READ THESE INSTRUCTIONS FIRST

Write your name, class and index number in the spaces on the top of this 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.

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 \( \pi \), use either your calculator value or 3.142, unless the question requires the answer in terms of \( \pi \).

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 50.
Answer all the questions

1. Expand and simplify \(2(2 - m)^2 - m(5 - 4m)\).

   Answer: ........................................... [2]

2. The mean weight of 40 students in a class is 52.6 kilograms. After one student is removed from the class, the mean weight decreased to 52.2 kilograms. Find the weight of the student who was removed from the class.

   Answer: .....................kg [2]

3. Given that \(a - b = 3\) and \(ab = 5\), find, without the use of a calculator, the value of \(a^2 + b^2\).

   Answer: ......................... [2]
4. \( y \) is inversely proportional to the square of \( x \). When \( x = 4 \), \( y = 0.25 \).

(a) Find the values of \( x \) when \( y = 25 \).

Answer (a): \( x = \) ......................... [3]

(b) Describe the change in \( y \) when \( x \) is halved.

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

5. (a) Solve \( 3x^2 + 7x - 6 = 0 \).

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

(b) Hence state the positive value of \( y \) for which \( \frac{3}{y^2} + \frac{7}{y} - 6 = 0 \).

Answer (b): \( y = \) ......................... [1]
6. Factorise completely

(a) $28x^2 - 343$

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

(b) $6a^2 - 3ay - 8y + 16a$

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

7. A crane arm 20 meters long lowers a parcel from $A$ to $B$. When the parcel is at $A$, the crane arm makes an angle of $55^\circ$ with the horizontal. When the parcel is at $B$, the crane arm makes an angle of $20^\circ$ with the horizontal.

Find the vertical distance moved by the parcel.

Answer: ....................... m [3]
(a) Triangle $ABC$ and triangle $PQR$ are congruent.

$BC = 6$ cm, $PR = 15$ cm and angle $ABC = 90^\circ$.

Find angle $PRQ$.

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

(b) A right pyramid with square base of side 2 cm has a volume of $20$ cm$^3$.

Calculate the height of the pyramid.

Answer (b): .................................. cm [2]
The waiting times, to the nearest minute, of twelve customers queuing at the cashier of a supermarket are recorded as a list:

4, 3, 4, 2, 5, 3, 4, 1, 2, 6, 3, 4

(a) Complete the dot diagram.

Answer (a):

(b) Find the median.

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

(c) Find the mode.

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

(d) The supermarket manager claims that the distribution of waiting times is evenly distributed. Do you agree with his claim? Give a reason for your answer.

Answer (d): I agree/disagree because .................................................................
.................................................................
Each letter of the word “PIONEERS” is written on an identical card. The cards are then placed inside a box. Rainee picks a card at random from the box.

Find the probability that

(a) the letter P is chosen,

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

(b) the letter A is chosen,

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

(c) the letter E or S is chosen,

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

(d) a letter with a horizontal line of symmetry is chosen.

Answer (d): ..................[1]
11 Solve the following equations.

(a) \( \frac{x + 3}{7} - \frac{4x - 5}{6} = x \)

Answer (a): \( x = \ldots \quad [2] \)

(b) \( \frac{y - 1}{y + 2} = \frac{y}{3y + 2} \)

Answer (b): \( y = \ldots \quad [3] \)
A solid cylinder of base radius 8 cm and length 25 cm has a square cross section of diagonal 12 cm removed from the cylinder, as shown in the diagram.

Find the total surface area of the remaining solid.

*Answer*: ................. cm$^2$ [5]
The Day Safari charges $x$ for an adult ticket and $y$ for a child ticket. The Lee family consists of 2 adults and 3 children. They paid a total of $49. The Lim family consists of 3 adults and 1 child. They paid a total of $56. Write down two equations in terms of $x$ and $y$. Hence find the value of $x$ and of $y$.

\[ \text{Answer : } x = \ldots, y = \ldots [4] \]

Thomas measured the heights of 30 students in his class. The table below shows the results.

<table>
<thead>
<tr>
<th>Heights (cm)</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>$130 &lt; h \leq 140$</td>
<td>6</td>
</tr>
<tr>
<td>$140 &lt; h \leq 150$</td>
<td>$k$</td>
</tr>
<tr>
<td>$150 &lt; h \leq 160$</td>
<td>8</td>
</tr>
<tr>
<td>$160 &lt; h \leq 170$</td>
<td>5</td>
</tr>
</tbody>
</table>
(a) Find the value of $k$. 

Answer (b): $k = \ldots \ldots [1]$

(b) On the grid below, draw the histogram representing the data.
Use a scale of 2 cm to 10 cm on the horizontal $h$-axis.

Answer (b):

(c) Give one reason why a histogram is better than a pie chart.

Answer (c): \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots [1]
Answer Key

1. 14.4 km/h
2(a) 30°  (b) 20°  (c) 130°
3(a) 120°  (b) 13 cm
4(a) \( x = \frac{y}{2} \)  (b) \( m + n = 5q \)
5(a) \( a = -1 \)  (b) \( c = -2 \)
6. \( x = \frac{2}{3} \) cm
7(a) 70°  (b) 70°  (c) 110°
8(a) \( 5x + 5 \)  (b) \( 6x - 3 \)  (c) \( \frac{4x + 3}{6} \)
9(a) 13.3 cm  (b) 11.9 cm
10(a) 14.7 km  (b) 6.75 kg
11(a) \( a = 20 \)  (b) \( b = 5.5 \)  (c) \( c = 1 \)
12(a) \( 2x \)  (b) \( x + 3 \)  (c) \( x = 7 \)
13(a) 4.47 m  (b) 12 cm  (c) 19.2 cm
### Solution and Mark Scheme

#### 1.
\[
2(2 - m)^2 - m(5 - 4m) \\
= 2(4 - 4m + m^2) - 5m + 4m^2 \\
= 8 - 8m + 2m^2 - 5m + 4m^2 \\
= 6m^2 - 13m + 8
\]

M1

A1

#### 2.
\[
40 \times 52.6 - 39 \times 52.2 = 2104 - 2035.8 = 68.2 \text{ kg}
\]

M1, A1

#### 3.
\[
a^2 + b^2 = (a - b)^2 + 2ab \\
= 3^2 + 2(5) \\
= 19
\]

M1

A1

#### 4(a)

\[
y = \frac{k}{x^2}
\]

When \( x = 4 \) and \( y = 0.25 \),

\[
0.25 = \frac{k}{4^2} \\
k = 4
\]

Hence \( y = \frac{4}{x^2} \) or \( xy^2 = 4 \)

When \( y = 25 \),

\[
25 = \frac{4}{x^2} \\
x^2 = \frac{4}{25} \\
x = \frac{2}{5} \text{ or } \frac{2}{5}
\]

A1

#### 4(b)
When \( x \) is halved, the value of \( y \) is increased 4 times.
Also accept: the value of \( y \) is multiplied by 4.

B1

#### 5(a)
\[
3x^2 + 7x - 6 = 0 \\
(3x - 2)(x + 3) = 0 \\
x = \frac{2}{3} \text{ or } x = -3
\]

M1

A1

#### 5(b)
\[
\frac{1}{y} = \frac{2}{3} \Rightarrow y = \frac{3}{2}
\]

B1
6(a) \[ 28x^2 - 343 = 7(4x^2 - 49) \]
\[ = 7(2x - 7)(2x + 7) \]

6(b) \[ 6a^2 - 3ay - 8y + 16a = 3a(2a - y) - 8(y - 2a) \]
\[ = 3a(2a - y) + 8(2a - y) \]
\[ = (3a + 8)(2a - y) \]

7 \[ \sin 55^\circ = \frac{x}{20} \Rightarrow x = 20\sin 55^\circ = 16.383 \]
\[ \sin 20^\circ = \frac{y}{20} \Rightarrow y = 20\sin 20^\circ = 6.8404 \]
16.383 - 6.8404 = 9.54 m (3 sf)

8(a) \[ \cos \angle PRQ = \frac{6}{15} \]
\[ \angle PRQ = \cos^{-1}\left(\frac{6}{15}\right) = 66.4^\circ \text{ (1 dp)} \]

8(b) Set \( \frac{1}{3}(2^2)h = 20 \)
\[ h = \frac{3 \times 20}{2^2} = 15 \text{ cm} \]

9(a) \[ \text{B1 – all correct} \]

9(b) \[ \frac{3 + 4}{2} = 3.5 \]

9(c) \[ 4 \]

9(d) Agree, because there are more dots from 1 to 3 minutes as compared to 5 to 6 minutes.
Accept: The number of dots at 2 and 5 minutes are not equal.
The number of dots at 3 and 4 minutes are not equal.
<table>
<thead>
<tr>
<th>10(a)</th>
<th>$\frac{1}{8}$</th>
<th>B1</th>
</tr>
</thead>
<tbody>
<tr>
<td>10(b)</td>
<td>0</td>
<td>B1</td>
</tr>
<tr>
<td>10(c)</td>
<td>$\frac{3}{8}$</td>
<td>B1</td>
</tr>
<tr>
<td>10(d)</td>
<td>The letters with horizontal line of symmetry are $l, O, E$ $\frac{4}{8}$ $\frac{1}{2}$</td>
<td>B1</td>
</tr>
<tr>
<td>11(a)</td>
<td>$\frac{x+3}{7} - \frac{4x-5}{6} = x$ $\frac{6(x+3)-7(4x-5)}{42} = x$ $\frac{6x+18-28x+35}{64x} = 53$ $x = \frac{53}{64}$</td>
<td>M1 A1</td>
</tr>
<tr>
<td>11(b)</td>
<td>$\frac{y-1}{y+2} = \frac{y}{3y+2}$ $(y-1)(3y+2) = y(y+2)$ $3y^2 - y - 2 = y^2 + 2y$ $2y^2 - 3y - 2 = 0$ $(2y+1)(y-2) = 0$ $y = \frac{1}{2}$ or $y = 2$</td>
<td>M1 A1</td>
</tr>
</tbody>
</table>
12. Curved surface area = \(2\pi(8)(25) = 400\pi\) or 1256.6 (5 sf)

Let side of square be \(x\) cm.

\[x^2 + x^2 = 12^2\]
\[2x^2 = 144\]
\[x^2 = 72\]
\[x = \sqrt{72} \text{ or } 8.4853\ (5\ sf)\]

Two ends = \(2 \left[ \pi(8)^2 - (\sqrt{72})^2 \right] = 2[64\pi - 72] = 128\pi - 144\)

or 258.12 (5 sf)

Four rectangles = \(4\left( \sqrt{72} \times 25 \right) = 100\sqrt{72} \text{ or } 848.53\ (5\ sf)\)

Total = \(400\pi + 128\pi - 144 + 100\sqrt{72}\)
= 2363.29
= 2360 cm\(^2\) (3 sf)

