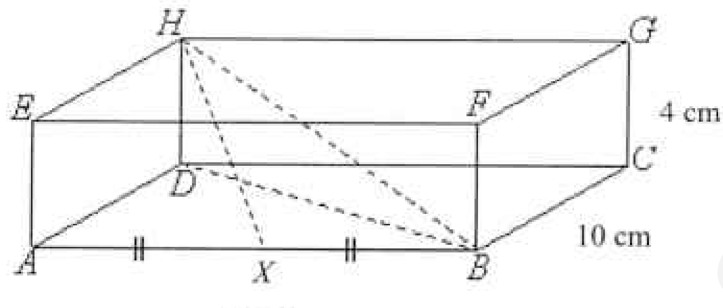
When $x=0$,
$y=-3$
max. point (3, 6)

END OF SECTION A

SECTION B (44 MARKS)

Answer **ALL** the questions on the writing papers provided.

12. The diagram below shows a cuboid of dimensions 16 cm by 10 cm by 4 cm. Point X lies on AB such that $AX = XB$ and angle $HBX = 33.9°$.



Calculate

(a) the length of BH, [3]

(b) angle HBD, [2]

(c) HX, [2]

(d) angle DHX. [2]

[Solution]

(a) Length of $BD = \sqrt{16^2 + 10^2}$

$= \sqrt{356}$

$= 18.868$ cm

Length of $BH = \sqrt{4^2 + 18.868^2}$

$= \sqrt{16 + 356}$

$= \sqrt{372}$

$= 19.287$

$= 19.3$ cm (to 3 s.f.)

(b) $\tan\angle HBD = \dfrac{4}{\sqrt{356}}$

$\angle HBD = \tan^{-1}\dfrac{4}{\sqrt{356}}$

$\approx 11.969°$

$= 12.0°$ (to 1 d.p.)

(c) By cosine rule,

$HX^2 = BH^2 + XB^2 - 2(BH)(XB)\cos\angle HBX$

$HX^2 = \left(\sqrt{372}\right)^2 + 8^2 - (\sqrt{372})(8)\cos 33.9°$

$HX \approx 13.411$

$= 13.4$ cm (to 3 s.f.)

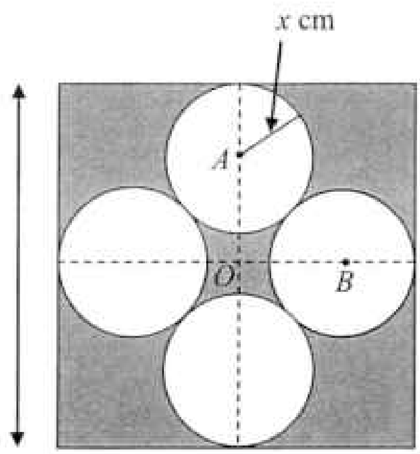
(d) $\cos\angle DHX = \dfrac{4}{13.411}$

$\angle DHX = \cos^{-1}\dfrac{4}{13.411}$

$\approx 72.647°$

$= 72.6°$ (to 1 d.p.)

13.



The diagram shows a square of length 20 cm. O is the intersection of the diagonals of the square. Four smaller identical circles, touching each other, with radius x cm are drawn as shown. A and B are the centres of two of the smaller circles.

(a) Express the length of OA and of AB in terms of x. [2]

(b) Use Pythagoras' Theorem to form an equation in x and show that it can be simplified to $x^2 + 20x - 100 = 0$. [3]

(c) Solve the equation $x^2 + 20x - 100 = 0$, giving your answers correct to 2 decimal places. [3]

(d) Calculate the area of the shaded region. [2]

[Solution]

(a) $OA = \dfrac{20}{2} - x$

$= (10 - x)$ cm

$AB = 2x$ cm

(b) By Pythagoras' Theorem,

$(10-x)^2 + (10-x)^2 = (2x)^2$

$2(100 - 20x + x^2) = 4x^2$

$2x^2 + 40x - 200 = 0$

$x^2 + 20x - 100 = 0$ (shown)

(c) $x = \dfrac{-20 \pm \sqrt{(20)^2 - 4(1)(-100)}}{2}$

$= \dfrac{-20 \pm \sqrt{800}}{2}$

≈ -24.142 or 4.1421

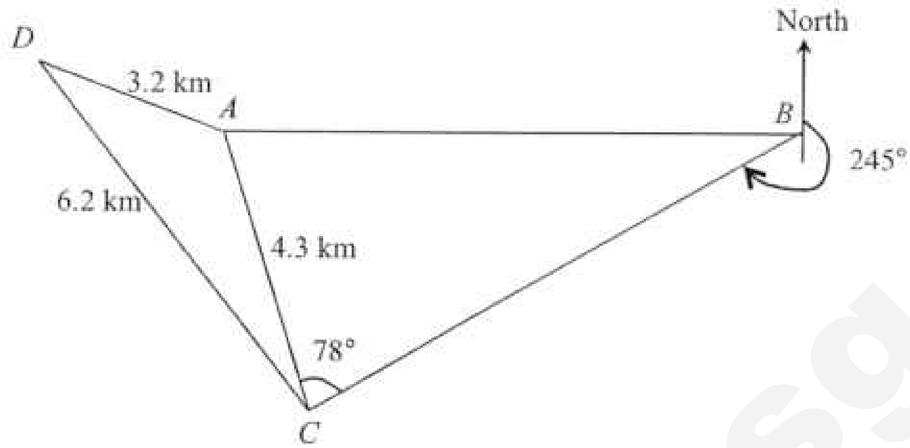
$= -24.14$ or 4.14 (to 2 d.p.)

(d) $x = -24.1$ rejected as $x > 0$

Area of shaded region $= 20^2 - 4\pi(4.1421)^2$

$= 184 \text{ cm}^2$ (to 3 s.f.)

14.



In the diagram, A, B, C and D are four points on level ground. It is given that $AC = 4.3$ km, $AD = 3.2$ km, $CD = 6.2$ km, angle $ACB = 78°$, the bearing of C from B is $245°$ and B is due east of A. Calculate

(a) angle ACD, [3]

(b) the bearing of B from C, [2]

(c) the length of AB, [3]

(d) the area of triangle ADC. [2]

Alex walked from D to C along the path DC.

(e) He stopped at point X when he is at the shortest distance to point A. Calculate AX. [2]

(f) At point X, Alex saw a building standing vertically at point A. Given that the height of the building is 980 m tall, calculate the angle of elevation of the top of building when viewed by Alex. [2]

[Solution]

(a) By cosine rule,

$$3.2^2 = 6.2^2 + 4.3^2 - 2(6.2)(4.3)\cos\angle ACD$$

$$\cos\angle ACD = \frac{3.2^2 - 6.2^2 - 4.3^2}{-2(6.2)(4.3)}$$

$$\angle ACD = \cos^{-1}\left(\frac{4669}{5332}\right)$$

$$\approx 28.877°$$

$$= 28.9° \text{ (to 1 d.p.)}$$

(b) Bearing from B to C

$= 245° - 180°$

$= 065°$

(c) $\angle ABC = 270° - 245°$

$= 25°$

By sine rule,

$$\frac{\sin 25°}{4.3} = \frac{\sin 78°}{AB}$$

$$AB = \frac{4.3 \sin 78°}{\sin 25°}$$

≈ 9.9523

$= 9.95$ km (to 3 s.f.)

(d) Area of $\Delta ADC = \frac{1}{2}(4.3)(6.2)\sin\angle ACD$

$= \frac{1}{2}(4.3)(6.2)\sin 28.877°$

≈ 6.4375

$= 6.44 \text{ km}^2$ (to 3 s.f.)

(e) $\sin \angle ACD = \frac{AX}{4.3}$

$AX = (\sin 28.877°)(4.3)$

≈ 2.0766

$= 2.08$ km (to 3 s.f.)

(f) $\tan \angle TXA = \frac{0.98}{2.0766}$

$\angle TXA = \tan^{-1}\left(\frac{0.98}{2.0766}\right)$

$\approx 25.264°$

$= 25.3°$ (to 1 d.p.)

---

15. **Answer the whole of this question on a piece of graph paper.**

The variables x and y are connected by the equation $y = 2x^2 - 5x - 3$. Some corresponding values are given in the following table.

x	-2	-1	0	0.5	1	2	3	4
y	a	4	-3	-5	-6	-5	0	9

(a) Calculate the value of a. [1]

(b) Taking 2 cm to represent 1 unit on the x-axis and 2 cm to represent 5 units on the y-axis, draw the graph of $y = 2x^2 - 5x - 3$ for the range $-2 \le x \le 4$. [3]

(c) From your graph, find

(i) the value(s) of x when $y = 5$, [2]

(ii) the minimum value of y. [1]

(d) By adding suitable line(s) on the same graph paper, find

(i) the value(s) of x for which $2x^2 - 5x - 3 = 0$, [1]

(ii) the solutions for the equation $2x^2 - 7x = 0$. [3]

END OF PAPER

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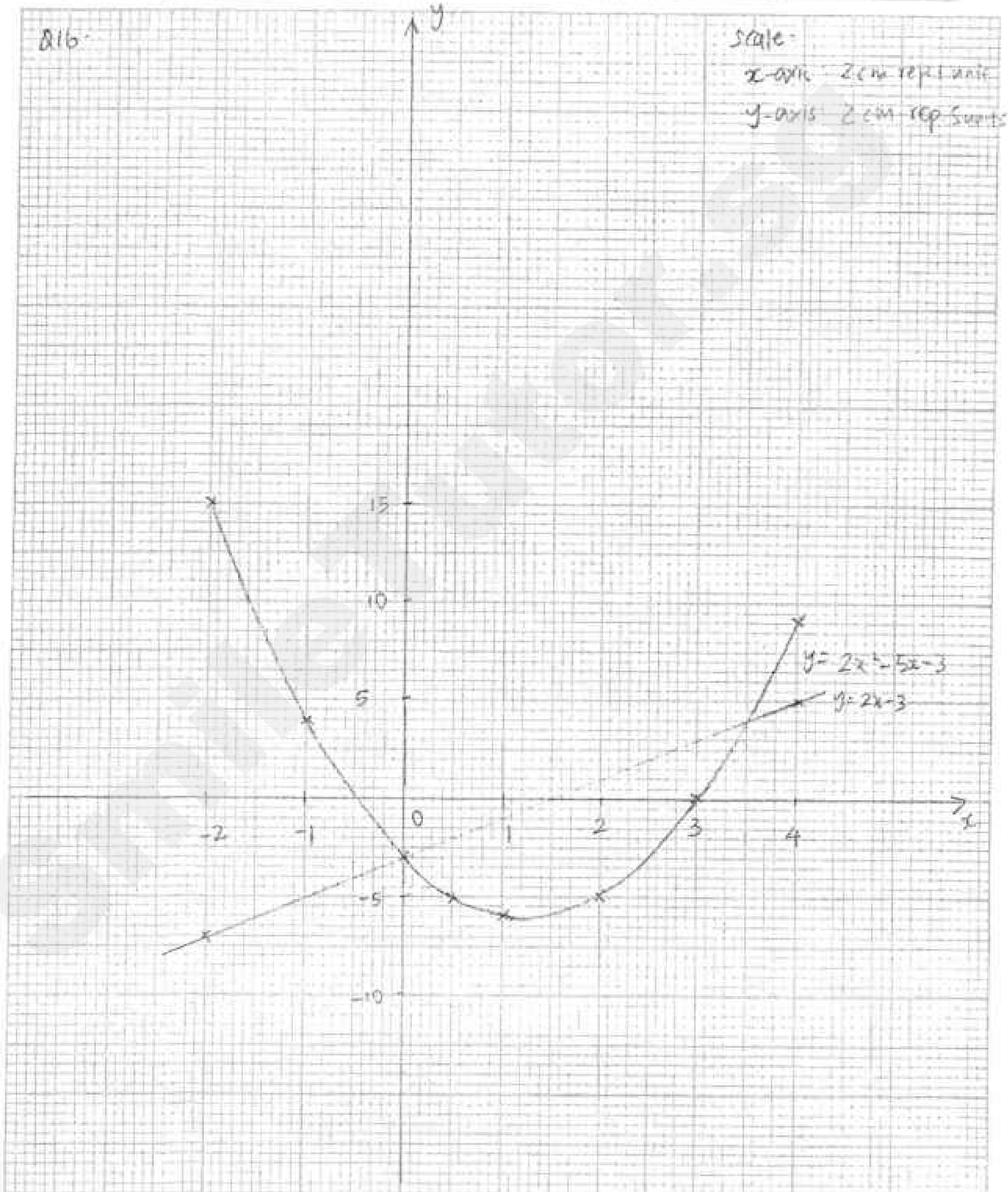


(a) $a = 15$ — B1

(c)(i) When $y = 5$, $x = -1.1$ or $x = 3.6$ (± 0.05) — B1, B1

(ii) min value of $y = -6$ (± 0.25) — B1

(d)(i) $2x^2 - 5x - 3 = 0$

$x = -0.5$ or $x = 3$ — B1

(ii) $2x^2 - 7x = 0$

$2x^2 - 5x - 2x - 3 = -3$

$2x^2 - 5x - 3 = 2x - 3$ — M1

Plot $y = 2x - 3$ — B1

From the graph, $x = 0$ or $x = 3.5$ — A1

For Examiner's Use

1 **(a)** Calculate $\dfrac{22.7 \times 2016}{1956 + \sqrt{60}}$.

Write down the first five digits on your calculator.

Answer.................................. [1]

(b) Write your answer to part **(a)** correct to 2 decimal places.

Answer.................................. [1]

2 The Land Transport Authority announced in a recent news that there were 14 major breakdowns on the MRT network in 2015 which was an increase of 40 percent from the previous year.

How many major breakdowns were there in 2014?

Answer.................................. [2]

3 These are the first four terms in a sequence.

60 57 54 51

(a) Write down the next two terms.

Answer.............. , ... [1]

(b) Write down an expression, in terms of n, for the n^{th} term in the sequence.

Answer.................................. [1]

[Turn over]

For Examiner's Use

4 John thought of five positive numbers.
The median is 11 and the mode is 15.
The biggest number is five times of the smallest number.
The mean of the five numbers is 10.4.
Find the five numbers.

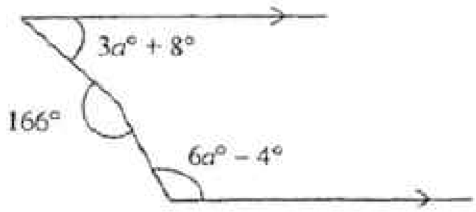
Answer ...., ..., ..., ..., ... [2]

5 If y is inversely proportional to $\sqrt{x}$ and $y = 0.8$ when $x = 16$, find the value of y when $x = 100$.

Answer $y =$ .... [2]

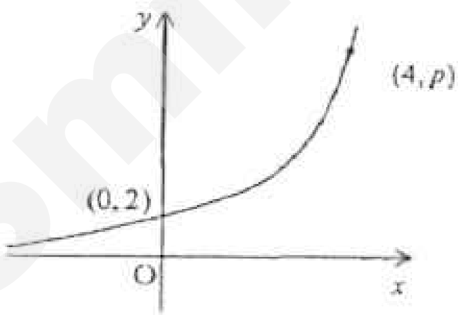
For Examiner's Use

6 Calculate the value of a.



Answer $a =$ .... [2]

7 The sketch shows the graph of $y = k(3^x)$. The points (0, 2) and (4, p) lie on the graph. Find the values of k and of p.



Answer $k =$ .... [1]

$p =$ .... [1]

[Turn over]

For Examiner's Use

8 The numbers 60 and 2016, written as the product of their prime factors, are $60 = 2^2 \times 3 \times 5$ and $2016 = 2^5 \times 3^2 \times 7$.

(a) Find the highest common factor and lowest common multiple of 60 and 2016.

Answer HCF = ... LCM = ... [2]

(b) Given that $60k$ is a perfect cube, write down the smallest possible integer value of k.

Answer $k =$ .... [1]

(c) Find the smallest positive integer value of n for which $60n$ is a multiple of 2016.

Answer $n =$ .... [1]

---

9 ξ = {first 17 natural numbers}
$A = \{1, 4, 9, 16\}$
$B = \{5, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17\}$

(a) Describe the set A in words.

Answer .... [1]

(b) List the elements in B'.

Answer .... [1]

(c) Express {9, 16} in terms of A and B in set notation.

Answer .... [1]

For Examiner's Use

10 There are 22 boys and x girls in a group. The probability of selecting a girl from the group is $\frac{3}{14}$.

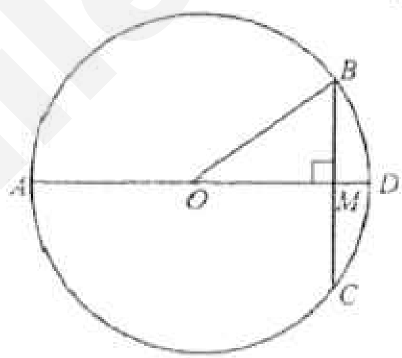
(i) Find the value of x.

Answer x = ... [1]

(ii) Using your value of x found in part (i), find the extra number of boys that have to join the group so that the probability of selecting a boy from the group will be $\frac{5}{6}$.

Answer .... [2]

11 The diagram shows a circle with centre O and radius 41 cm.
$BC = 18$ cm and $\angle BMO = 90°$. $AOMD$ is a straight line.



(a) Find AM.

Answer ....cm [2]

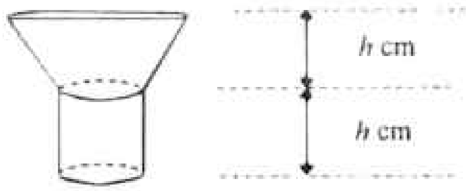
(b) Write down the exact value of cos $A\hat{O}B$.

Answer .... [1]

[Turn over]

For Examiner's Use

12 The diagram shows a container which is made up of a frustum and a cylinder of the same height. It is initially full of water.
The volumes of the frustum and the cylinder are in the ratio of 3 : 1.
Water is leaking through a hole at the bottom of the container at a constant rate.
The container is completely empty in 16 minutes.

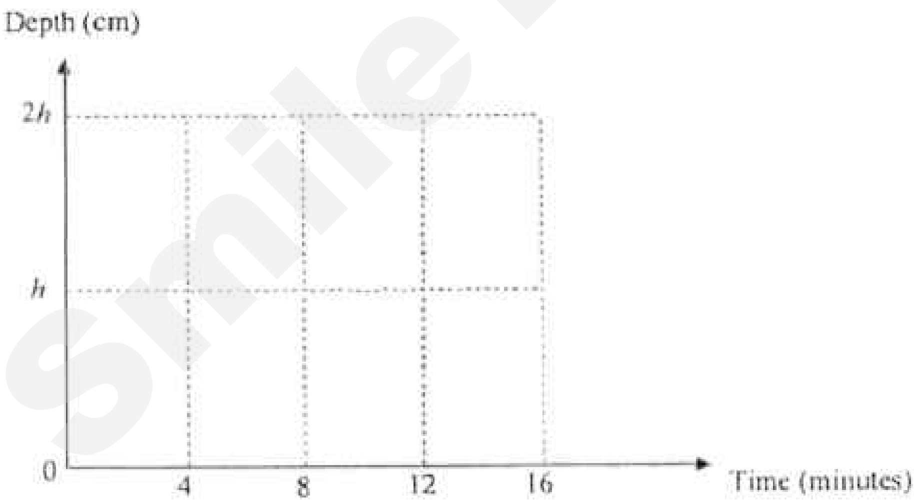


(a) Find the time taken for the depth of the water to be h cm.

Answer....................minutes [1]

(b) On the axes in the answer space, sketch the graph showing how the depth of the water, h cm, in the container varies over the 16 minutes.

Answer



[2]

For Examiner's Use

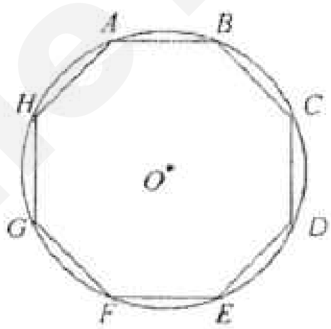
13 (a) Express $x^2 - 10x - 13$ in the form $(x-a)^2 + b$.

Answer .... [1]

(b) **Hence** solve the equation $x^2 - 10x - 13 = 0$.

Answer $x =$ ....or .... [2]

14 A regular octagon $ABCDEFGH$ fits exactly inside a circle of centre O and radius 6 cm.



Find the area of the circle not covered by the octagon.

Answer .... cm^2 [4]

[Turn over]

For Examiner's Use

15 (a) Factorise $a^2 - 2ab + b^2 - 4b^2c^2$ completely.

Answer .... [2]

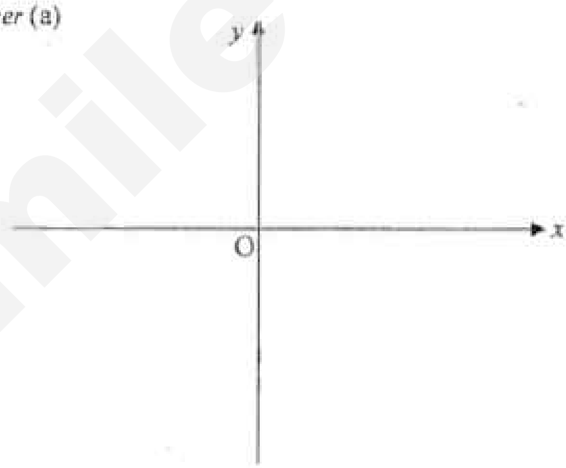
(b) Given that $T = 2\pi\sqrt{\frac{L}{g}}$, make L the subject of the formula.

Answer .... [2]

---

16 (a) Sketch the graph of $y = 2(x-3)(x+1)$.

Answer (a)



[2]

(b) Write down the equation of the line of symmetry of $y = 2(x-3)(x+1)$.

Answer .... [1]

(c) Write down the coordinates of the turning point.

Answer (.............. , ...) [1]

(d) Write down another quadratic equation, other than $y = 2(x-3)(x+1)$ that has the same roots.

Answer .... [1]

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For Examiner's Use

17 Solve the following equations.

(a) $16^{x} \div 4^{1-x} = 0.25$

Answer $x =$ .... [2]

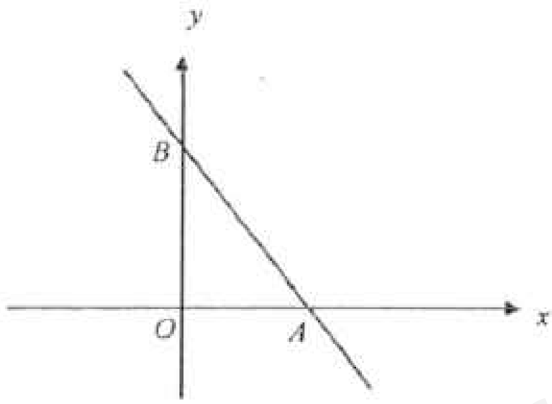
(b) $\sqrt[p]{25} = 125$

Answer $p =$ .... [2]

[Turn over]

For Examiner's Use

18 The diagram shows a straight line $4y + 5x = 20$ passing through the points A and B.



(a) Find the coordinates of A and of B.

Answer A (.......... , ...) [1]

B (.......... , ...) [1]

(b) Find the area of ΔOAB and hence find the shortest distance from O to the line AB .

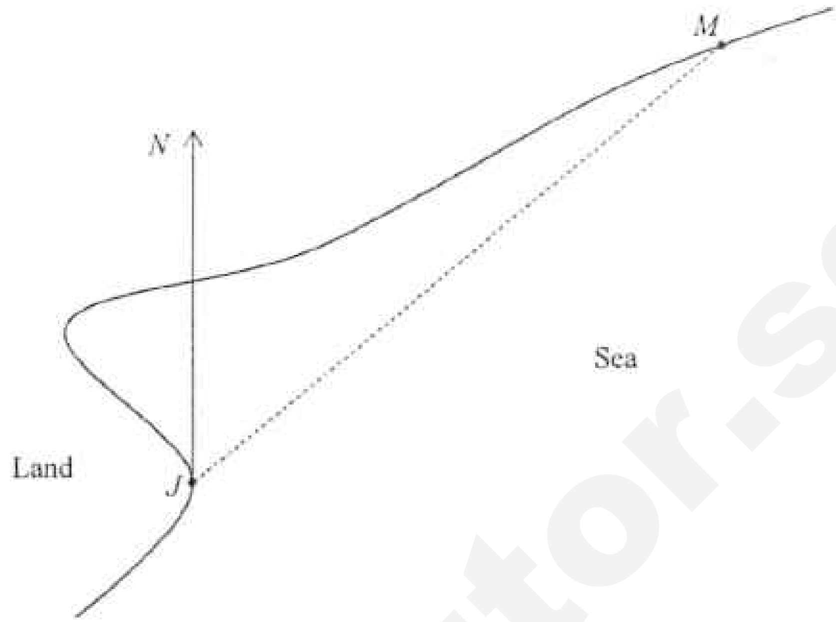
Answer *Area* = ... units^2 [1]

Shortest distance = ...units [2]

[Turn over]

For Examiner's Use

19 The scale drawing shows a jetty, J, and a man, M.
The scale is 1 cm to 10 km.



(a) Measure the bearing of M from J.

Answer..............................° [1]

(b) A boat is 85 km from J on a bearing of 110°.
Mark and label on the diagram the position, B, of the boat. [1]

State the bearing of J from B.

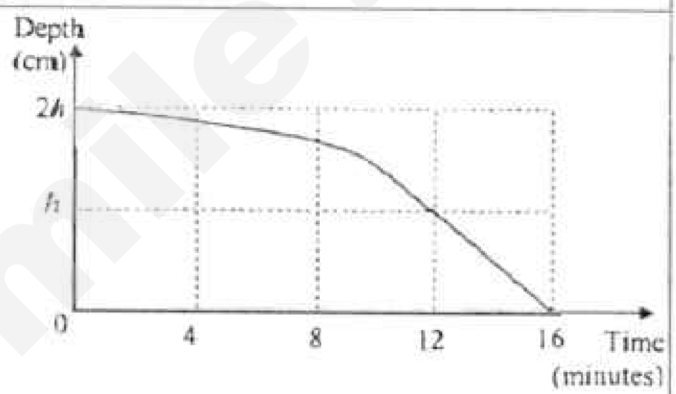
Answer..............................° [1]

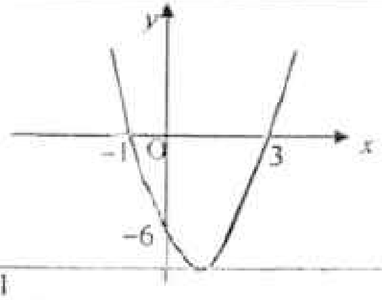
(c) The boat travels in a straight line towards J at an average speed of 35 km/h.
Calculate the travelling time of the boat.
Give your answer in hours and minutes, to the nearest minute.

Answer..........h ....mins [2]

End of paper

Answers

1	(a)	23.304
	(b)	23.30
2		10
3	(a)	48, 45
	(b)	$63 - 3n$ or $60 - 3(n-1)$
4		5, 8, 11, 15, 15
5		0.32
6		18
7		$k = 2$; $p = 162$
8	(a)	HCF = 12 LCM = 10080
	(b)	$k = 450$
	(c)	$n = 168$
9	(a)	Squares numbers /Perfect squares
	(b)	1, 2, 3, 4, 6, 12
	(c)	$A \cap B$
10	(i)	6
	(ii)	8
11	(a)	81cm
	(b)	$-\frac{40}{41}$
12	(a)	12
	(b)	
13	(a)	$(x-5)^2 - 38$
	(b)	$x = 11.2$ or 1.16
14		$11.3\ \text{cm}^2$
15	(a)	$(a-b+2bc)(a-b-2bc)$
	(b)	$L = \frac{gT^2}{4\pi^2}$

16	(a)	
16	(b)	$x = 1$
	(c)	$(1, -8)$
	(d)	$y = (x+1)(x-3)$ / $y = -(x+1)(x-3)$ / $y = 5(x+1)(x-3)$
17	(a)	1
	(b)	$\frac{2}{3}$
18	(a)	A (4, 0) B (0, 5)
	(b)	10 units^2 Shortest distance = 3.12 units
19	(a)	050° (± 1°)
	(b)	290°
	(c)	2 h 26 mins

1 A map is drawn to a scale of 1 : 20 000.

(a) (i) This scale can be expressed as 1 cm represents n km.
Find n. [1]

(ii) The distance between two towns on the map is 20 cm.
Find the actual distance, in kilometres, between the two towns. [1]

(iii) A garden has a map area of 0.25 cm^2.
Find the actual area, in square kilometres, of the garden. [2]

(b) Lee is making a pond in the garden.
He has a maximum of $100 to spend on a water pump for the pond.
The pump must have a flow rate of at least 250 litres per minute.

His local garden centre has four water pumps for sale.

Pump	Cost	Flow rate
A	$92.50	4.2 litres per second
B	$104.99	4.4 litres per second
C	$80.75	13 000 litres per hour
D	$89.99	15 120 litres per hour

Explain which pump he should buy. [2]

2 The table below shows information about the population and area of four different countries in 2016.

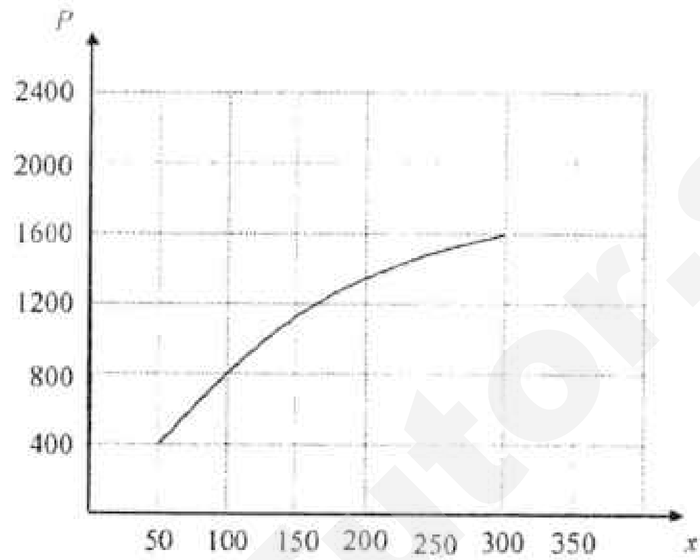
	Singapore	Malaysia	UK	Australia
Population	5.6×10^6	2.9×10^7	6.4×10^7	2.8×10^7
Area (km^2)	700	3.4×10^5	2.4×10^5	7.7×10^6

(a) Find the ratio of the population of Singapore to the population of Australia.
Give your answer in the form of 1 : n. [1]

(b) How many more people live in UK than in Singapore?
Give your answer in standard form. [2]

(c) Calculate the average number of people per square kilometres in Malaysia. [2]

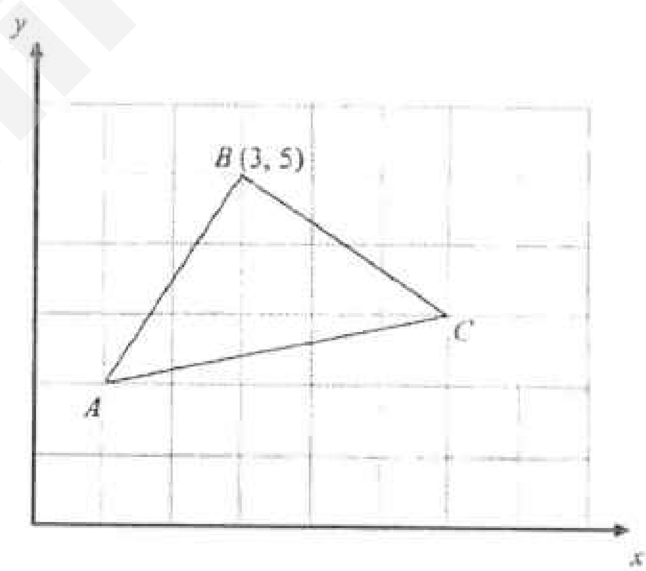
3 (a) A company earns a weekly profit of P dollars by selling x items.
The graph below shows how P varies with x.



(i) Find the weekly profit per item for 100 items. [1]

(ii) Estimate the weekly profit for 350 items. [1]

(b) Find the area of triangle ABC below. [2]



4 Part of a number grid is shown below.

A square can be placed anywhere on the grid outlining four numbers.

The numbers in opposite corners of the square are multiplied together and the difference between the products is found.

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20				

$$9 \times 14 - 8 \times 15 = 126 - 120$$
$$= 6$$

The grid is continued downwards.

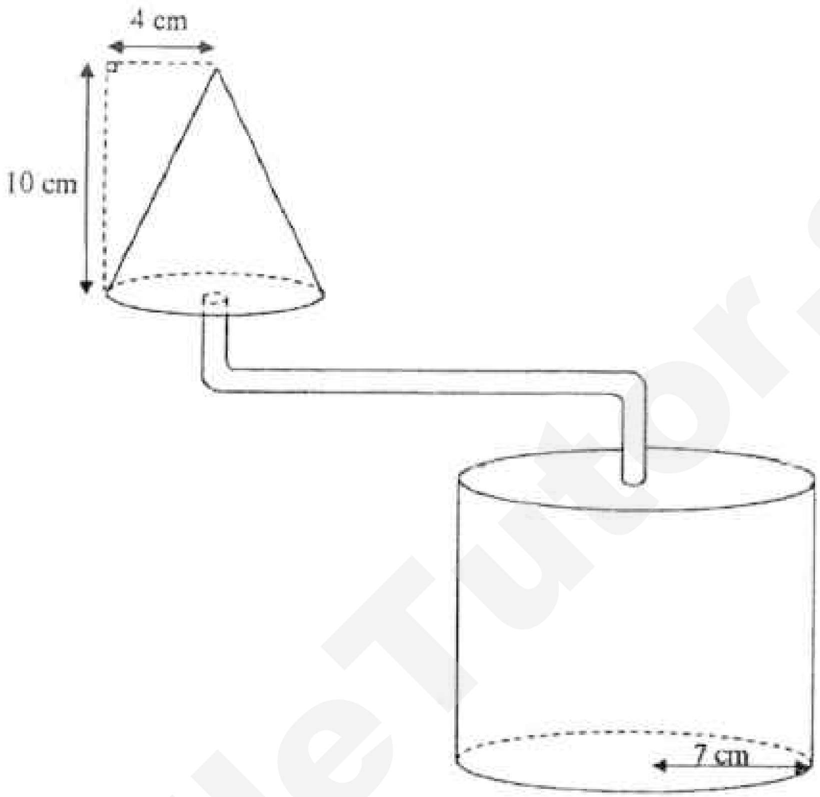
(a) If n represents the number in the top left corner of the square, write down an expression in terms of n, for the number in the bottom right corner of the square. [1]

(b) Show that the difference between the products of the numbers in the opposite corners of the square is always 6. [2]

(c) Show that the sum of the four numbers in the square cannot be 260. [3]

5 The diagram shows a cone with radius 4 cm and height 10 cm which is full of water. A pipe connects the cone to a cylinder.

The cylinder has a radius of 7 cm.



(a) Calculate the volume of water in the cone. [1]

(b) Water flows from the cone through the pipe into the empty cylinder at a constant rate of 2 cm^3 per second.

(i) Calculate the time taken to empty the cone in seconds. [1]

(ii) Find the height of the water in the cylinder when the cone is empty. [2]

6 (a) (i) Solve the inequality $17 - 3x < 3x + 1 \leq 46 - 5x$. [2]

(ii) Represent your answer on a number line. [1]

(b) Given that $-6 \leq a \leq 10$ and $2 \leq b \leq 7$, find the smallest value of $\frac{a}{b}$. [1]

(c) A rectangle has length 127 cm and width 87 cm, both correct to the nearest whole number. Calculate the least and greatest possible perimeter of the rectangle. [3]

(d) Given that $7^m = 3$ and $7^n = 8$, find the value of $7^{2m - \frac{n}{3}}$. [3]

7 The distance between London and York is 320 km.

A train takes x hours to travel from London to York.

(a) Write down an expression, in terms of x, for the average speed of the train in km/h. [1]

(b) A car takes $2\frac{1}{2}$ hours longer than the train to travel from London to York.

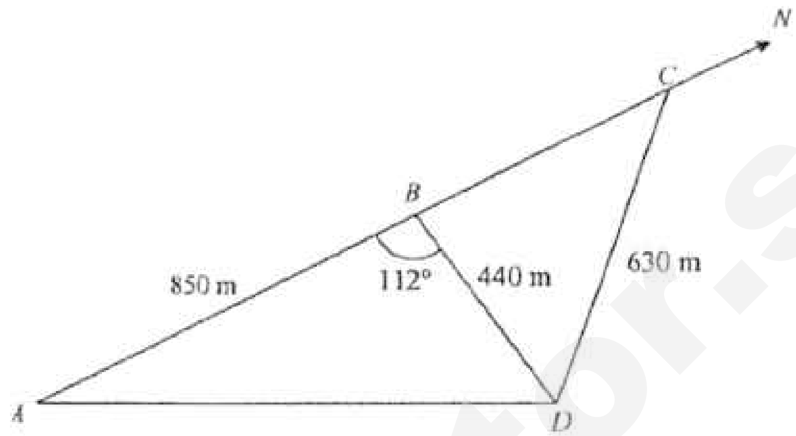
Write down an expression, in terms of x, for the average speed of the car in km/h. [1]

(c) The average speed of the train is 80 km/h greater than the average speed of the car. Form an equation in x and show that it simplifies to $2x^2 + 5x - 20 = 0$. [3]

(d) Solve the equation $2x^2 + 5x - 20 = 0$. [3]

(e) Find the average speed of the car correct to the nearest km/h. [2]

8 Four points A, B, C and D on level ground are as shown in the diagram below.



ABC is a straight line. C is due North of A and $\angle ABD = 112°$. It is given that $AB = 850$m, $BD = 440$m and $CD = 630$m.

(a) Find

(i) AD, [3]

(ii) $\angle BCD$, [2]

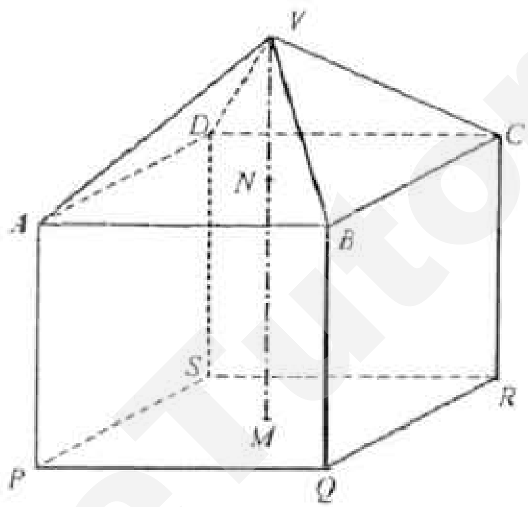
(iii) the bearing of D from C, [1]

(iv) the bearing of C from D. [1]

(b) A vertical building at point B has a height of 380 m.
Find the greatest angle of elevation of the top of the building from a point along AD. [4]

9 A man wants to build a farmhouse as shown in the diagram below.

The farmhouse can be modelled by a square pyramid sitting on a cuboid.



Its roof is represented by a square-based pyramid, $VABCD$. The vertical line, VNM, passes though the centres, N and M, of the horizontal squares $ABCD$ and $PQRS$.
$AB = 60$ m and $VN = 40$ m.

(a) Show that the total surface area of the slant roof in the model is 6000 m^2. [3]

(b) (i) The slant roof in the model is to be covered with tiles with dimensions of 30 cm by 20 cm by 1 cm. Information about the tiles is shown below.

Useful Information
• Density of tiles : 2.6 g/cm^3 • 1 kg is equivalent to 9.81 N

Find the weight of each tile, in N. [3]

(ii) The roof in the model will collapse if the total weight of the tiles exceeds 1600 kN. Justify whether this type of tile is suitable. [5]

10 Answer the whole of this question on a piece of graph paper.

The table below gives some values of x and y where $y = 12 + 8x + \frac{27}{x}$.

x	1	1.5	2	2.25	3	3.5
y	p	42	41.5	42	45	47.7

(a) Find the value of p. [1]

(b) Using a scale of 2 cm to 0.5 units, draw a horizontal x-axis for $0 \le x \le 4$.
Using a scale of 2 cm to 1 unit, draw a vertical y-axis for $38 \le y \le 48$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]

(c) Find the gradient of the curve at the point where $x = 1.5$. [2]

(d) Use your graph to find the values of x for which $12 + 8x + \frac{27}{x} = 46$. [2]

(e) Explain why the line $x = 1.875$ is not a line of symmetry for the curve $y = 12 + 8x + \frac{27}{x}$. [1]

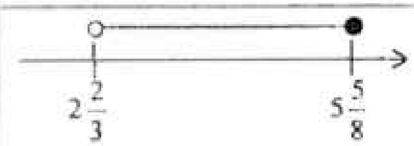
(f) The line AB has a gradient of -1 and passes through the point $(0, 52)$. The x coordinates of the points where the line AB intersects the curve $y = 12 + 8x + \frac{27}{x}$ are the solutions of the equation $9x^2 + ax + b = 0$.

Find the values of a and b. [4]

End of Paper

Answers

No	Solution	No	Solution
1(a)(i)	$n = 0.2$	7(a)	$\frac{320}{x}$
1(a)(ii)	4 km	7(b)	$\frac{320}{x+2.5}$
1(a)(iii)	0.01 km^2	7(c)	$\frac{320}{x} - 80 = \frac{320}{x+2.5}$
1(b)	Flow rate for A $= 252$ *l*/min Flow rate for C $= 216\frac{2}{3}$ *l*/min Flow rate for D $= 252$ *l*/min He should buy pump D.	7(d)	$x = 2.15, -4.65$
2(a)	1 : 5	7(e)	69 km/h
2(b)	5.84×10^7 people	8(a)(i)	$AD = 1090$ or 1093.75762 or 1093 m
2(c)	85.3 people/km^2	8(a)(ii)	$\angle BCD = 40.4°, 40.36°, 40.35766°$
3(a)(i)	$8 per item	8(a)(iii)	139.6°,139.64°,139.64234°
3(a)(ii)	$1620 -$1750	8(a)(iv)	319.6°,319.64°,319.64234°
3(b)	6.5 units^2	8(b)	319.6°,319.64°,319.64234°
4(a)	$n + 7$	9(b)(i)	15.30360 N
4(b)	$(n+1)(n+6) - n(n+7)$ $= 6$	9(b)(ii)	1530.36kN < 1600 kN Tile is suitable
4(c)	$n = 61.5$ n is a whole number/natural number/positive integer/integer. Or n cannot be a fraction/decimal. Therefore the sum cannot be 260.		

No	Solution	No	Solution
5(a)	168cm^3	10(a)	$p = 47$
5(b)(i)	83.8 s	10(c)	-4
5(b)(ii)	$h = 1.09\text{cm}$	10(d)	1.0 to 1.1, 3.15 to 3.25
6(a)(i)	$2\frac{2}{3} < x \leq 5\frac{5}{8}$	10(e)	y is different at $x = 1.8$ and $x = 1.95$. $x = 1.875$ is not a line of symmetry.
6(a)(ii)		10(f)	$a = -40$, $b = 27$
6(b)	-3		
6(c)	426 cm, 430 cm		
6(d)	4.5		

Name:	Register No.:	Class:

CRESCENT GIRLS' SCHOOL
SECONDARY THREE
END OF YEAR EXAMINATION 2016

MATHEMATICS

4048

05 October 2016

2 hours 30 minutes

For Section A, candidates answer on the Question Paper.
For Section B, candidates answer on the writing paper and graph paper given.

READ THESE INSTRUCTIONS FIRST

Write your name, register number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer all questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
Calculators should be used where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, submit section A and B separately.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for Section A is 40.
The total of the marks for Section B is 60.

For Examiner's Use	
Section A	40
Section B	60
Total	100

This paper consists of **15** printed pages, including this cover page.

Mathematical Formulae

Compound Interest

$$\text{Total amount} = P\left(1+\frac{r}{100}\right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard Deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

SECTION A

Answer all the questions.

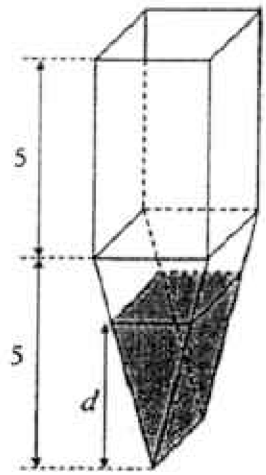
1 Solve the inequality $\frac{3x}{2}-1 \le \frac{2x-3}{3} < -\frac{3-x}{4}$.

Answer .... [2]

2 The force, F, between two particles is inversely proportional to the square of the distance between them.
The force is 36 units when the distance between the two particles is r metres.
Find the force when the distance is $3r$ metres.

Answer .... units [2]

3



The container shown in the diagram is a prism.
The cross-section consists of a rectangle and a triangle.
The heights of both the rectangle and the triangle are 5 cm.
Water is poured into the empty container at a constant rate and filled it in 6 minutes.
How many minute(s) will it take to fully fill the triangular prism?

Answer ………… minute(s) [2]

---

4 Simplify the following and leave your answer in positive index.

$$\frac{9m^{-3}n^{-4}}{81\left(m^{3}n\right)^{-1}} \times \frac{162\left(mn^{3}\right)^{-1}}{27m^{-3}n}$$

Answer ………………………………… [3]

---

5 The diameter of a strand of hair with a circular cross-sectional area is 1000 pico-metres.
(a) Express 1000 pico-metres, in metres, in standard form.

Answer .... m [1]

(b) Assuming that the strand of hair has a uniform cross-sectional area, calculate the length of the hair given that the volume of the strand of the hair is 3.2×10^{-20} m^3, leaving your answer in standard form.

Answer .... m [2]

---

6 Let j and k be the roots of the equation $x^2 + ax + 5 = 0$.
(a) Find the value of jk.

Answer $jk =$ .... [1]

(b) If $j + \frac{1}{k}$ and $k + \frac{1}{j}$ are the roots of the equation $x^2 + gx + h$, find the value of h.

Answer $h =$ .... [2]

---

7 A is an obtuse angle and $\sin A = \dfrac{12}{13}$.

(a) Find angle A.

Answer .... ° [1]

(b) It is given that A and B are supplementary angles.
Without using a calculator, find the exact values of $\sin B$ and $\cos A$.

Answer $\sin B =$ .... [2]

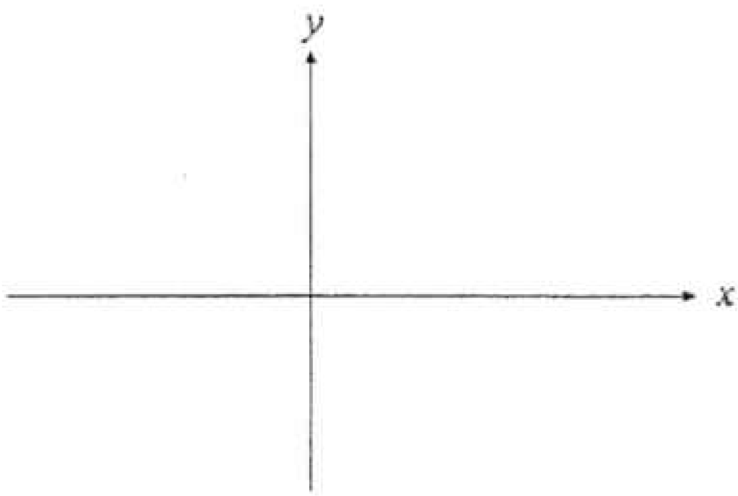
$\cos A =$ ....

8 (a) Express $x^2 - 4x + 1$ in the form $(x-a)^2 + b$.

Answer .... [2]

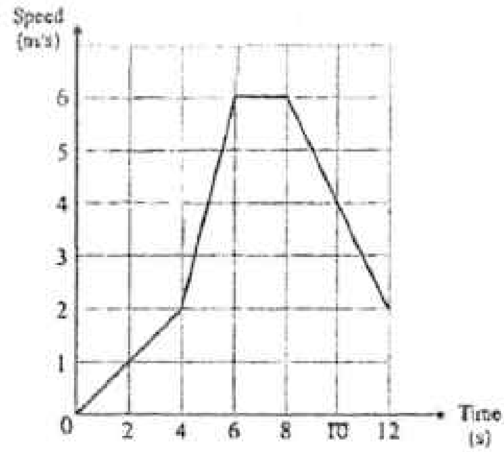
(b) Sketch the graph of $y = x^2 - 4x + 1$.

Answer



[2]

9 The diagram represents the speed-time graph of a particle.



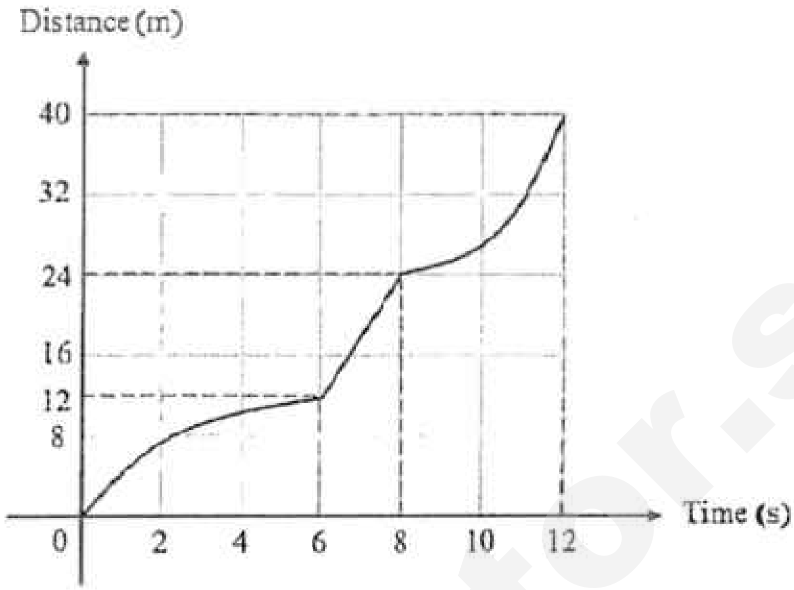
(a) Showing your working clearly, find the speed of the particle when time = 8.2 seconds.

Answer ………………………… m/s [2]

(b) Calculate the time taken for the particle to travel the first 21 metres.

Answer ……………………… seconds [2]

(c) Alan drew the following distance-time graph.



Barry claimed that Alan's graph is wrong.
Who is correct?
Explain your answer with appropriate mathematical knowledge.

Answer [2]

....

....

....

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....

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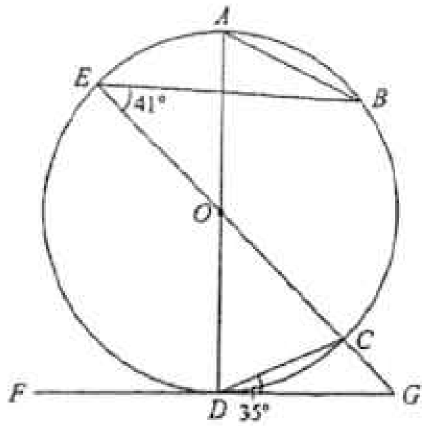
10



A, B, C, D and E are points on the circumference of the circle with centre O.
AD intersects CE at O and FD is a tangent to the circle at D.
EC produced meets FD produced at the point G.
Angle $BEC = 41°$ and angle $CDG = 35°$.

(a) Find $C\hat{G}D$.

Answer .... ° [2]

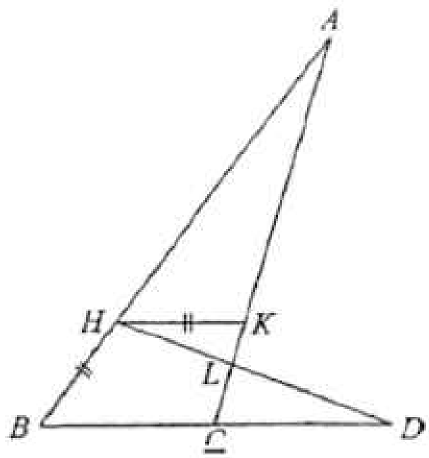
(b) Find reflex $A\hat{O}C$.

Answer .... ° [2]

(c) Find $A\hat{C}B$.

Answer .... ° [2]

11



In the diagram, AHB, AKC, BCD and HLD are straight lines.
$AH = BD$, $HK = HB$ and HK is parallel to BD.

(a) Show that triangle AHK is congruent to triangle DBH.

Answer

[2]

(b) Show that triangles AHL and DCL are similar.

Answer

[2]

(c) Given that $AL = 11.3$ cm, $HL = 3$ cm and $CL = 2$ cm, calculate DH.

Answer .... cm [2]

END OF SECTION A

2016 CGS SEC 3 EM EOY

SECTION B

Answer all the questions.

1 Tap A can fill a rectangular tank in x hours.
Tap B can fill the same tank in $(x+5)$ hours.
If both taps are turned on at the same time, the tank can be filled in 10 hours.

(a) Write down, an expression in terms of x, the amount of water in the tank that is filled by Tap A in an hour. [1]

(b) Write down, an expression in terms of x, the amount of water in the tank that is filled by Tap B in an hour. [1]

(c) Form an equation in x and show that it reduces to $x^2-15x-50=0$. [2]

(d) Solve the equation $x^2-15x-50=0$ leaving your answer(s) to 2 decimal places. [2]

(e) Tap A is turned on to fill the rectangular tank. [2]
When the tank is one-third filled, Tap B is also turned on until the tank is completely filled.
How long will it take for the empty tank to be completely filled?
Give your answers in hours and minutes (correct to the nearest minute).

---

2 (a) Triangle ABC has points $A(-2,-3)$ and $C(2,4)$.
AB is parallel to the x-axis and B has a positive x-coordinate.

(i) Find the equation of the line BC, given that the length of AB is 6 units. [3]

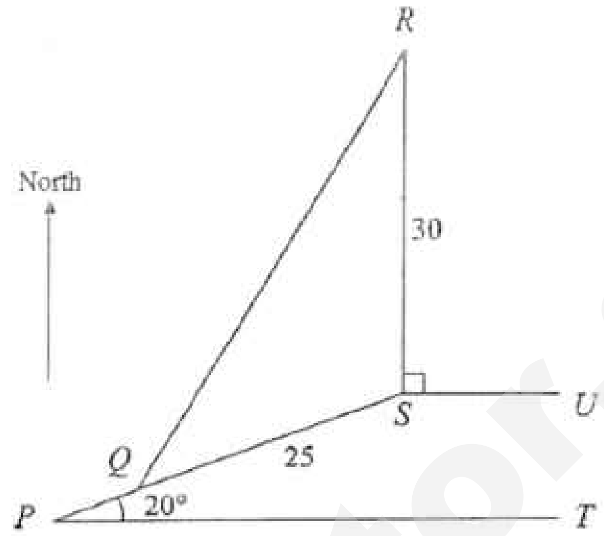
(ii) Calculate BC. [2]

(iii) Calculate the shortest distance from A to BC, given that the area of triangle ABC is 20 units^2. [2]

(b) Paul has \$9000 to invest in either Company A or Company B. [4]
Company A offers 5.9% per annum simple interest.
Company B offers 5.8% per annum compound interest, compounded half-yearly.
Paul wishes to invest the money for a period of 5 years.

Calculate the difference in interest earned after 5 years and suggest which company Paul should invest in.

3



In the diagram, P, Q, R, S, and T are five points on a horizontal field.
$QS = 25$ m and $RS = 30$ m.
Angle $RSU = 90°$ and angle $SPT = 20°$.
SU is parallel to PT and R is north of S.

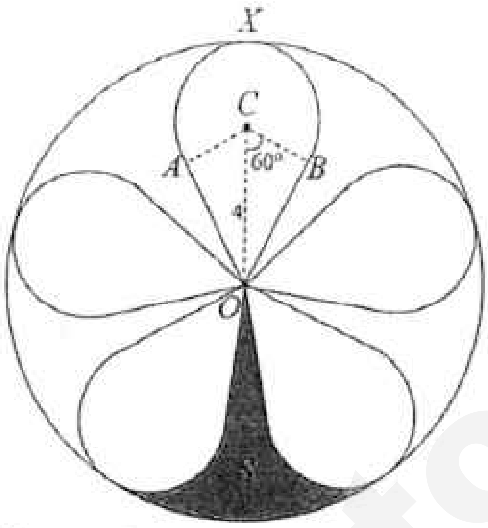
(a) Calculate QR. [4]

(b) Calculate the bearing of Q from R. [3]

(c) Given that the area of the field enclosed by ΔPRS is 416 m^2, find the length of PQ. [2]

(d) A radio mast of height 1000 cm stands at S. [3]
Calculate the greatest angle of elevation of the top of the radio mast when viewed by a man walking along RQ.

4 The diagram shows a toy made of wire.



AXB is an arc of circle with centre C.
O is the centre of a large circle which touches the arc AXB at X.
The lines OA and OB are tangents to the circle with centre C and together with the arc AXB they form a flap of $OAXBO$.
The other four flaps are identical to $OAXBO$ and placed equidistant from each other.
Given that $OC = 4$ cm and angle $BCO = 60°$,

(a) Show that the radius of the large circle = 6 cm. [2]

(b) Find the total length of the wire needed to make the toy. [3]

(c) Calculate the area of the shaded region, S, in the diagram. [4]

5 **Answer the whole of this question on a sheet of graph paper.**

The variables x and y are connected by the equation

$$y = 3x - 2 + \frac{10}{x+3}.$$

Some corresponding values of x and y are given in the table below.

The values of y are corrected to 2 decimal places where appropriate.

x	−2.25	−2	−1.5	−1	−0.5	0	0.5	1
y	4.58	2	0.17	0	0.5	1.33	p	3.5

(a) Calculate the value of p. [1]

(b) Use a scale of 4 cm to represent 1 unit, draw a horizontal x-axis for $-2.5 \le x \le 1$. [3]
Use a scale of 4 cm to represent 1 unit, draw a vertical y-axis for $-0.5 \le y \le 5$.

On your axes, plot the points given in the table and join them with a smooth curve.

(c) By drawing the tangent, find the gradient of the curve when $x = -1.65$. [2]

(d) Using your graph, find the range of values of x in the range $-2.5 \le x \le 1$ for which

(i) $3x + \frac{10}{x+3} < 3$ [2]

(ii) $(x+3)(8-5x) = 20$ [2]

6 A supplier received an order to customise a gold trophy for a competition.
A sample of the gold trophy is shown in Diagram I.

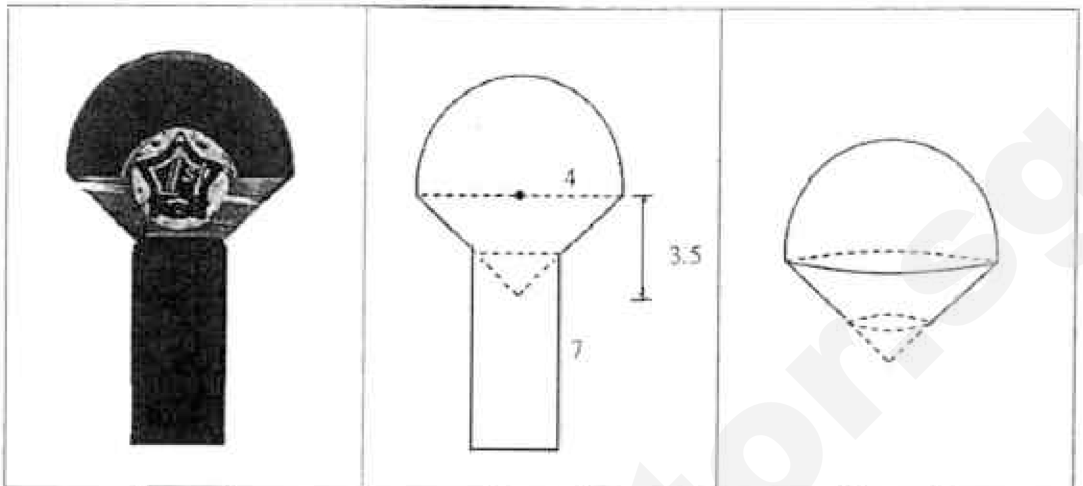


Diagram I | Diagram II | Diagram III

Diagram II shows the cross-section of the gold trophy.
The trophy consists of a hemisphere with radius 4 cm joined to a cone with a height of 3.5 cm, partly embedded into a cylinder with height 7 cm.
The total height of the trophy is 13.1 cm.

(a) Show that the part of the cone embedded into the cylinder has a height of 1.4 cm. [1]

(b) Find the total volume of the trophy. [3]

(c) The surface of the trophy is painted in different colours. [3]
The top part of the trophy, as shown in Diagram III is painted with gold paint.
A litre of gold paint cost \$3.60 and can be used to paint 100 cm^2 of area.
Find the cost of paint used for 20 gold trophies.

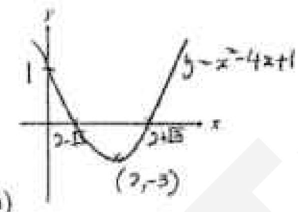
(d) A silver trophy for the same competition is geometrically similar to the gold trophy. [3]
The height of the silver trophy is 10% shorter than the gold trophy.
Given that the mass of the silver trophy is 540 g, find the mass of the gold trophy and the density of the material used to make the trophies, in g/cm^3.

End of Section B

Answer Key

Section A

1. $x \le 0$
2. 4
3. 2
4. $\dfrac{2m^2}{3n^7}$
5. (a) 1×10^{-9} (b) 4.07×10^{-2}
6. (a) 5 (b) 7.2
7. (a) 112.6° (b) $\sin B = \dfrac{12}{13}$ $\cos A = -\dfrac{5}{13}$
8. (a) $(x-2)^2 - 3$ (b)



9. (a) 5.8 (b) 7.5 (c) Barry is correct
10. (a) 20° (b) 250° (c) 14°
11. (c) 10.5

Section B

1. (a) $\dfrac{1}{x}$ (b) $\dfrac{1}{x+5}$ (d) $x = 17.81$ or -2.81 (e) 12 hours 37 minutes
2. (a)(i) $y = -\dfrac{7}{2} + 11$ (ii) 7.28 units (iii) 5.49 units (b) Company B
3. (a) 45.1 m (b) 211.4° (c) 4.51 (d) 32.6°
4. (a) 6 cm (b) 114 cm (c) 7.31 cm^2
5. (a) 2.36 (c) $-2.46(\pm 0.5)$ (d)(i) $-1.82 < x < -0.18(\pm 0.1)$

   (ii) $x = -1.84$ or $x = 0.44(\pm 0.1)$
6. (b) 245 cm^3 (c) $112.77 (d) 3.02 g/cm^3

NAME: ______________________________ (   )   CLASS: ______

FAIRFIELD METHODIST SCHOOL (SECONDARY)

END-OF-YEAR EXAMINATION 2016
SECONDARY 3 EXPRESS

MATHEMATICS 4048/01

Paper 1

Date: 12 October 2016   Duration: 2 hours

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer all questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
You are expected to use a scientific calculator to evaluate explicit numerical expressions.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

For Examiner's Use	
Paper 1	/ 80

Setter: Ms Michelle Tan

This question paper consists of 20 printed pages including the cover page.

Name: ______________________________ (   )   Class: ________

Answer all the questions

1. The world's population is predicted to reach 0.097×10^{11} by 2050.

   (a) 0.097×10^{11} can be expressed as n million. Find n.

   Answer (a) n = ... [1]

   (b) The world's population was 7.2×10^{9} in 2013. Find the predicted increase in the world's population from 2013 to 2050, giving your answer in standard form.

   Answer (b) .... [1]

---

2. Given the recurring decimal number $p = 0.636363\ldots$,

   (a) without the use of a calculator, evaluate $100p - p$.

   Answer (a) .... [1]

   (b) Hence, write p as a fraction in its simplest form.

   Answer (b) p = ... [1]

Name: ______________________________ (   )   Class: __________

3. Given that the gradient of the line joining the points $A(-3, -7)$ and $B(4, r)$ is $\frac{3}{5}$.

(a) Find the value of r.

Answer (a) r = ... [2]

(b) Find the equation of the line passing through $C(-10, 2)$ and is parallel to the line AB.

Answer (b) .... [1]

4. (a) Make x the subject of the formula $m = \sqrt{\frac{5x}{p} - n^2}$

Answer (a) .... [2]

(b) Hence, find the value of x when $p = -2$, $n = 3$ and $m = -1$.

Answer (b) x = ... [1]

Name: ______________________________ (   )   Class: __________

5. (a) Written as a product of its prime factors, $9720 = 2^x \times 3^y \times 5$.

Find the values of x and of y.

Answer (a) x = ..., y = ... [1]

(b) Written as a product of its prime factors, $1134 = 2 \times 3^4 \times 7$.

Find the smallest positive integer m such that $\frac{1134}{m}$ is a square number.

Answer (b) m = ... [1]

Name: ________________________________ (   )   Class: ________

6. The number of cases of dengue fever reported each week is recorded over a particular year.

No. of cases	$40 \le x < 60$	$60 \le x < 80$	$80 \le x < 100$	$100 \le x < 120$
Frequency	11	18	15	8

Calculate an estimate of the mean number of cases of dengue fever.

Answer ....cases of dengue fever [2]

7. Each of the numbers 2, 6 and 7 are written on a card. One or two of these cards are drawn at random to form a one- or two-digit number. Find the probability of the number formed

(a) consists of two digits,

Answer (a).................................... [1]

(b) is a prime number,

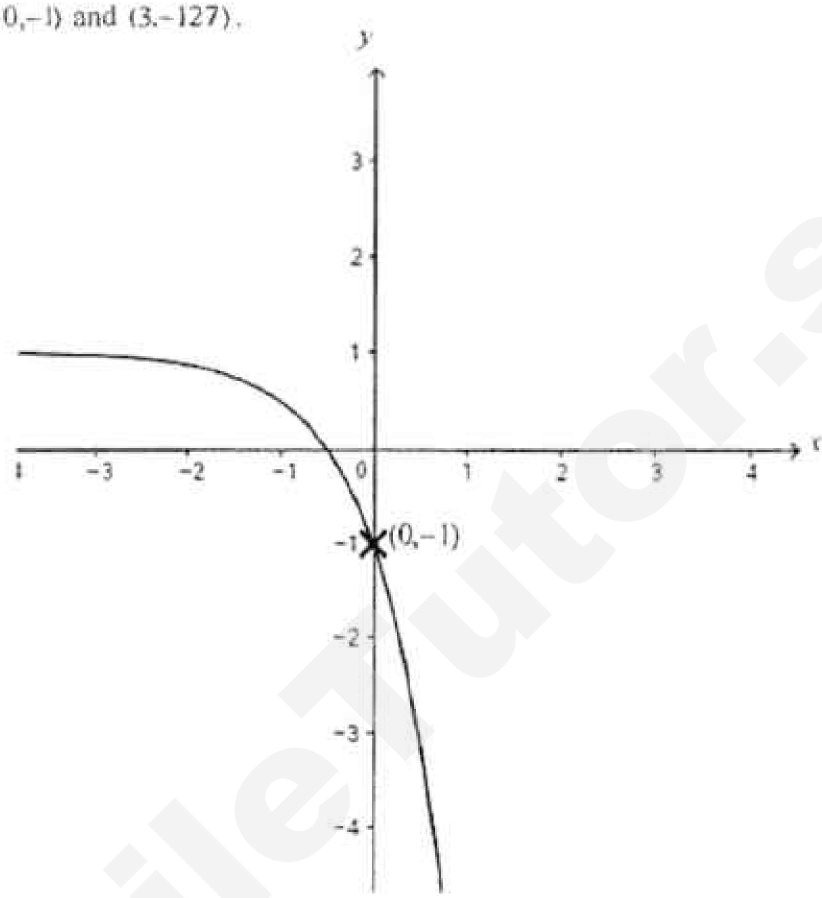
Answer (b).................................... [1]

(c) is a multiple of 5.

Answer (c).................................... [1]

Name: ________________________________ (   )   Class: __________

8. The sketch below shows the graph of $y = ka^x + 1$. The graph passes through the points $(0,-1)$ and $(3,-127)$.



Find

(a) the value of k, and

Answer (a) k = ... [1]

(b) a.

Answer (b) a = ... [2]

9. A plantation has an area of 225 km^2.

(a) A map has a scale of 1 cm to 5 km. Find the area on the map, in cm^2, which represents the plantation.

Answer (a) .... cm^2 [2]

(b) On another map, the same plantation is represented by an area of 36 cm^2 and a river is represented by a length of 3 cm. Find the actual length, in km, of the river.

Answer (b) .... km [2]

Name: ______________________________ (   )   Class: ________

10. Solve $\frac{3}{m} = 2 + \frac{m}{2m-1}$, giving your answers to 2 decimal places.

Answer $m =$ ………… or $m =$ ………… [4]

Name: ______________________________ (   )   Class: __________

11. Given that $\frac{2-x}{4} \le 3 + x < 11$ and $0 < y < 5$, where x and y are integers, find

(a) the range of values of x,

Answer (a).................................... [2]

(b) the greatest possible value of $(x+y)^2$,

Answer (b).................................... [1]

(c) the least possible value of $(x+y)(x-y)$.

Answer (c).................................... [1]

Name: ____________________________ (   )   Class: __________

12. (a) Simplify $\left(\dfrac{x}{9}\right)^{-\frac{1}{2}} \times x^2$, leaving your answer in positive index form.

Answer (a) .... [2]

(b) Given that $\dfrac{y^3 \times y^{\frac{1}{k}}}{\sqrt[4]{y^{21}}} = 1$, find the value of k.

Answer (b) $k =$ .... [3]

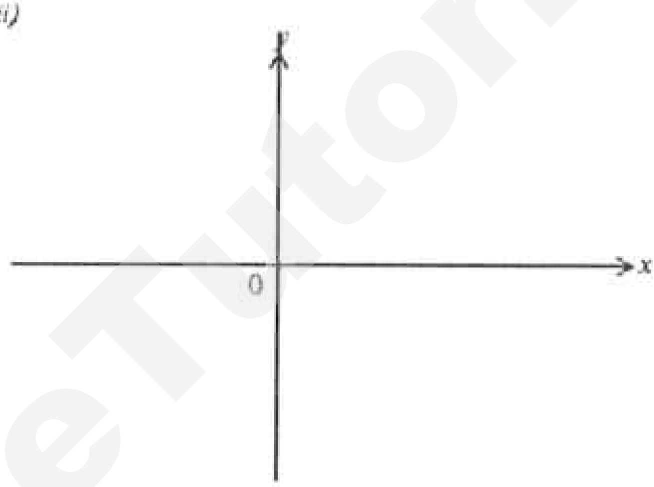
Name: ______________________________ (   )   Class: ________

13. (a) (i) Express $x^2 - 8x + 2$ in the form $(x+p)^2 + q$

Answer (a)(i) .... [1]

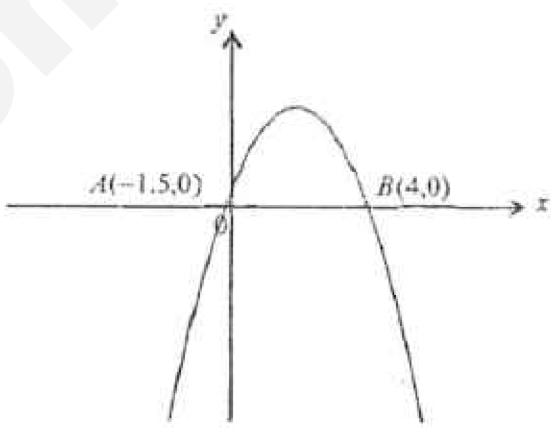
(ii) Hence, sketch the graph of $y = x^2 - 8x + 2$, indicating the coordinates of the turning point and the y-intercept.

Answer (a)(ii)



[2]

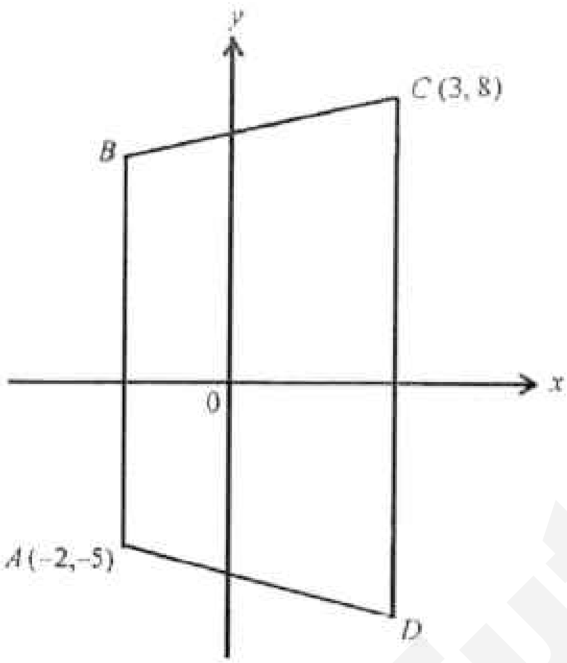
(b) The diagram below shows a quadratic curve. The equation of the curve is $y = p + qx - 2x^2$. Find the values of p and of q.



Answer (b) $p =$ ...., $q =$ .... [2]

Name: ______________________________ (   )   Class: __________

14. $ABCD$ is a trapezium where AB and CD are parallel to the y-axis. It is given that $A(-2,-5)$, $C(3, 8)$, AB is 12 units and the area of the trapezium is 65 square units.



Find

(a) the coordinates of B,

Answer (a) B (................, ...) [1]

(b) the coordinates of D,

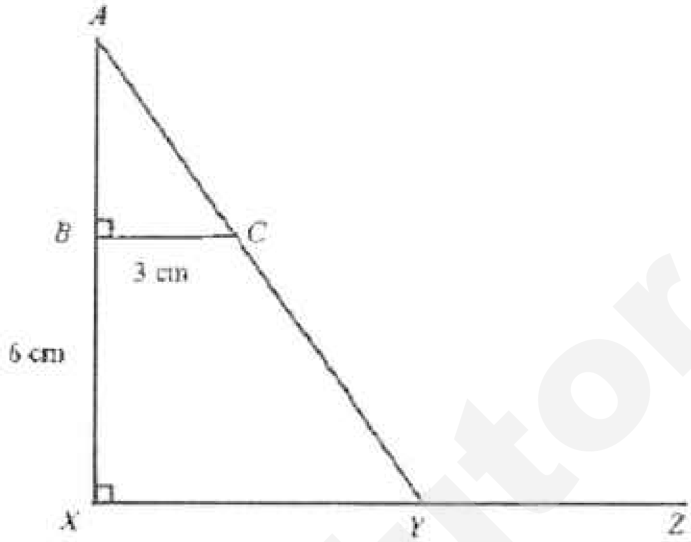
Answer (b) D (................, ...) [1]

(c) length of AD.

Answer (c) .... units [2]

Name: ________________________________ (   )   Class: ________

15. The diagram below is made up of two similar right-angled triangles ABC and AXY. XYZ is a straight line. It is given that $BX = 6$ cm, $BC = 3$ cm and $BC : XY = 2 : 5$.



Giving your answers as a fraction in its lowest term, find

(a) $\tan\angle BAC$.

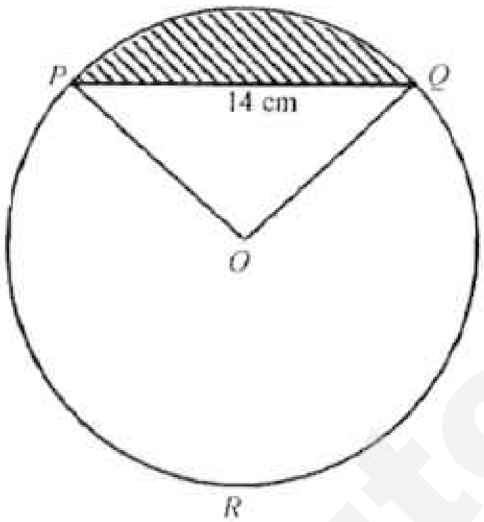
Answer (a).................................. [2]

(b) $\cos\angle AYZ$.

Answer (b).................................. [2]

Name: ______________________________ (   )   Class: _________

16. The figure shows a circle with centre O, of radius 10 cm and $PQ = 14$ cm.



(a) Show that $\angle POQ = 1.55$ radians.

Answer (a) [2]

(b) Find the length of major arc PRQ.

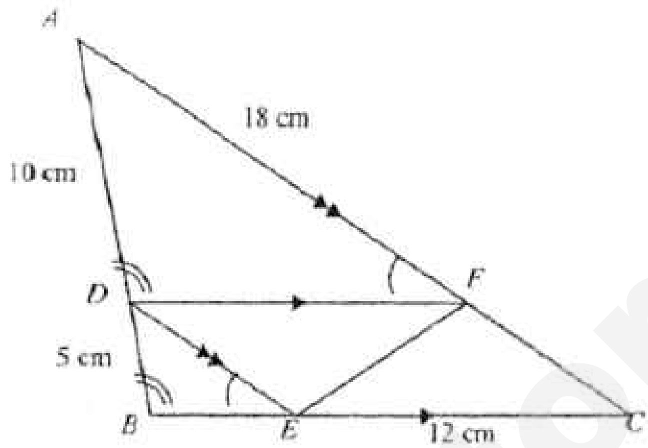
Answer (b) ....cm [2]

(c) Find the area of the shaded region.

Answer (c) ....cm^2 [3]

Name: ______________________________ (   )   Class: __________

17. In the diagram, DF is parallel to BC and AC is parallel to DE. The points D, E and F lie on the line AB, BC and AC respectively. Given that $DB = 5$ cm, $AD = 10$ cm, $EC = 12$ cm and $AF = 18$ cm.



(a) Prove that ΔADF is similar to ΔABC.

Answer (a)

....

....

....

....

.... [2]

(b) Prove that ΔCEF is congruent to ΔDFE.

Answer (b)

....

....

....

....

.... [2]

17. (c) Find

(i) the length of BC,

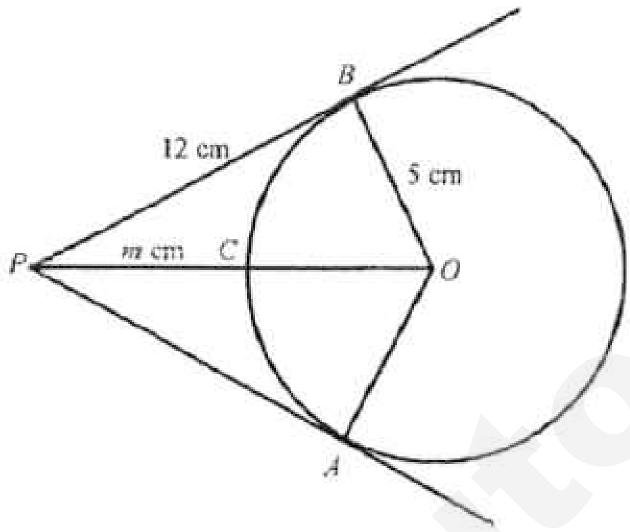
Answer (c)(i).......................cm [1]

(ii) $\dfrac{\text{area of } \Delta DBE}{\text{area of parallelogram } DECF}$.

Answer (c)(ii).............................. [2]

Name: ______________________________ (   )   Class: ________

18. In the diagram, PA and PB are tangents to the circle with centre, O. PCO is a straight line where C is a point on the circle.



Find

(i) the value of m, where $PC = m$ cm,

Answer (i) m = ... [2]

(ii) the angle BPA.

Answer (ii) ....° [2]

Name: ______________________________ (   )   Class: ________

19. The price of 1 litre of Shell FuelSave 95 petrol in Singapore costs S$1.89.

(a) Shell rewards loyal customers with privilege cards, a 14% discount. Andy uses the privilege card to pump x litres of petrol at Shell. Find the value of x if he paid $56.89 for his petrol bill.

Answer (a) x = ... [2]

(b) The same type of petrol in Johor Bahru costs RM1.75 per litre. Using your answer from (a), calculate the total amount of money that Andy has to pay if he pumps x litres of petrol at Shell in Johor Bahru.

Answer (b) RM .... [1]

(c) There is a compulsory toll of RM20 for Singapore vehicles going in to Johor Bahru. Given that the exchange rate is S$1=RM2.92, find the percentage savings that Andy will have if he pumps x litres of petrol in Johor Bahru.

Answer (c) ....% [2]

Name: ______________________________ (   )   Class: __________

20. Show your construction lines clearly, using a ruler, compasses and a protractor. The line PQ has been drawn for you.

(a) Construct a parallelogram $PQRS$ such that $PQ = RS = 8$ cm, $PS = QR = 9$ cm, and $\angle PQR = 70°$. [2]

(b) Find the two possible positions of A and label them A_1 and A_2, if $RA = 9.4$ cm and $\angle SPA = 120°$. [1]

(c) On the parallelogram $PQRS$, construct

(i) the angle bisector of $\angle PSR$. [1]

(ii) the perpendicular bisector of the line PS. [1]

(d) Label the point Y where the perpendicular bisector and the angle bisector meet and measure the length of PY.

(e) Complete the statement about point Y below.