13. \(2x + 3y = 49\)
\(3x + y = 56 \implies y = 56 - 3x\)

Sub \(y = 56 - 3x\) into \(2x + 3y = 49\)
\(2x + 3(56 - 3x) = 49\)
\(2x + 168 - 9x = 49\)
\(-7x = -119\)
\[x = 17\]

Then, \(y = 56 - 3(17) = 5\)

14(a) \(k = 30 - 6 - 8 - 5 = 11\)
<table>
<thead>
<tr>
<th>14(b)</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

B1 – horizontal axis scale correct, and labelled

B1 – all bars correct height

<table>
<thead>
<tr>
<th>14(c)</th>
<th>A histogram is better than a pie chart because the heights of the histogram represent the frequencies and hence the frequencies can be easily compared at a glance (while the sectors of a pie chart are less easy to compare.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B1</td>
</tr>
</tbody>
</table>

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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 50.
1  The masses, measured to the nearest kilogram, of 20 boys are given below.

\[
\begin{array}{cccccc}
57 & 45 & 42 & 48 & 58 \\
51 & 45 & 50 & 52 & 57 \\
57 & 45 & 46 & 57 & 53 \\
44 & 48 & 46 & 43 & 41 \\
\end{array}
\]

(a) Represent the above data in a split stem-and-leaf diagram. [3]

(b) Find the mean mass. [2]

2 (a) An area of 4 cm\(^2\) on a map represents an actual area of 0.36 km\(^2\).
Calculate

(i) the actual area in square kilometres represented by 80 cm\(^2\) on the map, [1]

(ii) the scale of the map in the form 1 : n, [2]

(iii) the distance on the map in centimetres which represents an actual distance of 6 km. [1]

(b) In the diagram below, triangle \(ABX\) is similar to triangle \(CDX\).

\[
\begin{array}{c}
A \\
\downarrow \\
2 \\
B \\
\downarrow \\
3 \\
X \\
\downarrow \\
7 \\
C \\
D \\
\end{array}
\]

Given that \(AB = 3\) cm, \(AX = 2\) cm and \(CX = 7\) cm, find

(i) the length of \(CD\), [2]

(ii) the ratio of \(DX : DB\). [1]
3 (a) Simplify \( \frac{25xz^2}{3y} \div \frac{5yz^2}{6y^2} \). [2]

(b) Express as a single fraction in its simplest form

\[
\frac{6x}{4x^2 - 1} - \frac{3}{4x - 2} [3]
\]

(c) Given that \( \frac{p}{r} = \sqrt{\frac{q}{3} + p^2} \), express \( p \) in terms of \( q \) and \( r \). [3]

4 (a) Using the second Causeway at Tuas, Mr Ng travelled a distance of 600 km from Singapore to Penang in a time of \( t \) hours. Write down the average speed of the journey, in km/h, in terms of \( t \). [1]

(b) If Mr Ng reduced his average speed by 5 km/h, he will take 30 minutes more to complete the same journey. Form an equation in \( t \) and show that it reduces to \( 2t^2 + t - 120 = 0 \). [3]

(c) Solve the equation \( 2t^2 + t - 120 = 0 \). [2]

(d) Find the original average speed. [1]

5 In the diagram, \( AP \) is perpendicular to \( BC \).

[Diagram with right triangle \( ABC \) with \( AP \) perpendicular to \( BC \).]

Given that \( AP = 10 \) cm, \( AC = 26 \) cm and \( \angle BAP = 31^\circ \), calculate

(a) \( \angle PAC \), [2]

(b) \( PC \), [2]

(c) \( PB \), [2]

(d) the shortest distance from \( P \) to the line \( AC \). [2]
6 Diagram I shows a hollow cone partially filled with water to a height of 24 cm. The cone has a height of 30 cm and a radius of 5 cm.

Formula: Curved surface area of a cone = \( \pi rl \)  
Surface area of a sphere = \( 4\pi r^2 \)

Volume of a cone = \( \frac{1}{3} \pi r^2 h \)
Volume of a sphere = \( \frac{4}{3} \pi r^3 \)

Diagram I

(a) Show that the radius of the water surface is 4 cm. [1]

(b) Find
(i) the volume of the water in the cone,
(ii) the area of the inner surface of the cone in contact with the water. [2]

The water is poured into hemispherical bowls of radius 2.8 cm as shown in Diagram II.

(c) Find the numbers of bowls that is completely filled with water. [3]

7 Answer the whole of this question on a piece of graph paper.
The variables \( x \) and \( y \) are connected by the equation \( y = 10 - x - x^2 \).
Some corresponding values of \( x \) and \( y \) are given in the table below.

<table>
<thead>
<tr>
<th>( x )</th>
<th>-4</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>-2</td>
<td>4</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>4</td>
<td>a</td>
</tr>
</tbody>
</table>

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

(b) Taking 2 cm to represent 1 unit on the \( x \)-axis and 1 cm to represent 1 unit on the \( y \)-axis, draw the graph of \( y = 10 - x - x^2 \) for \(-4 \leq x \leq 3\). [3]

(c) Use your graph to find
(i) the values of \( x \) when \( y = 6.2 \), [2]
(ii) the value of \( y \) when \( x = -1.2 \). [1]

(d) Write down the equation of the line of symmetry. [1]
<table>
<thead>
<tr>
<th>Qn</th>
<th>Answer</th>
</tr>
</thead>
</table>
| 1a | ste
   m
   4 1 2 3 4
   4 5 5 5 6 6 8 8
   5 0 1 2 3
   5 7 7 7 8
   Key: 4|1 means 41 kg |
| 1b | Mean = 49.25 kg |
| 2ai | Actual area = 7.2 km² |
| 2a(ii) | 1 : 30000 |
| 2aiii | Distance on map = 20 cm |
| 2bi | CD = 10.5 cm |
| 2b(ii) | 7:9 |
| 3a | 10x |
| 3b | \( \frac{3}{2(2x+1)} \) |
| 3c | \( p = \pm \sqrt{\frac{gr^2}{(3)(1-r^2)}} \) |
| 4a | \( \frac{600}{t} \) km/h |
| 4b | \( \frac{600}{t} = \frac{600}{t} - 5 \) |
| 4c | \( t = 7.5 \) or \( t = -8 \) |
| 4d | 80 km/h |

\( \angle PAC = 67.4^\circ \) (1 d.p.)

PC = 24 cm

BP = 6.01 cm (3 s.f.)

Shortest distance = \( 9\frac{3}{13} \) cm

Volume of the water = 402 cm²

Inner surface in contact with the water = 306 cm² (3sf)

Number of hemisphere filled = 8

\( a = -2 \)

\( x = -2.51, x = 1.51 \) (+0.1)

\( y = 9.8 (+0.2) \)

\( x = -0.5 \)
BEATTY SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2015

SUBJECT : Mathematics  LEVEL : Sec 2 Express
PAPER : 2  DURATION : 1 hour 30 minutes
SETTER : Mr Ng Choon Cheng  DATE : 08 Oct 2015

CLASS :  NAME :  REG NO :

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three significant figures. Give answers in degrees to one decimal place.
For \( \pi \), use either your calculator value or 3.142, unless the question requires the answer in
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The total number of marks for this paper is 50.

This paper consists of 4 printed pages (including this cover page)
1 The masses, measured to the nearest kilogram, of 20 boys are given below.

57  45  42  48  58
51  45  50  52  57
57  45  46  57  53
44  48  46  43  41

(a) Represent the above data in a split stem-and-leaf diagram. [3]

<table>
<thead>
<tr>
<th>stem</th>
<th>leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>4</td>
<td>5 5 5 6 6 8 8</td>
</tr>
<tr>
<td>5</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>5</td>
<td>7 7 7 7 8</td>
</tr>
</tbody>
</table>

Key: 4|1 means 41 kg

M1 Correct labelling and Stem and Leaf.

[2m] Stem and leaf for correct splitting

[1m] for Not splitting or split wrongly

[0 out of 2m] for back to back or non logical stem and leaf

(b) Find the mean mass [2]

Mean = $\frac{985}{20}$ kg

= 49.25 kg

M1

A1

2 (a) An area of 4 cm$^2$ on a map represents an actual area of 0.36 km$^2$.

Calculate

(i) the actual area in square kilometres represented by 80 cm$^2$ on the map, [1]

Actual area = $0.36 \times 20 = 7.2$ km$^2$

B1

(ii) the scale of the map in the form 1 : n, [2]

Map : actual

area 4 cm$^2$ : 0.36 km$^2$

dist 2 cm : 0.6 km

1 cm : 0.3 km

1 : 30000

M1

A1

(iii) the distance on the map in centimetres which represents an actual distance of 6 km. [1]

Distance on map = $\frac{1}{0.3} \times 6$

= 20 cm

B1
(b) In the diagram below, triangle $ABX$ is similar to triangle $CDX$. 

![Diagram of triangles ABX and CDX]

Given that $AB = 3\text{ cm}$, $AX = 2 \text{ cm}$ and $CX = 7\text{ cm}$, find

(i) the length of $CD$, 

\[
\frac{2}{7} = \frac{3}{CD} \quad \text{M1}
\]

\[
CD = 10.5\text{ cm} \quad \text{A1}
\]

(ii) the ratio of $DX : DB$. 

7:9

3 (a) Simplify \( \frac{25xz^2}{3y} \div \frac{5yz^2}{6y^2} \). 

\[
\frac{25xz^2}{3y} \div \frac{5yz^2}{6y^2} = \frac{25xz^2}{3y} \times \frac{6y^2}{5yz^2} \quad \text{M1}
\]

\[
= \frac{10x}{y} \quad \text{A1}
\]

(b) Express as a single fraction in its simplest form 

\[
\frac{6x}{4x^2 - 1} - \frac{3}{4x - 2} = \frac{6x}{4x^2 - 1} - \frac{3}{4x - 2} = \frac{3}{2(2x - 1)(2x + 1)} \quad \text{M1 (factorise)}
\]

\[
= \frac{2(6x)}{2(2x - 1)(2x + 1)} - \frac{3(2x + 1)}{2(2x - 1)(2x + 1)} \quad \text{M1}
\]

\[
= \frac{12x - 6x - 3}{2(2x - 1)(2x + 1)} \quad \text{M1}
\]

\[
= \frac{6x - 3}{2(2x - 1)(2x + 1)} \quad \text{M1}
\]

\[
= \frac{3(2x - 1)}{2(2x - 1)(2x + 1)} \quad \text{M1}
\]

\[
= \frac{3}{2(2x + 1)} \quad \text{A1}
\]
(c) Given that \( \frac{p}{r} = \sqrt{\frac{q}{3} + p^2} \), express \( p \) in terms of \( q \) and \( r \).

\[
\frac{p}{r} = \sqrt{\frac{q}{3} + p^2}
\]

\[
\left( \frac{p}{r} \right)^2 = \frac{q}{3} + p^2
\]

\[
\frac{p^2}{r^2} - p^2 = \frac{q}{3}
\]

\[
\frac{p^2 - r^2 p^2}{r^2} = \frac{q}{3}
\]

\[
\frac{p^2 (1 - r^2)}{r^2} = \frac{qr^2}{3}
\]

\[
p^2 = \frac{qr^2}{(3)(1 - r^2)}
\]

\[
p = \pm \sqrt{\frac{qr^2}{(3)(1 - r^2)}} \quad \text{or} \quad p = \pm \sqrt{\frac{qr^2}{(3)(1 - r^2)}} \quad \text{or} \quad p = \pm \sqrt{\frac{qr^2}{(3 - 3r^2)}} \quad \text{A1}
\]

4 (a) Using the second Causeway at Tuas, Mr Ng travelled a distance of 600 km from Singapore to Penang in a time of \( t \) hours. Write down the average speed of the journey, in km/h in terms of \( t \).

(b) If Mr Ng reduced his average speed by 5 km/h, he will take 30 minutes more to complete the same journey.

Form an equation in \( t \) and show that it reduces to \( 2t^2 + t - 120 = 0 \).
(c) Solve the equation \(2t^2 + t - 120 = 0\).

\[
2t^2 + t - 120 = 0 \\
(2t - 15)(t + 8) = 0 \\
t = 7.5 \text{ or } t = -8
\]

A1

(d) Find the original average speed.

When \(t = 7.5 \text{ hrs}\)

\[
\text{Originial Speed} = \frac{600}{7.5} = 80 \text{ km/h (Only)}
\]

B1

5 In the diagram, \(AP\) is perpendicular to \(BC\). Given that \(AP = 10 \text{ cm}\), \(AC = 26 \text{ cm}\) and \(\angle BAP = 31^\circ\), calculate

\[\angle PAC,\]

\[
\cos \angle PAC = \frac{10}{26} \\
\angle PAC = 67.380^\circ \\
= 67.4^\circ \text{ (1 d.p.)}
\]

M1 A1

(b) \(PC\),

\[
\tan 67.380 = \frac{PC}{10}
\]

\[
PC^2 = 26^2 - 10^2 \text{ or } \tan 67.380 = \frac{PC}{10} \text{ or } \sin 67.380 = \frac{PC}{26}
\]

M1

PC = 24 cm A1

(c) \(PB\),

\[
\tan 31^\circ = \frac{BP}{10}
\]

BP = 6.0086

= 6.01 cm (3 s.f.) A1

(d) the shortest distance from \(P\) to the line \(AC\).

\[
\text{Area of triangle} = \frac{1}{2} \times (24)(10)
\]

\[
= 120
\]

\[
\text{Shortest distance} = \frac{120 \times 2}{26}
\]

\[
= 9\frac{3}{13} \text{ or } 9.230769
\]

\[
= 9\frac{3}{13} \text{ or } 9.23 \text{ cm}
\]

A1
Diagram I shows a hollow cone partially filled with water to a height of 24 cm. The cone has a height of 30 cm and a radius of 5 cm.

**Formula:** Curved surface area of a cone = \( \pi rl \)  
Surface area of a sphere = \( 4\pi r^2 \)

Volume of a cone = \( \frac{1}{3} \pi r^2 h \)  
Volume of a sphere = \( \frac{4}{3} \pi r^3 \)

Diagram I

Diagram II

(a) Show that the radius of the water surface is 4 cm.

\[
\frac{24}{30} = \frac{r}{5} \\
\Rightarrow r = 4\text{ cm}
\]

(b) Find

(i) the volume of the water in the container,

\[
\text{volume of the water} = \frac{1}{3} (\pi)(4^2)(24) \\
= 402.123 \\
= 402\text{ cm}^2
\]

(ii) the area of the inner surface of the cone in contact with the water.

\[
\text{Slanted height} = \sqrt{4^2 + 24^2} \\
= \sqrt{592} \\
= 24.331
\]

inner surface in contact with the water

\[
= \pi \times 4 \times \sqrt{592} \\
= 305.75 \\
= 306\text{ cm}^2 \text{ (3sf)}
\]

The water is poured into hemispherical bowls of radius 2.8 cm as shown in Diagram II.

(c) Find the numbers of bowls that is completely filled with water.

Volume of hemisphere = \( \frac{2}{3} \times \pi \times 2.8^3 \)

\[
= 45.976
\]

Number of hemisphere filled = \( \frac{402.123}{45.976} \)

\[
= 8.746 \\
= 7 \text{ (Follow tho from B(i) and vol)}
\]
Answer the whole of this question on a piece of graph paper.

The variables $x$ and $y$ are connected by the equation $y = 10 - x - x^2$.

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

(a) Given that $y = 10 - x - x^2$, calculate the values of $a$. \[1\]

<table>
<thead>
<tr>
<th>$x$</th>
<th>$-4$</th>
<th>$-3$</th>
<th>$-2$</th>
<th>$-1$</th>
<th>$0$</th>
<th>$1$</th>
<th>$2$</th>
<th>$3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>$-2$</td>
<td>$4$</td>
<td>$8$</td>
<td>$10$</td>
<td>$10$</td>
<td>$8$</td>
<td>$4$</td>
<td>$a$</td>
</tr>
</tbody>
</table>

\[a = -2\]

(b) Taking 2 cm to represent 1 unit on the $x$-axis and 1 cm to represent 1 unit on the $y$-axis, draw the graph of $y = 10 - x - x^2$ for $-4 \leq x \leq 3$. \[3\]

G1 Correct scale, G1 Correct plot, G1 Smooth graph

(c) Using your graph, find

(i) the value of $x$ when $y = 6.2$. \[2\]

$x = -2.51, x = 1.51 \quad (+0.1)$

(ii) The value of $y$ when $x = -1.2$. \[1\]

$y = 9.8 \quad (+0.2)$

(d) Write down the equation of the line of symmetry of the graph. \[1\]

$x = -0.5$

[Turn over]
READ THESE INSTRUCTIONS FIRST

Write your class, register 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 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 when 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 \( \pi \), use either your calculator value or 3.142.

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 50.
2

Answer all the questions

1. Use a calculator to evaluate the following correct to the number of decimal places or significant figures required.

   (a) \( \frac{\sqrt{778.2} + 568}{\sqrt[3]{834.4}} \) [2 decimal places]

   (b) \( (0.14)^3 + \frac{(0.65)^2}{\sqrt{7 - 1\frac{4}{9}}} \) [4 significant figures]

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

   (b) ........................................ [1]
Given that $2016 = 2^5 \times 3^2 \times 7$ and $3240 = 2^3 \times 3^4 \times 5$, find

(a) the smallest integer that is a multiple of both 2016 and 3240,

(b) the smallest possible integer $k$ such that $2016k$ is a perfect cube.

**Answer**

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

(b) $k = ............................................. [1]$

3. Joseph drives at $(2x+5)$ km/h for 3 hours. He then rested for 1 hour.

If his average speed for the whole journey is $\frac{13}{8}x$ km/h, find the value of $x$.

**Answer**

$x = ............................................. [2]$
4 (a) Expand and simplify the following expression,

\[ 50a^2 - (7a - 4b)^2 \]

(b) Factorise the following expressions completely.

(i) \[ 64c^2 - 25d^2 \]

(ii) \[ 32pr - 28qr + 21sq - 24sp \]

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

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

(ii) ......................................... [2]
Suppose that 6 cm on a map represents an actual distance of 15 km.

(a) Express the scale in the form $1 : r$.

(b) The length of an underground tunnel measures 2.8 km. Calculate the length of the underground tunnel on the map in cm.

(c) The area of a town measures 13.4 cm$^2$ on the map. Find the actual area of the town in km$^2$.

Answer

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

(b) ........................................cm [1]

(c) ........................................km$^2$ [2]
6 Solve each of the following equations.

(a) \(6x^2 + 18x = 0\)

(b) \(4x^2 - 24x + 35 = 0\)

Answer (a) \(x = \ldots \) or \(\ldots\) [2]

Answer (b) \(x = \ldots \) or \(\ldots\) [2]

7 Solve the following simultaneous equations.

\[4x + 5y = -9\]
\[-3x + 7y = 39\]

Answer \(x = \ldots\) [3]

Answer \(y = \ldots\)
In the diagram, \( \triangle PQRS \) is similar to \( \triangle WXYZ \) with \( PQ = 5 \text{ cm}, WX = 7 \text{ cm}, XY = 8.4 \text{ cm} \) and \( \angle PQR = 70^\circ, \angle XYZ = 74^\circ \) and \( \angle YZW = 140^\circ \).

Find

(a) \( \angle ZWX \),

(b) \( QR \).

Answer

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

(b) ........................................ [2]
In the diagram below, $ABE$ is a right-angled triangle with $AB = 24$ cm and $AE = 7$ cm. $CBE$ is a right-angled triangle with a point $D$ on $EC$ such that $DC = 11$ cm and $BC = 20$ cm.

(a) By finding the length of $BE$ first, show that the length of $DE = 4$ cm

(b) Write down the value of

(i) $\cos \angle ABE$,
(ii) $\sin \angle BEC$,
(iii) $\tan \angle DBC$.

(c) Find the shortest distance of $C$ to $BE$.

\[ \text{Answer} \quad (b) \quad (i) \hspace{1cm} (ii) \hspace{1cm} (iii) \]

\[ \text{cm} \hspace{1cm} \text{cm} \hspace{1cm} \text{cm} \]

\[ \text{[TURN OVER} \]
10 The diagram below shows a right square pyramid with height 10 cm.

If it has a volume of 480 cm³, find

(a) the value of \(x\),

(b) its total surface area.

Answer

(a) \(x = \ldots\) \[2\]

(b) \(\ldots\) cm² \[3\]

[TURN OVER]
The table shows the record of scores by 19 students in a Mathematics test.

<p>| | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>81</td>
<td>36</td>
<td>51</td>
<td>65</td>
<td>71</td>
<td>70</td>
<td>58</td>
<td>62</td>
</tr>
<tr>
<td>32</td>
<td>60</td>
<td>43</td>
<td>35</td>
<td>59</td>
<td>64</td>
<td>36</td>
<td>60</td>
<td>62</td>
</tr>
</tbody>
</table>

The full score is 100 marks.

Mrs Lee tabulated the scores in the ordered stem-and-leaf diagram below.

<table>
<thead>
<tr>
<th>Stem</th>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2 6 6 6</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>1 4 8 9</td>
</tr>
<tr>
<td>6</td>
<td>0 0 2 2 4 5 8</td>
</tr>
<tr>
<td>7</td>
<td>0 1</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>

Key: 3 | 2 represents 32 marks

(a) Write down the modal score of the 19 students.
(b) Calculate the median score of the 19 students.
(c) The top 6 students were selected to participate in a mathematics competition. What is the minimum mark a student needs to obtain to participate in the competition?
(d) The passing mark for the test is 50. The scores of another 6 students were added to the record and the number of students who passed increase to 76%. How many new students passed the test?