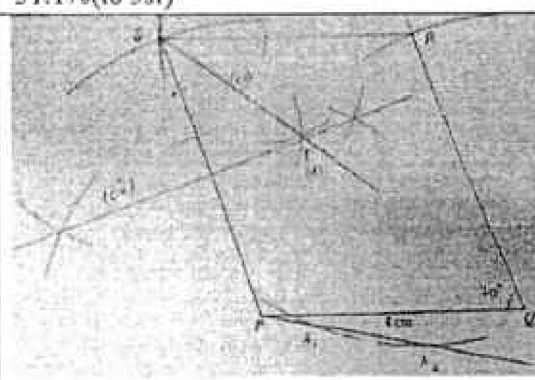
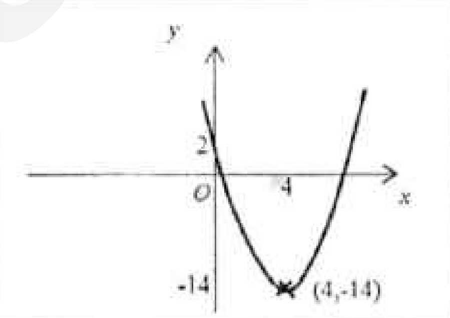
The lines .... and .... are equidistant from the point Y. [1]

Answer (a), (b), (c)(i) and (c)(ii)

P 8 cm Q

Answer (d) $PY =$ ....cm [1]

~ End of Paper ~

2016 Sec 3Exp EOY P1 Answer Key		14(c)	5.10 units (to 3sf)
1(a)	$n = 9700$	15(a)	$\frac{3}{4}$
1(b)	2.5×10^9		
2(a)	63	15(b)	$-\frac{3}{5}$
2(b)	$p = \frac{7}{11}$		
3(i)	$r = -\frac{14}{5}$ or $r = -2\frac{4}{5}$ or $r = -2.8$	16(a)	Let R be the midpoint of PQ. $PR = RQ = 7$ cm $\sin \angle POR = \frac{7}{10}$ $\angle POR = \sin^{-1}\left(\frac{7}{10}\right)$ $\angle POQ = 2 \times \angle POR = 2 \times \sin^{-1}\left(\frac{7}{10}\right) = 1.55$ radians (to 3sf)
3(ii)	$y = \frac{3}{5}x + 8$		
4(a)	$x = \frac{p(m^2 + n^2)}{5}$		
4b	-4		
5(a)	$x = 3, y = 5$		
5(b)	$m = 14$	16(b)	47.3 cm (3 s.f.)
6	77.7 (to 3sf) or $\frac{1010}{13}$ or $77\frac{9}{13}$	16(c)	27.5 cm^2 (3 s.f.)
7(a)	$\frac{2}{3}$	17(a)	$\angle ADF = \angle ABC$ (corr. $\angle$s, $DF // BC$) $\angle DAF = \angle BAC$ (common angle) Or $\angle AFD = \angle ACB$ (corr. $\angle$s, $DF // BC$) $\therefore \Delta DAF$ is similar to ΔABC by AA Similarity Test
7(b)	$\frac{1}{3}$		
7(c)	0		
8(a)	$k = -2$	17(b)	$\angle DFE = \angle CEF$ (alt. $\angle$s, $DF // CE$) $\angle DEF = \angle CFE$ (alt. $\angle$s, $DE // CF$) EF is common side $\therefore \Delta CEF \equiv \Delta DFE$ by ASA Congruence Test
8(b)	$a = 4$		
9(a)	9 cm^2		
9(b)	7.5 km	17(c)(i)	18 cm
10	$m = 0.54$ or $m = -1.87$	17(c)(ii)	$\frac{1}{4}$
11(a)	$-2 \le x < 8$	18(a)(i)	$m = 8$
11(b)	121	18(a)(ii)	45.2° (to 1 dp)
11(c)	-16	19(a)	35.0
12(a)	$3x^{\frac{3}{2}}$ or $3x^{1.5}$ or $3x^{1\frac{1}{2}}$	19(b)	RM61.25
12(b)	$k = 9$	19(c)	51.1% (to 3sf)
13(a)(i)	$(x-4)^2 - 14$	20(a)-(c)(iii)	
13(a)(ii)			
13(b)	$p = 12, \ q = 5$		
14(a)	$B(-2, 7)$	20(d)	5.5 cm (± 0.1)
14(b)	$D(3, -6)$	20(e)	PS and SR

NAME: ______________________________ (   )   CLASS: ______

FAIRFIELD METHODIST SCHOOL (SECONDARY)

END-OF-YEAR EXAMINATION 2016
SECONDARY 3 EXPRESS

MATHEMATICS — 4048/02

Paper 2

Date: 10 October 2016 — Duration: 2 hours 30 minutes

Additional Materials: Answer Paper
Graph paper

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer all questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
You are expected to use a scientific calculator to evaluate explicit numerical expressions.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 100.

Setter: Mdm Haliza and Mrs Lynn Pang

This question paper consists of 13 printed pages including the cover page.

Name: ______________________________ (   )   Class: __________

Answer all the questions.

1 (a) (i) Factorise $2x^2 - 7x + 3$. [1]

(ii) Hence, simplify $\dfrac{2x^2 - 7x + 3}{x^2 - 9}$. [2]

(b) Express as a single fraction in its simplest form.

$$\frac{4}{x-3y} - \frac{1}{6y-2x}$$ [3]

(c) A formula is given as $r = \dfrac{s+3}{1-2s}$.

(i) Find the value of r when $s = -2$. [1]

(ii) Express s in terms of r. [2]

(d) Solve the equation $1 - \dfrac{4m+2}{2m} = \dfrac{5}{m}$. [3]

---

2 (a) Matthew has \$20 000 to invest in Company A or Company B. Company A offers 3.8% per annum simple interest while Company B offers 3.5% per annum compound interest, compounded half-yearly.
Matthew wishes to invest the money for a period of 5 years.
Which company should he invest in? Explain your answer. [3]

(b) The cost of making a particular washing machine is divided between materials, wage and other miscellaneous costs in the ratio 4 : 3 : 2. The material cost used for a washing machine is \$600.

(i) What is the total cost of making a washing machine? [1]

(ii) Due to a new minimum wage regulation, the wage was raised by 10%.
Express, correct to one decimal place, the new wage as a percentage of the new total cost. [4]

Name: ______________________________ (   )   Class: __________

2   (c)   In 2014, Mrs Lee earned a gross annual salary of $84 000. Of this $84 000, the amount that will not be subjected to income tax includes her donation of 5% of her gross annual salary to charity, an annual relief amount of $10 000 for looking after her mother who in turn looks after her children and her annual Central Provident Fund (CPF) contributions which amounted to $16 800.
By referring to the Income Tax table below, find Mrs Lee's income tax payable for 2014.   [3]

Chargeable Income	Income Tax Rate (%)	Gross Tax Payable
First $20,000 Next $10,000	0 2	0 200
First $30,000 Next $10,000	- 3.50	200 350
First $40,000 Next $40,000	- 7	550 2,800
First $80,000 Next $40,000	- 11.5	3,350 4,600

[*chargeable income refers to the annual gross income less all donations and relief for the same year*]

Name: ______________________________ (   )   Class: ________

3 The stem and leaf diagram below shows the scores of 21 students in a Mathematics class test. The full mark of the test is 60 marks.

Stem	Leaf
2	5 7 9
3	0 1 y 2 3 9
4	2 4 5 6 6 x 9
5	0 1 3 6 6

Key: 2|5 represents 25 marks

(a) Given that the modal score is 46 marks, and the mean score is 41 marks, find

(i) the value of x and, [1]

(ii) the value of y.

[2]

(b) Find the median score. [1]

(c) What is the percentage of students who scored 42 marks and above? [1]

(d) It was discovered that one of the questions had error and thus all the students were given 1 more mark. Explain how the median and mean have been affected by the error. [2]

Name: ______________________________ (   )   Class: __________

4 (a) The sequence of numbers 1, 5, 11, 19, 29, ...can also be expressed in the form:

Term, n	Number	Pattern
1	1	$1^2 + 0$
2	5	$2^2 + 1$
3	11	$3^2 + 2$
4	19	$4^2 + 3$
5	29	

(i) Find the pattern for the 5^{th} term. [1]

(ii) Find an expression, in terms of n, for the nth term. [1]

(iii) Find the value of the 111^{th} term of the sequence. [1]

(iv) For which term will the number 271 appear in the sequence? [2]

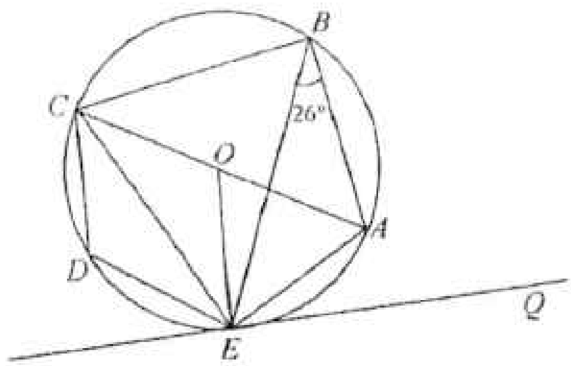
(v) Explain why 56 is not a member of the above sequence? [1]

(b) Write down an expression in terms of n, for the n^{th} term of the sequence

4, 7, 10, 13, 16 ... [1]

Name: ______________________________ (   )   Class: __________

5 (a)



The points A, B, C, D and E lie on a circle, centre O. AC is a diameter of the circle. EQ is a tangent to the circle at E and $\angle ABE = 26°$.

(i) Stating your reasons clearly, find

(a) $\angle ACE$, [1]

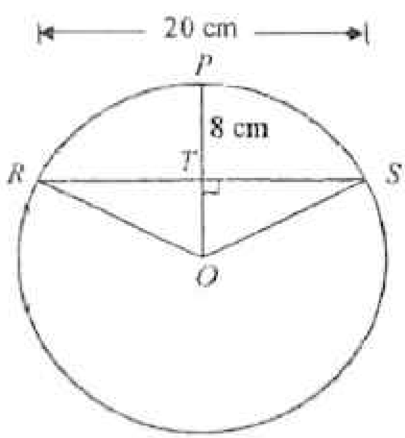
(b) $\angle CBE$, [1]

(c) $\angle CDE$, [1]

(d) $\angle AEQ$. [2]

(ii) Given that $\angle AEB = 38°$, determine whether the lines EO and AB are parallel. Give a reason for your answer. [2]

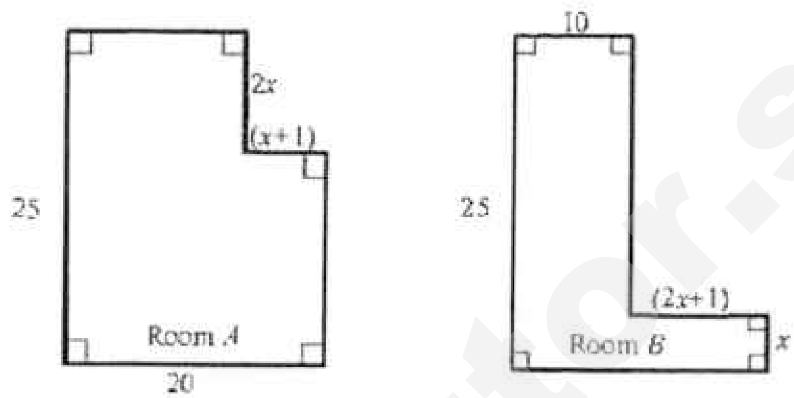
(b) The perpendicular bisector of a chord, RS, cuts it at T and the circumference of the circle at P. If $RS = 20$ cm and $TP = 8$ cm, find the radius of the circle.



[2]

Name: ________________________________ (   )   Class: ________

6 The diagram below, not drawn to scale, shows the layout of two rooms, A and B. All dimensions are given in metres.



(a) Write down an expression, in terms of x, for the area of Room A and show that that it reduces to $-2x^2-2x+500$. [1]

(b) Write down an expression, in terms of x, for the area of Room B and show that that it reduces to $2x^2+x+250$. [1]

(c) A contractor was hired to lay tiles in Room B. The cost for tiling was \$25 per square metre.

(i) Find in terms of x, the cost of tiling Room B. [1]

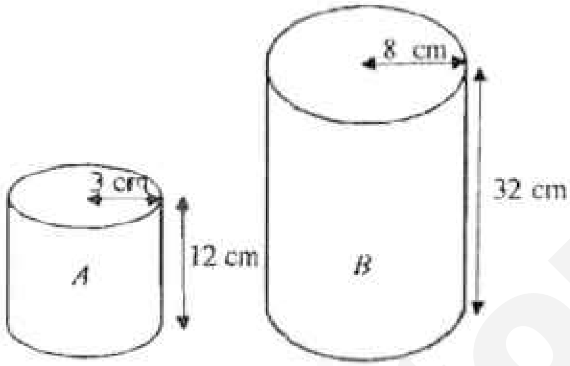
(ii) If the cost of tiling Room B is \$7 500, form an equation in terms of x, and show that it reduces to $2x^2+x-50=0$. [1]

(iii) Hence, find the value of x. [3]

(iv) Using the value of x from (iii), find the cost of tiling Room A. [1]

Name: ______________________________ (   )   Class: __________

7 The diagrams, not drawn to scale, show two solid cylinders with their dimensions. These cylinders are made with the same material.



(a) Show that cylinders A and B are similar. [2]

(b) Find the ratio of the total surface area of cylinder B to that of cylinder A. [1]

(c) Given that cylinders A and B are similar to another cylinder C with a height of 4.5 cm. Find the curved surface area of cylinder C. [2]

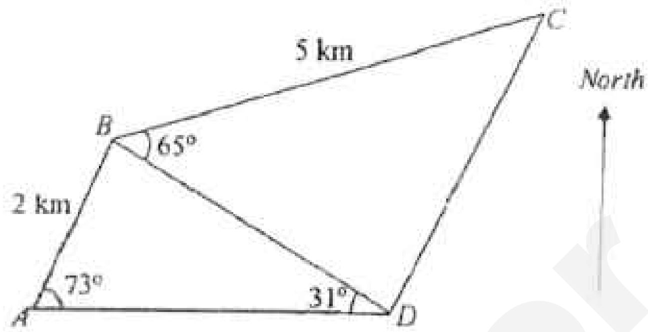
(d) If the mass of A is 360 g, find the mass of B in kg, leaving your answer in 3 decimal places. [2]

Name: ______________________________ (   )   Class: __________

8 A, B, C and D are four points on a field.

Angle DAB is $73°$, angle ADB is $31°$, angle DBC is $65°$, AB is 2 km and BC is 5 km.

D is due east of A.



(a) Show that $BD = 3.714$. [2]

(b) Calculate

(i) CD, [3]

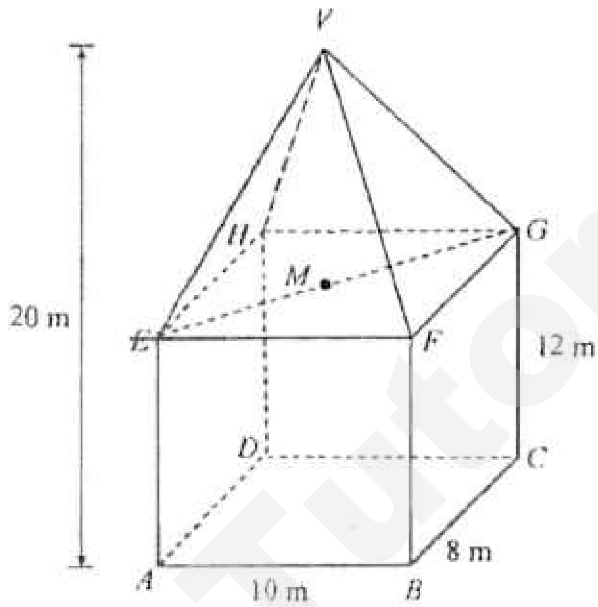
(ii) the area of triangle BCD, [2]

(iii) the shortest distance from D to BC, [2]

(iv) the bearing of B from D. [1]

Name: ______________________________ (   )   Class: ________

9 A simplified diagram of a building is shown below. It is 20 m tall. $ABCD$ represents the rectangular floor of the building. E, F, G and H are vertically above A, B, C and D respectively. V represents the vertex of the roof in the shape of a pyramid. M is the midpoint of EG. It is given that $AB = 10$ m, $BC = 8$ m and $CG = 12$ m.



Calculate

(a) AC, [1]

(b) $\angle VEM$, [2]

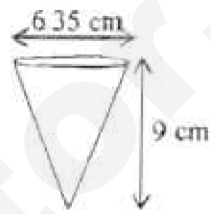
(c) AG, [1]

(d) $\angle AGD$, [2]

(e) the angle of depression of B from V. [2]

Name: ______________________________ (   )   Class: ________

10 The figure below shows a 22.7 litre cylindrical bottle and the conical paper cup used by a company in its water dispenser. The cup has diameter of 6.35 cm and a height of 9 cm.



(Take $\pi = 3.142$)

(a) Calculate the volume of one conical cup. [2]

(b) Calculate the number of conical cups required for one cylindrical bottle. [2]

(c) The conical cups are sold in packets of 5000. Calculate the area of paper required to make 5000 conical cups. [4]

(d) The company decides to switch to a different shaped paper cup that looks like a frustum, as shown in the figure below. The frustum has slanted edges that are parallel to the conical cup and the diameter of the base of the frustum is the same as the diameter of the mouth of the conical cup. It also has the same volume as the conical cup.

Will the height of the new cup be the same as the conical cup? Use a suitable model and justify your answer with calculations. [3]

Name: ______________________________ (   )   Class: __________

11 **Answer the whole of this question on a sheet of graph paper.**

The table below shows some values of x and the corresponding values of y, where $y = 1 - 2^x$.

x	-2	-1	0	0.5	1	1.5	2	2.5
y	p	0.5	0	-0.4	-1	-1.8	-3	-4.66

(a) Find value of p. [1]

(b) Using a scale of 4 cm to represent 1 unit on the x-axis, and 2 cm to represent 1 unit on the y-axis, draw the graph of $y = 1 - 2^x$ for $-2 \le x \le 2.5$. [3]

(c) Use your graph to find

(i) the value of y when $x = -1.5$, [1]

(ii) the value of x when $y = -2.2$. [1]

(d) By drawing a tangent, find the gradient of the curve at the point where $x = 2$.

[2]

(e) Use the graph to solve the equation $2^x + 2x - 2 = 0$. [2]

~ End of Paper ~

Name: ______________________________ (   )   Class: __________

Answer Key for Sec 3 Express EOY Mathematics Paper 2 2016

QN	Answer	QN	Answer
1(ai)	$(2x-1)(x-3)$	3(d)	New median score is still at the 11th score and thus new median is 45 marks. Median and mean values will be affected. • Mean value is increased by 1 mark and • its median value is also increased by 1 mark
1(aii)	$\frac{2x-1}{x+3}$	4(a)(i)	$5^{th}\ term = 5^2 + 4$
1(b)	$\frac{9}{2(x-3y)}$	4(a)(ii)	$n^2+(n-1)$
1(c)(i)	$\frac{1}{5}$ OR 0.2	4(a)(iii)	12431
1(c)(ii)	$s=\frac{r-3}{1+2r}$	4(a)(iv)	$n=16.$
1(d)	$m=0$ (reject) or -6	4(a)(v)	$n^2+(n-1) = 56$ $n^2+n-57 = 0$ The solution for n will not be an integer, thus 56 cannot be a member of the sequence.
2(a)	Company A is = \$23800 Company B is = \$23788.89 He should invest in Company A since the total amount is greater	4(b)	$3n+1$
2(b)(i)	\$1350	5a(i)(a)	$\angle ACE = 26°$ (angles in the same segment)
2(b)(ii)	35.5% (to 1 d.p.)	5a(i)(b)	$\angle CBE = 90-26 = 64°$ (angle in a semicirc
2(c)	\$1460	5a(i)(c)	$\angle CDE = 180-64 = 116°$ (angles in opp. se
3(ai)	$x=6$	5a(i)(d)	$\angle CAE = 64°$ (angles in the same segment) $\angle AEQ = 90-64$ (tan $\perp$ rad) $= 26°$ Or $\angle AEQ = 26°$ (angle in alt. segment)
3(aii)	$y=1$	5a(v)	$\angle OEB = 64-38 = 26°$ $\therefore \angle OEB = \angle ABE = 26°$ Hence, lines EO and AB are parallel since $\angle OEB$ and $\angle ABE$ are <u>alternate angles.</u>

Class	Index Number	Name

新加坡海星中学

MARIS STELLA HIGH SCHOOL

SEMESTRAL ASSESSMENT TWO

SECONDARY THREE

MATHEMATICS **4016/01**

Paper 1

07 October 2016

Additional Materials: Nil

2 hours

INSTRUCTIONS TO CANDIDATES

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
You are expected to use a scientific calculator to evaluate explicit numerical expressions.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give your answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

Subtotal	
P	
R	
U	

For Examiner's Use
80

This document consists of **16** printed pages.

Mathematical Formulae

Compound Interest

$$\text{Total amount} = P\left(1+\frac{r}{100}\right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta \text{, where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta \text{, where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

Answer **all** the questions.

1. Factorise the expression $16-9m^2-6mn-n^2$.

Answer ______________________ [2]

2. Given that $7^x=3$ and $7^y=5$, find the value of 7^{3x+y}.

Answer ______________________ [2]

3. Given that $m^2+\frac{1}{m^2}=11$, find the values of $\frac{1}{4}\left(m-\frac{1}{m}\right)$.

Answer ______________________ [3]

4. y is inversely proportional to the square root of x, where $x > 0$. It is given that $y = 12$ for a particular value of x. Find the decrease in the value of y when this value of x is increased by 800%.

Answer ______________ [3]

5. Given that $p = 1 - \sqrt{\frac{m^2 + n}{m^2}}$, make m the subject of the formula.

Answer $m =$ ______________ [3]

6. If 2 men can make 50 tables in 7 days, how long will 14 men take to make 225 tables?

Answer ______________ days [3]

7. Simplify $\left(\frac{2x^2y^2}{54x^5y^{-4}}\right)^{-\frac{1}{3}}$, expressing your answer in the positive index form.

Answer ____________________ [3]

8. **(a)** A polygon has n sides. Three of its interior angles are $148°$, $157°$ and $175°$.
The remaining interior angles are $155°$ each. Find the value of n.

Answer $n =$ ____________________ [2]

(b) Explain why the interior angle of a regular polygon cannot be $130°$.

____

____ [1]

9. Express $\dfrac{5x+2}{3x^2-12}+\dfrac{1}{2-x}$ as a single fraction in its simplest form.

Answer ______________________ [3]

10. It is given that Cylinder A has a volume of 300 cm^3. Calculate the volume of

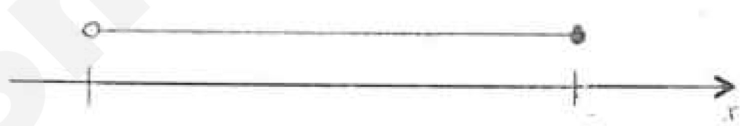
(a) Cylinder B with base radius $\dfrac{2}{5}$ that of Cylinder A and a height thrice that of Cylinder A.

(b) Cylinder C which is geometrically similar to Cylinder A but has a curved surface area 16 times that of Cylinder A.

Answer (a) ______________________ cm^3 [2]

(b) ______________________ cm^3 [2]

11. **(a)** Solve the inequality $-\frac{1}{3}+x \le \frac{x+3}{2} < x+4$. Represent your answer on the number line below.



Answer (a) __________________________ [4]

(b) Write down all the integers that satisfy $-\frac{1}{3}+x \le \frac{x+3}{2} < x+4$.

Answer (b) __________________________ [1]

12. The radius of a spherical particle is approximately 5 picometres.
Find, leaving your answer in standard form,

(a) the diameter of one such particle in centimetres,

(b) the number of particles that must be placed side by side in order to make a length of 30 millimetres,

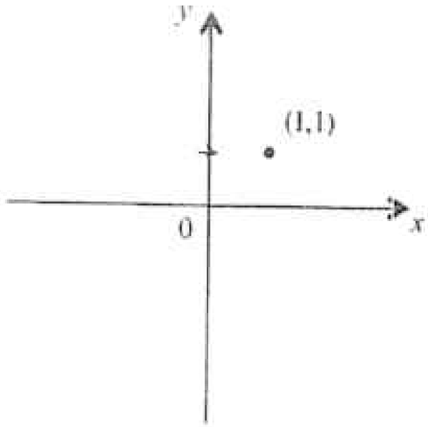
(c) the total volume, in cubic centimetres, of 1 million of such particles. Give your answer correct to 3 significant figures.

Answer (*a*) ____________________ cm [2]

(b) ____________________ [1]

(c) ____________________ cm^3 [2]

13. The point $(1,1)$ is marked on the diagram below. Sketch the graph of $y = 3^x$.

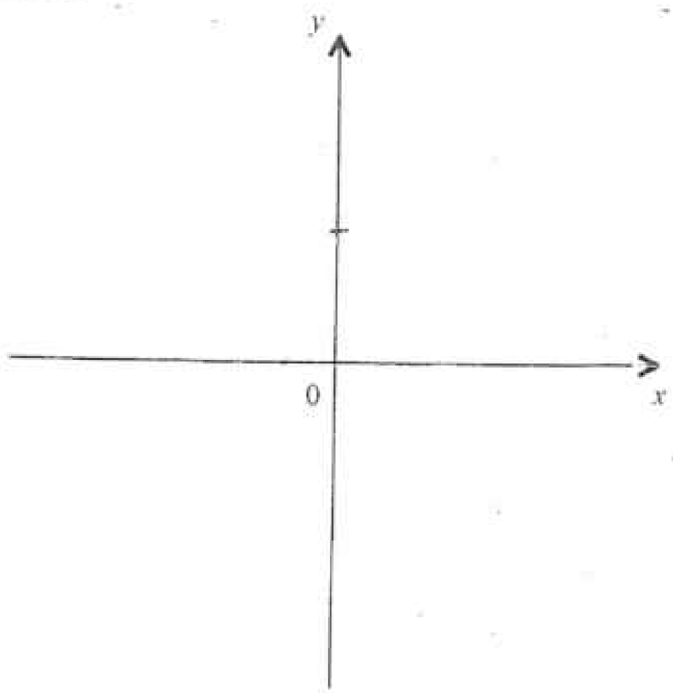


[1]

14. (a) Express $-x^2 + 4x + 7$ in the form of $-(x+h)^2 + k$.

Answer (a) ______________ [3]

(b) Hence, sketch the graph of $y = -x^2 + 4x + 7$ on the axes below, indicating the turning point and the y – intercept. [2]



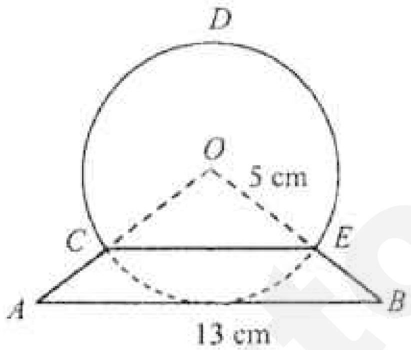
15. The diagram below shows the cross-section of a snowglobe with centre O, of radius 5 cm. The base makes an isosceles triangle OAB. AB is a tangent to the circle and is 13 cm long.

(a) Show that angle AOB = 1.83 radians, correct to 3 significant figures. [2]

(b) Calculate

(i) the area of major segment CDE,

(ii) the perimeter of the snowglobe $ABEDC$.



Answer (*b*) (i) ______________ cm^2 [3]

(ii) ______________ cm [3]

16. (a) Express the numbers 66 and 2520 as products of their prime factors.

(b) Find the smallest positive integer, k, such that $2520k$ is a perfect cube.

(c) Find the smallest positive integer, n, such that $66n$ is a multiple of 2520.

Answer (*a*) 66 = ______________ [1]

2520 = ______________ [1]

(*b*) k = ______________ [2]

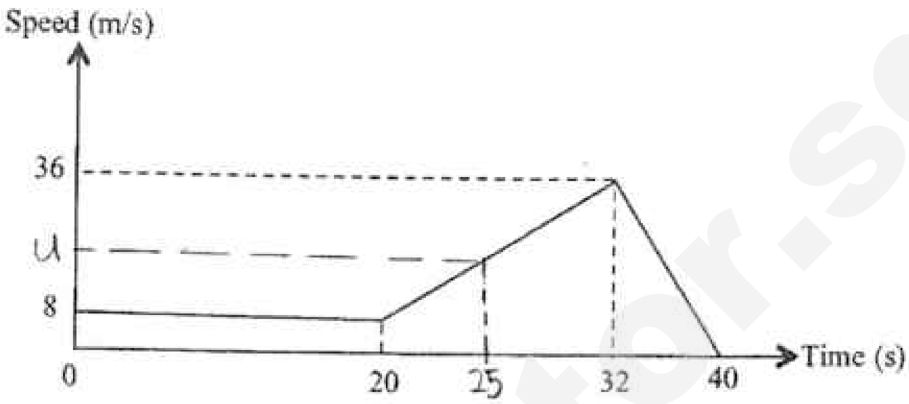
(*c*) n = ______________ [2]

17. The graph below shows the speed of a car during a period of 40 seconds.

(a) Calculate

(i) the speed of the car after 25 seconds,

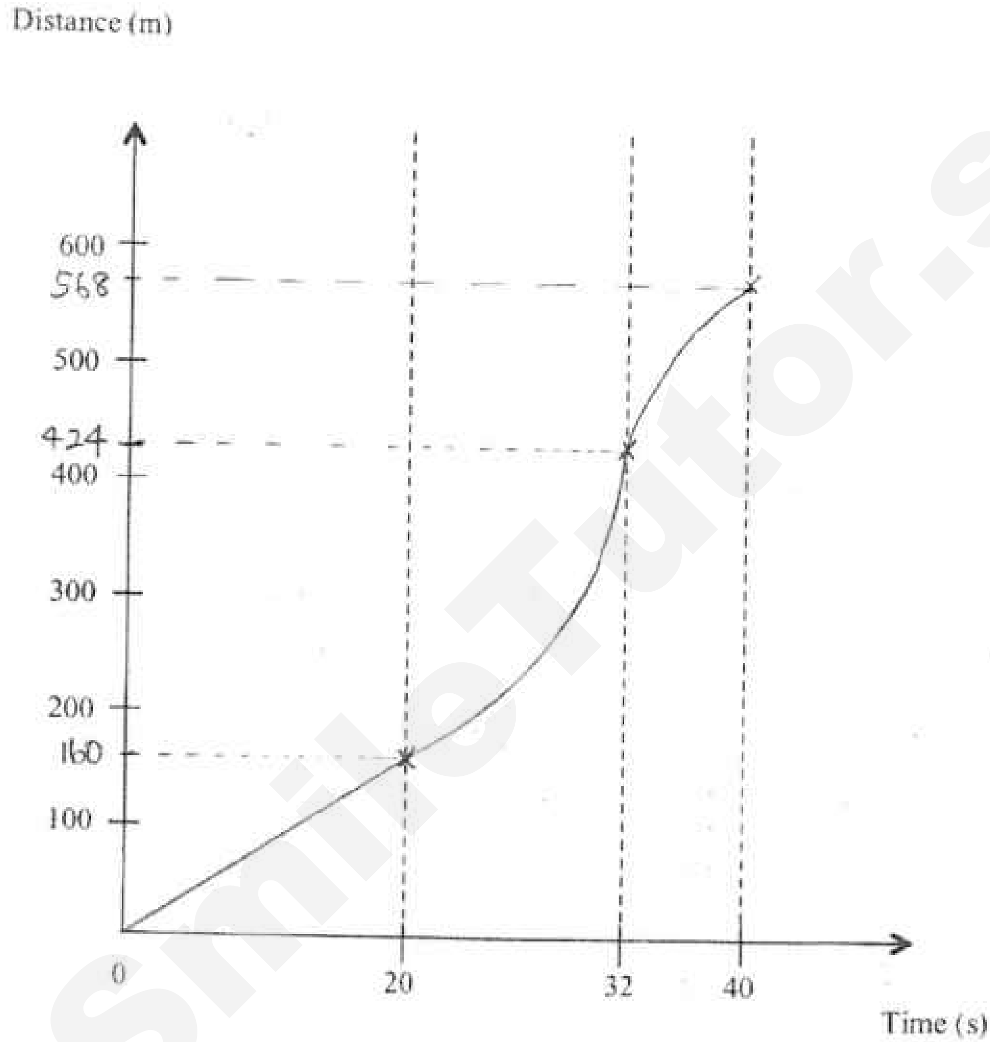
(ii) the deceleration of the car during the last five seconds.



Answer (a) (i) ____________ m/s [2]

(ii) ____________ m/s^2 [2]

(b) On the axes given below, sketch the distance-time graph for the whole journey. [3]



18. In triangle ABC, $AB = 12$ cm, $BC = 13$ cm and $AC = 5$ cm.
AC is produced to D and $CD = 30$ cm.

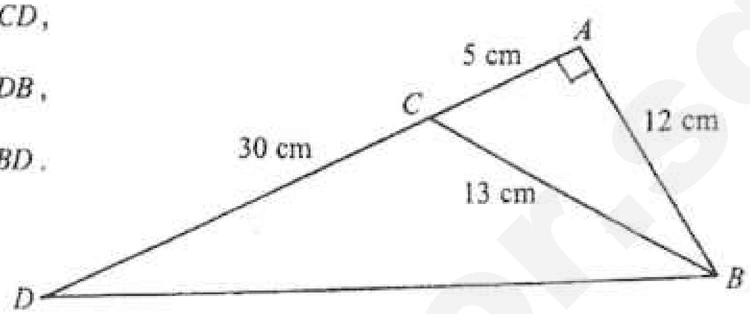
(a) Explain why angle BAC is a right angle. [2]

(b) Express each of the following as a fraction in its exact form.

(i) $\cos\angle BCD$,

(ii) $\tan\angle ADB$,

(iii) $\sin\angle CBD$.



Answer (b) (i)____________________ [1]

(ii)____________________ [1]

(iii)____________________ [3]

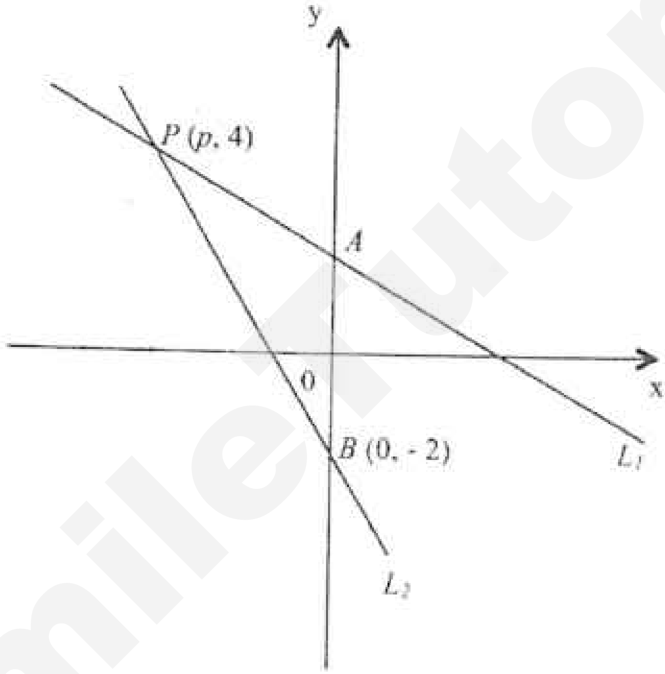
19. The diagram below, which is not drawn to scale, shows two lines, L_1 and L_2, intersecting at the point $P(p,4)$ and cutting the y – axis at the points A and $B(0,-2)$ respectively. The equation of L_1 is $2y+x-6=0$.

(a) State the equation of the line passing through A and is parallel to the x – axis.

(b) Show that $p=-2$, and hence find the equation of line L_2.

(c) Find the length of PB.

(d) A trapezium $PABC$ with AB parallel to PC, has an area of 12 units^2. Find the coordinates of C.



Answer (a) ______________________ [1]

(b) ______________________ [3]

(c) ______________________ [1]

(d) (______ , ______) [2]

END OF PAPER

Class	Index Number	Name

新加坡海星中学

MARIS STELLA HIGH SCHOOL
SEMESTRAL ASSESSMENT TWO
SECONDARY THREE

MATHEMATICS **4016/01**
Paper 1

07 October 2016

Additional Materials: Nil

2 hours

INSTRUCTIONS TO CANDIDATES

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use paper clips, highlighters, glue or correction fluid.

Answer all questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
You are expected to use a scientific calculator to evaluate explicit numerical expressions.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give your answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

Subtotal	
P	
R	
U	

For Examiner's Use
80

This document consists of **16** printed pages.

Mathematical Formulae

Compound Interest

$$\text{Total amount} = P\left(1+\frac{r}{100}\right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta\text{, where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta\text{, where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

Answer **all** the questions.

1. Factorise the expression $16-9m^2-6mn-n^2$.

$16-9m^2-6mn-n^2 = 16-(9m^2+6mn+n^2)$
$= (4)^2-(3m+n)^2$
$= [4-(3m+n)][4+(3m+n)]$
$= (4-3m-n)(4+3m+n)$ //

Answer $(4-3m-n)(4+3m+n)$ [2]

2. Given that $7^x=3$ and $7^y=5$, find the value of 7^{3x+y}.

$7^{3x+y} = 7^{3x}\times 7^y$
$= (7^x)^3\times 7^y$
$= (3)^3\times 5$
$= 135$ //

Answer 135 [2]

3. Given that $m^2+\frac{1}{m^2}=11$, find the values of $\frac{1}{4}\left(m-\frac{1}{m}\right)$.

$\left(m-\frac{1}{m}\right)^2 = m^2-2(m)\left(\frac{1}{m}\right)+\frac{1}{m^2}$
$= m^2+\frac{1}{m^2}-2$
$= 11-2$
$= 9$
$\therefore\ m-\frac{1}{m} = \pm\sqrt{9}$
$= 3$ or -3
Hence, $\frac{1}{4}\left(m-\frac{1}{m}\right) = \frac{1}{4}(3)$ or $\frac{1}{4}(-3)$
$= \frac{3}{4}$ or $-\frac{3}{4}$

Answer $\frac{3}{4}$ or $-\frac{3}{4}$ [3]

4. y is inversely proportional to the square root of x, where $x > 0$. It is given that $y = 12$ for a particular value of x. Find the decrease in the value of y when this value of x is increased by 800%.

$$y = \frac{k}{\sqrt{x}}$$

Let $x = a$ when $y = 12$. $\quad 12 = \frac{k}{\sqrt{a}}$

$$k = 12\sqrt{a}$$

Let the new y-value be y_1.

$$y_1 = \frac{12\sqrt{a}}{\sqrt{900\% \times a}} \quad * \frac{12\sqrt{a}}{\sqrt{9a}}$$

$$= \frac{12\sqrt{a}}{3\sqrt{a}}$$

$$= 4$$

$\therefore$ Decrease in value $= 12 - 4$

$= 8$ //

Answer 8 [3]

---

5. Given that $p = 1 - \sqrt{\frac{m^2 + n}{m^2}}$, make m the subject of the formula.

$$p - 1 = -\sqrt{\frac{m^2+n}{m^2}}$$

$$1 - p = \sqrt{\frac{m^2+n}{m^2}}$$

$$(1-p)^2 = \frac{m^2+n}{m^2}$$

$$m^2(1-p)^2 = m^2 + n$$

$$m^2(1-p)^2 - m^2 = n$$

$$m^2[(1-p)^2 - 1] = n$$

$$m^2 = \frac{n}{[(1-p)^2 - 1]}$$

$$m = \pm\sqrt{\frac{n}{[(1-p)^2 - 1]}}$$

$$= \pm\sqrt{\frac{n}{[(1-p)+1][(1-p)-1]}}$$

$$= \pm\sqrt{\frac{n}{[2-p][-p]}}$$

$$= \pm\sqrt{\frac{n}{p(p-2)}} \quad //$$

Answer $m = \pm\sqrt{\frac{n}{p(p-2)}}$ [3]

---

6. If 2 men can make 50 tables in 7 days, how long will 14 men take to make 225 tables?

Men	tables	days
2	50	7
2x7=14	50	1
14	225	$\frac{225}{50} = 4\frac{1}{2}$ //

Answer $4\frac{1}{2}$ days [3]

7. Simplify $\left(\dfrac{2x^2y^2}{54x^5y^{-4}}\right)^{-\frac{1}{3}}$, expressing your answer in the positive index form.

$$\left(\frac{54x^5y^{-4}}{2x^2y^2}\right)^{\frac{1}{3}} = \left(27x^{5-2}y^{-4-2}\right)^{\frac{1}{3}}$$
$$= \left(27x^3y^{-6}\right)^{\frac{1}{3}}$$
$$= 27^{\frac{1}{3}}xy^{-2}$$
$$= \frac{3x}{y^2}$$

Answer $\dfrac{3x}{y^2}$ [3]

---

8. (a) A polygon has n sides. Three of its interior angles are 148°, 157° and 175°.

The remaining interior angles are 155° each. Find the value of n.

$$\left.\begin{aligned} 180° - 148° &= 32° \\ 180° - 157° &= 23° \\ 180° - 175° &= 5° \end{aligned}\right\} \text{(adj. ∠s on st. line)}$$

Three of the exterior angles are 32°, 23° and 5°

$180° - 155° = 25°$ (adj. ∠s on st. line)

There are $(n-3)$ exterior angles that are 25°.

$32° + 23° + 5° + (n-3)(25)° = 360°$

$25n - 75° = 300°$

$25n° = 375°$

$\therefore n = 15$

Answer $n =$ 15 [2]

(b) Explain why the interior angle of a regular polygon cannot be 130°.

Let the no. of sides of the polygon be n.

Exterior ∠ $= 180° - 130° = 50°$

$n = \dfrac{360°}{50°} = 7\frac{1}{5}$

Since n is not an integer, the interior angle of the regular polygon cannot be 130°. [1]

9. Express $\frac{5x+2}{3x^2-12}+\frac{1}{2-x}$ as a single fraction in its simplest form.

$$\frac{5x+2}{3(x^2-4)}+\frac{1}{2-x} = \frac{5x+2}{3(x-2)(x+2)} - \frac{1}{x-2}$$

$$= \frac{(5x+2)-3(x+2)}{3(x-2)(x+2)}$$

$$= \frac{5x+2-3x-6}{3(x-2)(x+2)}$$

$$= \frac{2x-4}{3(x-2)(x+2)}$$

$$= \frac{2(x-2)}{3(x-2)(x+2)}$$

$$= \frac{2}{3(x+2)}$$ //

Answer $\frac{2}{3(x+2)}$ [3]

---

10. It is given that Cylinder A has a volume of 300 cm³. Calculate the volume of

(a) Cylinder B with base radius $\frac{2}{5}$ that of Cylinder A and a height thrice that of Cylinder A.

(b) Cylinder C which is geometrically similar to Cylinder A but has a curved surface area 16 times that of Cylinder A.

(a) Let base radius of cylinder A be r cm and its height be h cm

Volume of A $= \pi r^2 h = 300\,cm^3$

Volume of B $= \pi(\frac{2}{5}r)^2(3h)$

$= \frac{12}{25}\pi r^2 h$

$= \frac{12}{25}(300)$

$= 144\,cm^3$ //

(b) $\frac{\text{Height of C}}{\text{Height of A}} = \sqrt{\left(\frac{16}{1}\right)}$

$= \frac{4}{1}$

$\frac{\text{Volume of C}}{\text{Volume of A}} = \left(\frac{4}{1}\right)^3$

Volume of C $= \frac{64}{1} \times 300\,cm^3$

$= 19200\,cm^3$ //

Answer (a) 144 cm³ [2]

(b) 19200 cm³ [2]

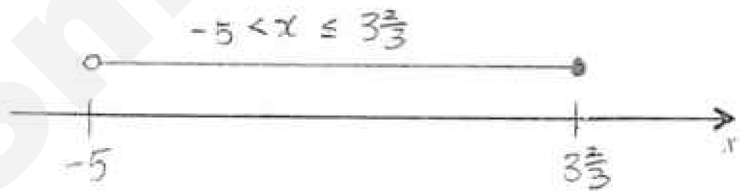
11. (a) Solve the inequality $-\frac{1}{3}+x \leq \frac{x+3}{2} < x+4$. Represent your answer on the number line below.

$$-\frac{1}{3}+x \leq \frac{x+3}{2} \qquad \underline{\underline{\text{AND}}} \qquad \frac{x+3}{2} < x+4$$

$$-\frac{2}{3}+2x \leq x+3 \qquad\qquad x+3 < 2x+8$$

$$x \leq 3\frac{2}{3} \qquad\qquad -5 < x$$

$$\therefore -5 < x \leq 3\frac{2}{3}$$



Answer (a) $-5 < x \leq 3\frac{2}{3}$ [4]

(b) Write down all the integers that satisfy $-\frac{1}{3}+x \leq \frac{x+3}{2} < x+4$.

Answer (b) $-4, -3, -2, -1, 0, 1, 2, 3.$ [1]

12. The radius of a spherical particle is approximately 5 picometres.
Find, leaving your answer in standard form,

(a) the diameter of one such particle in centimetres,

(b) the number of particles that must be placed side by side in order to make a length of 30 millimetres,

(c) the total volume, in cubic centimetres, of 1 million of such particles. Give your answer correct to 3 significant figures.

Radius of particle $= 5 \times 10^{-12}$ m

(a) Diameter of one particle $= 2 \times 5 \times 10^{-12}$ m
$= 10 \times 10^{-12}$ m
$= 100 \times 10 \times 10^{-12}$ m
$= 1 \times 10^{-9}$ cm //

(b) $(30 \times 10^{-3}\text{ m}) \div (10 \times 10^{-12}\text{ m}) = 3 \times 10^{9}$ //

(c) Volume of 1 particle $= \frac{4}{3}\pi\left(\frac{1 \times 10^{-9}}{2}\right)^3$
$= \frac{\pi}{6} \times 10^{-27}$ cm^3

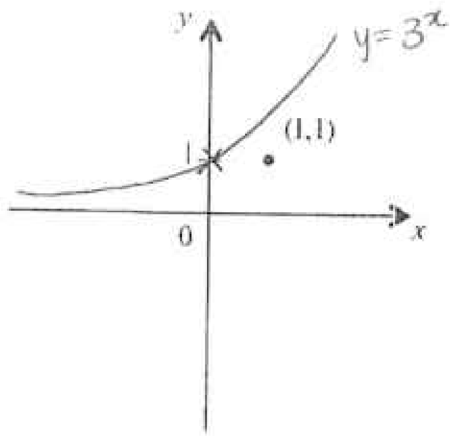
Volume of 1 million particles $= \left(\frac{\pi}{6} \times 10^{-27}\right) \times 10^{6}$
$= \frac{\pi}{6} \times 10^{-21}$
$\approx 0.523599 \times 10^{-21}$
$= 5.24 \times 10^{-22}$ (3 s.f.) //

Answer (a) 1×10^{-9} cm [2]

(b) 3×10^{9} [1]

(c) 5.24×10^{-22} cm^3 [2]

13. The point $(1,1)$ is marked on the diagram below. Sketch the graph of $y=3^x$.



When $x=0$,
$y=3^0$
$=1$
When $x=1$,
$y=3^1$
$=3$

[1]

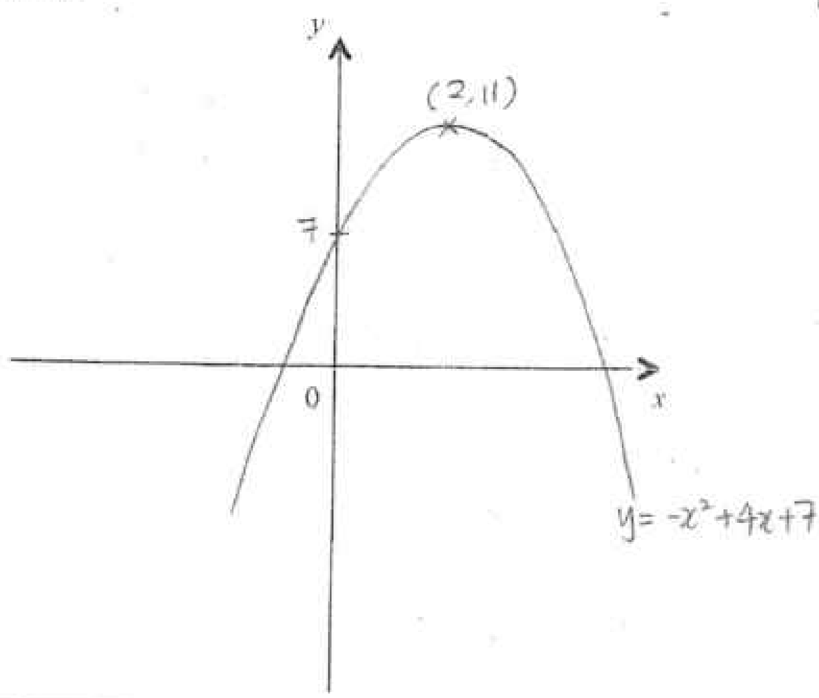
14. (a) Express $-x^2+4x+7$ in the form of $-(x+h)^2+k$.

$$-x^2+4x+7 = -(x^2-4x-7)$$
$$= -\left[x^2-4x+\left(-\tfrac{4}{2}\right)^2-\left(-\tfrac{4}{2}\right)^2-7\right]$$
$$= -\left[(x-2)^2-11\right]$$
$$= -(x-2)^2+11$$

Answer (a) $-(x-2)^2+11$ [3]

(b) Hence, sketch the graph of $y=-x^2+4x+7$ on the axes below, indicating the turning point and the y – intercept. [2]

① ∩
② y-intercept: $(0,7)$
③ turning pt: $(2,11)$



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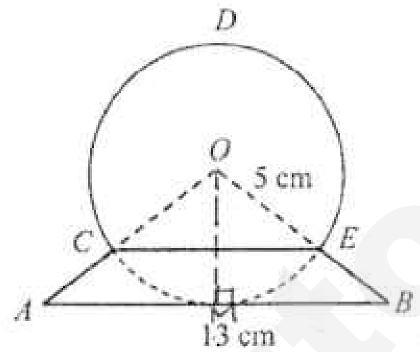
15. The diagram below shows the cross-section of a snowglobe with centre O, of radius 5 cm. The base makes an isosceles triangle OAB. AB is a tangent to the circle and is 13 cm long.

(a) Show that angle $AOB = 1.83$ radians, correct to 3 significant figures. [2]

(b) Calculate

(i) the area of major segment CDE,
(ii) the perimeter of the snowglobe $ABEDC$.



(a) Let the foot of the perpendicular from point O to AB be M.

$OM = 5\text{cm}$ and $MB = \frac{13}{2}$
$= 6\frac{1}{2}\text{cm}$

$\tan M\hat{O}B = \frac{6\frac{1}{2}}{5}$

$M\hat{O}B \approx 0.9151007$

$A\hat{O}B = 2 \times M\hat{O}B$
$= 2 \times 0.9151007$

$\therefore A\hat{O}B = 1.83$ (3sf). (shown)

(bi) Area of major sector $OCDE = \frac{1}{2}(5)^2(2\pi - 1.8302014)$
$\approx 55.662299 \text{ cm}^2$

Area of $\triangle OCE = \frac{1}{2}(5)(5)\sin(1.8302014)$
$\approx 12.081784 \text{ cm}^2$

$\therefore$ Area of major segment $CDE = 55.662299 + 12.081784$
$= 67.7 \text{ cm}^2$ (3s.f.)

(ii) Length of major arc $CDE = (5)(2\pi - 1.8302014)$
$\approx 22.2649195 \text{ cm}$

By Pythagoras' Theorem,

$OA = \sqrt{5^2 + (6\frac{1}{2})^2}$
$= \sqrt{\frac{269}{4}}$ cm.

$\therefore CA = (\sqrt{\frac{269}{4}} - 5)$cm

Perimeter of $ABEDC = 22.2649195 + 2(\sqrt{\frac{269}{4}} - 5) + 13$
$= 41.7$ cm (3sf)

Answer (b) (i) 67.7 cm² [3]

(ii) 41.7 cm [3]

16. (a) Express the numbers 66 and 2520 as products of their prime factors.

(b) Find the smallest positive integer, k, such that $2520k$ is a perfect cube.

(c) Find the smallest positive integer, n, such that $66n$ is a multiple of 2520.

(a) $66 = 2 \times 3 \times 11$

$2520 = 2^3 \times 3^2 \times 5 \times 7$

2520
5 504
8 63
9 7

(b) $2520k = 2^3 \times 3^2 \times 5 \times 7 \times k$

For 2520k to be a perfect cube,

$k = 3 \times 5^2 \times 7^2$

$= 3675$

(c) $66n = 2 \times 3 \times 11 \times n$

For 66n to be a multiple of 2520,

$n = 2^2 \times 3 \times 5 \times 7$

$= 420$

*66n must have 2520 as its factor

Answer (a) 66 = $2 \times 3 \times 11$ [1]

2520 = $2^3 \times 3^2 \times 5 \times 7$ [1]

(b) k = 3675 [2]

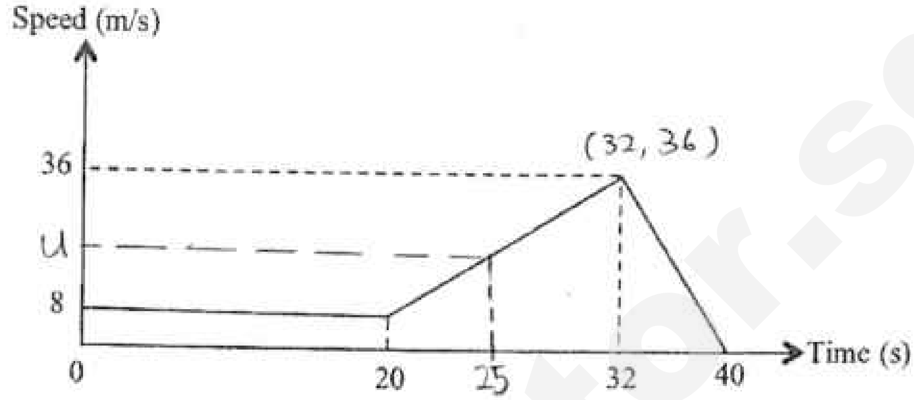
(c) n = 420 [2]

17. The graph below shows the speed of a car during a period of 40 seconds.

(a) Calculate

(i) the speed of the car after 25 seconds,

(ii) the deceleration of the car during the last five seconds.



17(ai) Let speed of the car at 25^{th} second be u m/s.

$$\frac{u-8}{25-20} = \frac{36-8}{32-20} \quad \text{(equal gradients)}$$

$$\frac{u-8}{5} = \frac{7}{3}$$

$$u = \left(\frac{7}{3}\times 5\right) + 8$$

$$= 19\tfrac{2}{3}$$

$\therefore$ Speed of car at 25^{th} second is $19\frac{2}{3}$ m/s.

(ii) $$\text{Acceleration} = \frac{36-0}{32-40}$$

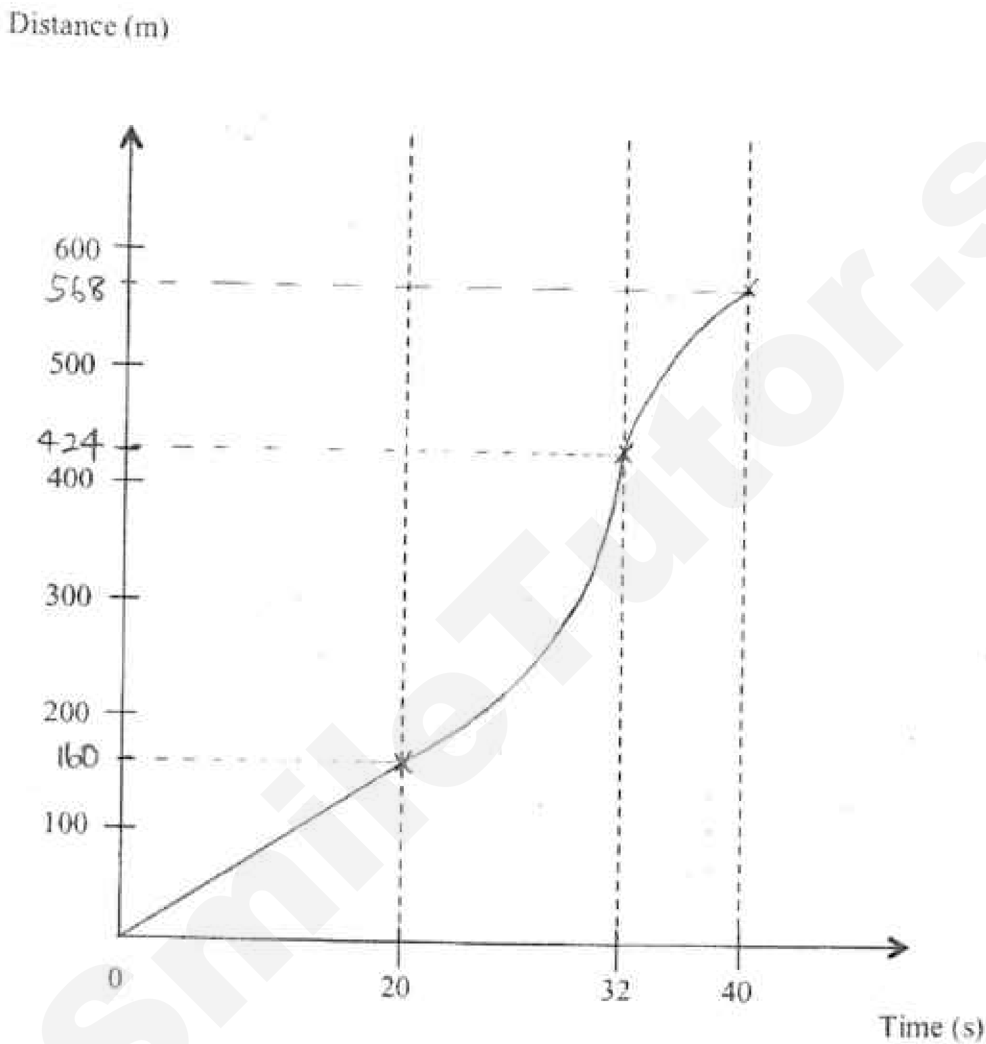
$$= -4\tfrac{1}{2}\ \text{m/s}^2$$

$\therefore$ Deceleration is $4\frac{1}{2}$ m/s^2

Answer (a) (i) $19\frac{2}{3}$ m/s [2]

(ii) $4\frac{1}{2}$ m/s^2 [2]

(b) On the axes given below, sketch the distance-time graph for the whole journey. [3]



Distance covered in first 20s = 20×8
$= 160$m

Distance covered from 20s to 32s $= \frac{1}{2}(8+36)(32-20)$
$= 264$m.

Distance covered from 32s to 40s $= \frac{1}{2} \times (40-32)(36)$
$= 144$m.

18. In triangle ABC, $AB = 12$ cm, $BC = 13$ cm and $AC = 5$ cm.
AC is produced to D and $CD = 30$ cm.

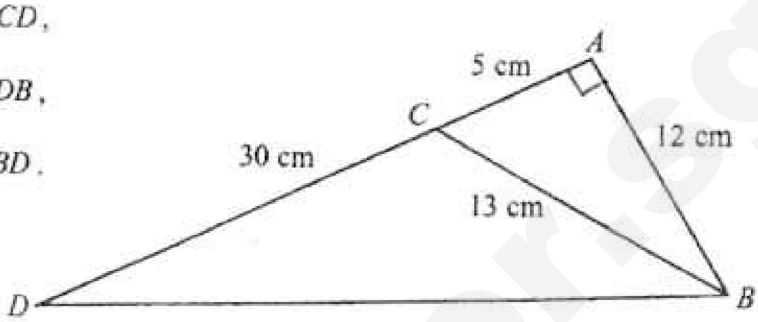
(a) Explain why angle BAC is a right angle. [2]

(b) Express each of the following as a fraction in its exact form.

(i) $\cos\angle BCD$,

(ii) $\tan\angle ADB$,

(iii) $\sin\angle CBD$.



(a) $BC^2 = 13^2$
$= 169$
$AC^2 + AB^2 = 5^2 + 12^2$
$= 169$
Since $BC^2 = AC^2 + AB^2$, by converse of Pythagoras' Theorem, $\triangle ABC$ is a right-angle triangle and $\angle BAC = 90°$.

(b i) $\cos\angle BCD = -\cos(180° - \angle BCD)$
$= -\cos(\angle BCA)$
$= -\frac{5}{13}$ //

(ii) $\tan\angle ADB = \frac{12}{30+5}$
$= \frac{12}{35}$ //

(iii) Area of $\triangle BCD = \frac{1}{2} \times 30\text{cm} \times 12\text{cm}$
$= 180\text{cm}^2$

$BD^2 = 35^2 + 12^2$
$BD = \sqrt{1369}$
$= 37$ cm

$\frac{1}{2}(37)(13)\sin\angle CBD = 180$
$\sin\angle CBD = \frac{180}{\frac{1}{2}(37)(13)}$
$= \frac{360}{481}$ //

Answer (b) (i) $-\frac{5}{13}$ [1]

(ii) $\frac{12}{35}$ [1]

(iii) $\frac{360}{481}$ [3]

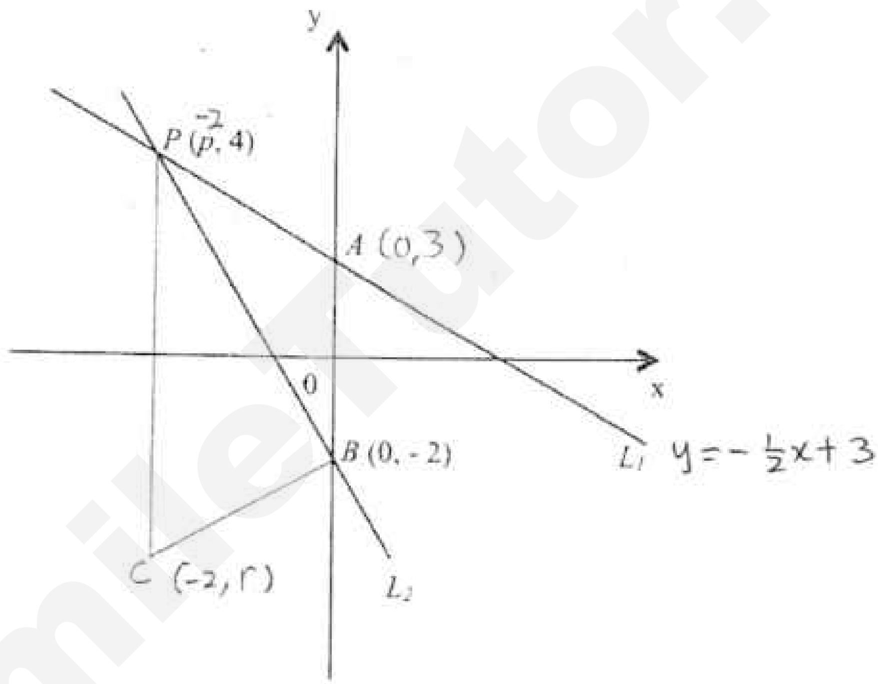
19. The diagram below, which is not drawn to scale, shows two lines, L_1 and L_2, intersecting at the point $P(p,4)$ and cutting the y – axis at the points A and $B(0,-2)$ respectively. The equation of L_1 is $2y+x-6=0$. → $2y = -x+6 \Rightarrow y = -\frac{1}{2}x+3$

(a) State the equation of the line passing through A and is parallel to the x – axis.

(b) Show that $p=-2$, and hence find the equation of line L_2.

(c) Find the length of PB.

(d) A trapezium $PABC$, with AB parallel to PC, has an area of 12 units². Find the coordinates of C. ~~7~~ *C is vertically below P.



(a) When $x=0$,

$y = -\frac{1}{2}(0)+3$

$y = 3$

Coordinates of A are (0, 3).

∴ Equation of line passing through A and parallel to x-axis is $y=3$ //

(b) When $x=p$ and $y=4$,

$4 = -\frac{1}{2}p+3$

$\frac{1}{2}p = -1$

$p = -2$ (shown) //

Gradient of $L_2 = \frac{4-(-2)}{-2-0}$

$= -3$

∴ Equation of L_2 is $y=-3x-2$ //

(c) Length of PB $= \sqrt{(-2-0)^2 + [4-(-2)]^2}$

$= \sqrt{4+36}$

$= \sqrt{40}$

$= 6.32$ units (3 s.f.)

(d) Let coordinates of C be $(-2, r)$

$\frac{1}{2}\{[3-(-2)]+(4-r)\} \times 2 = 12$

$\{5+4-r\} = 12$

$9-r = 12$

$-3 = r$

$\therefore$ Coordinates of C are $(-2, -3)$.

Answer (a) $y=3$ [1]

(b) $y=-3x-2$ [3]

(c) 6.32 units [1]

(d) (−2 , −3) [2]

END OF PAPER

Class	Index Number	Name

新加坡海星中学

MARIS STELLA HIGH SCHOOL

SEMESTRAL ASSESSMENT TWO

SECONDARY THREE

MATHEMATICS

12 Oct 2016

2 hours

Additional Materials:

Writing paper (4 sheets)

Graph paper (1 sheet)

INSTRUCTIONS TO CANDIDATES

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
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For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 80.

This document consists of 10 printed pages.

1. A small pond can be filled by two taps A and B in 3 hours. Tap A can fill up the pond in x hours while Tap B takes $(2x+3)$ hours to fill.

(a) Find the fraction of the pond that can be filled up in 1 hour by

(i) Tap A, [1]

(ii) Tap B. [1]

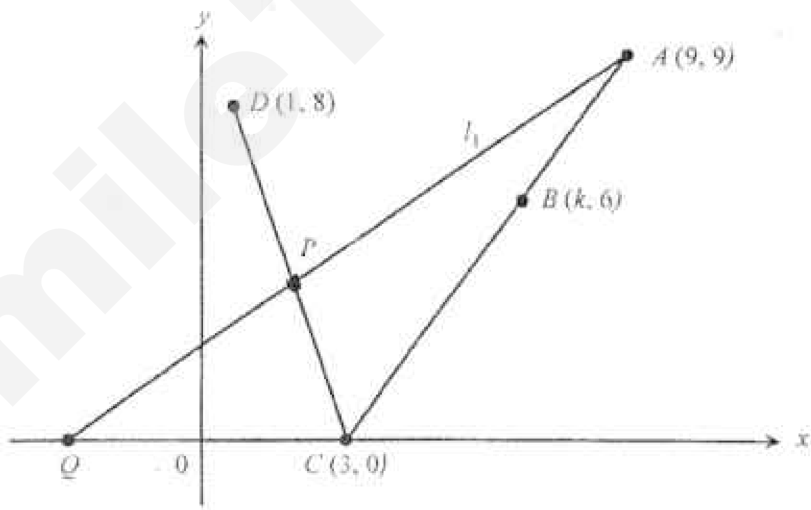
(b) Form an equation in x and show that it reduces to $2x^2-6x-9=0$. [3]

(c) Solve the equation $2x^2-6x-9=0$, giving your answers correct to 2 decimal places. [2]

(d) Explain why one of the solutions in **(c)** is rejected. [1]

(e) How much longer does it take for Tap B to fill up the pond than Tap A? Give your answer correct to the nearest minute. [2]

2. The coordinates of points A, B, C and D are (9, 9), (k, 6), (3, 0) and (1, 8) respectively.



(a) Find the length of AC. [2]

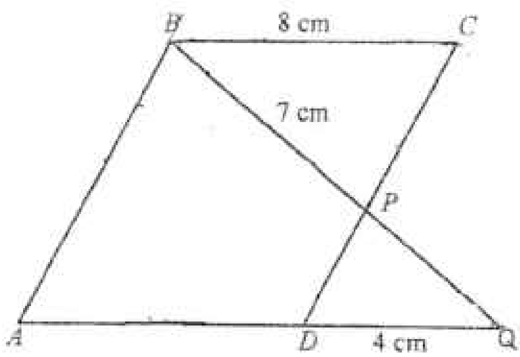
(b) Given that the point B lies on AC, find the value of k. [2]

(c) Find the equation of CD. [2]

(d) A line l_1 with equation $7y-5x-18=0$ intersects CD at the point P. Find the coordinates of P. [2]

(e) Find the coordinates of the point Q where l_1 cuts the x-axis. [2]

3. **(a)** In the diagram, $ABCD$ is a parallelogram. The point Q lies on AD produced. The line BQ intersects CD at point P. It is given that $BP = 7\text{ cm}$, $BC = 8\text{ cm}$ and $DQ = 4\text{ cm}$.



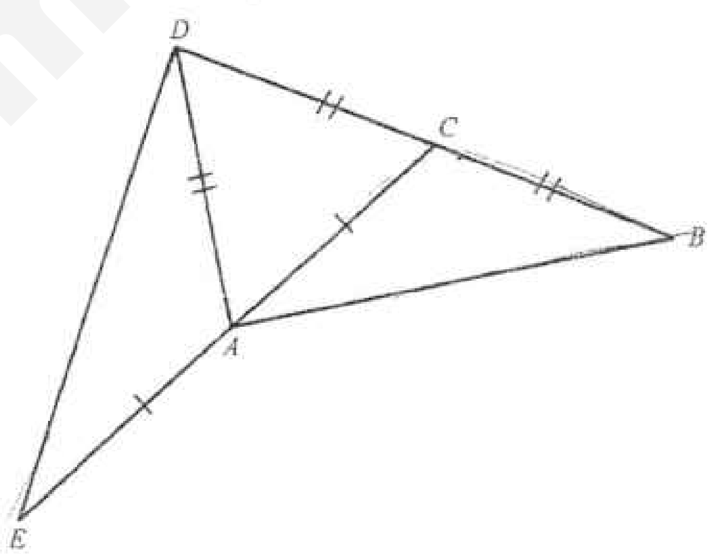
(i) Prove that triangles BCP and QAB are similar. [2]

Find

(ii) PQ, [2]

(iii) $\dfrac{\text{Area of } \Delta BPC}{\text{Area of quadrilateral } ABPD}$. [2]

(b) In the diagram below, $BC = CD = DA$ and $AC = AE$. Show that triangles ABC and EDA are congruent. [3]



4. A series of diagrams of shaded and unshaded small triangles is shown below.

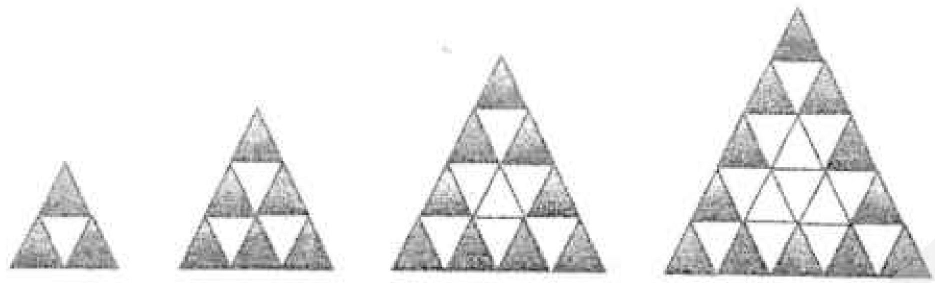


Diagram 1 *Diagram 2* *Diagram 3* *Diagram 4*

The shaded triangles are those which have at least one side on the edge of the big triangle. All of the other small triangles are unshaded.

The following table shows numbers of small triangles.

Diagram	1	2	3	4	5	...	n
Number of shaded triangles	3	6	9	12			x
Total number of triangles	4	9	16	25			y
Number of unshaded triangles	1	3	7	13			z

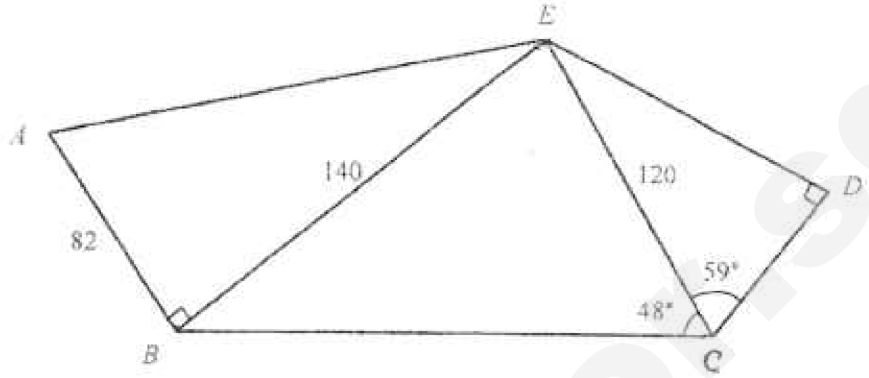
By considering the number patterns, without drawing further diagrams,

(i) write down the number of shaded triangles, the total number of triangles and the number of unshaded triangles in Diagram 5, [2]

(ii) find, in terms of n, expressions for x, y and z, [3]

(iii) find the number of unshaded triangles when $n = 2016$. [1]

5. The diagram shows footpaths BE and CE in a park $ABCDE$. There are Pokestops at locations A, B, C, D and E. Given that $AB = 82$ m, $BE = 140$ m, $CE = 120$ m, $B\hat{C}E = 48^\circ$, $D\hat{C}E = 59^\circ$ and $A\hat{B}E = C\hat{D}E = 90^\circ$.



(a) Calculate

(i) the distance between Pokestops A and E, [2]

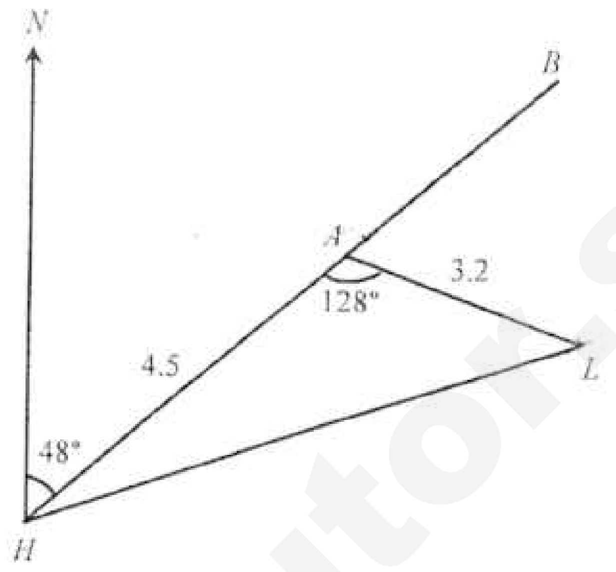
(ii) the distance between Pokestops C and D, [2]

(iii) $C\hat{E}B$. [3]

(b) Given that there is a lure set to attract pokemons at Pokestops B, C and E, find the area of the triangle formed by these three pokestops. [2]

(c) Using the radar map, a rare pokemon, Snorlax, is sighted at C. Given that Snorlax will disappear in 15 minutes, determine if a trainer will be able to catch the Snorlax if he runs from B at 10 km/h. [3]

6. The diagram shows the positions of Tanah Merah Habour H, a lighthouse L and two buoys A and B. HAB forms a straight line. The bearing of A from H is 048°. It is given that $HA = 4.5$ km, $AL = 3.2$ km and $H\hat{A}L = 128^\circ$.



(a) Calculate the

(i) bearing of L from A, [2]

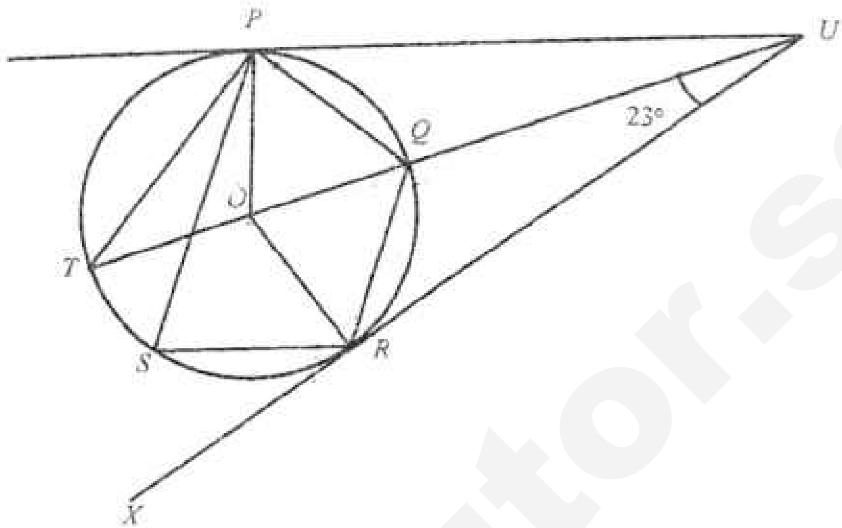
(ii) bearing of H from L. [3]

(b) A boat sailed from the habour along the route HAB.

(i) The boat sailed at a constant speed of 5 m/s. Given that the boat reached A at 09 45, find the time it left the habour. [2]

(ii) Given that the height of the lighthouse is 130 m, calculate the greatest angle of elevation of the top of the lighthouse when viewed from the boat along its path from H to B. [3]

7. In the diagram, $PQRST$ are points on a circle with centre O. UP and UR are tangents to the circle. $TOQU$ is a straight line and $O\hat{U}R = 23°$.



Find, stating your reasons clearly,

(a) $\angle ORU$, [1]

(b) $\angle TPQ$, [1]

(c) reflex $\angle POR$, [2]

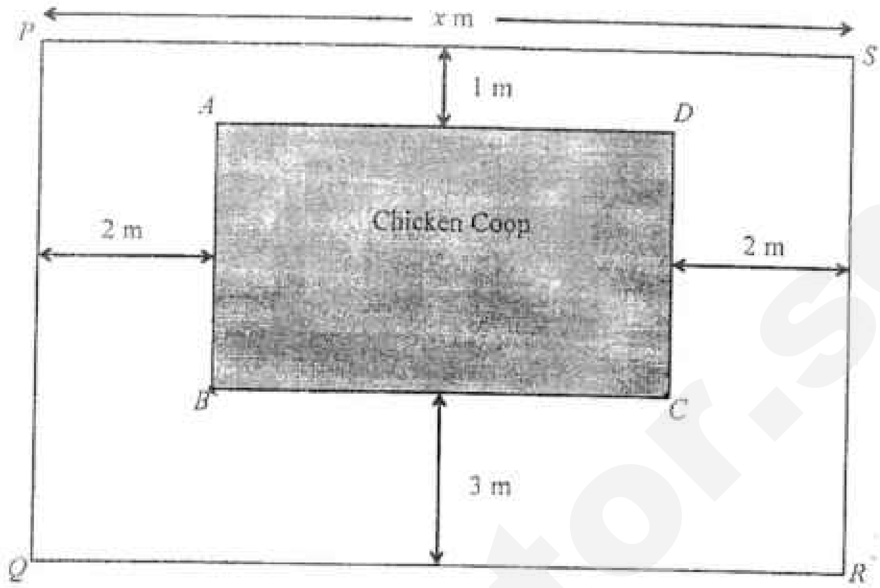
(d) $\angle PQR$, [2]

(e) $\angle PSR$, [2]

(f) $\angle QRX$. [2]

8. **Answer the whole of this question on a sheet of graph paper.**

The area of a rectangular plot of land $PQRS$ in a primary school is 180 m^2.



(a) Given that the length of the plot of land is x m, write down expressions, in terms of x, for

(i) BC, [1]

(ii) AB. [2]

(b) Hence, show that the area, y m^2, of the chicken coop, $ABCD$, is given by

$$y = 196 - 4x - \frac{720}{x}.$$ [2]

The table below shows some values of x and the corresponding values of y, correct to 1 decimal place, where $y = 196 - 4x - \frac{720}{x}$.

x	5	10	15	20	25	30	35	40
y	32	84	88	a	67.2	52	35.4	18

(c) Find the value of a. [1]

(d) Using a scale of 2 cm to represent 5 m on the x-axis ~~for $11 \le x \le 18$~~ and 2 cm to represent 10 m^2 on the y-axis ~~for $50 \le y \le 64$~~, draw the graph of

$$y = 196 - 4x - \frac{720}{x}.$$ [3]

(e) By drawing a tangent, find the gradient of the curve where $x = 20$. [2]

(f) Use your graph to find

(i) the range of values of x for which the area of the chicken coop is at least 60 m^2. [1]

(ii) the value of x for which the area of the chicken coop is greatest. [1]

- End of Paper -

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1a(i) Fraction of pond filled by A in 1h $= \frac{1}{x}$

(ii) Fraction of pond filled by B in 1h $= \frac{1}{2x+3}$

(b) Fraction of pond filled by BOTH A and B in 1h $= \frac{1}{3}$

$$\frac{1}{x} + \frac{1}{2x+3} = \frac{1}{3}$$

$$3(2x+3) + 3x = x(2x+3)$$

$$6x+9+3x = 2x^2+3x$$

$$2x^2-6x-9 = 0 \quad \text{(shown)}$$

(c)
$$x = \frac{-(-6) \pm \sqrt{(-6)^2 - 4(2)(-9)}}{2(2)}$$

$$= \frac{6 \pm \sqrt{108}}{4}$$

$$= 4.10 \text{ or } -1.10 \quad (2\text{ d.p.})$$

(d) As the measurement of time is positive, ∴ x cannot be -1.10.

(e) $2x+3-x = x+3$

When $x \approx 4.098076$,

∴ Time difference $= 4.098076 + 3$

$= 7.098076$ h

$= 426$ min (nearest min.)

For Examiner's Use

2(a) Length of AC $= \sqrt{(9-3)^2 + (9-0)^2}$

$= \sqrt{117}$

≈ 10.8 units (3 s.f.)

(b) Gradient of AB = Gradient of AC

$$\frac{9-6}{9-k} = \frac{9-0}{9-3}$$

$$\frac{3}{9-k} = \frac{9}{6}$$

$$18 = 9(9-k)$$

$$2 = 9-k$$

$$-7 = -k$$

$$\therefore k = 7$$

(c) Gradient of CD $= \frac{8-0}{1-3}$

$= -4$

$$\frac{y-0}{x-3} = -4$$

$$y = -4x+12$$

Equation of CD is $y = -4x+12$.

(d)

$$7y - 5x - 18 = 0 \quad \text{— ①}$$

$$y = -4x+12 \quad \text{— ②}$$

Sub. ② into ①,

$$7(-4x+12) - 5x - 18 = 0$$

$$-28x + 84 - 5x - 18 = 0$$

$$-33x + 66 = 0$$

$$-33x = -66$$

$$x = 2$$

Sub. $x = 2$ into ②,

$$y = -4(2)+12$$

$$= 4$$

$\therefore$ Coordinates of P are (2, 4).

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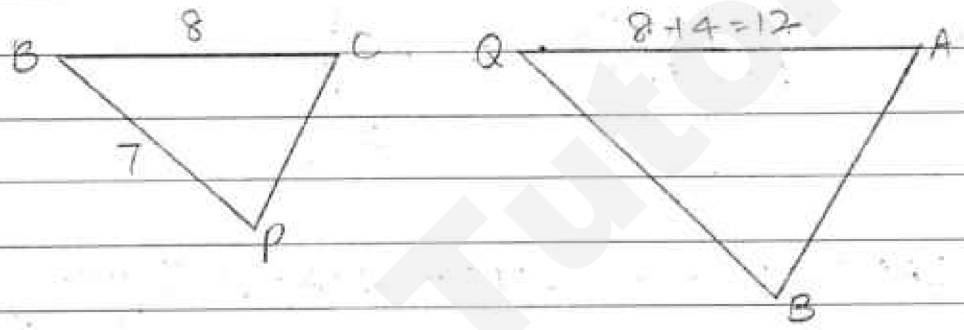
(cont'd)

2(e) When $y=0$,

$$7(0)-5x-18=0$$
$$-5x=18$$
$$x=-3\tfrac{3}{5}$$

$\therefore$ coordinates of Q are $(-3\tfrac{3}{5}, 0)$

3(a) 

① $\angle BCP = \angle QAB$ (opposite $\angle$s in a parallelogram are equal).