Answer

(a) ........................................... [1]
(b) ........................................... [1]
(c) ........................................... [1]
(d) ........................................... [1]
The time taken by 70 Secondary Two Express students to complete their mathematics homework is given in the table below.

<table>
<thead>
<tr>
<th>Time in minutes (min)</th>
<th>Number of Students ($f$)</th>
<th>Mid-value ($x$)</th>
<th>$fx$</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 &lt; $x$ ≤ 36</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36 &lt; $x$ ≤ 44</td>
<td>24</td>
<td>40</td>
<td>960</td>
</tr>
<tr>
<td>44 &lt; $x$ ≤ 52</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52 &lt; $x$ ≤ 60</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

(a) Complete the table above and hence calculate an estimate of the mean time taken.

(b) If a student is chosen from the group, what is the probability that he/she completes homework within 44 minutes?

Answer (a) ........................................... [3]

(b) ........................................... [1]
The mean of 5 numbers is $\frac{343}{5}$.

(a) Find the sum of the 5 numbers.

3 of the numbers are 36.75, 87 and 9.25.

The remaining 2 numbers are in the ratio of $3:5$.

(b) Find the smaller of the remaining 2 numbers.

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

(b) ........................................  [2]
Consider the number pattern,

Line 1: \( 11 - 2 = 3^2 \)
Line 2: \( 1111 - 22 = 33^2 \)
Line 3: \( 111111 - 222 = 333^2 \)

\[ \ldots \]
\[ x - y = 333\,333\,333\,333^2 \]

(a) Write down Line 4 for the pattern above.

(b) Find the number of '1' in \( x \).

\[ \text{Answer} \quad (a) \quad \ldots \ldots \ldots \ldots \ldots \ldots \quad [1] \]
\[ (b) \quad \ldots \ldots \ldots \ldots \ldots \ldots \quad [1] \]

End-of-Paper 1
Bukit Merah Secondary School  
End of Year Examination 2015  
Secondary 2 Express  
(Mathematics Paper 1) – Marking Scheme

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a</td>
<td>63.30</td>
<td>B1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>0.1820</td>
<td>B1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>a</td>
<td>90720</td>
<td>B1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>294</td>
<td>B1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>( \frac{3(2x+5)}{4} = \frac{13}{8} ) &amp; x</td>
<td>M1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6(2x+5) = 13x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12x + 30 = 13x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>x = 30</td>
<td></td>
<td></td>
<td>A1</td>
</tr>
<tr>
<td>4</td>
<td>a</td>
<td>50a² − (49a² − 56ab + 16b²)</td>
<td>M1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>= a² + 56ab − 16b²</td>
<td></td>
<td>A1</td>
<td></td>
</tr>
<tr>
<td>b(i)</td>
<td>(8e + 5d)(8e − 5d)</td>
<td></td>
<td>B1</td>
<td></td>
</tr>
<tr>
<td>b(ii)</td>
<td>32pr − 28qr + 21sq − 24sp</td>
<td>M1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>= 4r(8p − 7q) + 3s(7q − 8p)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>= 4r(8p − 7q) − 3s(8p − 7q)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>= (8p − 7q)(4r − 3s)</td>
<td></td>
<td>A1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>a</td>
<td>1:250000</td>
<td>B1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>1.12 cm</td>
<td>B1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>1cm² : 6.25km²</td>
<td>M1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13.4cm² : 83.75km²</td>
<td>A1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>a</td>
<td>6x(x + 3) = 0</td>
<td>M1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>x = 0or −3</td>
<td>A1</td>
<td></td>
<td>for both</td>
</tr>
<tr>
<td>b</td>
<td>(2x − 7)(2x − 5) = 0</td>
<td>M1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>x = 3.5or2.5</td>
<td>A1</td>
<td></td>
<td>for both</td>
</tr>
<tr>
<td>7</td>
<td>43y = 129</td>
<td>M1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>y = 3</td>
<td>A1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>x = −6</td>
<td>A1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>a</td>
<td>76</td>
<td>B1</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>( \frac{QR}{8.4} = \frac{5}{7} ) &amp; QR = 6</td>
<td>M1</td>
<td>aef</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>a</td>
<td>BE = 25</td>
<td>M1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DE = 4</td>
<td>A1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b(ii)</td>
<td>( \frac{24}{25} )</td>
<td>B1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii)</td>
<td>( \frac{4}{5} )</td>
<td>B1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iii)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( \frac{11}{20} )</td>
<td>B1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>( \frac{1}{2} \times 15 \times 20 = 150 )</td>
<td>M1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( h = 12 )</td>
<td>A1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>a</td>
<td>M1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( \frac{1}{3} x^2(10) = 480 )</td>
<td>M1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( x^2 = 144 )</td>
<td>A1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( x = 12 )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>( 12 \times 12 = 144 )</td>
<td>M1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( 4 \left( \frac{1}{2} \times 12 \times \sqrt{136} \right) )</td>
<td>M1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>424</td>
<td>A1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>a</td>
<td>B1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>36</td>
<td>B1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>60</td>
<td>B1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>64</td>
<td>B1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>5</td>
<td>B1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>a</td>
<td>M1 ecf</td>
<td></td>
<td></td>
</tr>
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<tr>
<td></td>
<td>56, 728</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>( \frac{544 + 960 + 768 + 728}{70} )</td>
<td>M1 ecf</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean score = ( 42 \frac{6}{7} )</td>
<td>A1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>173</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>a</td>
<td>B1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>11111111 - 2222 = 3333^2</td>
<td>B1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Bukit Merah Secondary School
End-of-Year Examination 2015
Secondary 2 Express

MATHEMATICS

8 Oct 2015
1 hour 30 minutes

Candidates answer on foolscap and graph papers

READ THESE INSTRUCTIONS FIRST

Write your class, register 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 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 when 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.

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.

Calculator Model:

<table>
<thead>
<tr>
<th>Class</th>
<th>Register No</th>
<th>Name</th>
</tr>
</thead>
</table>

For Examiner’s Use

This document consists of 7 printed pages.
2

Answer all the questions

1 In the figure below, $CD = 4.3$ m, $AB = 7.2$ m and $\angle BCD = 58^\circ$.

Find

(a) $BD$.

(b) $\angle ABD$.

2 (a) Simplify each of the following algebraic fractions.

(i) $\frac{35b^2}{2y} \times \frac{y^2}{7ab^3}$

(ii) $\frac{6}{8x^2 - 6xy} \div \frac{9}{3y - 4x}$

(b) Express $\frac{5}{x^2 + 3x - 4} - \frac{2}{x - 1}$ as a single fraction in its simplest form.

3 (a) Given that $y$ is inversely proportional to the cube root of $x$, and that $x = 64$ when $y = 12.75$.

(i) Find the equation connecting $x$ and $y$.

(ii) Find the value of $x$ when $y = 3$.

(iii) Find the change in the value of $y$ when the value of $x$ is divided by 125.

(b) A formula is given as $\frac{\sqrt{x - 2p}}{9w + 5x} = y$.

Make $x$ the subject of the formula.

[TURN OVER]
Mrs Lee bought some crabs and fish.

(a) She bought \( x \) kg of crabs for \$140. Write down an expression, in terms of \( x \) for the cost of 1 kg of crabs. \[1\]

(b) She bought some fish with \$140. She received 3 kg more fish than crabs. Write down an expression, in terms of \( x \) for the cost of 1 kg of fish. \[1\]

(c) The cost of 1 kg of fish is \$15 less than the cost of 1 kg of crab. Write down an equation in terms of \( x \) and show that it reduces to \( 3x^2 + 9x - 84 = 0 \). \[3\]

(d) Solve the equation \( 3x^2 + 9x - 84 = 0 \). \[2\]

(e) How many kilograms of fish and crabs did she buy? \[1\]

5 The two triangles shown below are congruent to each other.

(a) Name the triangle that is congruent to \( \triangle ABC \). \[1\]

(b) Find \( \angle BAC \). \[1\]

(c) Find the length of \( CD \). \[1\]
6  (a) A card is drawn at random from a pack of 25 cards, numbered 1 to 25. Find the probability that the number on the card is,

(i) a multiple of 6,
(ii) not more than 13,
(iii) a prime number.

(b) Jim is equally interested in buying rabbits named \(A, B, C, D\) and \(E\). He bought two of them at random because of the budget.

(i) List down the sample space of his possible purchases.
(ii) Find the probability that rabbit \(C\) is bought.
(iii) Find the probability that rabbit \(B\) is bought but rabbit \(D\) is not bought.
7 (a) The time in minutes taken by 20 patrons at a food court $A$ to finish their meal is represented by the dot diagram below.

![Dot diagram showing time taken in minutes]

(i) Find the mean, median and mode of the data. [3]

(ii) The management of the food court $A$ says that the average time taken by a patron to finish a meal is 22 minutes. Does your data prove or disprove this statement? Explain briefly. [1]

(b) The time in minutes taken by another 20 patrons at a food court $B$ to finish their meal is represented by the frequency table below.

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>16</th>
<th>18</th>
<th>20</th>
<th>22</th>
<th>24</th>
<th>26</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patrons</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>7</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

This distribution is to be shown in a pie chart.

(i) Calculate the angle representing the patrons who spent more than 24 minutes. [1]

(ii) Calculate the median time taken by the patron in food court $B$. [1]

(iii) State, with a reason, which food court has their patrons leaving earlier after their meal. [1]
Diagram I below shows a solid balancing toy made up of a hemisphere attached to the bottom of the cylinder. The radius of the hemisphere is 2 cm and the height of the cylinder is 8 cm.

(a) Find the volume of the toy. [3]

(b) To lighten its weight, a cone with radius 1 cm and height 7.6 cm is sawed away from the toy as shown in Diagram II below.

(i) Find the total surface area of the newly created toy in Diagram II. [4]

(ii) Given that the newly created toy (in Diagram II) is melted to form a cube, what is the largest possible integer length of the cube?

\[
\begin{align*}
\text{Volume of Cone} &= \frac{1}{3}\pi r^2 h \quad \text{; Volume of Sphere} = \frac{4}{3}\pi r^3, \\
\text{Curved Surface Area of Cone} &= \pi rl \quad \text{; Surface Area of Sphere} = 4\pi r^2
\end{align*}
\]
9 Answer the whole of this question on a sheet of graph paper.

The variables \( x \) and \( y \) are connected by the equation \( y = 2x^2 - 6x + 11 \).

The table of values is as shown below.