② $\angle CBP = \angle AQB$ (alt. $\angle$s, $BC // QA$)

$\therefore \triangle BCP$ is similar to $\triangle QAB$. (AA-similarity)

(ii) $\dfrac{BQ}{7} = \dfrac{12}{8}$

$BQ = 10\tfrac{1}{2}$ cm

$\therefore PQ = 10\tfrac{1}{2} - 7$

$= 3\tfrac{1}{2}$ cm

(iii) $\dfrac{\text{Area } \triangle BPC}{\text{Area } \triangle QAB} = \left(\dfrac{8}{12}\right)^2$

$= \dfrac{4}{9}$

(cont'd)
3(aiii) * Observe that $\triangle QDP$ is similar to $\triangle QAB$.

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$$\frac{\text{Area } \triangle QDP}{\text{Area } \triangle QAB} = \left(\frac{3\frac{1}{2}}{10\frac{1}{2}}\right)^2$$
$$= \frac{1}{9}$$

$$\therefore \frac{\text{Area of } \triangle QAB}{\text{Area of } ABPD} = \frac{9}{9-1}$$
$$= \frac{9}{8}$$

Area $\triangle BPC$: Area $\triangle QAB$	Area $\triangle QAB$: Area $ABPD$
4 : 9	9 : 8

Hence, $\frac{\text{Area } \triangle BPC}{\text{Area } ABPD} = \frac{4}{8}$
$$= \frac{1}{2} \,//$$

(b) ① Let $\angle ADC = \beta$ and $\angle DAC = \angle DCA = \alpha$ (base $\angle$s of isos. $\triangle ADC$)

$\angle DAE = \alpha + \beta$ (ext. $\angle$ of $\triangle$)
$\angle BCA = \alpha + \beta$ (ext. $\angle$ of $\triangle$)
$\therefore \angle DAE = \angle BCA$

② Given $BC = DA$ and $AC = EA$,
$\therefore \triangle ABC \equiv \triangle EDA$ (SAS) //

*Remember: $\angle$ used must be an included $\angle$!

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4(i) Number of shaded triangles $= 3 \times 5$

$= 15$

Total number of triangles $= 6^2$

$= 36$

Number of unshaded triangles $= 36 - 15$

$= 21$

(ii) $x = 3n$

$y = (n+1)^2$ OR n^2+2n+1

$z = (n+1)^2 - 3n$ OR n^2-n+1

5(a)(i) By Pythagoras' Theorem,

$AE^2 = 82^2 + 140^2$

$= 26324$

$AE = \sqrt{26324}$

$= 162\text{ m}$ (3s.f)

(ii) $\cos 59^\circ = \frac{CD}{120}$

$CD = 120 \cos 59^\circ$

$= 61.8\text{ m}$ (3s.f.)

(iii) Using sine rule,

$\frac{\sin E\hat{B}C}{120} = \frac{\sin 48^\circ}{140}$

$\sin E\hat{B}C = \frac{\sin 48^\circ}{140} \times 120$

$E\hat{B}C \approx 39.56709^\circ$

$B\hat{E}C = 180^\circ - 39.56709^\circ - 48^\circ$ ($\angle$ sum of $\triangle$)

$= 92.43291^\circ$

$= 92.4^\circ$ (1d.p.)

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5 (b) Area of $\triangle BEC = \frac{1}{2}(140)(120)\sin(92.43291^\circ)$

$\approx 8392.4283\ m^2$

$= 8390\ m^2$ (3 s.f.)

(c) Using sine rule,

$$\frac{BC}{\sin 92.43291^\circ} = \frac{140}{\sin 48^\circ}$$

$$BC = \frac{140}{\sin 48^\circ} \times \sin 92.43291^\circ$$

$$\approx 188.21877\ m$$

$$= 0.18821877\ km$$

Time taken by trainer to reach C from B $= \frac{0.18821877}{10}\ h$

$= 0.018821877\ h$

$= 1.13\ min$ (3 s.f.)

$\therefore$ The trainer will reach C in time to try and catch the Snorlax.

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6(a)(i) $\angle BAL = 180° - 128°$ (adj. ∠s on st. line)

$= 52°$

Bearing of L from A $= 48° + 52°$

$= 100°$

(ii) Using cosine rule,

$HL^2 = (4.5)^2 + (3.2)^2 - 2(4.5)(3.2)\cos 128°$

$= 30.49 - 28.8\cos 128°$

$HL = \sqrt{30.49 - 28.8\cos 128°}$

≈ 6.94414 km

Using sine rule,

$$\frac{\sin A\hat{H}L}{3.2} = \frac{\sin 128°}{6.94414}$$

$$\sin A\hat{H}L = \frac{\sin 128°}{6.94414} \times 3.2$$

$$A\hat{H}L \approx 21.29263°$$

Bearing of H from L $= 180° + (48° + 21.29263°)$ (alt. ∠s)

$= 249.3°$ (1 d.p.)

b(i) $4.5 \text{ km} = 4500 \text{ m}$

Time taken by boat to sail from H to A $= \frac{4500}{5}$

$= 900$ s

$= 15$ min

∴ The boat left the harbour at 0930

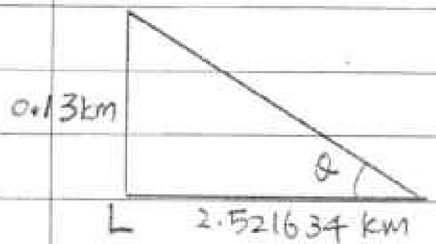
For Examiner's Use

6 b(ii) Let the perpendicular distance from L to HB be d.

$$\sin 52^\circ = \frac{d}{3.2}$$

$$d = 3.2 \times \sin 52^\circ$$

$$\approx 2.521634 \text{ km}$$



Let the greatest ∠ of elevation be θ.

$$\tan \theta = \frac{0.13}{2.521634}$$

$$\theta = 3.0^\circ \text{ (1 d.p.)}$$

7(a) $\angle ORU = 90^\circ$ (tan ⊥ rad.)

(b) $\angle TPQ = 90^\circ$ (∠ in semicircle)

(c) $\angle PUO = \angle RUO = 23^\circ$ (tan. from ext. pt.)

$\angle OPU = 90^\circ$ (tan ⊥ rad.)

$\angle POR = 360^\circ - 90^\circ - 90^\circ - (2 \times 23^\circ)$

$= 134^\circ$

reflex $\angle POR = 360^\circ - 134^\circ$ (∠s at a pt.)

$= 226^\circ$

(d) $\angle PQR = 226^\circ \div 2$ (∠ at centre = 2×∠ at circumference)

$= 113^\circ$

(e) $\angle PSR = 134^\circ \div 2$ (∠ at centre = 2×∠ at circumference)

$= 67^\circ$

f) $\angle UOR = 180^\circ - 90^\circ - 23^\circ$ (∠ sum of △UOR)

$= 67^\circ$

$\angle ORQ = \frac{180^\circ - 67^\circ}{2}$ (base ∠s of isos. △OQR)

$= 56.5^\circ$

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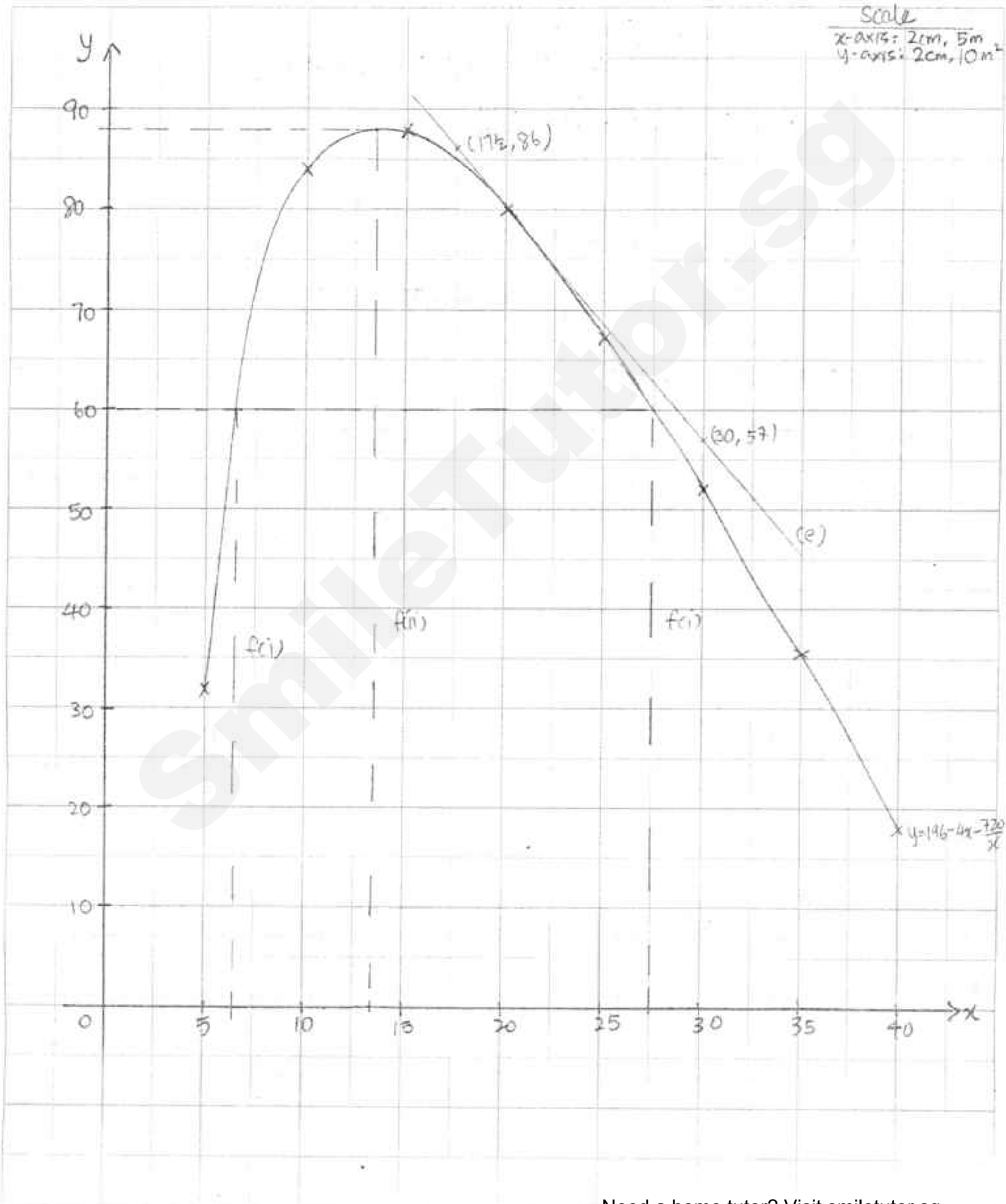
(cont'd)

7(f) $\angle QRX = 90^\circ + 56.5^\circ$

$= 146.5^\circ$ //



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a(i) $BC = (x-4)$ m //

(ii) $SR = \frac{180}{x}$ m

$\therefore AB = \left(\frac{180}{x} - 4\right)$ m //

(b) $y = (x-4)\left(\frac{180}{x} - 4\right)$

$y = 180 - 4x - \frac{720}{x} + 16$

$\therefore y = 196 - 4x - \frac{720}{x}$ (shown) //

(c) $a = 196 - 4(20) - \frac{720}{20}$

$= 80$ //

(e) Gradient of curve (at $x = 20$) $= \frac{86 - 57}{17\frac{1}{2} - 30}$

$= -2.32$ (3 s.f.) //

f(i) $6.5 \leq x \leq 27.5$ //

(ii) $x = 13\frac{1}{2}$ //

Name: Register Number: Class:

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NAN CHIAU HIGH SCHOOL

END-OF-YEAR EXAMINATION 2016
SECONDARY THREE EXPRESS

MATHEMATICS
Paper 1

4048/01

4 October 2016, Tuesday

2 hours

Candidates answer on Question Paper

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number at the top of the cover page.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
Calculators should be used where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total marks for this paper is 80.

This paper consists of **18** printed pages including the cover page.

Name: **Register Number:** **Class:**

Setter: Mr Yuen Wen Jun, Ms Tan Yi Chiann

This paper consists of **18** printed pages including the cover page.

Mathematical Formulae

Compound interest

$$\text{Total amount} = P\left(1+\frac{r}{100}\right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi rl$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta\text{, where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta\text{, where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\Sigma fx}{\Sigma f}$$

Answer **all** the questions.

1 There is approximately 6.022×10^{23} atoms in 12 grams of Carbon.
An average Singaporean's mass is found to be approximately 58.935 kilograms.
It is given that 18.5% of a person's body mass is composed of Carbon.
Find the number of Carbon atoms found in an average Singaporean.
Leave your answer in standard form.

Answer ....atoms [2]

---

2 **(a)** List all the prime numbers that satisfy $-2 \le x < 11$.

Answer (a) .... [1]

(b) Solve the inequality $2x - 9 < x + 1 \le 2x - 5$.
Represent the solution on a number line.

Answer (b)

[2]

---

3 A salesman earns a 3% commission on the sales he makes.
He earned \$35 after selling a laptop that was on a 25% discount.
Find the original selling price of the laptop.

Answer \$ .... [2]

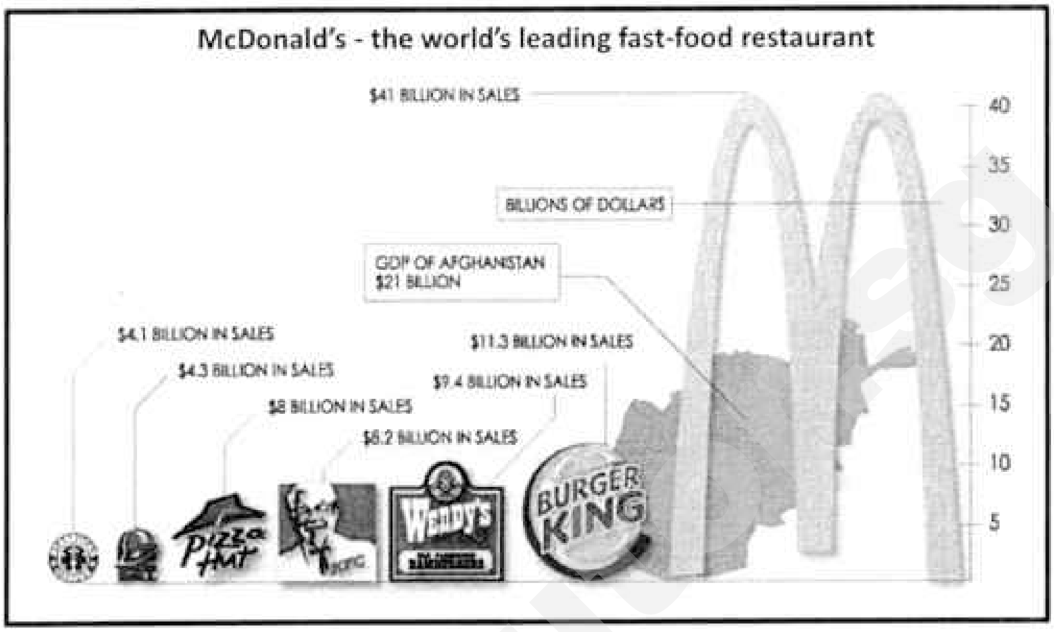
---

4 Singapore with an area of 719.1 km^2 is represented on a map by an area of 28.764 cm^2.
If the map has a scale of $1 : n$, find the value of n.

Answer $n =$ .... [2]

---

5 In 2002, a study was conducted by Princeton's International Networks Archive, to illustrate the sales by the leading global fast food restaurants, shown in the infographic below.



Explain one way in which the infographic is misleading.

....

....

.... [2]

---

6 Make x the subject for the equation $y = \dfrac{2x^2 - 1}{x^2 - 2}$.

Answer $x =$ .... [2]

---

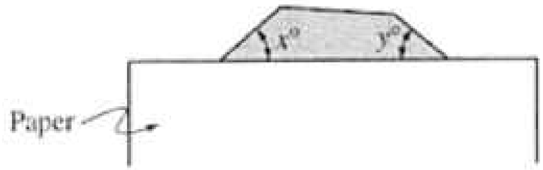
7 Given that $\dfrac{\frac{1}{x}-\frac{1}{y}}{\frac{2}{y}-\frac{1}{x}}=\dfrac{1}{2}$, find the exact value of $\dfrac{y}{x}$.

Answer $\dfrac{y}{x}=$ .... [3]

8 The remainder of $(k \div 13)$, $(k \div 14)$ and $(k \div 35)$ are all equal to 1.
Find the two smallest possible values of k.

Answer .... [3]

9 **(a)**



In the figure above, a regular polygon is partially covered with a sheet of paper.
If $x + y = 72$, find the number of sides that the polygon has.

Answer (a) .... [2]

(b) In a convex n-sided irregular polygon, the largest interior angle is $160°$ while the smallest interior angle is $130°$.
Find the greatest and least possible value of n.

Answer (b) Greatest n =..........................

Least n =.......................... [3]

10 **(a)** The number of push-ups, N, done per minute by an NCC cadet is inversely proportional to his mass, m kg. If a 50 kg cadet can do 30 push-ups per minute, form an equation connecting N and m.

Answer (a) .... [2]

(b) Given that 3 NCC cadets can do a total of 12 push-ups in 5 seconds at the same time and assuming that all cadets will do push-ups at the same constant rate without getting tired. Find the amount of time needed for 20 cadets to do a total of 1600 push-ups at the same time.

Answer (b) .... seconds [2]

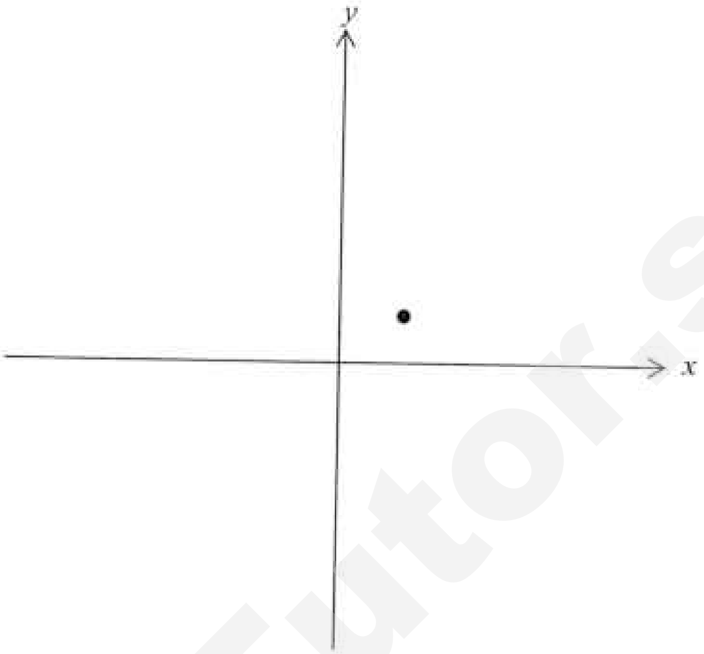
11 The figure below shows a Pascal's Triangle.

Find N, the third term from the left in the n-th row, where $n \geq 3$, in terms of n.

Answer $N =$ .... [2]

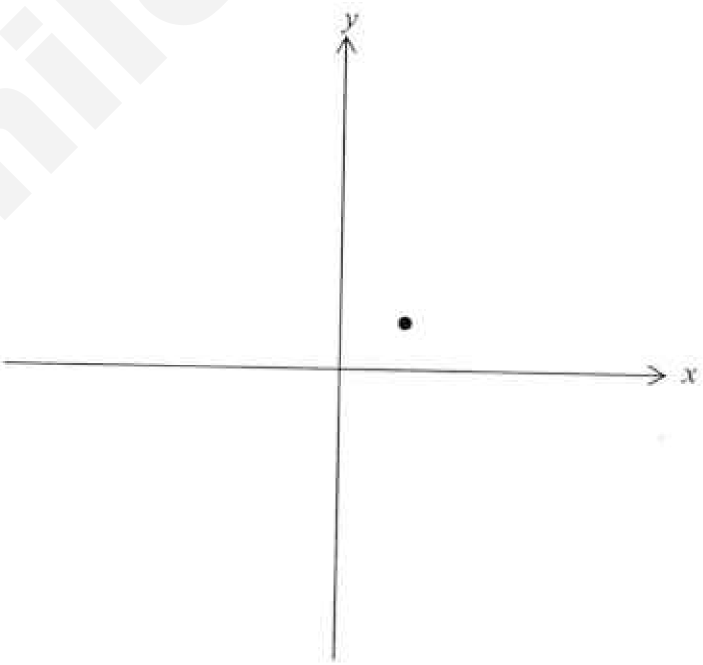
14 The point $(1, 1)$ is marked on the diagrams below.
Sketch the following graphs, indicating any x and/or y intercepts with the axes,

(a) $y = 3(4^x)$,



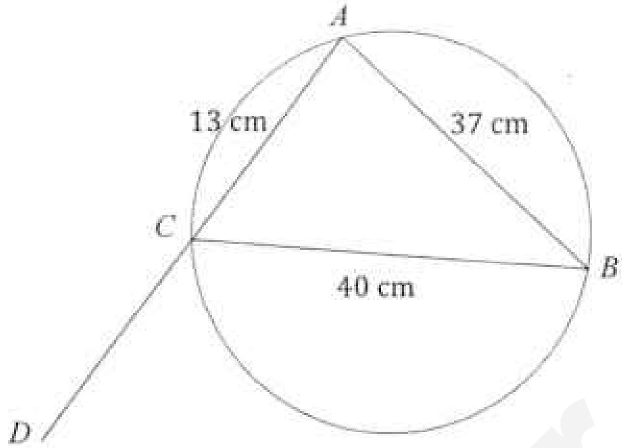
[2]

(b) $xy = 4x - 3$.



[2]

15 In the diagram, A, B and C lie on the circumference of the circle.
Given $AC = 13$ cm, $AB = 37$ cm, $BC = 40$ cm and ACD is a straight line.



(a) Explain why BC is not a diameter of the circle.

....

....

....

....
[2]

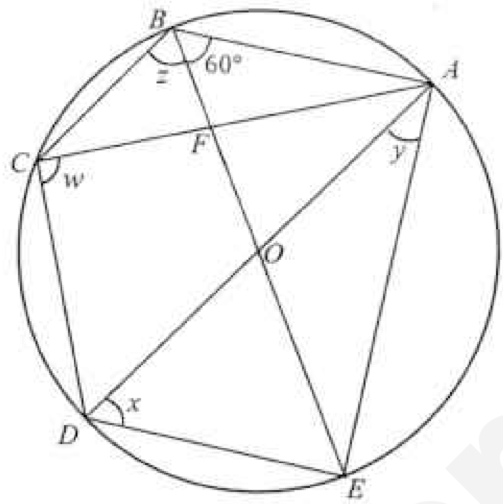
(b) Find the **exact value** of
(i) $\cos B\hat{C}D$,

Answer (b) (i) .... [3]

(ii) the shortest distance of A to BC.

Answer (b) (ii) .... cm [3]

16



In the diagram, the points A, B, C, D, E lie on a circle with centre O.
Lines AC and BE intersect at F such that $BC = FC$.
AOD and $BFOE$ are straight lines and $\angle OBA = 60°$.

Find

(a) w,

(b) x,

(c) y,

(d) z.

Answers (a) $w =$ ....° [1]

(b) $x =$ ....° [1]

(c) $y =$ ....° [1]

(d) $z =$ ....° [2]

17 During Keven's recent holiday to Western Maryland (United States of America), he chanced upon a magnificent Brush Tunnel, shown in the figure 1.

Being a leading civil engineer, Keven decided to construct a similar railway tunnel in Singapore, to contribute as one of the tourism attraction.

In figure 2, he modelled the uniform cross-section of the Brush Tunnel, into a shape of a major segment $ABCD$, removed from a circle with centre O and radius 12 m.
Given BOD is a straight line and $BD = 17$ m. Angle $ABD = 90°$.

Figure 1

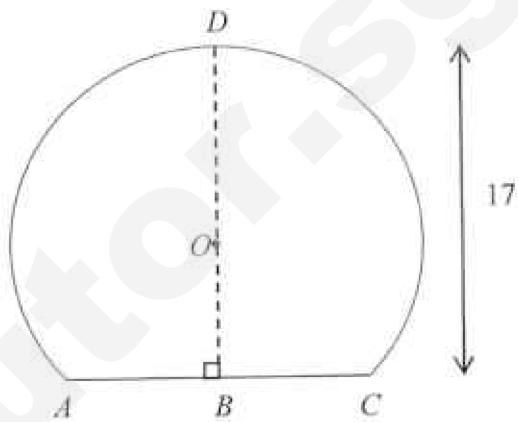
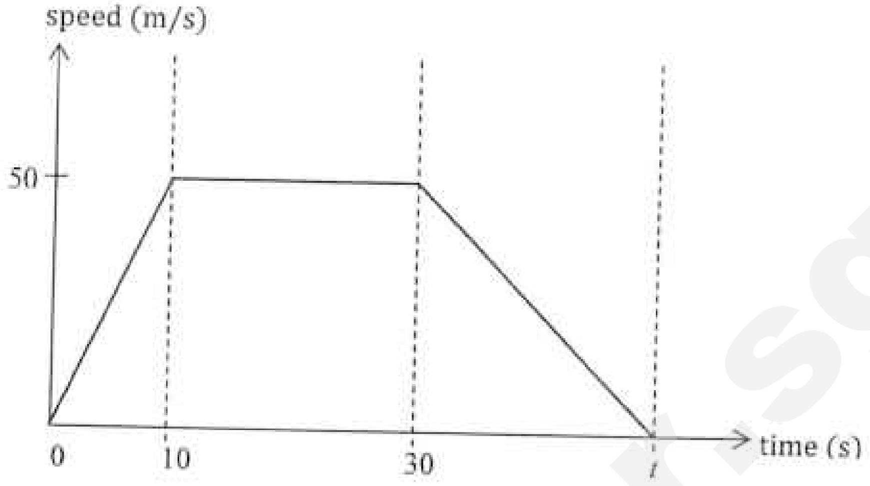


Figure 2

Calculate the volume of the tunnel that Keven has constructed if the length of the tunnel is 0.5 km long.

Answer .... m^3 [5]

18 The diagram shows the speed-time graph for a car journey.



(a) Calculate the acceleration of the car at 5 seconds.

Answer (a) .... ms^{-2} [1]

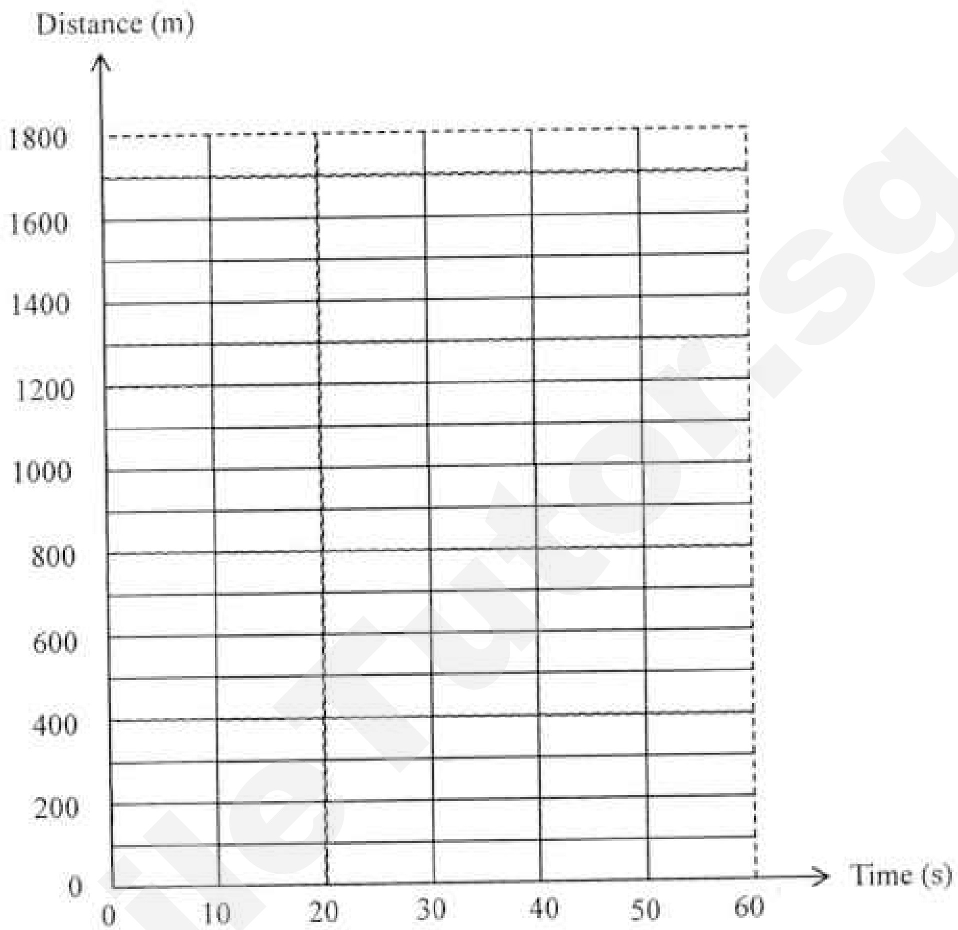
(b) Find the value of t, which the car comes to rest if its retardation is $2\frac{1}{2}\,m/s^2$.

Answer (b) .... s [2]

(c) Calculate the total distance travelled.

Answer (c) .... m [2]

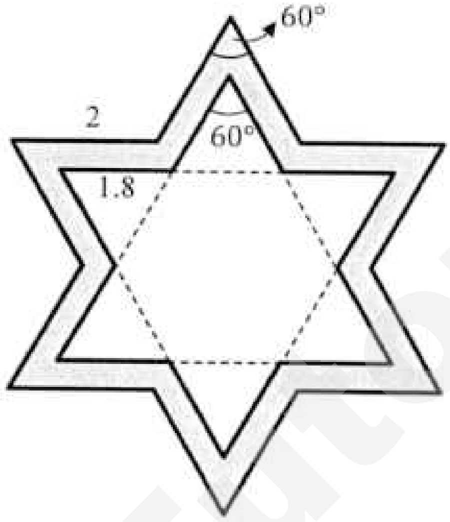
(d) Use the grid below to draw the distance-time graph for the journey.



[3]

19 The figure shows a gold pendant. The outer outline of the pendant has the shape of a regular 6-sided star and the inner outline of the pendant has the shape of another **similar** smaller regular 6-sided star.

The interior angles of both stars are $60°$ as shown.
The lengths of each side of outer star and inner star are 2 cm and 1.8 cm respectively.
The uniform thickness of the pendant is 0.3 cm.



Calculate the mass of the pendant if the density of gold is 19.32 g/cm^3.

Answer .... g [5]

20 Universal Studios Singapore (USS) provides an immersive entertainment experience in seven different zones as indicated on the map shown in figure 1.

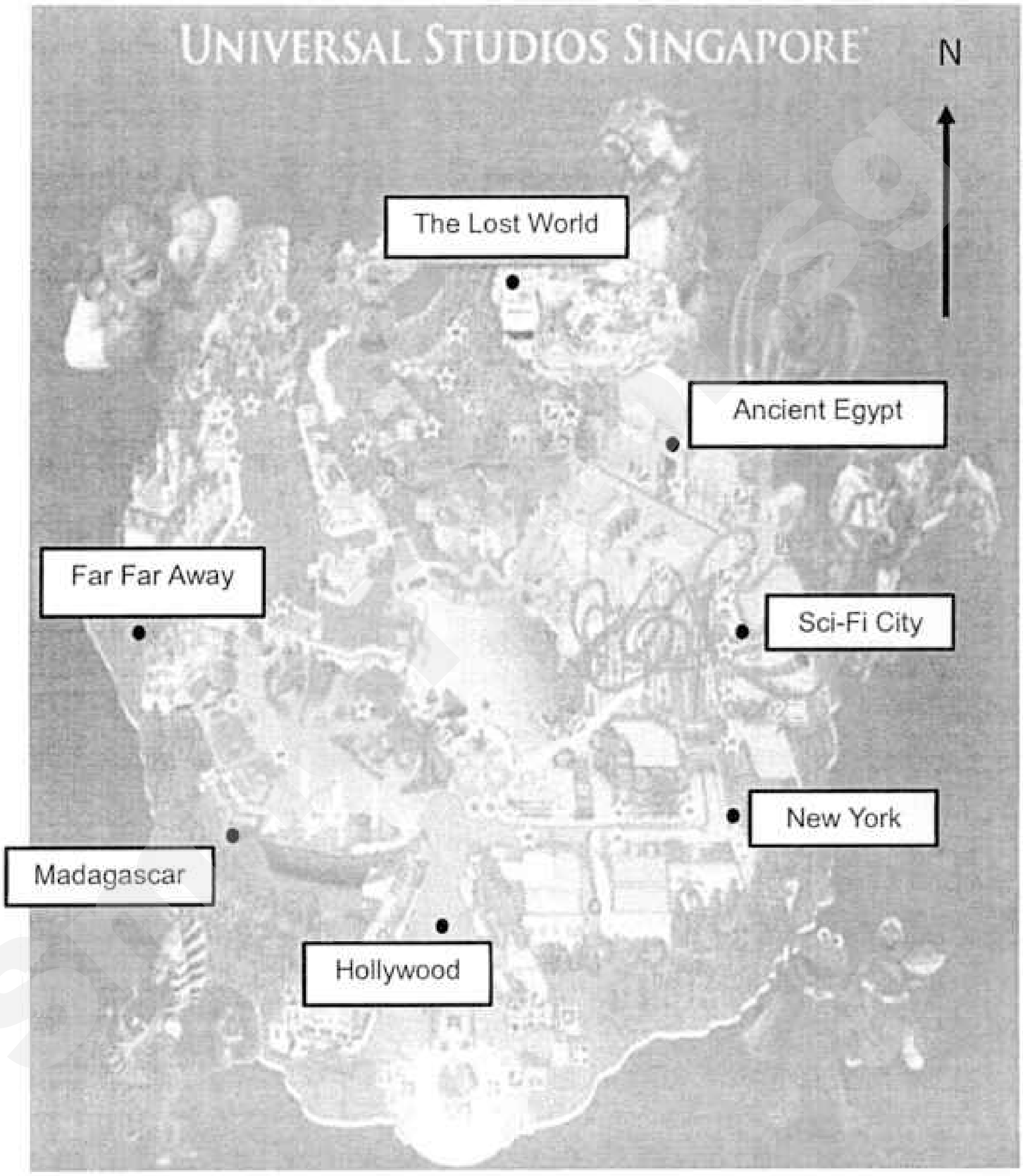


Figure 1

19

(a) In the recent Pokémon Go craze, the following information are given to locate the Pikachu Nest in USS:

- On a bearing of 205° from Ancient Egypt;
- 650 m away from Sci-Fi City .

Using the scale of 1 cm : 100 m, with appropriate constructions on figure 1, at which zone is the Pikachu Nest located?

Answer (a) .... [3]

(b) Niantic (the programming firm for Pokémon Go) builds a new gymnasium in USS, where tourists can send their Pokémons to battle virtually.

The location of the gymnasium in USS can be found with the given information:

- Equidistant from Far Far Away and Madagascar;
- Equidistant from the line which joined New York and Hollywood, and the line which joined New York and The Lost World.

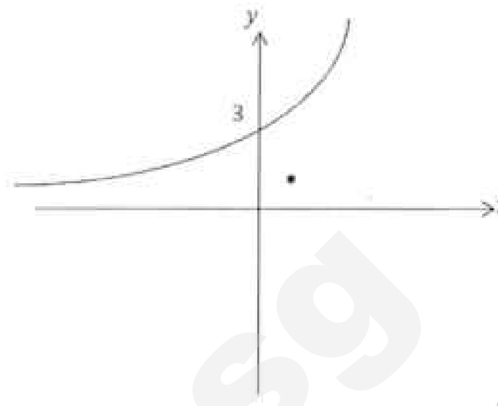
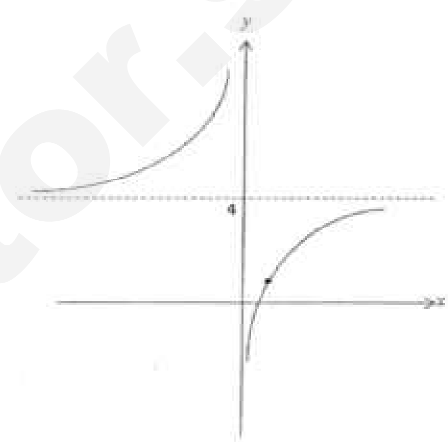
By constructing perpendicular and/or angle bisectors, locate and label the position of the gymnasium, G on figure 1. [3]

(c) Hence, estimate how far a Pokémon trainer would have to walk from the Pikachu Nest to the gymnasium, G.

Answer (c) .... m [1]

~ End of Paper ~

Answer Key

1	5.47×10^{26}
2	a) $2, 3, 5, 7$ b) $6 \leq x < 10$
3	\$1555.56
4	$n = 500{,}000$
5	1. The **title of the infographic** [B1] **didn't allow the readers to make their own judgement** on the leading fast-food restaurant [B1]. 2. The **size of the fast-food icon** [B1] **exaggerated the sales amount between the fast-food restaurants** [B1], for example Burger King to MacDonald's only differs in 4 times of sales but represented with almost 9 times in area.
6	$x = \pm\sqrt{\dfrac{2y-1}{y-2}}$
7	$\dfrac{y}{x} = \dfrac{4}{3}$
8	Smallest k = 911 or 1 2nd smallest k = 1821
9	a) 10 b) Greatest n = 14 Least n = 6
10	a) $N = \frac{1500}{m}$ b) 100
11	$\frac{(n-1)(n-2)}{2}$ OR $\frac{1}{2}n^2 - \frac{3}{2}n + 1$
12	a) $x = 8$ b) $y = 17, x = 9$
13	i) $=(x+1)^2 - \dfrac{9}{4}$ ii) $x = -1$ iii) $(-1, -\frac{9}{4})$
14	
15	$BC^2 = 40^2 = 1600$; $AB^2 + AC^2 = 37^2 + 13^2 = 1538$ $(\neq BC^2)$ [B1] Since $BC^2 \neq AB^2 + AC^2$ [B1], $C\hat{A}B$ is not equal to 90°, BC is not a diameter of the circle. b) i) $-\frac{5}{13}$ ii) 12 cm
16	a) $w = 90°$ b) $x = 60°$ c) $y = 30°$ d) $z = 75°$
17	$171000\ m^3$
18	a) $5\ ms^{-2}$ b) $t = 50s$ c) $1750\ m$
19	22.9 g
20	a) Hollywood b) $4.3 \times 100 = 430\ m\ (\pm 10\ m)$

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NAN CHIAU HIGH SCHOOL

END-OF-YEAR EXAMINATION 2016
SECONDARY THREE EXPRESS

MATHEMATICS
Paper 1

4 October 2016, Tuesday

2 hour

Candidates answer on Question Paper

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number at the top of the cover page.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
Calculators should be used where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total marks for this paper is 80.

Setter: Mr Yuen Wen Jun & Ms Tan Yi Chiann

This paper consists of **17** printed pages.

Mathematical Formulae

Compound interest

$$\text{Total amount} = P\left(1+\frac{r}{100}\right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi rl$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta\text{, where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta\text{, where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\Sigma fx}{\Sigma f}$$

$$\text{Standard deviation} = \sqrt{\frac{\Sigma fx^2}{\Sigma f} - \left(\frac{\Sigma fx}{\Sigma f}\right)^2}$$

Answer **all** the questions.

1 There is approximately 6.022×10^{-23} atoms in 12 grams of Carbon.
An average Singaporean's mass is found to be approximately 58.935 kilograms.
It is given that 18.5% of a person's body mass is composed of Carbon.
Find the number of Carbon atoms found in an average Singaporean.
Leave your answer in standard form.

$[(58.935 \times 1000 \times 0.185) \div 12] \times 6.022 \times 10^{-23}$ -----------[M1]
$= 5.47 \times 10^{26}$ ------------[A1] or [B2]

Answer ....atoms [2]

---

2 **(a)** List all the prime numbers that satisfy $-2 \le x < 11$.

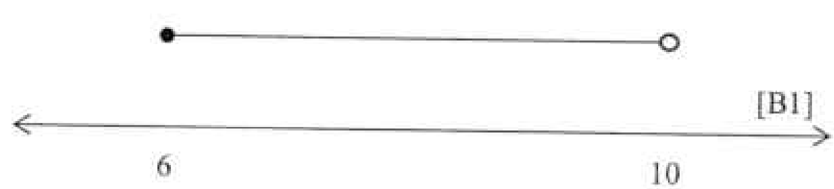
$2, 3, 5, 7$ ----------[B1]

Answer .... [1]

(b) Solve the inequality $2x - 9 < x + 1 \le 2x - 5$.
Represent the solution on a number line.

$-10 < -x \le -6$
$6 \le x < 10$ --------------[B1]

Answer



[2]

---

3 A salesman earns a 3% commission on the sales he makes.
He earned \$35 after selling a laptop that was on a 25% discount.
Find the original selling price of the laptop.

Sales price $= 35 \times \frac{100}{3}$ -----[M1]
Original price $= \frac{3500}{3} \times \frac{100}{75}$
$= \$1555.56$ (2d.p.) -----------[A1]

Answer \$........................ [2]

---

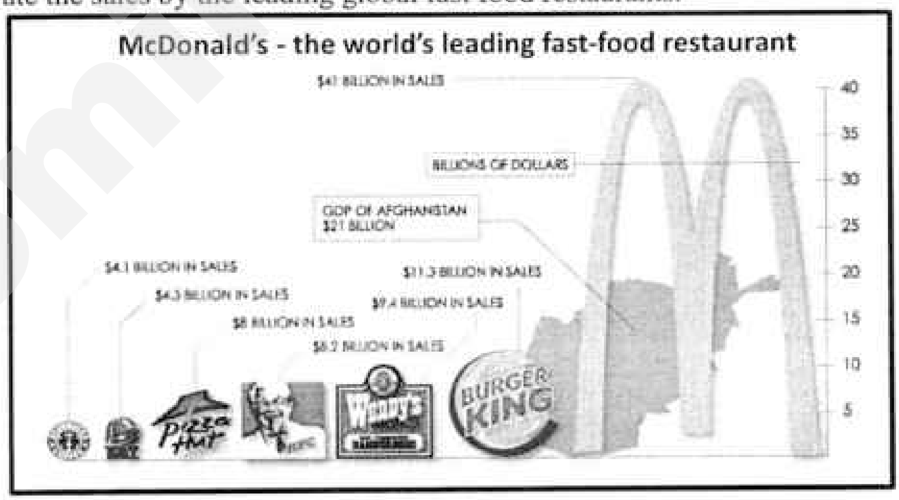
4 Singapore with an area of 719.1 km^2 is represented on a map by an area of 28.764 cm^2.
If the map has a scale of 1 : n, find the value of n.

$28.764\ cm^2 : 719.1\ km^2$
$1\ cm^2 : 25\ km^2$
1cm : 5km -----------[M1 for square root]
1 : 500,000 $n = 500{,}000$ --------[A1]

Answer .... [2]

---

5 In 2002, a study was conducted by Princeton's International Networks Archive, to illustrate the sales by the leading global fast food restaurants.



Explain one way in which the infographic is misleading.

[Misleading feature + effect] – accept any reasonable answer.

1. The **title of the infographic** [B1] **didn't allow the readers to make their own judgement** on the leading fast-food restaurant [B1].
2. The **size of the fast-food icon** [B1] **exaggerated the sales amount between the fast-food restaurants** [B1], for example Burger King to MacDonald's only differs in 4 times of sales but represented with almost 9 times in area. [2]

6 Make x the subject for the equation $y = \dfrac{2x^2 - 1}{x^2 - 2}$.

$y(x^2 - 2) = 2x^2 - 1$

$x^2(y - 2) = 2y - 1$ ----------[M1]

$x^2 = \dfrac{2y-1}{y-2}$

$x = \pm\sqrt{\dfrac{2y-1}{y-2}}$ ------------[A1]

Answer .... [2]

---

7 Given that $\dfrac{\frac{1}{x} - \frac{1}{y}}{\frac{2}{y} - \frac{1}{x}} = \dfrac{1}{2}$, find the exact value of $\dfrac{y}{x}$.

$\dfrac{\frac{y-x}{xy}}{\frac{2x-y}{xy}} = \dfrac{1}{2}$ -------------[M1]

$2(y - x) = 2x - y$ ---------[M1]

$3y = 4x$

$\dfrac{y}{x} = \dfrac{4}{3}$ ----------------------[A1]

Answer .... [3]

---

8 The remainder of $(k \div 13)$, $(k \div 14)$ and $(k \div 35)$ are all equal to 1.
Find the two smallest possible values of k.

$k - 1$ is a multiple of 13, 14, 35

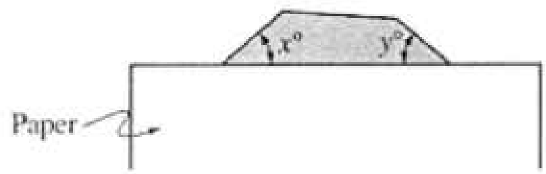
LCM of 13, 14, 35 = 910 -------------[M1]

Smallest $k = 910 + 1 = 911$ or 1 -------------[A1]
2nd smallest $k = 910 + 910 + 1 = 1821$ ---------------[A1]

Answer .... [3]

---

9 (a)



In the figure above, a regular polygon is partially covered with a sheet of paper.
If $x + y = 72$, find the number of sides that the polygon has.

$2 \times \textit{Interior angle} = 180 - 72 = 108$
$ext.angle = 180 - \frac{108}{2} = 36°$ -------[M1]
$Number\ of\ sides = \frac{360}{36} = 10$ ----------[A1]

Answer .... [2]

(b) In a convex n-sided irregular polygon, the largest interior angle is 160°
while the smallest interior angle is 130°.
Find the greatest and least possible value of n.

Smallest Ext. angle = 20°
Largest Ext. angle = 50° --------------- [M1 for either]

Greatest value of n:
Total Ext. angle = 360 = $(50 + 20 + [n - 2]20)$
$n = 14.5 = 14$ (round down) ------------[A1]

Least value of n:
Total Ext. angle = 360 = $(50 + 20 + [n - 2]50)$
$n = 5.8 = 6$ (round up) --------------[A1]

Answer .... [3]

10 **(a)** The number of push-ups done per minute, N, by an NCC cadet is inversely proportional to his mass, m. If a 50 kg cadet can do 30 push-ups per minute, find an equation connecting N and m.

$N = \frac{k}{m}$

$k = (50)(30) = 1500$ -----------[M1]

$N = \frac{1500}{m}$ ----------------------[A1]

Answer .... [2]

(b) Given that 3 NCC cadets can do a total of 12 push-ups in 5 seconds. Assuming that all the cadets do push-ups at a constant rate without getting tired, find the amount of time needed for 22 cadets to do 160 push-ups **each**.

Cadets	Push-ups	Seconds	
3	12	5	
1	4	5	----------[M1]
1	160	100	----------[A1]

Answer ....seconds [2]

---

11 The figure below shows a Pascal's Triangle.

Row 1: 1
Row 2: 1 1
Row 3: 1 2 1
Row 4: 1 3 3 1
1 4 6 4 1
⋮ 1 5 10 10 5 1
⋮ 1 6 15 20 15 6 1
⋮ 1 7 21 35 35 21 7 1
⋮ 1 8 28 56 70 56 28 8 1
1 9 36 84 126 126 84 36 9 1
⋮ 1 10 45 120 210 252 210 120 45 10 1
⋮
Row n: 1 n ... ... n 1

Find the value of the third term from the left in the n-th row, where $n \geq 3$. Leave your answer in terms of n.

Find the value of the third term from the left in the n-th row, where $n \geq 3$.

Leave your answer in terms of n.

$\frac{(n-1)(n-2)}{2}$ OR $\frac{1}{2}n^2 - \frac{3}{2}n + 1$ -------------------[B2]

Answer .... [2]

12 **(a)** Mr Lee has five children. His eldest child is 19 years old.
The mean, median and mode of his children's ages are all equal to 15.
Find the least possible age of the youngest child.

$x, 15, 15, 18, 19$ ------------------[M1]

$\frac{x+15+15+18+19}{5} = 15$

$x = 8$ --------------[A1]

Answer .... [2]

(b) It is further given that the mean age of the three children is equal to 17.
Find the age of the youngest child.

$x, 15, 15, y, 19$

$\frac{15+y+19}{3} = 17$

$y = 17$ ------------------[M1]

$\frac{x+15+15+17+19}{5} = 15$

$x = 9$ -------------------[A1]

Answer .... [2]

---

13 **(i)** By using completing the square method, express $x^2 + 2x - \frac{5}{4}$ in the form $(x-h)^2 + k$.

$x^2 + 2x - \frac{5}{4} = (x+1)^2 - 1^2 - \frac{5}{4}$ ------------[M1]

$= (x+1)^2 - \frac{9}{4}$ -----------[A1]

Answer .... [2]

(ii) Write down the equation for the line of symmetry for $y = x^2 + 2x - \frac{5}{4}$.

$x = -1$ --------------[B1]

Answer .... [1]

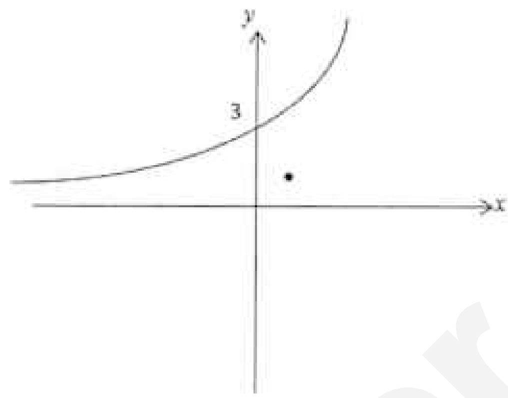
(iii) Write down the coordinates of the minimum point for $y = x^2 + 2x - \frac{5}{4}$.

$(-1, -\frac{9}{4})$ ----------------[B1]

Answer .... [1]

14 The point $(1, 1)$ is marked on the diagrams below.
Sketch the following graphs, indicating any x and/or y intercepts with the axes,

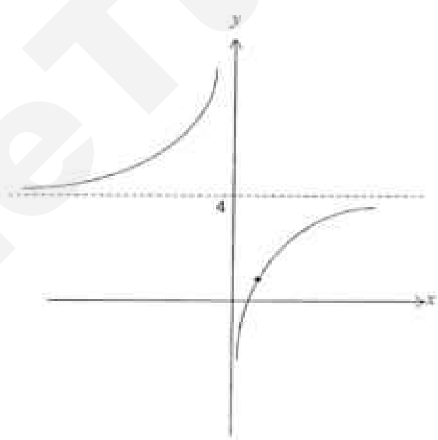
(i) $y = 3(4^x)$,



[2]

B1 – Shape
B1 – y-intercept

(ii) $xy = 4x - 3$.



[2]

B1- asymptote + shape
B1- graph thru (1, 1)

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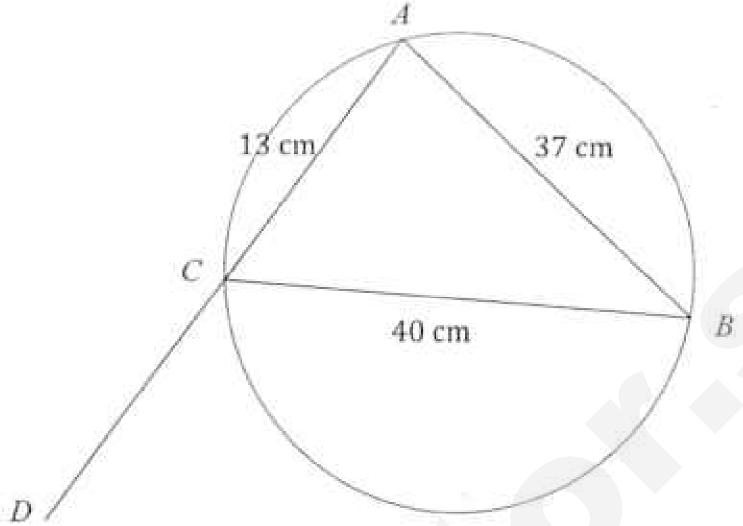
15 In the diagram, A, B and C lies on the circumference of the circle.
Given $AC = 13$ cm, $AB = 37$ cm, $BC = 40$ cm and ACD is a straight line.



(a) Explain why BC is not a diameter of the circle.

$BC^2 = 40^2 = 1600$; $AB^2 + AC^2 = 37^2 + 13^2 = 1538$ $(\neq BC^2)$ [B1]

Since $BC^2 \neq AB^2 + AC^2$ [B1] , $C\hat{A}B$ is not equal to $90°$, BC is not a diameter of the circle.

[2]

(b) Find the **exact value** of

(i) $\cos B\hat{C}D$,

Consider ΔACB, using cosine rule,

$37^2 = 13^2 + 40^2 - 2(13)(40)\cos A\hat{C}B$ [M1]

$\cos A\hat{C}B = \frac{5}{13}$ [M1]

$\cos B\hat{C}D = -\cos A\hat{C}B = -\frac{5}{13}$ [A1]

Answer .... [3]

(ii) the shortest distance of A to BC.

$A\hat{C}B = \cos^{-1}\frac{5}{13}$

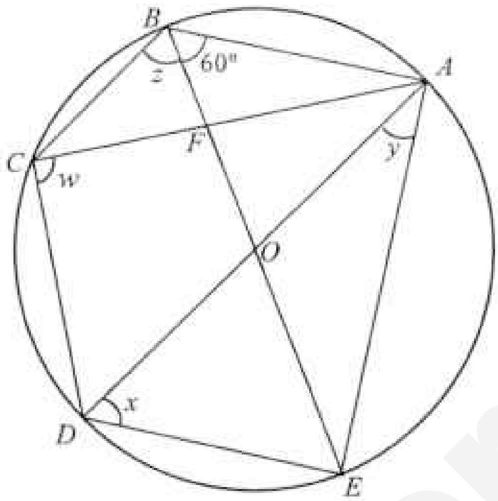
$area\ of\ \Delta ABC = \frac{1}{2}(13)(40)\sin(\cos^{-1}\frac{5}{13}) = \frac{1}{2}(shortest\ distance)(40)$

[M2]

$shortest\ distance = 12$ cm [A1]

Answer .... [3]

16



In the diagram, the points A, B, C, D, E lie on a circle, centre O.
Lines AC and BE intersects at F such that $BC = FC$.
AOD and BOE are diameters, and $\angle OBA = 60^\circ$.

Find

(a) w,

(b) x,

(c) y,

(d) z.

$w = 90^\circ$ (angle in semicircle) -------------------[B1]
$x = 60^\circ$ (angle in same segment) ---------------[B1]

$\angle DEA = 90^\circ$ (angle in semicircle)
$y = 180^\circ - 90^\circ - 60^\circ = 30^\circ$ (angle sum of triangle) --------------[B1]

$\angle OBA = \angle OAB = 60^\circ$ $(OA = OB = radius)$
$\angle BCD = 180 - 60 = 120^\circ$ (angles in opp. segment) ----------------[M1]
$\angle BCF = 120 - 90 = 30^\circ$
$z = \frac{180-30}{2}$ (base angle of isosceles triangle)
$z = 75^\circ$ --------------------------[A1]

Answers $w =$ ....° [1]

$x =$ ....° [1]

$y =$ ....° [2]

$z =$ ....° [2]

17 During Keven's recent holiday to Western Maryland (United States), he chanced upon a magnificent brush tunnel, shown in the **Figure 1**.

Being a leading civil engineer, Keven decided to initiate a project to bring railway trains into Singapore, to contribute as one of the tourism attractions.

He modelled the brush tunnel, shown in **Figure 2**, into a major segment $ABCD$, centre O and radius 12 m. $BD = 17$ m. Angle $ABD = 90°$.

Figure 1

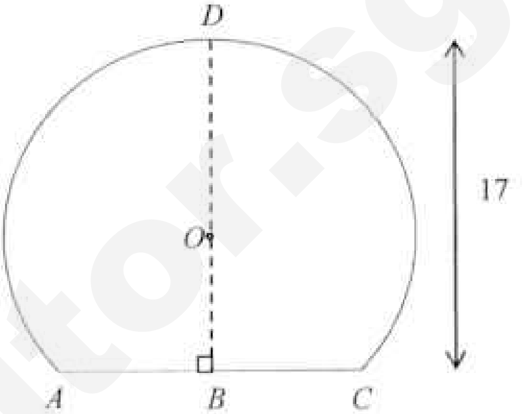


Figure 2

Calculate the area of the major segment which the railway train will be passing through.

$BO = 17 - 12$
$\quad = 5\,m$

Consider ΔOBC,

$\cos \angle BOC = \dfrac{5}{12}$ [M1]

$\angle BOC = 65.3757°$

Reflex $\angle AOC = 360° - 65.3757° \times 2 \quad (\angle at\ a\ point)$ [M1]

$\quad = 229.2468°$

$area\ of\ sector\ AOC = \dfrac{229.2486°}{360°} \times \pi(12)^2$

$\quad = 288.082\ m^2$

$area\ of\ \Delta AOC = \dfrac{1}{2}(12)(12)\sin(65.3757° \times 2)$

$\quad = 54.5435\ m^2$ [M1]

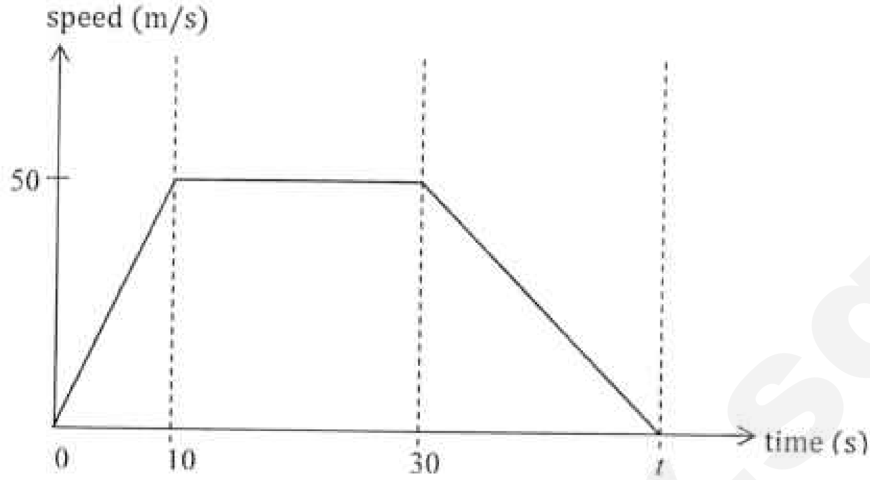
$Volume = (288.082 + 54.5435) \times 500$ [M1] – add area and 500 m

$\quad = 171313.0534\ m^3$

$\quad = 171000\ m^3\ (to\ 3sf)$ [A1]

Answer ....m^2 [5]

18 The diagram shows the speed-time graph for a car journey between two road junctions.



(a) Calculate the acceleration of the car after 5 seconds.

$$Acceleration = gradient = \frac{50}{10} = 5\ ms^{-2} \quad [B1]$$

Answer ....ms^{-2} [1]

(b) Calculate the time taken for the car to come to rest if the retardation is $2\frac{1}{2}\text{m/s}^2$.

$$-\frac{5}{2} = \frac{0-50}{t-30} \quad [M1]$$

$$t = 50s \quad [A1]$$

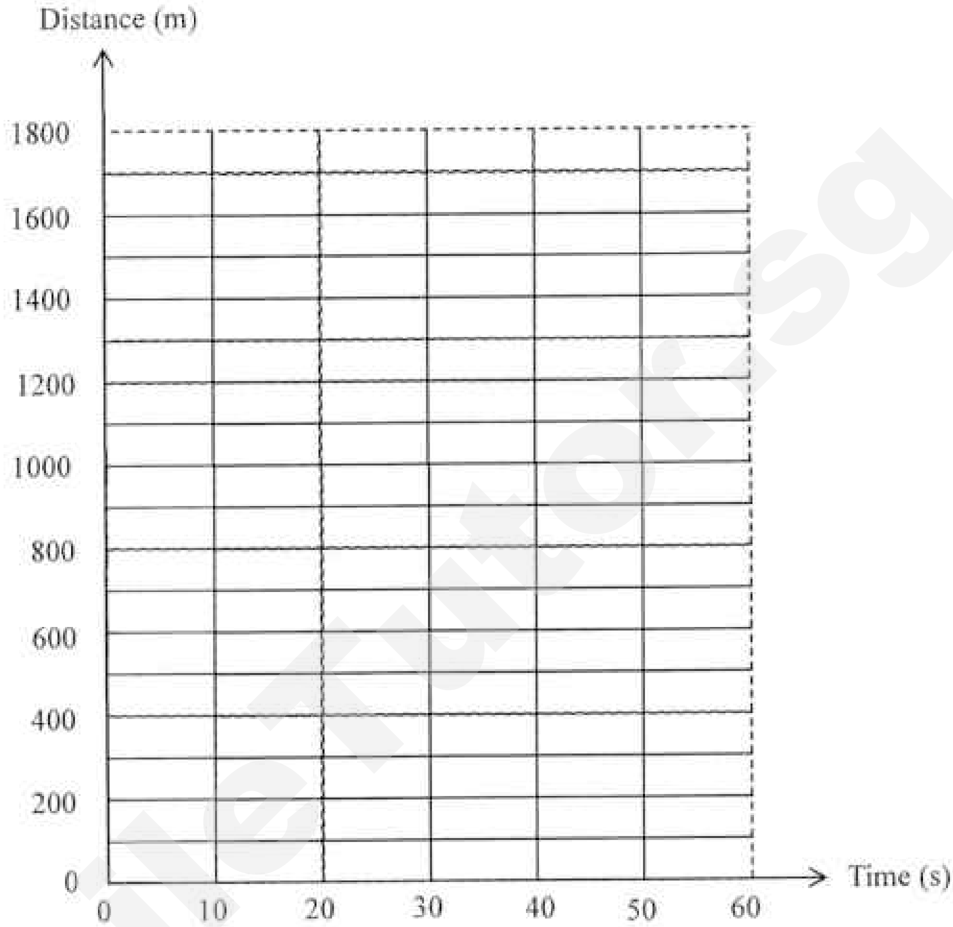
Answer ....s [2]

(c) Calculate the total distance travelled between the two road junctions.

$$total\ distance = \frac{1}{2}(50)(10) + (20)(30) + \frac{1}{2}(50-30)(50) \quad [M1]$$
$$= 1750\ m \quad [A1]$$

Answer ....m [2]

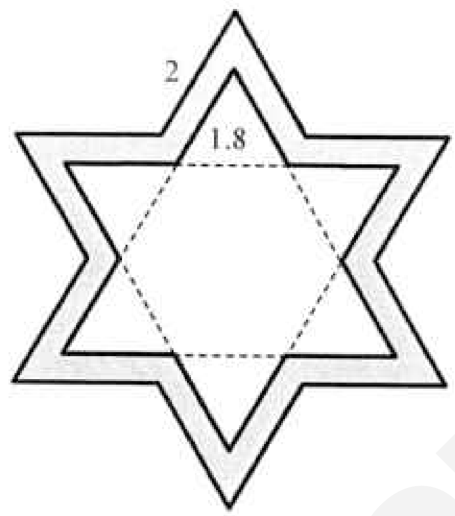
(d) Use the grid below to sketch the distance-time graph for the journey.



[3]

B1 – shape + end point of each segment

19 The shaded area in the figure below shows the cross section of a gold pendant is made up of two **similar** regular 6-sided star shape.



The outer length of the regular 6-sided star shape is 2 cm.
The inner length of the regular 6 sided star shape is 1.8 cm.
The uniform thickness of the pendant is 0.3 cm.

Calculate the mass of the pendant if the density of gold is $19.32\ \text{g/cm}^3$.

$$area\ of\ inner\ star = \frac{1}{2}(1.8)(1.8)\sin 60^\circ \times 12 \qquad [M1]$$
$$= 16.83553\ cm^2$$

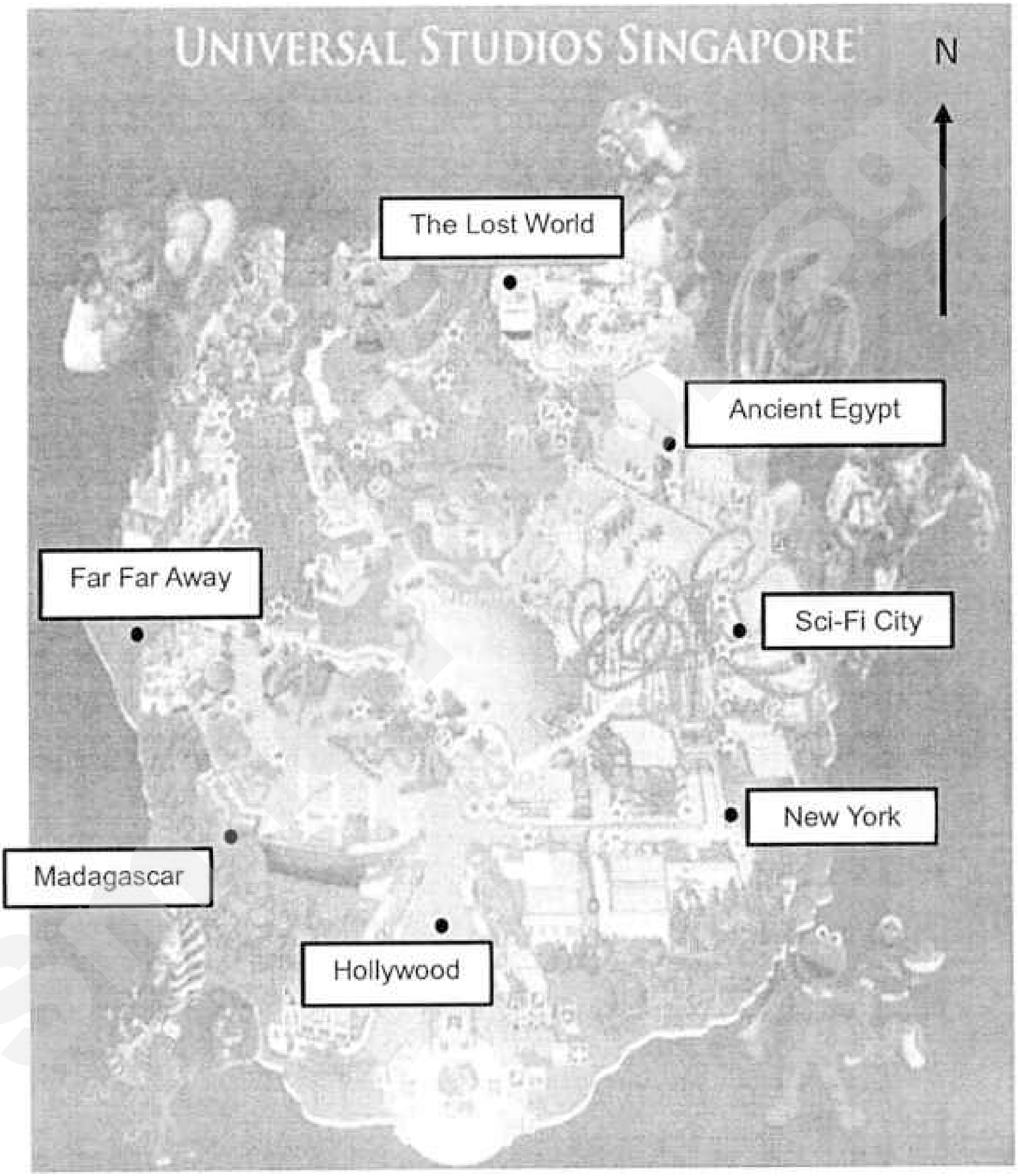
$$\frac{area\ of\ inner\ star}{area\ of\ outer\ star} = \left(\frac{1.8}{2}\right)^2$$
$$\frac{16.83553}{area\ of\ outer\ star} = \left(\frac{1.8}{2}\right)^2$$
$$area\ of\ outer\ star = 20.7846\ cm^2 \qquad [M1]$$

$$volume = (20.7846 - 16.83553) \times 0.3 \qquad [M1]$$

$$mass = density \times volume$$
$$= 19.32 \times (20.7846 - 16.83553) \times 0.3 \qquad [M1]$$
$$= 22.8888\ \text{g}$$
$$= 22.9\ \text{g (to 3sf)} \qquad [A1]$$

Answer ....cm^3 [5]

20 Universal Studios Singapore (USS) provides an immersive entertainment experience in seven different zones as indicated at the map below.



(a) In the recent Pokémon Go craze, the following pieces of information are given to locate the Pikachu Nest:

- On a bearing of 205° from Ancient Egypt;
- 650 m away from Sci-Fi City .

Using 1 cm : 100m, with appropriate constructions, at which zone is the Pikachu Nest located?

Hollywood [B1]

Answer .... [3]

(b) Niantic (the programming firm for Pokémon Go), decided to build a new gym in USS, where tourists can send their Pokémons to battle virtually.

They have decided to locate the new gym
- equidistant from Far Far Away and Madagascar AND
- equidistant from the line along New York and Hollywood AND the line along New York and The Lost World.

By constructing perpendicular and/or angle bisectors, locate and label the position of the gym, G. [3]

© Find the distance in which a Pokémon trainer would have to walk from the Pikachu Nest to the gym, G.

$4.3 \times 100 = 430\ m\ (\pm 10\ m)$ $[B1]$

Answer .... [1]

~ End of Paper ~

Name: Register Number: Class:

南僑中學

NAN CHIAU HIGH SCHOOL

END-OF-YEAR EXAMINATION 2016
SECONDARY THREE EXPRESS

MATHEMATICS **4048/02**
Paper 2

6 October 2016, Thursday

2 hours 30 minutes

Additional Materials: Writing Papers (7 sheets)
Graph paper (1 sheet)

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer all questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 100.

Setter: Mrs Tan – Ng Su Peng, Mr Lee Ah Ngee

This paper consists of **8** printed pages including the cover page.

Mathematical Formulae

Compound Interest

$$\text{Total amount} = P\left(1 + \frac{r}{100}\right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

Answer **all** the questions.

1. **(a)** **(i)** Factorise completely $3x^2-48$. [2]

(ii) Hence simplify $\dfrac{3x^2-48}{3x^2+6x-24}$. [2]

(b) Express as a single fraction in its simplest form [2]

$$\frac{m}{1-m}-\frac{4}{m-4}.$$

---

2. **(a)** Simplify $\left(\dfrac{2x^{-\frac{7}{18}}}{3y}\right)^{-3}\div\sqrt[3]{\sqrt{64xy^0}}$, expressing your answer in positive index form. [3]

(b) Solve the following equations.

(i) $16^x=\dfrac{1}{8}$ [2]

(ii) $\dfrac{10^{3a-1}}{\sqrt{10}}=0.01$ [3]

---

3. **(a)** **(i)** Given that $f(x)=x^2-19x+b$ where $f(x)$ is a perfect square, find the value of b. [2]

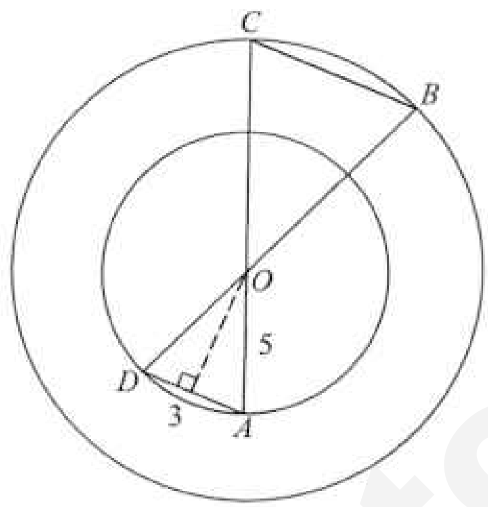
(ii) Hence, find the coordinates of the turning point of the graph of $y=f(x)$. [2]

(iii) Sketch the graph of $y=f(x)$, indicating the intercept(s) clearly. [3]

(b) Explain whether the graph of $y=f(x)$, sketched in **(a)(iii)**, will intersect the graph of $y=-(x-9.5)^2-1$. [2]

---

4. In the diagram, O is the centre of two concentric circles. A and D lie on the circumference of the smaller circle. B and C lie on the circumference of the larger circle. AOC and BOD are straight lines. The length of the radius, OA, of the smaller circle is 5 cm and the length of chord AD is 3 cm. It is given that $OA = \frac{5}{6}OB$.



(a) Prove that ΔOAD is similar to ΔOCB. [2]

(b) Find

(i) the perpendicular distance from O to the chord AD, [2]

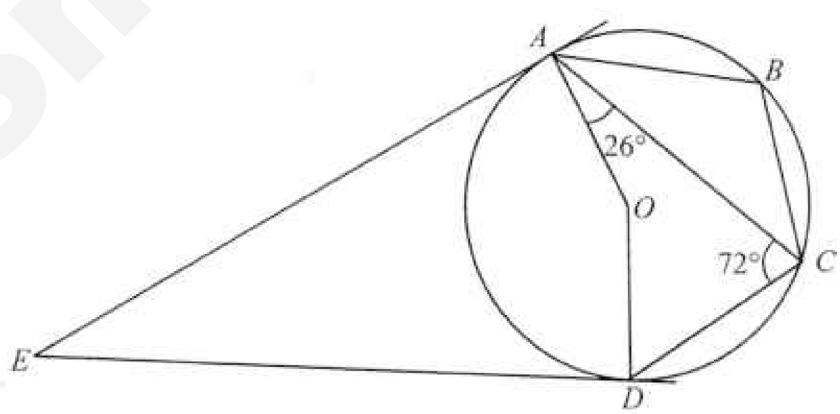
(ii) the length of CB, [3]

(iii) the distance between chords AD and BC. [2]

(c) Prove that ΔDOC is congruent to ΔAOB. [2]

---

5. The diagram shows a circle $ABCD$ with centre O. AE and DE are tangents to the circle. Given $\angle ACD = 72°$ and $\angle OAC = 26°$.



Find

(a) $\angle AOD$, [1]

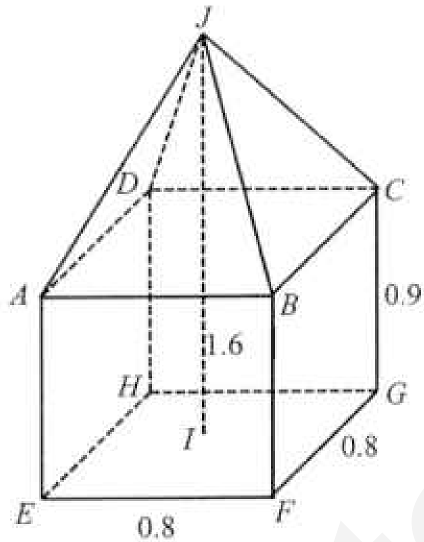
(b) $\angle OED$, [2]

(c) $\angle ADC$, [2]

(d) $\angle ABC$. [1]

---

6. A sculpture consists of a right pyramid, $JABCD$ attached to a cuboid $ABCDEFGH$ of height 0.9m. $ABCD$ and $EFGH$ are squares of side 0.8 m.
The vertical height, IJ, of the toy block is 1.6 m, and JA, JB, JC, JD are equal in length.



Calculate

(a) the volume of the sculpture, [3]

(b) the total surface area of the sculpture. [3]

---

7. Mr Ho drove a total distance of 420 km from Malacca to Kuala Lumpur.

(a) For the first $\frac{5}{6}$ of his journey, Mr Ho's average speed was x km/h. [1]
Write down an expression for the time, in hours, that Mr Ho took to travel this part of the journey.

(b) If the average speed of the remaining part of the journey is increased by 10 km/h, write down an expression for the time, in hours, that Mr Ho took for this part of the journey. [1]

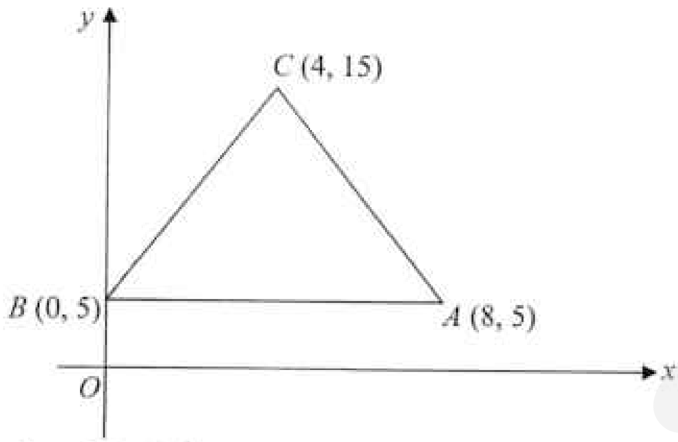
(c) Given that the total time taken for the whole journey was 5 hours and 20 minutes, form an equation in x and show that it reduces to $4x^2 - 275x - 2625 = 0$. [3]

(d) Solve the equation $4x^2 - 275x - 2625 = 0$. [3]

(e) How much time Mr Ho would have taken longer if he covers the whole journey with an average speed of x km/h? Give your answer correct to the nearest minutes. [2]

---

8. In the diagram, the points A, B and C have coordinates (8, 5), (0, 5) and (4, 15).

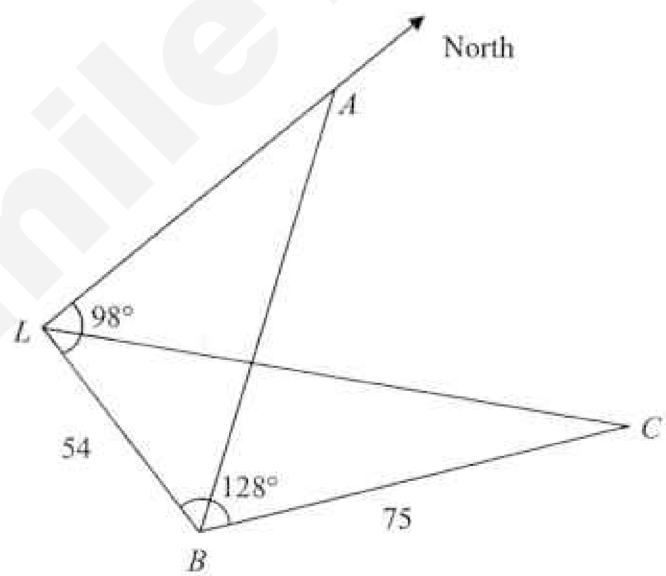


(a) Find the equation of the line passing through the midpoint of AC and parallel to the line $3y + 2x = 5$. [3]

(b) Calculate
(i) the area of the triangle ABC, [1]
(ii) the length of BC, [1]
(iii) the perpendicular distance from A to BC. [2]

---

9. The diagram shows the positions of three ships A, B and C and a lighthouse, L, which is is due south of A. The bearing of B from L is 098° and $\angle LBC = 128°$. $LB = 54$ km and $BC = 75$ km.



(a) Calculate the distance CL. [2]

(b) Calculate the bearing of C from B. [2]

(c) The bearing of B from A is 135°. Calculate the distance AB. [3]

(d) The ship C is moving towards the lighthouse L with a constant speed of 18 km/h. If it starts at 1300, at what time would it be nearest to B? [5]

---

10. **(a)** In Figure 1, part of the solid cylinder is sliced along AB to produce the solid shown in Figure 2. In Figure 2, the cross-section ACB of the slice is a segment of a circle of centre O and $\angle AOB = 90^\circ$.

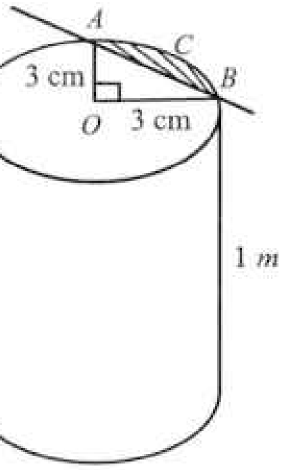


Figure 1

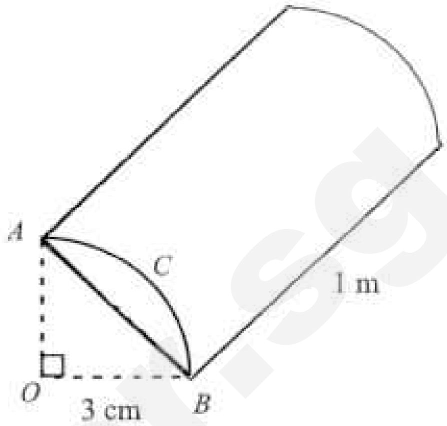


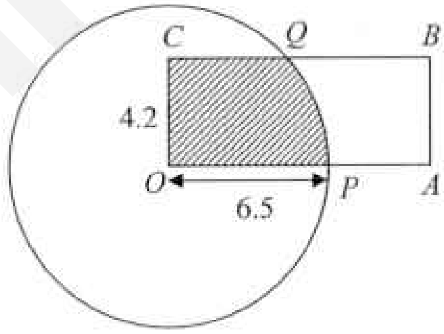
Figure 2

Find

(i) the area of the segment ACB, [2]

(ii) the total surface area of the slice in figure 2. [3]

(b) $OABC$ is a rectangle. The width, OC, of the rectangle is 4.2 cm. The radius of the circle with centre O is 6.5 cm. The rectangle intersects the circle at P and Q.



(i) Show that $\angle POQ$ is approximately 0.703 rad. [2]

(ii) Calculate the perimeter and the area of the shaded region. [6]

11. **Answer the whole of this question on a sheet of graph paper.**

The table gives some values of x and the corresponding values of y, correct to one decimal place, where $y = \frac{18}{x^2} + 3x$.

x	1	1.5	2	2.5	3	3.5	4	4.5
y	21.0	12.5	10.5	10.4	11.0	12.0	13.1	p

(a) Find the value of p. [1]

(b) Using a scale of 4 cm to represent 1 unit, draw a horizontal x-axis for $0 \le x \le 4.5$. [3]
Using a scale of 1 cm to represent 1 unit, draw a vertical y-axis for $0 \le y \le 21$.
On your axes, plot the points given in the table and join them with a smooth curve.