<table>
<thead>
<tr>
<th></th>
<th>(-2)</th>
<th>(-1)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>(x)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(y)</td>
<td>31</td>
<td>(p)</td>
<td>11</td>
<td>7</td>
<td>7</td>
<td>(q)</td>
</tr>
</tbody>
</table>

(a) Find the values of \( p \) and \( q \). [1]

(b) Using 2 cm to represent 1 unit along the horizontal \( x \)-axis and 2 cm to represent 5 units along the vertical \( y \)-axis, draw the graph of \( y = 2x^2 - 6x + 11 \) for \(-2 \leq x \leq 3 \). [3]

(c) From your graph,

(i) find the value of \( y \) when \( x = -0.5 \) [1]

(ii) write the coordinates of the minimum point. [1]

(iii) write the equation of the line of symmetry. [1]
<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a</td>
<td>[ \sin 58^\circ = \frac{BD}{4.3} ]</td>
<td>M1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>[ BD = 3.646606813 ]</td>
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<tr>
<td></td>
<td></td>
<td>[ BD = 3.65 ]</td>
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<tr>
<td></td>
<td></td>
<td>[ \cos \angle ABD = \frac{3.646606813}{7.2} ]</td>
<td>M1 ECF</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>[ \angle ABD = 59.57080651^\circ ]</td>
<td></td>
<td></td>
<td></td>
<td>A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[ = 59.6^\circ ]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>a(i)</td>
<td>[ \frac{5y}{2ab} ]</td>
<td>B1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii)</td>
<td>[ \frac{6}{2x(4x - 3y)} + \frac{9}{3y - 4x} ]</td>
<td>M1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>= [ \frac{6}{2x(4x - 3y)} \times \frac{- (4x - 3y)}{9} ]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>= [ \frac{1}{3x} ]</td>
<td>A1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>[ \frac{5}{x^2 + 3x - 4} - \frac{2}{x - 1} ]</td>
<td>M1</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>= [ \frac{5}{(x + 4)(x - 1)} - \frac{2}{x - 1} ]</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>= [ \frac{5 - 2(x + 4)}{(x + 4)(x - 1)} ]</td>
<td>M1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>= [ \frac{-2x - 3}{(x + 4)(x - 1)} ]</td>
<td></td>
<td></td>
<td></td>
<td>A1</td>
</tr>
<tr>
<td>3</td>
<td>a(i)</td>
<td>[ y = \frac{k}{\sqrt[3]{x}} ]</td>
<td>M1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>[ 12.75 = \frac{k}{\sqrt[3]{64}} ]</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>[ k = 51 ]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>[ y = \frac{51}{\sqrt[3]{x}} ]</td>
<td>A1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii)</td>
<td>[ 3\sqrt[3]{x} = 51 ]</td>
<td></td>
<td></td>
<td></td>
<td>B1 follow through</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[ 3\sqrt[3]{x} = 17 ]</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>[ x = 4913 ]</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>(iii)</td>
<td>$newy = \frac{51}{x^{\frac{3}{5}}} \sqrt[3]{125}$</td>
<td>M1 ECF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$= 5 (\frac{51}{125})^{\frac{1}{x}}$</td>
<td>A1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>New $y$ is 5 times of old $y.$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>$y^2 = \frac{x - 2p}{9w + 5x}$</td>
<td>M1</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>$y^2 (9w + 5x) = x - 2p$</td>
<td></td>
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<tr>
<td></td>
<td>$9y^2 w + 5xy^2 = x - 2p$</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>$9y^2 w + 2p = x - 5xy^2$</td>
<td>M1 for take out factor</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>$x(1 - 5y^2) = 9y^2 w + 2p$</td>
<td>A1</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>$x = \frac{9y^2 w + 2p}{1 - 5y^2}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>a</td>
<td>$\frac{140}{y}$</td>
<td>B1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>$\frac{140}{y + 3}$</td>
<td>B1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>$\frac{140}{x + 3} + 15 = \frac{140}{x}$</td>
<td>M1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$140x + 15x^2 + 45x = 140x + 420$</td>
<td>M1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$15x^2 + 45x - 420 = 0$</td>
<td>A1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$3x^2 + 9x - 84 = 0$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>$(3x - 12)(x + 7) = 0$</td>
<td>M1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$x = 4or - 7$</td>
<td>A1 for both</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>a</td>
<td>$\triangle ADE$</td>
<td>B1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>$55^\circ$ or 56.3 (error)</td>
<td>B1</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>c</td>
<td>1.6 cm or 1.49 (error)</td>
<td>B1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>a(i)</td>
<td>$\frac{4}{25}$</td>
<td>B1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii)</td>
<td>$\frac{13}{25}$</td>
<td>B1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iii)</td>
<td>$\frac{9}{25}$</td>
<td>B1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b(i)</td>
<td>${AB, AC, AD, AE, BC, BD, BE, CD, CE, ED}$</td>
<td>B1 for first 5 B1 for next 5</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(ii)</td>
<td>$\frac{2}{5}$</td>
<td>B1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iii)</td>
<td>$\frac{3}{10}$</td>
<td>B1</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>7</td>
<td>a(i)</td>
<td>Mean is 19.7, median is 19, mode is 18</td>
<td>B1 B1 B1</td>
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</tr>
<tr>
<td>(ii)</td>
<td>Disprove, all the averages are not 22.</td>
<td>B1 with reason</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b(i)</td>
<td>54°</td>
<td>B1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii)</td>
<td>23 min</td>
<td>B1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(iii)</td>
<td>Food court A, because median time is lower</td>
<td>B1 with reason</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8 a

\[ \text{volume} = (\pi \times 2^2 \times 8) + \left( \frac{2}{3} \times \pi \times 2^3 \right) \]
\[= 117.2861257 \]
\[= 117 \text{ cm}^3 \]

b(i)

\[ \text{curvedSA} = (2\pi \times 2^2) + (2\pi \times 2 \times 8) \]
\[= 125.6637061 \]
\[ \text{topbasearea} = \pi (2^2) - \pi (1)^2 \]
\[= 9.424779961 \]
\[ \text{slantedheight} = \sqrt{1^2 + 7.6^2} \]
\[= \sqrt{58.76} \]
\[\pi \times 1 \times \sqrt{58.76} \]
\[= 24.08190098 \]
\[ \text{totalSA} = 125.6637061 + 9.424779961 + 24.08190098 \]
\[= 159.170385 \]
\[= 159 \]

(ii)

\[117.2861257 - \left( \frac{1}{3} \times \pi \times 1^2 \times 7.6 \right) \]
\[= 109.3274243 \]
\[\sqrt{109.3274243} \]
\[= 4.781634454 \]
\[l_{\text{argestpossiblelength}} = 4 \text{ cm} \]

9 a

\[p = 19, q = 11 \]

b

Plotting  P1
Scaling  S1
Curve (smooth)  C1
c(i)  14.5 (plus minus 0.5)  B1
(ii)  (1.5, 6.5) x coordinate plus minus 0.1 , y coordinate plus minus 0.5  B1
(iii)  \( x = 1.5 \) plus minus 0.1  B1
FAIRFIELD METHODIST SCHOOL (SECONDARY)

END-OF-YEAR EXAMINATION 2015
SECONDARY 2 EXPRESS

MATHEMATICS

Paper 1

Date: 07 October 2015
Duration: 1 hour 30 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

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Write in dark blue or black pen.
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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 \( \pi \), use either your calculator value or 3.142, unless the question requires the answer in terms of \( \pi \).

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 60.

<table>
<thead>
<tr>
<th>For Examiner's Use</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper 1</td>
<td>/ 60</td>
</tr>
<tr>
<td>Paper 2</td>
<td>/ 60</td>
</tr>
<tr>
<td>Total</td>
<td>%</td>
</tr>
</tbody>
</table>

Setter: Miss Germaine J Peter

This question paper consists of 15 printed pages including the cover page.
Answer all the questions.

1. Arrange the following numbers in ascending order.

\[
\frac{1}{3} \quad 40\% \quad \sqrt[3]{-8} \quad \frac{2}{7} \quad 0.3
\]

Answer \[1\]

2. Estimate the value of \[\frac{11.835 \times 6.051}{\sqrt{17}}\], without the use of a calculator.

Answer \[2\]

3. The length of each side of a square, of length x cm, is increased by 20%. Find the percentage increase in the area of the square.

Answer \[2\]
4 (a) Express 1008 as a product of its prime factors, giving your answer in index notation.

\[ \text{Answer (a)} \] [1]

(b) Given that \(1350 = 2 \times 3^3 \times 5^2\), find the lowest common multiple of 1008 and 1350, giving your answer in index notation.

\[ \text{Answer (b)} \] [1]

(c) Given that \( \frac{1350}{k} \) is a square number, write down the smallest possible integer value of \( k \).

\[ \text{Answer (c)} \ k = \] [1]
The force of attraction, \( F \) newtons, between two magnets is inversely proportional to the square of the distance, \( x \) centimetres, between them.

It is given that when the magnets are 4 centimetres apart, the force is 3 newtons.

(a) Find an equation connecting \( F \) and \( x \).

\[ F = \frac{k}{x^2} \]

Answer (a) \[ F = \frac{k}{x^2} \] [1]

(b) Find the force when the magnets are 2 centimetres apart.

\[ F = \frac{k}{2^2} = \frac{k}{4} \]

Answer (b) \[ F = \frac{k}{4} \] newtons [1]

(c) When the magnets are a certain distance apart, the force is 1.25 newtons. Write down the force when the distance is halved.

\[ F = \frac{k}{x^2} = 1.25 \]

\[ \frac{k}{x^2} = \frac{k}{4x^2} \]

Answer (c) \[ \frac{k}{4x^2} \] newtons [2]
6 The diagram shows a right-angled triangle in a circle, with centre $O$.
Given that the diameter of the circle is $14$ cm, find the length of $AB$.

\[ \text{Answer} \dots \dots \dots \dots \text{cm} \quad [2] \]

7 A closed cylindrical container has a radius of $6.8$ cm and a volume of $1500$ cm$^3$.
[Take $\pi$ to be $3.142$]

(a) Show that the height of the cylindrical container is $10.3$ cm.

\[ \text{Answer (a)} \quad [2] \]

(b) Find the surface area of the cylindrical container.

\[ \text{Answer (b)} \quad \dots \dots \dots \text{cm}^2 \quad [2] \]
8 The diagram below shows a point \( Q \) with coordinates \((2, r)\).

\[ \text{(i) Find the length of } OQ. \]

\[ \text{Answer (i)} \ OQ = \ldots \ldots \ldots \ldots \text{cm} \ [2] \]

\[ \text{(ii) Find the value of } r. \]

\[ \text{Answer (ii)} \ r = \ldots \ldots \ldots \ldots \ldots \ldots \text{[2]} \]
9. Simplify the following expressions.

(a) \[ \frac{3a^2}{7bc} \div \frac{9a}{14b} \]

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

(b) \[ \frac{2x}{x^2 - 25} - \frac{1}{x - 5} \]

Answer (b) ........................................... [3]
10 Petrol costs $x$ cents per litre. John intends to take a road trip during the holidays. Find an expression for the number of litres of petrol that can be bought for $y$ dollars.