(c) By drawing a tangent, find the gradient of the curve at the point where $x = 2$. [2]

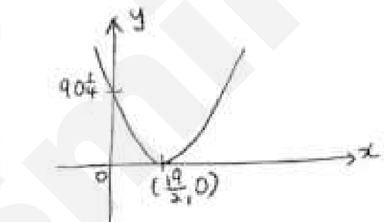
(d) Use your graph to find

(i) the least value of y, [1]

(ii) the values of x for which $3x + \frac{18}{x^2} = 14$, [2]

(iii) the values of x for which $\frac{18}{x^2} + 3x \le 18 - 2x$. [3]

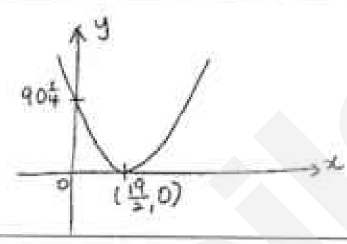
--- *End of Paper* ---

Qn	Answer
1(a)(i)	$3(x-4)(x+4)$
1(a)(ii)	$\frac{x-4}{x-2}$
1(b)	$\frac{m^2-4}{(1-m)(m-4)}$ or $\frac{(m-2)(m+2)}{(1-m)(m-4)}$ or $\frac{m^2-4}{-x^2+5m-4}$
2(a)	$\frac{27y^3x}{16}$
2(b)(i)	$x=\frac{-3}{4}$
2(b)(ii)	$a=-\frac{1}{6}$
3(a)(i)	$a=\frac{-19}{2}\ or\ \frac{19}{2}$ $b=\left(\frac{19}{2}\right)^2=90\frac{1}{4}$
3(a)(ii)	$\therefore\left(\frac{19}{2},0\right)$
3(a)(iii)	
3(b)	The graph of y = - (x – 9.5)^2 – 1 has a maximum point at (19/2 , -1). Which is below the minimum pt of the graph of y = f(x). Hence the graphs will **not** intersect.
4(a)	$\angle AOD=\angle BOC$ (vert. opp. $\angle$) $\angle ODA=\frac{180°-\angle AOD}{2}$ $=\frac{180°-\angle BOC}{2}$ $=\angle OBC$ ΔOAD is similar to ΔOCB (AA similarity test) OR
	$\angle AOD=\angle BOC$ (vert. opp. $\angle$) $\frac{DO}{BO}=\frac{AO}{CO}=\frac{5}{6}$ ΔOAD is similar to ΔOCB (SAS similarity test)
4bi	4.77 cm.
bii	$OA=\frac{5}{6}OB$ $5cm=\frac{5}{6}OB$ $OB=6cm$ Using similar triangles, $\frac{6}{CB}=\frac{5}{3}$ $CB=\frac{18}{5}cm/3\frac{3}{5}cm$ or 3.6 cm
(b)(ii)	10.5 cm
(b)(iii)	$\Delta DOC\equiv\Delta AOB$ (SAS)
5. (a)	144°
(b)	18°
(c)	64°
(d)	116°
6(a)	$\frac{272}{375}m^3$
6(b)	4.81m^2
7a	Time taken = $\frac{350}{x}h$
7(b)	Time taken = $\frac{70}{x+10}h$
7(c)	$\frac{350}{x}+\frac{70}{x+10}=5+\frac{20}{60}=\frac{16}{3}$
7(d)	$6\ min$
7(e)	

8(a)	$y=-\frac{2}{3}x+14$
(bi)	40 sq units
bii	length of $BC=\sqrt{(0-4)^2+(5-15)^2}$ $=10.8$ units
biii	$\therefore h=7.43\ units$
9(a)	116 *km*
(b)	046°
(c)	69.8*km*
(d)	16 53
10ai	2.57 cm^2
10ii	901 cm^2
10bI	0.703 *rad* (shown)
10bii	25.3 cm^2

2016 Sec 3 EOY Paper 2 marking scheme

Question	Answer	Marks
1(a)(i)	$3x^2-48$	
	$=3(x^2-16)$	M1
	$=3(x-4)(x+4)$	A1
1(a)(ii)	$\frac{3x^2-48}{3x^2+6x-24}$	
	$=\frac{3(x-4)(x+4)}{3(x^2+2x-8)}$	
	$=\frac{(x-4)(x+4)}{(x+4)(x-2)}$	M1
	$=\frac{x-4}{x-2}$	A1
1(b)	$\frac{m}{1-m}-\frac{4}{m-4}$	
	$=\frac{m(m-4)-4(1-m)}{(1-m)(m-4)}$	
	$=\frac{m^2-4m-4+4m}{(1-m)(m-4)}$	M1
	$=\frac{m^2-4}{(1-m)(m-4)}$ or $\frac{(m-2)(m+2)}{(1-m)(m-4)}$ or $\frac{m^2-4}{-x^2+5m-4}$	A1
2(a)	$(\frac{2x^{-\frac{7}{18}}}{3y})^{-3}\div\sqrt[3]{\sqrt{64xy^0}}$	
	$=(\frac{3y}{2x^{-\frac{7}{18}}})^3\times\frac{1}{\sqrt[3]{\sqrt{64x}}}$ (convert divide to multiply, power 0 = 1)	M1
	$=\frac{27y^3x^{\frac{7}{6}}}{8}\times\frac{1}{2x^{\frac{1}{6}}}$ (power 3 goes in and simplify the root)	M1
	$=\frac{27y^3x}{16}$	A1
2(b)(i)	$16^x=\frac{1}{8}$	
	$2^{4x}=2^{-3}$	M1
	$4x=-3$	
	$x=\frac{-3}{4}$	A1
2(b)(ii)	$\frac{10^{3a-1}}{\sqrt{10}}=0.01$	
	$10^{3a-1\frac{1}{2}}=10^{-2}$	M1

	$3a-1\frac{1}{2}=-2$	M1
	$3a=-\frac{1}{2}$	
	$a=-\frac{1}{6}$	A1
3(a)(i)	$x^2-19x+b$ $=(x+a)^2 \, or \, (x-a)^2$ $x^2+2ax+a^2=x^2-19x+b$ $x^2-2ax+a^2=x^2-19x+b$ $a=\frac{-19}{2} \, or \, \frac{19}{2}$ ------ M1 $b=\left(\frac{19}{2}\right)^2=90\frac{1}{4}$ ----- A1 Or $f(x)=\left(x-\frac{19}{2}\right)^2+b-\left(\frac{19}{2}\right)^2$ $b-\left(\frac{19}{2}\right)^2=0$ --------- M1 $b=\left(\frac{19}{2}\right)^2=90\frac{1}{4}$ -------- A1	shown
3(a)(ii)	$f(x)=x^2-19x+90\frac{1}{4}=\left(x-\frac{19}{2}\right)^2$	
	$\therefore\left(\frac{19}{2},0\right)$	B1 – correct x B1 – correct y
3(a)(iii)	 G1 - shape G1 - y-intercept G1 - turning pt at correct position	
3(b)	The graph of y = - (x – 9.5)² – 1 has a maximum point at (19/2 , -1). Which is below the minimum pt of the graph of y = f(x). Hence the graphs will **not** intersect.	M1 A1
	OR	
	Equate - (x – 9.5)² – 1 = (x – 9.5)² and derive the discriminant to be -8. No real roots – no intersections	M1 A1
	OR	
	Try to solve - (x – 9.5)² – 1 = (x – 9.5)² and realise that (x – 9.5)² < 0 which is not possible. No solutions for x – no intersections.	M1 A1
	OR	
	Max value of y for graph of y = - (x – 9.5)² – 1 is -1 while m value of y = f(x) is 1.	
	OR	
	Graph of y = - (x – 9.5)² – 1 is a reflection of y = f(x) about the x-axis followed by shifting downwards by 1 unit / reflection about y = -.05. Hence, the graphs will not intersect.	M1 A1
	OR	
	Graph of y = - (x – 9.5)² – 1 is always negative while graph of y = f(x) is never negative (cannot say always positive as it sits on x- axis). Hence no intersection.	M1 A1
4(a)		M1

	$\angle AOD = \angle BOC$ (vert. opp. $\angle$) $\angle ODA = \frac{180° - \angle AOD}{2}$ $= \frac{180° - \angle BOC}{2}$ $= \angle OBC$ ΔOAD is similar to ΔOCB (AA similarity test)	$\angle AOD = \angle BOC$ (vert. opp. $\angle$) $\frac{DO}{BO} = \frac{AO}{CO} = \frac{5}{6}$ ΔOAD is similar to ΔOCB (SAS similarity test)	A1
(b)(i)	Perpendicular distance = $\sqrt{5^2 - \left(\frac{3}{2}\right)^2}$		M1
	= 4.77 cm.		A1
(b)(ii)	$OA = \frac{5}{6}OB$		
	$5cm = \frac{5}{6}OB$		
	$OB = 6cm$		M1
	Using similar triangles,		
	$\frac{6}{CB} = \frac{5}{3}$		M1
	$CB = \frac{18}{5}cm / 3\frac{3}{5}cm$ or 3.6 cm		A1
(b)(iii)	Perpendicular distance from O to CB		
	$= \sqrt{6^2 - (\frac{18}{5} \div 2)^2}$		M1
	$= \sqrt{32\frac{19}{25}}$		
	= 5.7236 cm		
	Distance between chords		
	= 5.7236 + 4.7697		M1
	= 10.5 cm (to 3 sf)		A1
(c)	OC = OB (isos Δ)		M1
	$\angle DOC = \angle AOB$ (vert.opp. $\angle$)		
	OD = OA (isos Δ)		
	$\Delta DOC \equiv \Delta AOB$ (SAS)		A1
5.			
(a)	$\angle AOD = 2 \times 72° = 144°$		B1
(b)	$\angle ODE = 90°$ (tan $\perp$ rad)		M1
	$\angle EOD = 144° \div 2 = 72°$		
	$\angle OED = 180° - 90° - 72° = 18°$		A1
(c)	$\angle OAD = \frac{180° - 144°}{2} = 18°$		M1
	$\angle ADC = 180° - 26° - 72° - 18° = 64°$		A1
(d)	$\angle ABC = 180° - 64° = 116°$		B1
6(a)	Height of pyramid = 1.6 – 0.9 = 0.7 m		

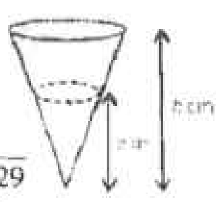
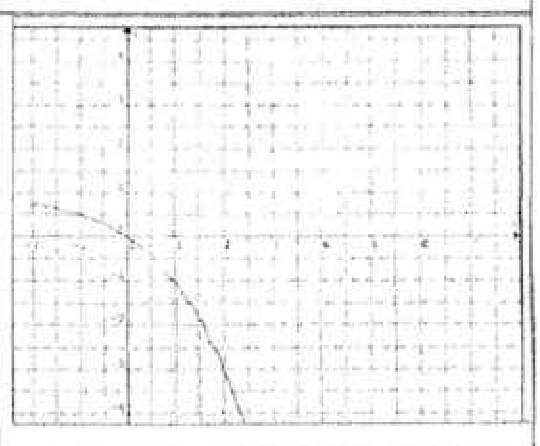
	Volume of pyramid = $\frac{1}{3}\times 0.8\times 0.8\times 0.7=\frac{56}{375}m^3$	M1
	Volume of cuboid = $0.8\times 0.8\times 0.9=\frac{72}{125}m^3$	M1
	Total volume = $\frac{56}{375}+\frac{72}{125}=\frac{272}{375}m^3$	A1
6(b)	Let the centre of base of pyramid be O.	
	Let the midpt of AB be M.	
	$JM=\sqrt{0.7^2+0.4^2}=\sqrt{\frac{13}{20}}$	M1
	Surface area of one slanted side of pyramid	
	$=\frac{1}{2}\times 0.8\times\sqrt{\frac{13}{20}}=0.32249m^2$	M1
	Total surface area = 4 X 0.32249 + (0.8 X4)(0.9) + 0.8 X 0.8	
	= 4.80996 = 4.81m^2	A1
7a	First $\frac{5}{6}$ distance = $\frac{5}{6}$ x 420 = 350 km Time taken = $\frac{350}{x}h$	
7(b)	Remaining journey = 420 – 350 = 70 km Time taken = $\frac{70}{x+10}h$	
7(c)	$\frac{350}{x}+\frac{70}{x+10}=5+\frac{20}{60}=\frac{16}{3}$ $3(420x+3500)=18x(x+10)$ $1260x+10500=16x^2+160x$ $16x^2-1100x-10500=0$ $8x^2-550x-5250=0$ $4x^2-275x-2625=0$	
7(d)	$x=\frac{275\pm\sqrt{275^2-4(4)(-2625)}}{2(4)}$ $=77.2\quad or\quad -8.49$	
7(e)	Extra time taken = $\frac{420}{77.2}-5\frac{1}{3}$ = 0.10708 *h* = 6 *min*	
8(a)	Midpoint of *AC* = $\left(\frac{4+8}{2},\frac{15+5}{2}\right)$ = (6, 10) For line 3*y* + 2*x* = 5 $y=-\frac{2}{3}x+\frac{5}{3}\Rightarrow m=-\frac{2}{3}$ With $m=-\frac{2}{3}, pt\ (6,10)$	

     (bi) bii biii	Equation of the line is $y-10=-\frac{2}{3}(x-6)$ $y=-\frac{2}{3}x+14$ area of ΔABC $=\frac{1}{2}\begin{vmatrix}0 & 8 & 4 & 0\\ 5 & 5 & 15 & 5\end{vmatrix}$ = 40 sq units length of $BC=\sqrt{(0-4)^2+(5-15)^2}$ = 10.8 units let h be the perpendicular distance $=\frac{1}{2}\times 10.77\times h=40$ $\therefore h=7.43\ units$	
9(a) (b) (c) (d)	$CL=\sqrt{54^2+75^2-2\times 54\times 75\times\cos 128^\circ}$ = 116.309 = 116 km $\theta = 180^\circ-98^\circ=82^\circ$ $\alpha=128^\circ-82^\circ=46^\circ$ $\therefore$ *bearing of C from B is* 046° $\beta=180^\circ-135^\circ=45^\circ$ $\frac{AB}{\sin 98^\circ}=\frac{54}{\sin 45^\circ}$ $AB=\frac{54\times\sin 98^\circ}{\sin 45^\circ}=75.624=75.6\ km$ $\frac{\sin\delta}{54}=\frac{\sin 128}{116.309}$ $\delta=\sin^{-1}(\frac{54\times\sin 128}{116.309})=\ 21.46^0$ $\therefore d=75\times\cos 21.46^\circ=69.80049=69.8km$ Time taken = $\frac{69.80049}{18}=3hrs53\min$ At time it would be nearest to B is 13 00 + 3 hrs 53 min = 16 53	
10ai 10ii	area of segment = $\frac{1}{4}\times\pi\times 3^2-\frac{1}{2}\times 3\times 3$ $=2.57\ cm^2$ total surface area of the slice $= 2.569\times\frac{1}{4}(2\pi)(3)(100)+\sqrt{3^2+3^2}\times 100$ = 5.138 + 471.239 + 424.264 = 900.641 = 901 cm^2	
10bI	$\cos\theta=\frac{4.2}{6.5}$ ϑ = 0.86826 *rad* $\angle POQ=\frac{\pi}{2}-0.86826$ = 0.703 *rad* (shown)	
10bii	Arc length PQ =6.5 x 0.7025 = 4.56625 cm	

	$CQ = \sqrt{6.5^2 - 4.2^2}$ $= 4.96085\ cm$ Perimeter of the shaded region $= 6.5 + 4.2 + 4.96085 + 4.56625$ $= 20.2\ cm$ Area of the shaded region $= \frac{1}{2} \times 4.2 \times 4.96085 + \frac{1}{2} \times 6.5^2 \times 0.703$ $= 25.3\ cm^2$	
11		

Name: ______________________________ (   )   Class: ________

3(b)	44 marks	5(b)	10.25 cm or $10\frac{1}{4}$ cm
3(c)	57.1%	6(a)	$25(20)-2x(x+1)$

6(b)	$25(10)+x(2x+1)$	8(b)(iv)	301°
6(c)(i)	$\$(50x^2+25x+6250)$	9(a)	12.8m
6(c)(ii)	$\$25(2x^2+x+250)=\$7500$	9(b)	51.3°
6(c)(iii)	4.76 or -5.26(3sf)	9(c)	17.5 or 17.6 m
6(c)(iv)	\$11 131.22 (2dp)	9(d)	27.1°
7(a)	Radius of A: Radius of B $= 3:8$ Height of A: Height of B $=12:32$ $=3:8$ The corresponding dimensions of the cylinders are in the same ratio. Therefore, cylinders A and B are similar.	9(e) 10(a)	72.2° 95.0 cm^3
7(b)	64 : 9	10(b)	239
7(c)	$31\frac{23}{28}$ or $\frac{891}{28}$ or 31.8 (3sf) cm^2	10(c)	476 028 cm^2 (to next whole number)
7(d)	6.827 kg (3dp)	11(a)	$p=0.75$ or $\frac{3}{4}$
8(b)(i)	4.81 km	11(ci) (cii)	When $x=-1.5$, $y=0.7$ When $y=-2.2$, $x=1.65$
8(b)(ii)	8.41 km^2	11(d)	$-2.83 \le m \le -3.13$
8(b)(iii)	3.37 km	11(e)	$x=0.375$
10(d)	Using similar figures, $\frac{V_1}{V_2}=\left(\frac{h}{9}\right)^3$ $\frac{2}{1}=\frac{h^3}{729}$ $h=\sqrt[3]{2\times 729}$ $=11.339$  Ht of frustum $= 11.339-9$ $=2.34$ cm Height of frustum is smaller than the height of conical cup.	11(b)	

Class	Register Number	Name

南洋女子中学校

NANYANG GIRLS' HIGH SCHOOL

End-of-Year Examination 2016
Secondary Three

MATHEMATICS PAPER 1 **1 hr 30 min**

Thursday **06 October 2016** **08 45 – 10 15**

READ THESE INSTRUCTIONS FIRST

INSTRUCTIONS TO CANDIDATES

1. Write your name, register number and class in the spaces at the top of this page.
2. Answer **all** the questions.
3. Write your answers in the spaces provided on the question paper.
4. **All working must be written in dark blue or black ink.**
5. **Omission of essential working will result in loss of marks.**
6. Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
7. The use of calculators is allowed for this paper.

INFORMATION FOR CANDIDATES

1. The number of marks is given in brackets [ ] at the end of each question or part question.
2. The total number of marks for this paper is 60.
3. You are reminded of the need for clear presentation in your answers.

Mathematical Formulae

MENSURATION

Area of triangle $ABC = \frac{1}{2}ab\sin C$

Arc length $= r\theta$, where θ is in radians

Sector area $= \frac{1}{2}r^2\theta$, where θ is in radians

TRIGONOMETRY

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Answer **all** the questions.

1 Simplify $25n^2 + 1 - (5n - 1)^2$.

Answer ____________________ [2]

2 Solve the equation $\dfrac{49}{(3x-2)} - (3x-2) = 0$

Answer $x =$ _________ or _________ [3]

3 Given that $16 \div 32^k = \dfrac{1}{4}$, find the value of k.

Answer $k =$ ____________________ [3]

[Turn over

4 **(a)** Solve $-15 < 5 - 3x \le 2x$.

Answer (a) ______________________ [2]

(b) Write down the largest prime number which satisfies $-15 < 5 - 3x \le 2x$.

Answer (b) ______________________ [1]

---

5 **(a)** Express $x^2 - 6x - 2$ in the form $(x-p)^2 - q$, where p and q are constants.

Answer (a) ______________________ [2]

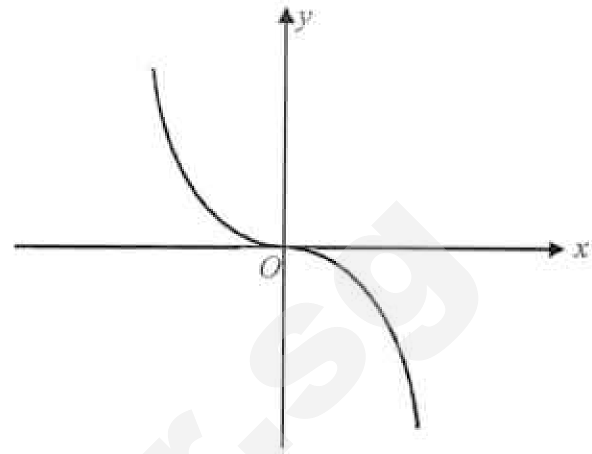
(b) Hence write down the value of k for which $x^2 - 6x - 2 \ge k$ for all values of x.

Answer (b) $k =$ ____________________ [1]

[Turn over

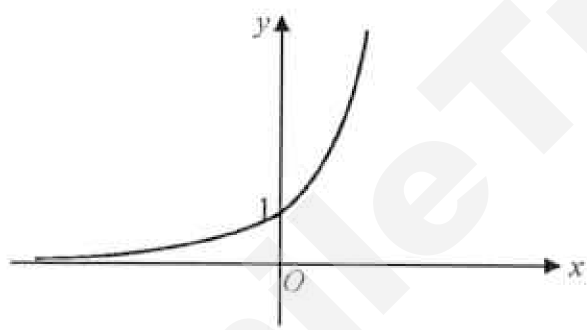
6 **(a)** The sketch represents the graph of $y = kx^n$.

Write down a possible value of k and of n.



Answer (a) $k =$ ________ , $n =$ ______ [2]

(b) Write down a possible equation for this graph.



Answer (b) ____________________ [1]

7 Two geometrically similar fruit juice bottles have base areas of 54 cm^2 and 96 cm^2 respectively.

(a) Find, in its simplest integer form, the ratio of the height of the smaller bottle to the height of the larger bottle.

Answer (a) ____________________ [2]

(b) The capacity of the larger bottle is 1.6 litres.

Find the capacity of the smaller bottle in cubic centimetres.

Answer (b) ________________ cm^3 [2]

---

8 The points A and B are $(1, -3)$ and $(7, 6)$ respectively.

(a) Given that the straight line $m(x + 1) = 4y - 5$ has the same gradient as the line AB, find the value of m.

Answer (a) $m =$ ________________ [3]

(b) Triangle ABC has a line of symmetry $y = -3$.

Find the coordinates of C.

Answer (b) C (_______ , _______) [1]

[Turn over

9 Weekday admission charges for a marine park attraction are \$16 per adult, \$10 per child and \$6 per senior citizen. Weekend admission charges are \$20 per adult, \$12 per child and \$10 per senior citizen.

This information can be represented by the matrix $\mathbf{P} = \begin{array}{cl} \begin{array}{cc} \text{Wkday} & \text{Wkend} \end{array} & \\ \begin{pmatrix} 16 & 20 \\ 10 & 12 \\ 6 & 10 \end{pmatrix} & \begin{array}{l} \text{Adult} \\ \text{Child} \\ \text{Senior Citizen} \end{array} \end{array}$

(a) Mr Tan intends to purchase tickets for 3 adults, 2 children and 2 senior citizens. Mr Lim intends to purchase tickets for 2 adults, 4 children and 1 senior citizen. Represent their intended purchases in a 2×3 matrix **R**.

Answer (a) R = ________________ [1]

(b) Evaluate the matrix **Q** = **RP**.

Answer (b) Q = ________________ [1]

(c) State what the elements of **Q** represent.

Answer (c) ____

____

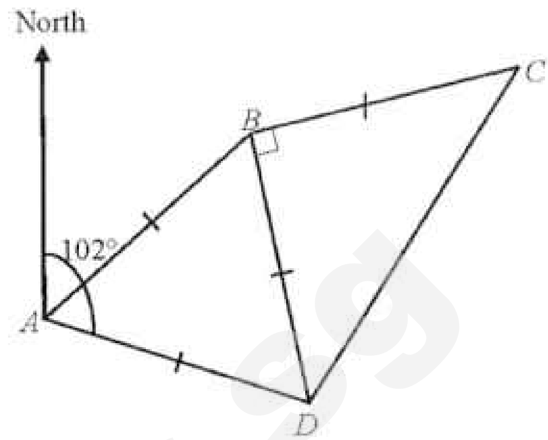
____ [1]

(d) For a certain month, a 10% discount was given per adult, a 20% discount per child and a 50% discount per senior citizen.
Write down a matrix **D**, which, when multiplied with matrix **P**, will show the total savings for a family consisting of an adult, a child and a senior citizen who are considering a weekday or a weekend visit during that month.

Answer (d) D = ________________ [1]

[Turn over

10 The diagram shows the locations of four signposts A, B, C and D on a map. A, B and D form an equilateral triangle. B, C and D form an isosceles triangle and $\angle CBD = 90°$. The bearing of D from A is $102°$ and $AB = 16$ km.



(a) Find the bearing of

(i) B from D,

Answer (a) (i) ________________ ° [2]

(ii) C from B.

Answer (a) (ii) ________________ ° [2]

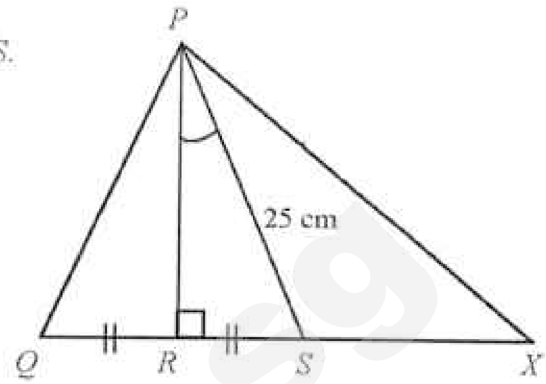
(b) Find how far B is north of A.

Answer (b) ________________ km [2]

[Turn over

11 In the diagram, $QRSX$ is a straight line.

$\angle PRS = 90°$, $PS = 25$ cm, $\sin \angle RPS = \frac{3}{5}$ and $QR = RS$.



(a) Find

(i) the length of QS,

Answer (a) (i)_______________ cm [2]

(ii) the exact value of $\tan \angle PSX$.

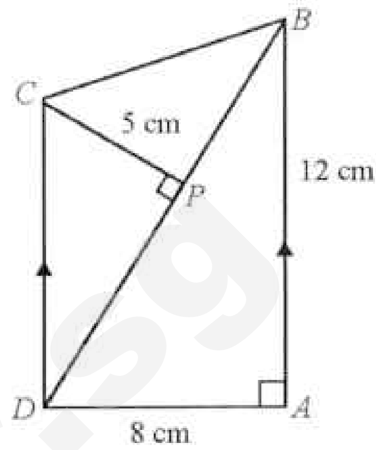
Answer (a) (ii) $\tan \angle PSX =$ _______ [2]

(b) If $2\sin \angle PXS = 3\sin \angle XPS$, find the length of SX.

Answer (b) $SX =$ ____________ cm [2]

[Turn over

12 In the diagram, $ABCD$ is a trapezium and BPD is a straight line.
AB is parallel to DC, $PC = 5$ cm, $AD = 8$ cm and $AB = 12$ cm.
$\angle CPD = \angle DAB = 90^\circ$.



(a) Show that ΔABD is similar to ΔPDC.

Answer (a)

____

____

____

____

____ [2]

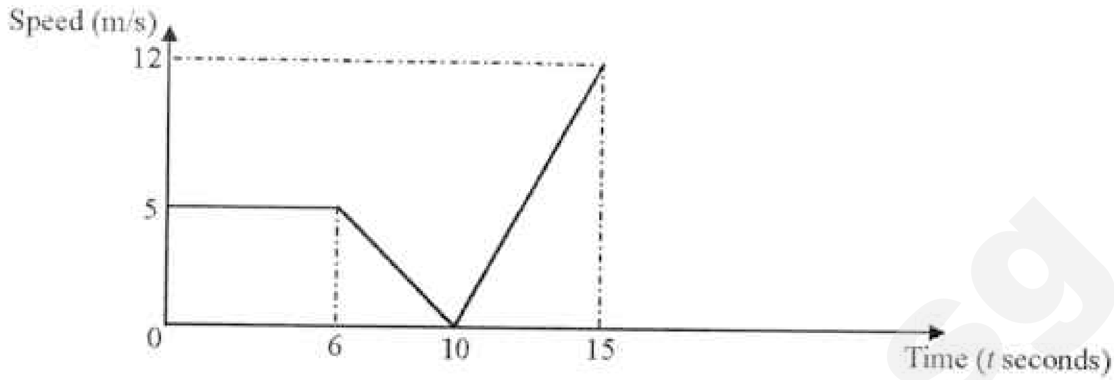
(b) Find the length of PD.

Answer (b) PD = ____________ cm [2]

(c) Find the radius of the circle which passes through the points A, B and D.

Answer (c) ________________ cm [2]

13 The diagram shows the speed-time graph for the first 15 seconds of a journey.



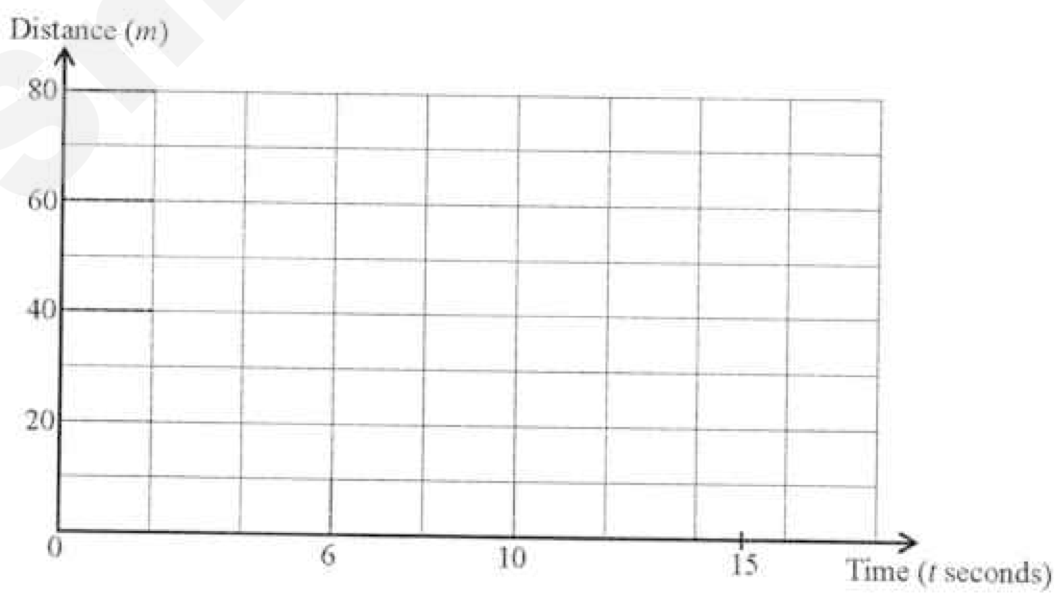
(a) Find the deceleration when $t = 7$.

Answer (a) ________________ m/s^2 [1]

(b) Find the average speed for the first 15 seconds of the journey.

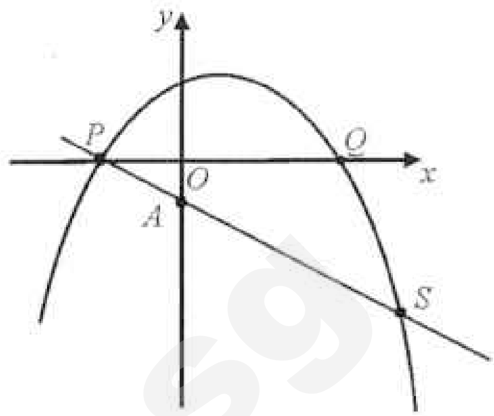
Answer (b) ________________ m/s [2]

(c) On the grid below, draw the distance-time graph for the same journey. [3]



[Turn over

14 The diagram shows a sketch of part of the graph of $y = (2 + x)(3 - x)$. The curve cuts the x-axis at P and Q.



(a) Write down the coordinates of P and Q.

Answer (a) P (________ , ________) [1]

Q (________ , ________) [1]

(b) Find the coordinates of the highest point on the graph.

Answer (b) (________ , ________) [2]

(c) Write down the range of values of x for which the gradient of the curve is negative.

Answer (c) ____________________ [1]

(d) A straight line PS cuts the y-axis at A (0, −2).
Write down, but do not simplify, an equation in x which has the x-coordinates of the points P and S as its solutions.

Answer (d) ____ [2]

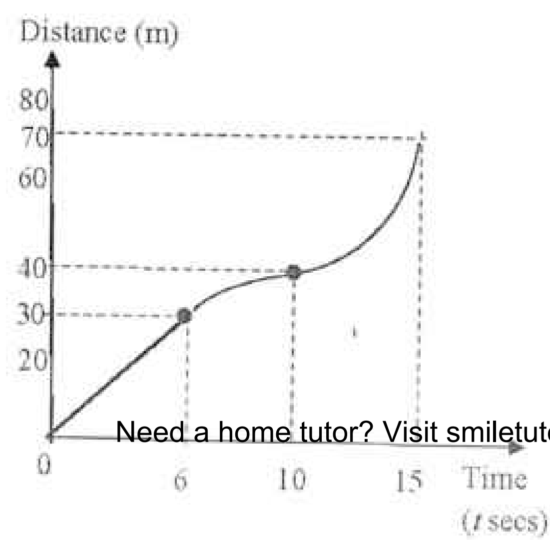
END OF PAPER

[Turn over

1	$10n$
2	$x=-1\frac{2}{3}$ or $x=3$
3	$k=\frac{6}{5}=1\frac{1}{5}$
4a	$1\le x<6\frac{2}{3}$
4b	5
5a	$(x-3)^2-11$
5b	$k=-11$
6a	$k=$ (any - ve number) $n=3$
6b	$y=(\text{any no.}>1)^{(\text{any +ve no.})\,x}$ eg $\boldsymbol{y=e^x}$, $\boldsymbol{y}=3^{2x}$ etc
7a	3 : 4
7b	675
8a	$m=6$
8b	$C\,(7,-12)$
9a	$\mathbf{R}=\begin{pmatrix}3&2&2\\2&4&1\end{pmatrix}$
9b	$\mathrm{Q}=\begin{pmatrix}80&104\\78&98\end{pmatrix}$
9c	The total amounts payable by Mr Tan for weekday tickets and for weekend tickets are \$80 and \$104 respectively. The total amounts payable by Mr Lim for weekday tickets and for weekend tickets are \$78 and \$98 respectively.
9d	$\begin{pmatrix}0.1&0.2&0.5\end{pmatrix}$
10ai **aii**	$342°$ $072°$

10b	11.9 km
11ai	30 cm
11aii	$-\frac{4}{3}$
11b	$16\frac{2}{3}$ cm
12a	$\angle BAD=\angle DPC$ (given $90°$) $\angle ABD=\angle PDC$ (alternate angles, $AB\,//\,CD$) $\therefore$ triangles $\boldsymbol{ABD}$ and PDC are similar
12b	$7\frac{1}{2}$ cm
12c	Radius = 7.21
13a	Deceleration $=1\frac{1}{4}$ m/s^2
13b	$4\frac{2}{3}$ m/s
14a	$P\,(-2,0)$ $Q\,(3,0)$
14b	$\left(\frac{1}{2},6\frac{1}{4}\right)$
14c	$x>\frac{1}{2}$
14d	$(2+x)(3-x)=-x-2$

13c



Class	Register Number	Name

南洋女子中学校

NANYANG GIRLS' HIGH SCHOOL

End-Of-Year Examination 2016
Secondary Three

MATHEMATICS
Paper 2
Monday

10 October 2016

1 hour 30 minutes

0845 - 1015

READ THESE INSTRUCTIONS FIRST

INSTRUCTIONS TO CANDIDATES

1. Answer **all** the questions.
2. Write your answers in and working on the separate answer paper provided.
3. Write your name, register number and class on each separate sheet of paper that you use and fasten the separate sheets together with the string provided. Do not staple your answer sheets together.
4. Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION FOR CANDIDATES

1. The number of marks is given in brackets [ ] at the end of each question or part question.
2. The total number of marks for this paper is 60.
3. You are reminded of the need for clear presentation in your answers.

Setter: Khoo KT

This document consists of 7 printed pages.
NANYANG GIRLS' HIGH SCHOOL

[Turn over

Mathematical Formulae

MENSURATION

Area of triangle $ABC = \frac{1}{2}ab\sin C$

Arc length $= r\theta$, where θ is in radians

Sector area $= \frac{1}{2}r^2\theta$, where θ is in radians

TRIGONOMETRY

Formulae for ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

1 (a) Given that $q = 2\sqrt{\frac{3r}{p-r}}$, express r in terms of p and q. [2]

(b) Factorise $2x^3 - x^2 - 8x + 4$ completely. [2]

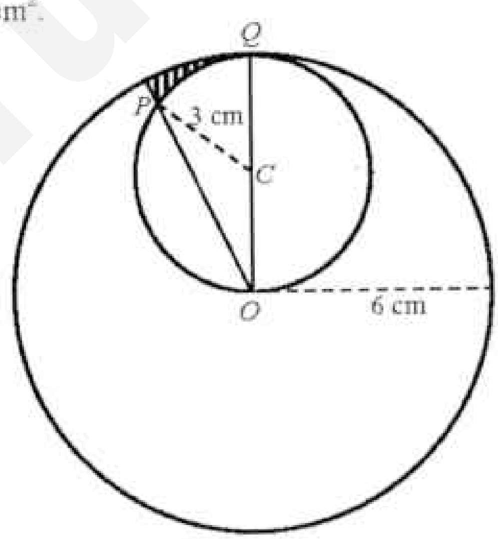
(c) Express $\frac{6}{x^2-9} - \frac{1}{(x-3)}$ as a single fraction in the simplest form. [3]

2 O and C are the centres of two circles with radii 6 cm and 3 cm respectively. P is a point on the circumference of the smaller circle while Q is the point where the two circles meet, as shown in the diagram below.

Angle $POQ = \frac{\pi}{6}$ radian.

(a) Find the length of minor arc PQ, in cm. [2]

(b) Calculate the shaded area, in cm^2. [3]



[Turn over

3 An express bus travels a 240 km journey daily at an average speed of x km/h.

(a) Write down, in terms of x, the time needed (in hours) for the bus to complete the daily journey. [1]

Last Monday, the bus left the bus terminal 10 minutes after the scheduled time of departure. The driver decided to increase the average speed by 5 km/h and managed to reach the destination at the usual time of arrival.

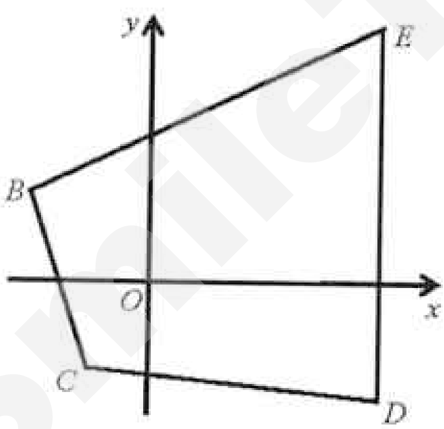
(b) Write down, in terms of x, the time taken to complete the delayed journey. [1]

(c) Using the information given above, show that $x^2 + 5x - 7200 = 0$. [2]

(d) Showing your method clearly, solve the equation $x^2 + 5x - 7200 = 0$, giving both solutions correct to two decimal places. [3]

(e) Find the time taken to complete the delayed journey, giving your answer in hours and minutes, correct to the nearest minute. [2]

4



The diagram above shows a quadrilateral $BCDE$, where B is $(-4, 3)$, C is $(-2, -3)$, D is $(6, -4)$ and E is $(6, 8)$.

(a) Find the equation of the line BE. [2]

(b) BE is extended to a point P where the coordinates are equal. Find the coordinates of P. [2]

(c) Calculate the area of triangle CDE. [2]

(d) A line through C and parallel to DE intersects BE at the point Q.

Determine the value of $\dfrac{\text{area of } \Delta CQB}{\text{area of } \Delta CQE}$. [2]

5 **(a)** In the diagram, O is the centre of the circle which passes through A, B, C and D. SAT is a tangent at A, BOD is a straight line and AC intersects BD at P. $\angle ACB = 56°$ and $\angle CAD = 26°$.