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

11 A sum of money is divided between Alice, Betty and Charlie in the ratio $2 : 3 : 4$ respectively. If, instead, this money had been divided equally between them, Alice would have received an extra $20.

What was the total sum of money given to Alice, Betty and Charlie?

Answer $..................$ \[2\]
12 The graph below shows the lines $-x + 2y = 2$ and $2x + 2y = 5$.

(a) State the solution of the simultaneous equations $-x + 2y = 2$ and $2x + 2y = 5$.

Answer (a) $x = \ldots \ldots \ldots \ldots \ y = \ldots \ldots \ldots \ldots$ [1]

(b) On the same grid above, draw and label clearly the line $x = 3$. [1]

(c) Find the area of the polygon enclosed by the 3 lines, $-x + 2y = 2$, $2x + 2y = 5$ and $x = 3$. Leave your answer in square units.

Answer (c) \( \ldots \ldots \ldots \ldots \) units² [1]
13 In the figure, $ABC$ and $DBE$ are similar triangles, where $\angle ACB = \angle DEB$.

Find

(a) the length of $AC$,

(b) the length of $CD$.

Answer (a) $\ldots$ cm [2]

Answer (b) $\ldots$ cm [2]
14 Factorise fully each of the following expressions completely.

(a) $3p^2 - 3pq - 5ap + 5aq$

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

(b) $6x^2 + 14x - 12$

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

15 A bag contains 10 red marbles, 5 blue marbles and 3 yellow marbles.
   (a) Find the probability that the marble is red.

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

(b) How many more blue marbles must be placed in the bag so that the probability of choosing a blue marble would be $\frac{1}{2}$?

Answer (b) .................. blue marbles [1]
16. Solve the equation \( \frac{5}{y-3} + \frac{10}{3(3-y)} = 3 \).

Answer \( y = \ldots \) [3]
17 Solve the following simultaneous equations.

\[ 4a + 15b = 15 \]
\[ 7a - 30b = 15 \]

Answer \( a = \ldots \ldots \ldots \), \( b = \ldots \ldots \ldots \) [3]
18. The following stem and leaf diagram represents the marks obtained by 10 boys and 10 girls in a Mathematics test.

<table>
<thead>
<tr>
<th>Boys</th>
<th></th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 2 0</td>
<td>5 8 9</td>
</tr>
<tr>
<td></td>
<td>9 5 1 1</td>
<td>6 4 7 8</td>
</tr>
<tr>
<td></td>
<td>7 5 7 1 3 5 6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0 8 0</td>
<td></td>
</tr>
</tbody>
</table>

Key (Boys): 2|5 means 52
Key (Girls): 5|8 means 58

From the data above, find
(a) (i) the mode of the boys’ marks,

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

(ii) the median of the girls’ marks,

*Answer (a)(ii)...........................marks [1]*

(iii) the mean of the boys’ marks.

*Answer (a)(iii)...........................marks [1]*

(b) Given that the mean of the girls’ marks is 69.1, explain briefly whether the boys or girls performed better in the test.

*Answer (b) [1]*
19  (a) Construct the perpendicular bisector of $BC$. 
(b) Construct the bisector of $\angle ABC$. 
(c) The point $D$ is such that $\angle BCD = 130^\circ$ and $AD = 7.5$ cm. 
Find the two possible positions of $D$ and label them $D_1$ and $D_2$. 
(d) It is given that the two bisectors in (a) and (b) meet at $P$. 
Complete the statement below.

The point $P$ is equidistant from the lines .................. and .................. 
and equidistant from the points ............ and .................. 

Answer (a), (b), (c)
## Fairfield Methodist School (Secondary)
### Sec 2 Express 2015 EOY Examination
### Mathematics Paper 1
### Answer Key

<table>
<thead>
<tr>
<th>No.</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$\sqrt{8}, \frac{2}{7}, 0.3, \frac{1}{3}, 40%$</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>44%</td>
</tr>
<tr>
<td>4a</td>
<td>$1008 = 2^4 \times 3^2 \times 7$</td>
</tr>
<tr>
<td>4b</td>
<td>LCM = $2^4 \times 3^3 \times 5^2 \times 7$</td>
</tr>
<tr>
<td>4c</td>
<td>$k = 6$</td>
</tr>
<tr>
<td>5a</td>
<td>$F = \frac{48}{x^2}$</td>
</tr>
<tr>
<td>5b</td>
<td>$F = 12$ newtons</td>
</tr>
<tr>
<td>5c</td>
<td>$F = 5$ newtons</td>
</tr>
<tr>
<td>6</td>
<td>$AB = 9.90$</td>
</tr>
<tr>
<td>7a</td>
<td>10.3</td>
</tr>
<tr>
<td>7b</td>
<td>$732 \text{ cm}^2$ or $731 \text{ cm}^2$</td>
</tr>
<tr>
<td>8i</td>
<td>OQ = 4</td>
</tr>
<tr>
<td>8ii</td>
<td>$h = 3.46$</td>
</tr>
<tr>
<td>9a</td>
<td>$\frac{2a}{3c}$</td>
</tr>
<tr>
<td>9b</td>
<td>$\frac{1}{x+5}$</td>
</tr>
<tr>
<td>10</td>
<td>$\frac{100y}{x}$</td>
</tr>
<tr>
<td>11</td>
<td>$$180$</td>
</tr>
<tr>
<td>12a</td>
<td>$x = 1, y = 1.5$</td>
</tr>
<tr>
<td>12c</td>
<td>3 units$^2$</td>
</tr>
<tr>
<td>13a</td>
<td>AC = 18 cm</td>
</tr>
<tr>
<td>13b</td>
<td>CD = 17 cm</td>
</tr>
<tr>
<td>14a</td>
<td>$(3p - 5a)(p - q)$</td>
</tr>
<tr>
<td>14b</td>
<td>$2(3x - 2)(x + 3)$</td>
</tr>
<tr>
<td>15a</td>
<td>$\frac{5}{9}$</td>
</tr>
<tr>
<td>15b</td>
<td>8 more</td>
</tr>
<tr>
<td>16</td>
<td>$\frac{5}{9}$</td>
</tr>
<tr>
<td>No.</td>
<td>Working</td>
</tr>
<tr>
<td>-----</td>
<td>---------</td>
</tr>
<tr>
<td>1</td>
<td>$\sqrt{-8}, \frac{2}{7}, 0.3, \frac{1}{3}, 40%$</td>
</tr>
<tr>
<td>2</td>
<td>$11.835 \times 6.051$</td>
</tr>
<tr>
<td></td>
<td>$\sqrt{17}$</td>
</tr>
<tr>
<td></td>
<td>$\approx \frac{12 \times 6}{\sqrt{16}}$</td>
</tr>
<tr>
<td></td>
<td>$= \frac{72}{4}$</td>
</tr>
<tr>
<td></td>
<td>$= 18$</td>
</tr>
<tr>
<td>3</td>
<td>Percentage increase $= \frac{(1.2x)^2 - x^2}{x^2} \times 100$</td>
</tr>
<tr>
<td></td>
<td>$= 44%$</td>
</tr>
<tr>
<td>4a</td>
<td>$1008 = 2^4 \times 3^2 \times 7$</td>
</tr>
<tr>
<td>4b</td>
<td>$\text{LCM} = 2^4 \times 3^3 \times 5^2 \times 7$</td>
</tr>
<tr>
<td>4c</td>
<td>$k = 2 \times 3 = 6$</td>
</tr>
<tr>
<td>5a</td>
<td>$F = \frac{k}{x^2}$</td>
</tr>
<tr>
<td></td>
<td>$3 = \frac{k}{4^2}$</td>
</tr>
<tr>
<td></td>
<td>$k = 3 \times 16$</td>
</tr>
<tr>
<td></td>
<td>$F = \frac{48}{x^2}$</td>
</tr>
<tr>
<td>5b</td>
<td>$F = \frac{48}{2^2}$</td>
</tr>
<tr>
<td></td>
<td>$F = 12 \text{ newtons}$</td>
</tr>
<tr>
<td>5c</td>
<td>$1.25 = \frac{k}{x^2}$</td>
</tr>
<tr>
<td></td>
<td>$F = \frac{k}{(\frac{x}{2})^2} = \frac{4k}{x^2}$</td>
</tr>
<tr>
<td></td>
<td>$\therefore F = 1.25 \times 4$</td>
</tr>
<tr>
<td></td>
<td>$= 5$</td>
</tr>
<tr>
<td></td>
<td>When $k = 48$,</td>
</tr>
<tr>
<td></td>
<td>$1.25 = \frac{48}{x^2}$</td>
</tr>
<tr>
<td></td>
<td>$F = \frac{48}{(\frac{x}{2})^2}$</td>
</tr>
<tr>
<td></td>
<td>$F = 4 \left( \frac{48}{x^2} \right)$</td>
</tr>
<tr>
<td></td>
<td>$F = 1.25 \times 4$</td>
</tr>
<tr>
<td></td>
<td>$= 5$</td>
</tr>
</tbody>
</table>
|   | By Pythagoras' Theorem, 
|   | \[ AB = \sqrt{\left(\frac{14}{2}\right)^2 + \left(\frac{14}{2}\right)^2} \]  
|   | \[ AB = 7\sqrt{2} \text{ or } AB = 9.90 \text{ (to 3sf) (since length > 0)} \]  
| 7a | \[ \pi r^2 h = 1500 \]  
|   | \[ h = \frac{1500}{3.142 \times 6.8^2} \]  
|   | \[ = 10.3244 \]  
|   | \[ = 10.3 \text{ (to 3sf)} \]  
| 7b | \[ 2\pi r^2 + 2\pi rh \]  
|   | \[ = 2(3.142)(6.8^2) + 2(3.142)(6.8)(10.3244) \]  
|   | \[ = 731.746 \]  
|   | \[ = 732 \text{ cm}^2 \text{ (to 3sf)} \]  
| 8i | \[ \cos 60^\circ = \frac{2}{OQ} \]  
|   | \[ \therefore OQ = 4 \]  
|   | Or \[ OQ = 4.00 \text{(3sf)} \]  
| 8ii | \[ r = \sqrt{4^2 - 2^2} \]  
|   | \[ r = 2\sqrt{3} \]  
|   | Or \[ r = 3.464 \text{ (to 3 sf)} \]  
| 9a | \[ \frac{3a^2}{7bc} + \frac{9a}{14b} \]  
|   | \[ = \frac{3a^2}{7bc} \times \frac{14b}{9a} \]  
|   | \[ = \frac{2a}{3c} \]  
| 9b | \[ \frac{2x}{x^2 - 25} - \frac{1}{x - 5} \]  
|   | \[ = \frac{2x - (x + 5)}{x^2 - 25} \]  
|   | \[ = \frac{x - 5}{x^2 - 25} \]  
|   | \[ a = 2 \]  
| 10 | \[ y \text{ dollars} = 100y \text{ cents} \]
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>
| 11 | Total number of units = 2 + 3 + 4 = 9  
If equally divided among A, B and C, each will get 3 units  
Therefore total sum of money $= (3 - 2) \times 9 \times $20  
= $180 |
| 12a | $x = 1, y = 1.5$ |
| 12b | Line drawn at $x = 3$ |
| 12c | Area $= \frac{1}{2} \times 6 \times 2$  
= 6 units² |
| 13a | $\frac{12}{8} = \frac{AC}{12}$  
$AC = \frac{144}{8} = 18$ cm |
| 13b | $\frac{CB}{6} = \frac{12}{8}$  
$CB = 9$  
$CD = 8 + 9 = 17$ cm |
| 14a | $3p^2 - 3pq - 5ap + 5aq$  
$= 3p(p - q) - 5a(p - q)$  
$= (3p - 5a)(p - q)$ |
| 14b | $6x^2 + 14x - 12$  
$= 2(3x^2 + 7x - 6)$  
$= 2(3x - 2)(x + 3)$ |
| 15a | Total no. of balls = 18  
Probability that ball is red $= \frac{10}{18} = \frac{5}{9}$ |
| 15b | Let additional blue marbles be $x$.  
$\frac{5 + x}{18 + x} = \frac{1}{2}$  
$18 + x = 10 + 2x$  
x = 8 |
|   | \[
\frac{5}{y-3} + \frac{10}{3(3-y)} = 3
\]
|   | \[
\frac{5}{y-3} - \frac{10}{3(y-3)} = 3
\]
|   | \[
\frac{5}{3(y-3)} = 3
\]
|   | \[
5 = 9y - 27
\]
|   | \[
y = \frac{32}{9}
\]
|   | \[
y = \frac{5}{9}
\]

[M1] for change of sign
[M1] for multiplying denominator to both sides and correct expansion

17  
\[
4a + 15b = 15
\]
\[
7a - 30b = 15
\]

(1) \times 2: 8a + 30b = 30 \quad (3)

(2) + (3):
\[
15a = 45
\]

\[
a = 3
\]

Sub \((a = 3)\) into (1):
\[
4(3) + 15b = 15
\]
\[
15b = 15 - 12
\]
\[
b = \frac{1}{5}
\]

[M1] for elimination or substitution method

18aii  
Modal marks = 61 marks

18aiii  
\[
\text{Median current} = \frac{68 + 71}{2}
\]
\[
= 69.5\text{marks}
\]

Mean of boys’ marks
\[
\frac{50 + 52 + 54 + 2(61) + 65 + 69 + 75 + 77 + 80}{10}
\]
\[
= 64.4\text{marks}
\]

B1

18b  
Sample Answer:
The girls preformed better. Because they attained a higher mean score as compared to the boys

*definitely is girls

B1

19d  
BA, BC;
B, C

B1

B1
Qn 19a, b, c

Marking Scheme.
Answer (a), (b), (c)
FAIRFIELD METHODIST SCHOOL (SECONDARY)

END-OF-YEAR EXAMINATION 2015
SECONDARY 2 EXPRESS

MATHEMATICS

Paper 2

Date: 08 October 2015 Duration: 1 hour 30 minutes

Candidates answer on Question Paper.

Additional Material : 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.
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 $\pi$, use either your calculator value or 3.142, unless the question requires the
answer in terms of $\pi$.

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 60.

At the end of the examination, fasten all your work securely together.

<table>
<thead>
<tr>
<th>For Examiner's Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper 2</td>
</tr>
</tbody>
</table>

Setter: Miss Michelle Tan

This question paper consists of 16 printed pages including the cover page.
Answer all the questions.

1. The ratio of the length and breadth of a rectangle is 5 : 3. Given that the perimeter of the rectangle is 32 cm, find the length of the rectangle.

   Answer

2. Mdm Teo bought 48 apples, 72 oranges and 96 pears. If she wants each type of fruit to be distributed equally among a certain number of fruit baskets, what is the greatest number of fruit baskets that can be prepared?

   Answer
3. If $y$ is directly proportional to $x^3$ and the difference in the values of $y$ when $x = 1$ and $x = 2$ is 35, find the value of $y$ when $x = -3$.

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

4. (a) Calculate the sum of the interior angles of a decagon.

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

(b) Seven of the interior angles of a decagon are $165^\circ$ each. The rest of the angles are $2x^\circ$, $(2x + 15)^\circ$ and $(x - 30)^\circ$. Find the value of the largest interior angle.

Answer (b) ........................................... [2]
5. Jennifer sold $x$ cupcakes at 60 cents each and 32 cookies at 20 cents each during a fund raising activity in school. At the end of the day, she received at least $168.

(a) Write down an inequality in $x$ to represent the information given above.

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

(b) Solve the inequality formed in (a).

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

(c) Hence, find the minimum number of cupcakes sold.

Answer (c)................. cupcakes [1]
6. Study the number pattern below.

<table>
<thead>
<tr>
<th></th>
<th>C₁</th>
<th>C₂</th>
<th>C₃</th>
<th>C₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>R₁</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>64</td>
</tr>
<tr>
<td>R₂</td>
<td>3</td>
<td>5</td>
<td>15</td>
<td>225</td>
</tr>
<tr>
<td>R₃</td>
<td>4</td>
<td>6</td>
<td>24</td>
<td>576</td>
</tr>
<tr>
<td>R₄</td>
<td>5</td>
<td>7</td>
<td>35</td>
<td>1225</td>
</tr>
<tr>
<td>R₅</td>
<td>6</td>
<td>8</td>
<td>48</td>
<td>2304</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Rₙ</td>
<td>n + 1</td>
<td>n + 3</td>
<td>575</td>
<td>330625</td>
</tr>
<tr>
<td>Rₙ₊₁</td>
<td>w</td>
<td>x</td>
<td>y</td>
<td>z</td>
</tr>
</tbody>
</table>

(a) Write down an expression for w, x and y in terms of n.

*Answer (a)*

\[ w = \]

\[ x = \]

\[ y = \] [1]

(b) (i) Form an equation in terms of n.

*Answer (b) [1]

(b) (ii) Show that your answer in (b)(i) can be simplified to \( n^2 + 4n - 572 = 0 \).

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

(c) Explain why the number 15000 would not appear in the column C₄.

*Answer (c)* [1]

(d) Write down an expression for z in terms of y.

*Answer (d)* [1]
7. (a) Given that \( \sqrt{\frac{1-x}{y}} = p \), express \( x \) in terms of \( p \) and \( y \).

\[ \text{Answer (a)} \] .................................. [2]

(b) Hence, find the value of \( x \) when \( p = -1 \) and \( y = 6 \).

\[ \text{Answer (b)} \] .................................. [1]

8. It is given that \( a^2 + b^2 = 548 \) and \( 2ab = 352 \) and \( a > b \), find the value of \( a^2 - b^2 \)

where \( a \) and \( b \) are positive integers.

\[ \text{Answer} \] .................................. [3]
9. Expand and simplify the following expressions.

(a) \(-3x(2x - 5)\)

\[\text{Answer (a)}\]

(b) \(7(x - 4) - 3(2x + 4)\)

\[\text{Answer (b)}\]

10. (a) Factorise \(3k(4 - h) - (h - 4)\).

\[\text{Answer (a)}\]

(b) Hence, simplify \(\frac{3k(4 - h) - (h - 4)}{16 - h^2}\)

\[\text{Answer (b)}\]
11. Solve the following equations.

(a) \( x - (2x - 8) = 28 + 4x \)

(b) \((m - 20)^2 = 144\)

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

Answer (b) \( m = \) ........ or .......... [2]
12. A map of Sentosa Island in Singapore is drawn to a scale of $1 : 50000$.

(a) The distance on the map between the Merlion Park and Tanjong Beach is 3.6 cm. Calculate, in kilometers, the actual distance between these two places.

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

(b) Sentosa Island has an actual area of 5 km$^2$. Calculate in square centimeters, the area of Sentosa Island on the map.

Answer (b) ......................... cm$^2$ [2]
13. The figure shows a vertical monument $AB$. Caine is standing on a platform 5.7 m away, at point $C$.

It is given that the angle of elevation from $C$ to the top of the monument is $20^\circ$ and the angle of elevation from the foot of the monument to $C$ is $28^\circ$. Find the height of the monument.

Answer: $\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots m$ [3]
14. The table shows the number of hours, $h$, spent by a group of 20 students on the computer in a week.

<table>
<thead>
<tr>
<th>5</th>
<th>2</th>
<th>14</th>
<th>8</th>
<th>17</th>
<th>0</th>
<th>11</th>
<th>3</th>
<th>9</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>10</td>
<td>12</td>
<td>22</td>
<td>14</td>
<td>20</td>
<td>18</td>
<td>20</td>
<td>12</td>
<td>24</td>
</tr>
</tbody>
</table>

(a) Complete the frequency table for the data.

<table>
<thead>
<tr>
<th>No. of hours</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0 \leq h &lt; 5$</td>
<td>4</td>
</tr>
<tr>
<td>$5 \leq h &lt; 10$</td>
<td></td>
</tr>
<tr>
<td>$10 \leq h &lt; 15$</td>
<td></td>
</tr>
<tr>
<td>$15 \leq h &lt; 20$</td>
<td></td>
</tr>
<tr>
<td>$20 \leq h &lt; 25$</td>
<td></td>
</tr>
</tbody>
</table>

(b) Draw a histogram to illustrate the data in (a).
14. (c) Calculate an estimated mean for the number of hours the group of students spent on the computer in a week.

Answer (c)

[2]
15. A metal ornament is made up of a pyramid with a rectangular cuboid as its base as shown in the diagram below.

(a) It is given that the height of the pyramid is 12 cm and the dimensions of the cuboid is 15 cm by 9 cm by 4 cm.

(i) Find the volume of the pyramid.

Answer (a)(i) \[ \text{cm}^3 \] [2]

(ii) Show that the volume of the metal ornament is 1080 cm\(^3\).

Answer (a)(ii) [1]
15. (b) The metal ornament was melted and recast into smaller solid cones with a base circumference of 12 cm and a slant height of 5 cm. Take $\pi = 3.142$.

(i) Find the volume of each cone.

Answer (b)(i) .................. cm$^3$  [3]

(ii) Hence, find the maximum number of cones that can be formed.

Answer (b)(ii) .................. cones  [1]
15. (c) An engineer then cut off the top of the cone with a vertical height of 2 cm and a diameter of 1 cm. He intends to paint the remaining of the ornament after the removal of the top of the cone.

(i) Find the curved surface area of the remaining ornament after the removal of the top of the cone.

Answer (c)(i) ......................... cm² [2]

(ii) Find the total surface area of the ornament to be painted.