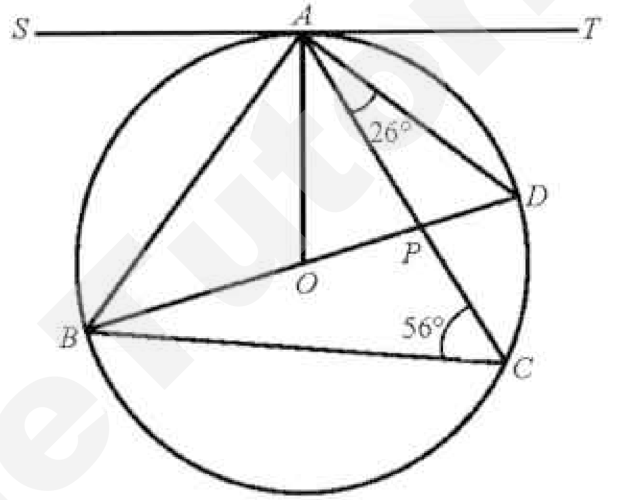
Explain briefly why $\angle OAS = 90°$. [1]

Find

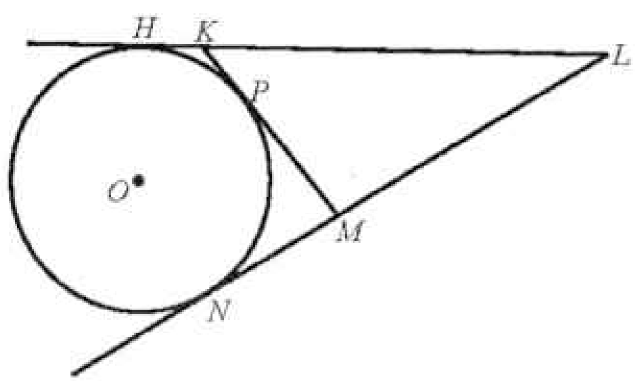
(i) $\angle AOB$,

(ii) $\angle BAS$,

(iii) $\angle OAC$. [3]



(b)

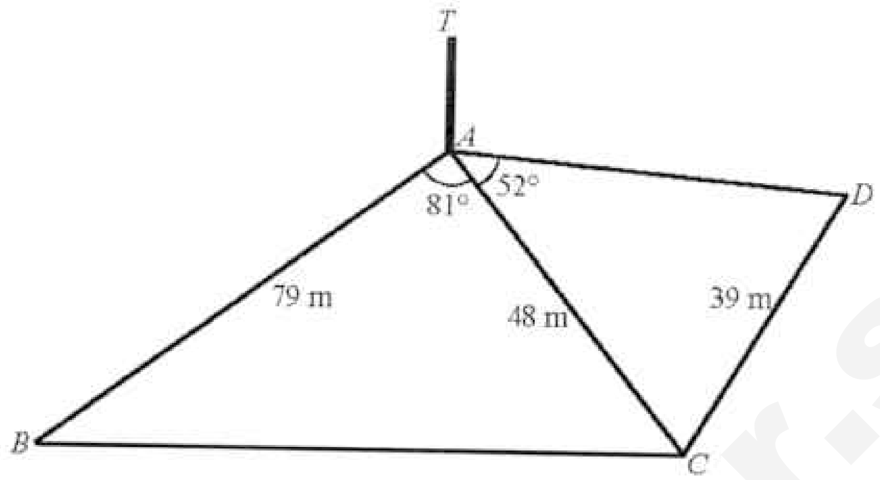


The diagram shows tangents HKL, KPM and LMN touching a circle at H, P and N respectively. The centre of the circle is O. $KL = 8$ cm, $KM = 5$ cm and $LM = 7$ cm.

Find the length of MN. [3]

[Turn over

6



In the diagram, $ABCD$ represents a horizontal field and T represents the top of a vertical tree at the corner A. A footpath runs along the edge BC of the field. $AB = 79$ m, $AC = 48$ m and $CD = 39$ m. $\angle BAC = 81°$ while $\angle CAD = 52°$.

(a) Given that the angle of depression of B from T is $6°$, calculate the height of the tree. [2]

(b) Find $\angle ADC$. [2]

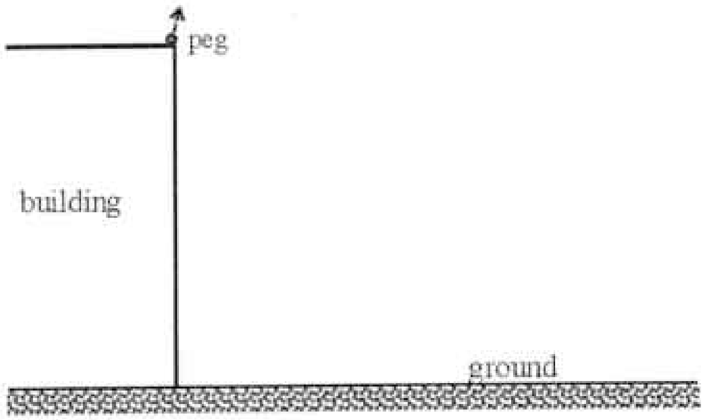
(c) Calculate the length of the footpath BC. [2]

(d) Calculate the area of triangle ABC. [2]

(e) Find the shortest distance from A to the footpath BC. [2]

(f) Find the greatest possible angle of elevation of the top of the tree when viewed from a point on the footpath BC. [2]

7 **Answer the whole of this question on a sheet of graph paper.**



A peg is projected upwards from the edge of the top of a building, as shown in the diagram above. The vertical height of the peg above the building, h metres, at t seconds after it is projected, is given by the equation $h = 6t(4-t)$.

The table below shows some values of t and the corresponding values of h.

t (seconds)	0	0.5	1	1.5	2	3	3.5	5
h (metres)	0	10.5	18	22.5	24	18	10.5	–30

(a) Using a scale of 2 cm to represent 1 second, draw a horizontal t-axis for $0 \le t \le 5$. Using a scale of 2 cm to represent 10 metres, draw a vertical h-axis for $-30 \le h \le 30$.

On your axes, plot the points given in the table above and join them with a smooth curve. [3]

(b) Use your graph to find

(i) the greatest distance of the peg above the top of the building, and the value of t when this happens,

(ii) the duration of time when the peg is at least 21 metres above the top of the building. [3]

(c) **(i)** By drawing a tangent, find the gradient of the curve when $t = 3$.

(ii) Explain what your answer to **c(i)** tells you about the motion of the peg when $t = 3$. [3]

(d) The peg hits the ground 5 seconds after it is projected. Deduce the height of the building. [1]

(e) By inserting a straight line on the same axes, solve the equation $3t^2 - 17t + 5 = 0$ for $0 \le t \le 5$. [2]

END OF PAPER

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2016 S3 EOY Exams Math P2 Answer Key

	Answers
1(a)	$r = \frac{pq^2}{12+q^2}$.
1(b)	$(2x-1)(x-2)(x+2)$
1(c)	$-\frac{1}{x+3}$

Qn	Answers
2(a)	π cm.
2(b)	The shaded area $= 0.815\ \text{cm}^2$

Qn	Answers
3(a)	$\frac{240}{x}$ h
3(b)	$\frac{240}{x+5}$ h
3(c)	$\frac{240}{x} - \frac{240}{x+5} = \frac{1}{6}$ To show $\therefore x^2 + 5x - 7200 = 0$.
3(d)	$x = 82.39$ or 87.39
3(e)	Time taken = 2 hours 45 minutes.

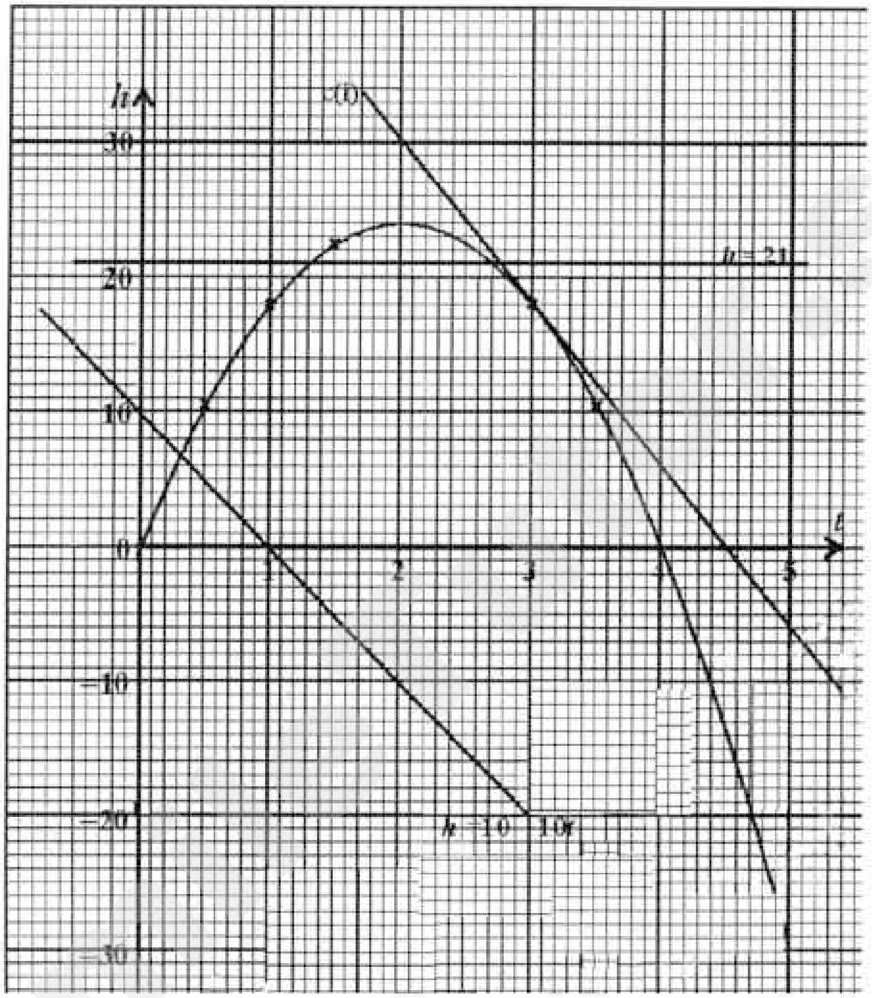
Qn	Answers
4(a)	$y = \frac{1}{2}x + 5$.
4(b)	$\therefore$ The coordinates of P are (10, 10).
4(c)	The area of $\Delta CDE = 48$ square units
4(d)	$\frac{\text{area of } \Delta CQB}{\text{area of } \Delta CQE} = \frac{BQ}{QE} = \frac{1}{4}$.

Qn	Answers
5(a)	The radius of a circle is perpendicular to the tangent at the point of contact.
(i)	$\angle AOB = 112°$
(ii)	$\angle BAS = 56°$
(iii)	$\angle OAC = 30°$
5(b)	$\therefore MN = 3$ cm.

6(a)	Height ≈ 8.30 m
6(b)	$\angle ADC \approx 75.9°$
6(c)	$BC \approx 85.8$ m.
6(d)	The area of ΔABC $\approx 1873\ \text{m}^2$.
6(e)	The shortest distance ≈ 43.7 m.
6(f)	The greatest angle of elevation $\approx 10.8°$

7

t (seconds)	0	0.5	1	1.5	2	3	3.5	5
h (metres)	0	10.5	18	22.5	24	18	10.5	−30



(b) (i) The greatest distance = 24 m, when $t = 2$

(ii) $1.3 \leq t \leq 2.7$ OR 1.4 sec

(c) (i) The gradient = −12

(ii) When $t = 3$, the peg is falling at a speed of 12 m/s

(d) The height of the building is 30 m.

(e) From $3t^2 - 17t + 5 = 0$, get $10 - 10t = 6t(4 - t)$.

Correct line of $h = 10 - 10t$

$t = 0.3$

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For Examiner's Use

Answer all the questions

1 Solve $15-\frac{x}{4}=2$.

Answer x = ... [1]

2 John played four rounds of golf.
His score has a mean of 65, a mode of 68 and a median of 66.

Find the four scores.

Answer ...., ..., ..., ... [2]

3 (a) Calvin thinks of a two-digit number.
It is a factor of 1320.
It is a prime number.

What is his number?

Answer (a) .... [1]

(b) Written as a product of its prime factors, $504=2^3\times3^2\times7$. Find the smallest positive integer value of n for which $70n$ is a multiple of 504.

Answer (b) .... [1]

[Turn over

For Examiner's Use

4 **(a)** Find the range of values of w such that $(2w-5)°$ is an obtuse angle.

Answer (a) .... [1]

(b) **Hence** write down the smallest integer that satisfies the range of values of w.

Answer (b) .... [1]

5 Factorise fully $9by-6bx-3ay+2ax$.

Answer .... [2]

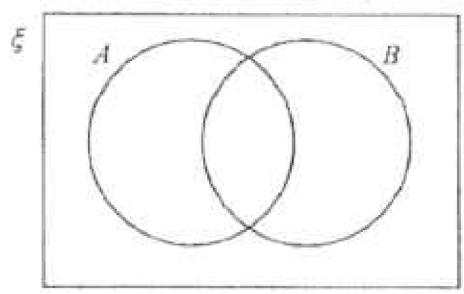
6 ξ = {positive integers x : $x<10$}
A = {factors of 8}
B = {odd numbers}

(a) List the elements in $A \cap B'$.

Answer (a) .... [1]

(b) On the Venn diagram, shade the region which represents $A \cap B'$.

Answer (b)



[1]

For Examiner's Use

7 $\mathbf{X}=\begin{pmatrix}2 & -3\\ 7 & 1\end{pmatrix}$ $\mathbf{Y}=\begin{pmatrix}10 & 3\\ 14 & -2\end{pmatrix}$

(a) Find $2\mathbf{X}-\mathbf{Y}$.

Answer (a) .... [1]

(b) Without evaluating $\frac{1}{3}\mathbf{Y}\begin{pmatrix}\frac{4}{5} & 0.5 & 3.7\\ 3 & \frac{1}{9} & 4.5\end{pmatrix}$, state the order of the result of

$\frac{1}{3}\mathbf{Y}\begin{pmatrix}\frac{4}{5} & 0.5 & 3.7\\ 3 & \frac{1}{9} & 4.5\end{pmatrix}$

Answer (b) .... [1]

8 Given that the lines $y=\frac{1}{3}x-4$ and $(9-2p)y=20+px$ are parallel, find the value of p.

Answer p = ... [2]

For Examiner's Use

9 (a) Write 0.000 007 82 in standard form.

Answer (a) .... [1]

(b) The total amount of waste collected is 7.67 million tonnes and 2878.6 thousand tonnes were disposed at the incinerator plants.

Calculate the percentage of waste disposed at the incinerator plants.

Answer (b) .... % [2]

---

10 Simon notices that his clock display shows 06 12.

06 : 12

He looks at his clock again between 08 00 and 09 00.
What is the probability that

(a) the clock display shows 10 00?

Answer (a) .... [1]

(b) the last digit in the clock display shows a 5?

Answer (b) .... [2]

---

11 Given that $5^x = 9$, write down the value of

(a) 5^{-x},

Answer (a) .... [1]

(b) $5^{\frac{x}{2}}$,

Answer (b) .... [1]

(c) 5^{x+1}.

Answer (c) .... [1]

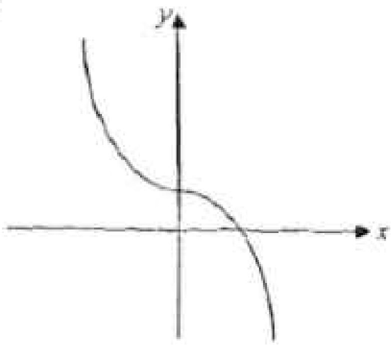
For Examiner's Use

12

$y = 3 - x^2$	$y = x^3 + 5$	$y = -x^3 + 5$
$y = -2^x$	$y = -3 + x^2$	$y = 2^{-x}$

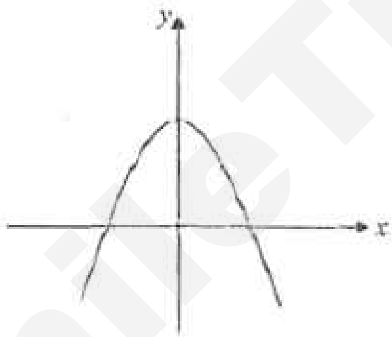
Write down a possible equation for each of the sketch graphs below.
In each case select one of the equations from the box above.

(a)



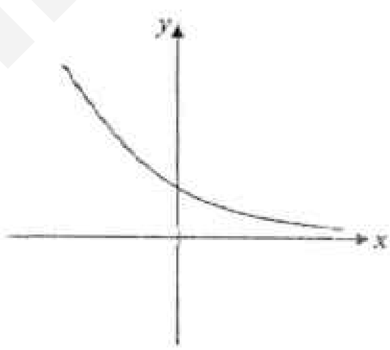
Answer (a) .... [1]

(b)



Answer (b) .... [1]

(c)



Answer (c) .... [1]

For Examiner's Use

13 8 spheres, each of radius 3 cm, have a total volume of $k\pi$ cm^3.

(a) Find the value of k.

Answer (a) k = ... [1]

(b) The spheres are placed inside an open cylinder, with radius 6 cm.
The cylinder stands on a horizontal surface and contains enough water to cover the spheres.

Calculate the change in depth of the water when the spheres are taken out of the cylinder.

Answer (b) .... cm [2]

14 A straight line passes through the points P (−4, 13) and Q (0, 5).

(a) Calculate the length of the line joining P and Q.

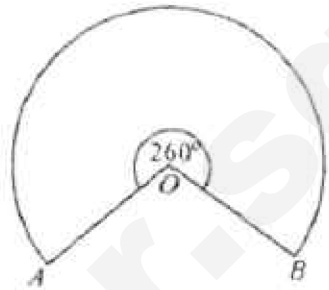
Answer (a) .... [2]

(b) Find the equation of the line PQ.

Answer (b) .... [2]

For Examiner's Use

15 The diagram shows the major sector of a circle, centre O and radius 15 cm.
The reflex angle AOB is 260°. A cone is formed by joining OA and OB together.



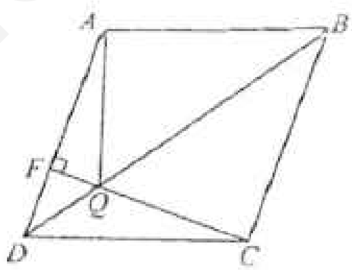
Calculate the
(a) radius of the cone,

Answer (a) .... cm [2]

(b) height of the cone.

Answer (b) .... cm [2]

16 $ABCD$ is a rhombus. CF is perpendicular to AD and intersects BD at Q.



(a) Prove that triangle CQB is congruent to triangle AQB.

Answer (a)

....

....

....

.... [3]

(b) Name two other triangles that are congruent.

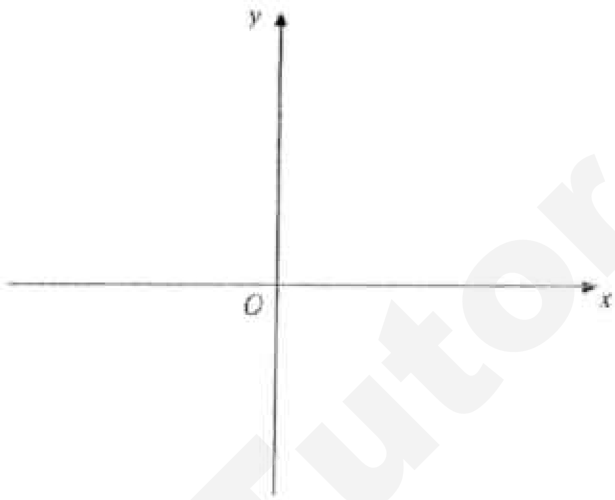
Answer (b) .... and .... [1]

For Examiner's Use

For Examiner's Use

17 **(a)** Sketch the graph of $y = (2 - x)(x + 3)$.

Answer (a)



[2]

(b) State the equation of the line of symmetry of the graph.

Answer (b) .... [1]

(c) Find the turning point of the graph.

Answer (c) (.............. , ...) [1]

For Examiner's Use

18 (a) The first four terms in a sequence are 67, 75, 83 and 91.

(i) Find an expression, in terms of n, for the nth term T_n, of this sequence.

Answer (a)(i).............................. [1]

(ii) Evaluate T_{21}.

Answer (a)(ii) .... [1]

(b) The scores of a group of 21 students were recorded.
The results are shown in the stem-and-leaf diagram.

2	5	6	7	7		
3	2	2	4			
4	5	5	5	6		
5	0	0	3	7	7	
6	1	8	8	8	9	

Key 3 | 2 means 32

(i) State the median score.

Answer (b)(i).............................. [1]

(ii) It was discovered that the scores had been recorded incorrectly.
The corrected scores are all 3 marks less than those recorded.

Explain how the mean of the corrected scores has been affected by this error.

Answer (b)(ii)

....

.... [1]

For Examiner's Use

19 **(a)** The line PQ is shown below. R is a point above PQ.
Construct the triangle PQR in which $\angle QPR = 40^\circ$ and $PR = 7$ cm.

[2]

(b) The point G is on the same side of PQ as R.
Find and label point G for which it is 5 cm away from point R and equidistant from point P and Q. [3]

For Examiner's Use

20 (a) The scale of a map is 1 cm : 0.25 km.

(i) The distance between the stadium and the airport is 14 km.
Find the distance between the stadium and the airport on the map.

Answer (a)(i) .... cm [1]

(ii) The area of the stadium on the map is 32 cm^2.
Calculate the actual area of the stadium.

Answer (a)(ii) .... km^2 [2]

(b) In a football league, each team gains 3 points for a win, 1 point for a draw and 0 point for a loss. The champion of the league plays 38 games and gains a total of 92 points.

Given that the champion does not lose any games, find the number of games that the champion wins.

Answer (b) .... [3]

For Examiner's Use

21 **(a)** A restaurant sells wine by the glass. The table lists the prices.

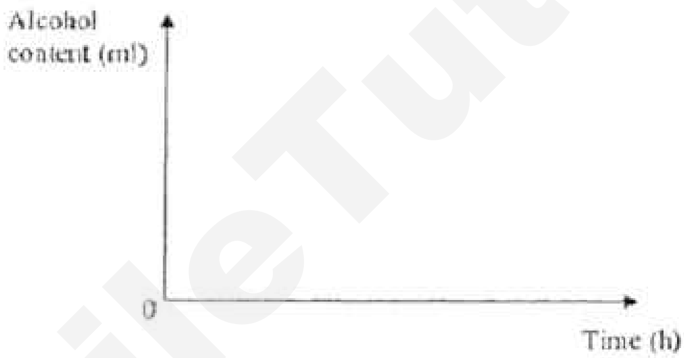
Glass 125 ml	$ 35
Glass 175 ml	$ 50
Glass 250 ml	$ 70

Determine whether the price of a glass of wine is directly proportional to the amount of wine. Justify your answer.

Answer (a) .... [1]

(b) The alcohol content in a glass of 250 ml is found to be 30 ml. Given the constant rate of decay of alcohol is 13ml/h, sketch a graph to represent the decay of 30 ml of alcohol. Label your intercept(s) clearly, if any.

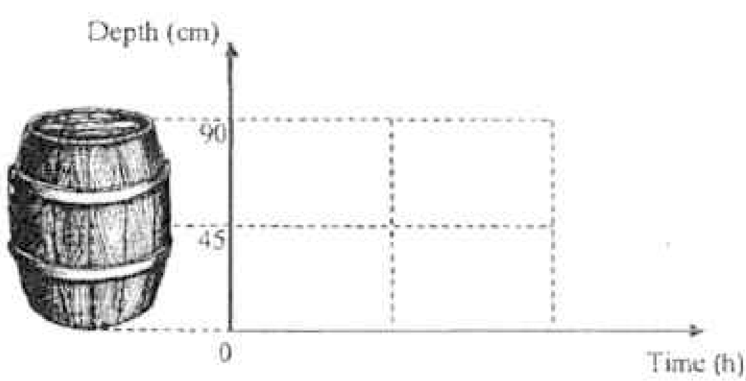
Answer (b)



[2]

(c) The 225-litre wine barrel is symmetrical about its biggest cross-sectional area in the middle. Wine is leaking through a hole at the base of the barrel at a constant rate of 15 ml per minute.

Complete the sketch below and fill in the time taken for the barrel to be completely emptied.



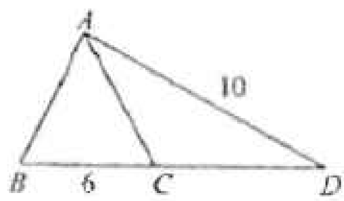
[3]

For Examiner's Use

22 (a) One approximate solution of the equation $\sin y° = 0.41$ is $y = 24.2$.
Use this value of y to find the solution of the equation that lies between 90° and 180°.

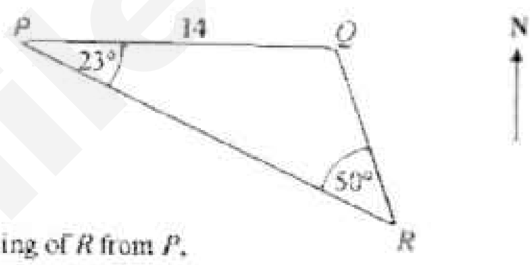
Answer (a) $y =$ .... [1]

(b) In the diagram, BCD is a straight line.
$BC = 6$ cm and $AD = 10$ cm.
Given that the area of $\Delta ABC = 14\text{ cm}^2$, find the exact value of $\sin\angle ADC$.



Answer (b) $\sin\angle ADC =$ .... [2]

(c) P, Q and R represent three islands that are on level ground such that P is 14 km due west of Q. Angle $QPR = 23°$ and angle $PRQ = 50°$.



Calculate
(i) the bearing of R from P.

Answer (c)(i) .... ° [1]

(ii) the distance RP.

Answer (c)(ii) .... km [2]

For Examiner's Use

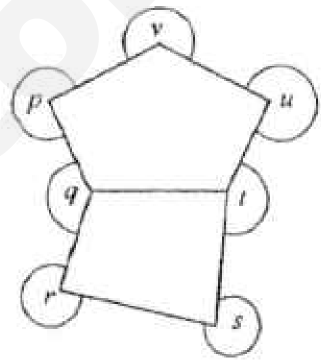
23 (a) One of the angles of an isosceles triangle is 32°.

Write down the possible values for the remaining two angles.

Answer (a) .... and ....

.... and .... [2]

(b) Calculate the sum of the angles p, q, r, s, t, u and v shown in the diagram.



Answer (b) .... [2]

(c) A regular polygon has n sides. Each exterior angle is $\frac{n}{40}$ degrees.

Find the size of each of an interior angle of this polygon.

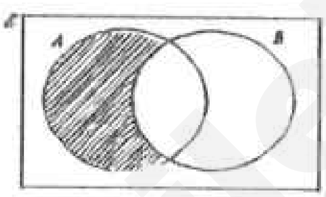
Answer (c) .... [3]

End of paper

1 52

2 60, 64, 68, 68

3a 11
3b 36
4a $47.5 < w < 92.5$
4b 48
5 $(3b - a)(3y - 2x)$
6a 2, 4, 8 or $A \cap B = \{2, 4, 8\}$
6b



7a $\begin{pmatrix} -6 & -9 \\ 0 & 4 \end{pmatrix}$

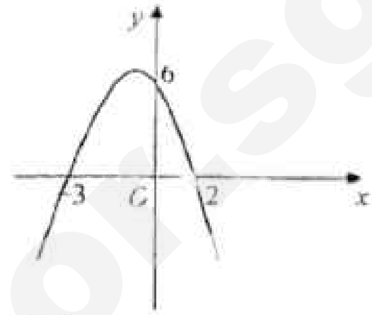
7b 2×3

8 1.8

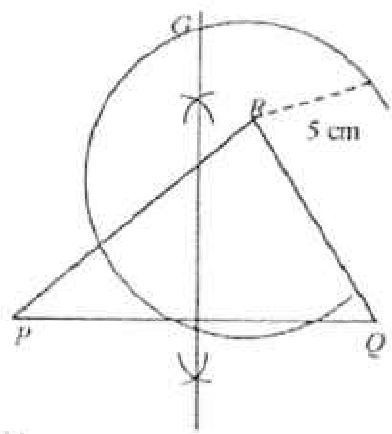
9a 7.82×10^{-6}

16b ΔAQD and ΔCQD
ΔABD and ΔCDB
ΔABC and ΔADC / ΔCDA

17a



17b $x = -0.5$
17c $(-0.5, 6.25)$
18ai $59 + 8n$
18aii 227
18bi 46
18bii The mean will reduce by 3
19



20ai 56

20aii $1\text{ cm}^2 : 0.0625\text{ km}^2$
2

20b $3x + y = 92$
$x + y = 38$

27

21a Not proportion because $\frac{125}{35} \neq \frac{175}{50}$

9b 37.5 %

10a 0

10b $\frac{6}{59}$

11a $\frac{1}{9}$

11b 3

11c 45

12a $y=-x^2+5$

12b $y=3-x^2$

12c $y=2^{-x}$

13a 288

13b $\frac{288\pi}{\pi(6)^2}$

$=8$

14a 8.94

14b $y=2x+5$

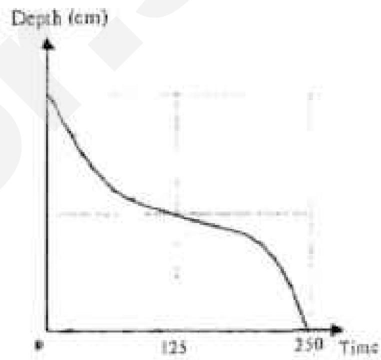
15a $10\frac{5}{6}$, 10.8, 10.83

15b $\sqrt{15^2-(10\frac{5}{6})^2}$

$=10.4$

21b

21c



22a 155.8

22b $\frac{7}{15}$

22ci 113

22cii $RP=17.5$

23a 32 and 116
74 and 74

23b 1620

23c 177

16a	QB is common side AB = CB (sides of rhombus) $\angle ABQ = \angle CBQ$ (diagonals of rhombus bisect)		

Mathematical Formulae

Mensuration

Curved surface area of a cone $= \pi r l$

Curved surface area of a sphere $= 4\pi r^2$

Volume of a cone $= \frac{1}{3}\pi r^2 h$

Volume of a sphere $= \frac{4}{3}\pi r^3$

Area of triangle $ABC = \frac{1}{2}ab\sin C$

Arc length $= r\theta$, where θ is in radians

Sector area $= \frac{1}{2}r^2\theta$, where θ is in radians

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

1 (a) Express $\frac{5x+1}{2x^2-x-6}+\frac{2}{2-x}$ as a single fraction in its simplest form. [3]

(b) Factorise $49m^4-(m^2-m)^2$ completely. [3]

(c) Express x^2-6x-5 in the form $(x-b)^2+c$.

Hence, solve $x^2-6x-5=0$, giving your answers correct to 2 decimal places. [4]

(d) Given that $\sqrt{\frac{k-p}{p}}=\frac{k}{2}$, express p in terms of k. [3]

---

2 (a) Mr Lim spends $\$x$ on petrol originally. When the cost of petrol rose by 8%, he decreased his petrol consumption by 8%. He claimed that there was no change in his expenditure on petrol. Explain if he is right or wrong. [2]

(b) A team of 3 players, Adam, Bruce and Calvin won \$10 000 in a competition.

(i) The money is to be divided among them in the ratio of 1 : 2 : 5 respectively.

Calculate

(a) the amount Adam will receive, [1]

(b) the percentage of the total sum that Bruce will get, [1]

(c) angle that will represent Calvin's share if the money distribution is to be represented on a pie chart. [2]

(ii) If they donated k% of the total prize money of \$10 000, the ratio becomes 1 : 3 : 6 respectively and Calvin now received \$4800.

(a) Find the value of k. [3]

(b) Calculate how much more or less will Adam get with this arrangement as compared to the one in part (i). [2]

3 A factory produces sports equipment.

(a) In 6 hours, it produces x floorball sticks.
Write down an expression, in terms of x, for the number of hours it takes to produce one floorball stick. [1]

(b) In 6 hours, it produces 15 less badminton rackets than floorball sticks.
Write down an expression, in terms of x, for the number of hours it takes to produce one badminton racket. [1]

(c) It takes 2 minutes longer to produce one badminton racket than one floorball stick.
Form an equation in x and show that it reduces to $x^2 - 15x - 2700 = 0$. [3]

(d) Solve the equation $x^2 - 15x - 2700 = 0$ [2]

(e) Find the time taken to produce 800 badminton rackets.
Give your answer in hours and minutes. [2]

4 There are three types of tickets available for sale for a concert.

Some of the information regarding the sale of the tickets are summarised in the table below.

	Type 1	Type 2	Type 3
Cost of 1 ticket (Saturday)	\$48	\$68	\$88
Cost of 1 ticket (Sunday)	\$68	\$88	\$108
Number of tickets available for sale per day	100	60	40

(a) Represent the cost of tickets in a 2×3 matrix **P**. [1]

(b) Represent the number of tickets available per day in a 3×1 column matrix **Q**. [1]

(c) Evaluate $\begin{pmatrix} 2 & 2 & 2 \end{pmatrix}\mathbf{Q}$ and state what your answer represent. [2]

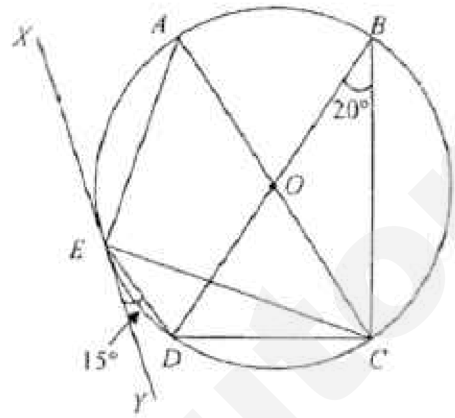
(d) It is given that 20, 9 and 4 tickets for Type 1, Type 2 and Type 3 tickets respectively for both days were unsold.

(i) Find a 3×1 column matrix **R** whose elements represent the number of different types of tickets sold per day. [2]

(ii) Evaluate **PR** and hence find the total revenue for the weekend. [3]

5 In the diagram, A, B, C, D and E are five points on the circle with centre O and diameters AC and BD. XEY is a tangent to the circle at E.

Angle $DBC = 20°$ and angle $DEY = 15°$.



(a) Giving your reasons, find

(i) $\angle DEC$, [1]

(ii) $\angle DOC$, [1]

(iii) $\angle DCE$, [1]

(iv) $\angle ABC$, [1]

(v) $\angle EAC$. [1]

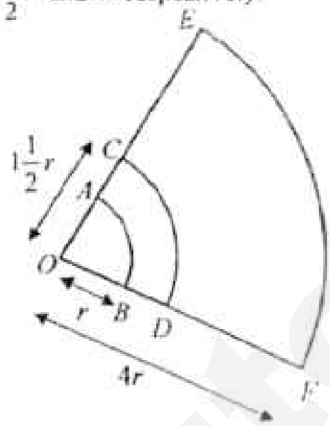
(b) Determine if AC is parallel to XEY. [2]

(c) A student claims that a new circle can be drawn using the points E, O, C and D to form a cyclic quadrilateral. Do you agree? Justify your answer with clear explanation. [3]

(d) If $AE = 8.5$ cm, find the radius of the circle. [2]

4048/2/Sec3YearEnd16 [Turn over

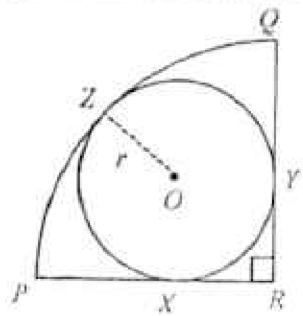
6 (a) The diagram shows the minor arcs AB, CD and EF of three concentric circles, centre O with radii r, $1\frac{1}{2}r$ and $4r$ respectively.



(i) Find the ratio of arc AB to arc EF. [1]

(ii) Find the ratio of the area of sector OCD to the area of sector OEF. [2]

(b) The diagram shows a circle of radius r cm, centre O. PR and QR are two tangents which are perpendicular to each other and they touch the circle at X and Y respectively. PQ is an arc of a circle, centre R, radius 18 cm.



Given that arc PQ meets the circle with centre O at Z,

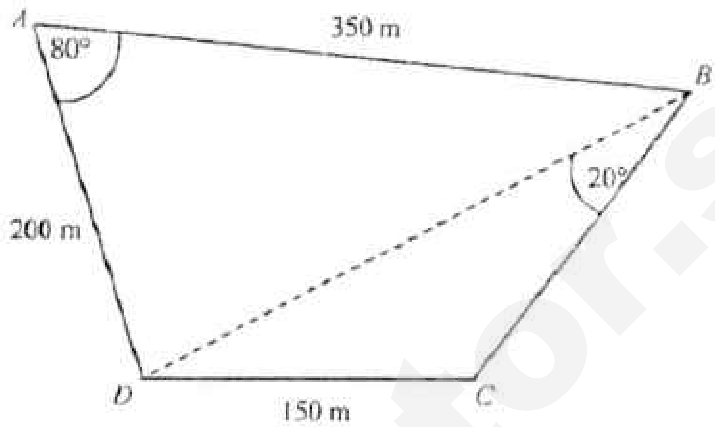
(i) show that $r = 7.456$ cm, [3]

(ii) calculate the area of PQR not covered by the circle. [3]

7 The diagram shows a plot of land $ABCD$ on horizontal ground.

$AB = 350$ m, $AD = 200$ m, angle $DAB = 80°$ and angle $DBC = 20°$.

Angle DCB is obtuse.



(a) Calculate

(i) the distance BD, [3]

(ii) angle BDC. [3]

(b) At noon, the farmer standing at A observes a hot air balloon, H directly above D.

The angle of elevation of the hot air balloon from the farmer at A is 19°.

(i) Calculate the height HD. [2]

(ii) The hot air balloon rises vertically at a constant speed of 1.5 m/s. Find the new angle of elevation of the hot air balloon from the farmer at A 3 minutes later. [3]

8 **Answer the whole of this question on a piece of graph paper.**

The number of bacteria, N units in a food item in time, t minutes are connected by the equation $N = 35(2^{t-1})$.

t	0	0.5	1	1.5	2	2.4	2.5
N	17.5	24.7	35	49.5	70	a	99.0

(a) Calculate the value of a. [1]

(b) Using the scale of 4 cm to represent 1 unit, draw a horizontal t-axis for $0 \le t \le 2.5$.
Using the scale of 2 cm to represent 10 units, draw a vertical N-axis for $0 \le N \le 100$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]

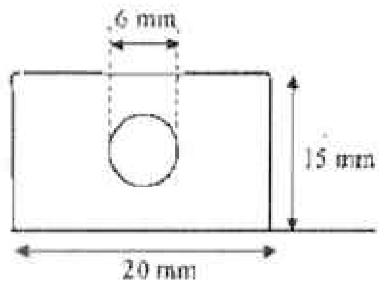
(c) Use your graph to find the range of values of t for $75 < 35(2^{t-1}) \le 80$. [2]

(d) By drawing a tangent, find the gradient of the curve at $(1, 35)$.
State what does this tangent represent. [3]

(e) Use your graph to solve the equation $35(2^{t-1}) + 5t - 80 = 0$. [3]

(f) When $t \ge k$ minutes, the number of bacteria has increased by 200% from its original amount and the food item is not safe to be consumed.
Use your graph to determine this value of k. [2]

9 The diagram shows the cross-section of a pendant, which is in the form of a rectangular prism of sides 20 mm by 15 mm and thickness 5 mm with a circular hole of diameter 6 mm drilled in the centre along the axis of the prism.



(a) Find the cross section area, in mm^2 of the pendant. [2]

(b) Find the volume of the pendant, in mm^3. [2]

(c) The manufacturer claims that the pendant is made of pure silver and has a mass of 0.48 oz. Justify his claim using the additional information given below. [5]

Density of pure silver = 10.5 g/cm^3
1 ounce (oz) = 28.35 g

(d) The manufacturer decides to melt the original pendant to form more than one identical cone.
The radius of the base of the cone is 5 mm and the height of the cone is 10 mm.
How many complete cones can he make? [3]

END OF PAPER

[Turn over

Answers

1(a) $\frac{x-5}{(x-2)(2x+3)}$ (b) $m^2(8m-1)(6m+1)$ (c) $(x-3)^2-14$
$x = 6.74, -0.74$

(d) $p = \frac{8k}{k^2+8}$

2(a) He is wrong.
New exp is 99.36%x (b)(i)(a) $1250 (b) 25% (c) 225% (ii)(a) 20 (b) $450 less

3(a) $\frac{6}{x}$ (b) $\frac{6}{x-15}$ (d) $x = 60$ or $x = -45$
(e) 106 h 40 mins

4(a) $\mathbf{P} = \begin{pmatrix} 48 & 68 & 88 \\ 68 & 88 & 108 \end{pmatrix}$

4(b) $\mathbf{Q} = \begin{pmatrix} 100 \\ 60 \\ 40 \end{pmatrix}$

4(c) (400)
Total number of tickets available for sale for Saturday and Sunday.

4(d)(i) $\mathbf{R} = \begin{pmatrix} 80 \\ 51 \\ 36 \end{pmatrix}$

4(e)(ii) $\begin{pmatrix} 10476 \\ 13816 \end{pmatrix}$
Total revenue for the weekend= $24292

5(a)(i) 20°
5(a)(ii) 40°
5(a)(iii) 15°
5(a)(iv) 90°
5(a)(v) 35°
5(c) $\angle OEY = 90°$ (tangent ⊥ radius)
$\angle OED = 75°$
$\angle OCD = 15 + 55$
$= 70°$
Since $\angle OED + \angle OCD = 145° \neq 180°$
They are not angles in opposite segments.
Do not agree/Points do not form a cyclic quadrilateral.
5(d) 5.188 cm

6(a)(i)	$\frac{1}{4}$ (ii) $\frac{9}{64}$
6(b)(ii)	79.82 cm^2
7(a)(i)	372m
7(a)(ii)	38.0°
7(b)(i)	68.9m
7(b)(ii)	59.5°
8(a)	a=92.4
8(c)	$2.1 < t \leq 2.2$
8(d)	24.53 How fast bacteria increase/change with time/ rate of change of number of bacteria
8(e)	$t = 2$
8(f)	1.6
9(a)	272mm^2
9(b)	1360 mm^3
9(c)	His claim is NOT TRUE.
9(d)	He can make 5 complete cones.

[Turn over