Answer (c)(ii) ......................... cm² [2]
16. Answer the whole of this question on a sheet of graph paper.

The variables $x$ and $y$ are connected by the equation $y = x^2 - 8x + 7$. The table below shows the corresponding values of $x$ and $y$ for the equation.

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>7</td>
<td>-5</td>
<td>-8</td>
<td>$p$</td>
<td>-8</td>
<td>-5</td>
</tr>
</tbody>
</table>

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

(b) Taking 2 cm to represent 1 unit on the $x$-axis and 1 cm to represent 1 unit on the $y$-axis, draw the graph of $y = x^2 - 8x + 7$ for $0 \leq x \leq 6$. \[3\]

(c) Using your graph, solve $x^2 - 8x + 7 = -4$. \[1\]

(d) State the equation of the line of symmetry of the graph. \[1\]

~End of Paper~
10 cm
24
-135
1440
165
60x + 32(20) ≥ 16800 or 0.6x + 32(0.2) ≥ 168
\( x ≥ \frac{269}{3} \)
270
w = \( n + 2 \), \( x = n + 4 \), \( y = (n + 2)(n + 4) \)
\( (n + 1)(n + 3) = 575 \)
\( (n + 1)(n + 3) = 575 \)
\( n^2 + 4n + 3 = 575 \)
\( n^2 + 4n - 572 = 0 \) (shown)

The numbers in \( C_4 \) are all perfect squares. Since 15000 is not a perfect square, it will not appear in \( C_4 \).

\( z = y^2 \)
\( x = 1 - y^2 \)
\( x = 1 - 6(-1)^3 = 7 \)
420
\( -6x^2 + 15x \)
\( x - 40 \)
\( a \) \( (4 - h)(3k + 1) \) or \( (h - 4)(-3k - 1) \) or \( -(-4 + h)(3k + 1) \)
\( b \) \( \frac{3k + 1}{4 + h} \)
\( a \) \( x = -4 \)
\( b \) \( m = 32 \) or \( m = 8 \)
\( a \) \( 1.8 \text{ km} \)
\( b \) \( 20 \text{ cm}^2 \)
\( i \) \( 5.11 \text{ m} \)

<table>
<thead>
<tr>
<th>No. of hours</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ≤ h &lt; 5</td>
<td>4</td>
</tr>
<tr>
<td>5 ≤ h &lt; 10</td>
<td>3</td>
</tr>
<tr>
<td>10 ≤ h &lt; 15</td>
<td>6</td>
</tr>
<tr>
<td>15 ≤ h &lt; 20</td>
<td>2</td>
</tr>
<tr>
<td>20 ≤ h &lt; 25</td>
<td>5</td>
</tr>
</tbody>
</table>

14c 12.75
15ai 540 cm³
15a(ii) Volume of ornament = 540 + (15 × 9 × 4) = 1080 cm³ (shown)
15bi 17.6 cm³
15bii 61
15ci 27.6 cm² (used int. values to 5sf) or 26.8 cm² (used exact int. values)
15cii 40.4 cm² (used int. values to 5sf) or 39.0 cm² (used exact int. values)
16a \( p = -9 \)
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>16c</td>
<td>Accept $x = 1.7$ to $1.8$</td>
</tr>
<tr>
<td>16d</td>
<td>$x = 4$</td>
</tr>
</tbody>
</table>
1. Length of rectangle $= \frac{32}{16} \times 5 = 10$ cm \([B1]\)

2. 
   $48 = 2^4 \times 3$
   $72 = 2^3 \times 3^2$
   $96 = 2^5 \times 3$

   HCF $= 2^3 \times 3$ \([M1]\)
   $= 24$ \([A1]\)

3. $y = kx^3$
   
   When $x = 1$, $y = k$
   When $x = 2$, $y = 8k$
   
   $8k - k = 35$
   $7k = 35$
   $k = 5$ \([M1]\)

   When $x = -3$,
   $y = 5(-3)^3 = -135$ \([A1]\)

4a. $(10 - 2) \times 180^\circ = 1440^\circ$ \([B1]\)

4b. 
   $7(165) + 2x + (2x + 15) + (x - 30) = 1440$
   $5x = 300$
   $x = 60$ \([M1]\)

   Larges interior angle $= 165^\circ$ \([A1]\)

5a. $60x + 32(20) \geq 16800$ \([B1]\) or $0.6x + 32(0.2) \geq 168$ \([B1]\)

5b. $60x + 32(20) \geq 16800$
   $60x \geq 16160$
   $x \geq 269\frac{1}{3}$ \([to\ 5sf]\) \([B1]\)

5c. $270$ \([B1]\)

6a. $w = n + 2$,
   $x = n + 4$,
   $y = (n + 2)(n + 4)$ \([B1]\)

6bi. $(n + 1)(n + 3) = 575$ \([B1]\)

6bii. $(n + 1)(n + 3) = 575$
   $n^2 + 4n + 3 = 575$
   $n^2 + 4n - 572 = 0$ (shown) \([B1]\)

6c. The numbers in $C_4$ are all perfect squares. Since 15000 is not a perfect square, it will not appear in $C_4$. \([B1]\)

6d. $z = y^2$ \([B1]\)
7.a. \[
\sqrt[3]{\frac{1-x}{y}} = p
\]
\[
\frac{1-x}{y} = p^3 \quad [M1]
\]
\[
1-x = yp^3
\]
\[
x = 1-yp^3 \quad [A1]
\]

7.b. \[
x = 1-6(-1)^3 = 7 \quad [B1]
\]

8. \[
\bar{a}^2 + b^2 + 2ab = 548 + 352
\]
\[
(a+b)^2 = 900
\]
\[
a + b = 30 \quad [M1]
\]
\[
a^2 + b^2 - 2ab = 548 - 352
\]
\[
(a-b)^2 = 196
\]
\[
a - b = 14 \quad [M1]
\]
\[
a^2 - b^2 = (a+b)(a-b)
\]
\[
= 30(14)
\]
\[
= 420 \quad [A1]
\]

9a. \[
-6x^2 + 15x \quad [B1]
\]

9b. \[
7(x-4) - 3(2x+4)
\]
\[
= 7x - 28 - 6x - 12 \quad [M1 \text{ for } -12]
\]
\[
= x - 40 \quad [A1]
\]

10a. \[
3k(4-h)-(h-4)
\]
\[
= 3k(4-h) + (4-h)
\]
\[
= (4-h)(3k+1) \quad [B1] \text{ accept } (h-4)(-3k-1) \text{ and } -(4+h)(3k+1)
\]

10b. \[
\frac{3k(4-h)-(h-4)}{16-h^2}
\]
\[
= \frac{(4-h)(3k+1)}{(4-h)(4+h)} \quad [M1 \text{ for factorising/denominator}]
\]
\[
= \frac{3k+1}{4+h} \quad [A1]
\]

11a. \[
x - (2x-8) = 28 + 4x
\]
\[
x - 2x + 8 = 28 + 4x \quad [M1 \text{ for } +8]
\]
\[
-5x = 20
\]
\[
x = -4 \quad [A1]
\]
11b. \((m - 20)^2 = 144\)
\[m - 20 = 12 \text{ or } m - 20 = -12\] [M1]
\[m = 32 \text{ or } m = 8\] [A1]

Or
\[(m - 20)^2 = 144\]
\[m^2 - 2(m)(20) + 20^2 = 144\]
\[m^2 - 40m + 256 = 0\]
\[(m - 8)(m - 32) = 0\] [M1 for factorisation]
\[m - 8 = 0 \text{ or } m - 32 = 0\]
\[m = 32 \text{ or } m = 8\] [A1]

12a.  
<table>
<thead>
<tr>
<th>Map</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 cm rep.</td>
<td>50000 cm</td>
</tr>
<tr>
<td>3.6 cm</td>
<td>rep. 180000 cm</td>
</tr>
<tr>
<td></td>
<td>1.8 km</td>
</tr>
</tbody>
</table>

12b.  
<table>
<thead>
<tr>
<th>Actual</th>
<th>Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>50000 cm</td>
<td>rep. 1 cm</td>
</tr>
<tr>
<td>0.5 km</td>
<td>rep. 1 cm</td>
</tr>
<tr>
<td>0.25km^2</td>
<td>rep. 1 cm^2</td>
</tr>
<tr>
<td>5km^2</td>
<td>rep. 20 cm^2</td>
</tr>
</tbody>
</table>

13.  
\[\angle ACX = 28^\circ \text{ (alt. angles)}\]
\[\tan 28^\circ = \frac{BX}{5.7}\]
\[BX = 3.0307 \text{ m (to 5 sf)}\] [M1]
\[\tan 20^\circ = \frac{AX}{5.7}\]
\[AX = 2.0746 \text{ m (to 5 sf)}\] [M1]

Height of monument \(= 3.0307 + 2.0746 = 5.11 \text{ m (to 3sf)}\) [A1]

Or
\[\angle XBC = 62^\circ\]
\[\tan 62^\circ = \frac{5.7}{BX}\]
\[BX = 3.0307 \text{ m (to 5 sf)}\] [M1]
\[\tan 70^\circ = \frac{5.7}{AX}\]
\[AX = 2.0746 \text{ m (to 5 sf)}\] [M1]

Height of monument \(= 3.0307 + 2.0746 = 5.11 \text{ m (to 3sf)}\) [A1]
14a.

<table>
<thead>
<tr>
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<td>6</td>
</tr>
<tr>
<td>$15 \leq h &lt; 20$</td>
<td>2</td>
</tr>
<tr>
<td>$20 \leq h &lt; 25$</td>
<td>5</td>
</tr>
</tbody>
</table>

[B1 for all correct]

14b.

Frequency

[B2] for all heights of bars drawn correctly [No FT mark]
[B1] for 2 or less error in height of bars
[No marks if 3 or more errors]
14c. Estimated mean = \[ \frac{(2.5 \times 4) + (7.5 \times 3) + (12.5 \times 6) + (17.5 \times 2) + (22.5 \times 5)}{20} \] [M1]

= \frac{255}{20}

= 12.75 [A1]

15ai. Volume of pyramid = \( \frac{1}{3} \times 15 \times 9 \times 12 \) [M1]

= 540 cm³ [A1]

15a(ii). Volume of ornament = 540 + (15 × 9 × 4) = 1080 cm³ (shown) [B1]

15bi. Radius of base = \( \frac{12}{3.142} \div 2 = 1.9096 \) cm [M1 for radius or height]

Height of cone = \( \sqrt{5^2 - 1.9096^2} = 4.6210 \) cm

Volume of cone = \( \frac{1}{3} \times 3.142 \times 1.9096^2 \times 4.6210 \) [M1]

= 17.648 cm³ (to 5 sf)

= 17.6 cm³ (to 3 sf) [A1]

15bii. Max. no. of cones = \( 1080 \div 17.648 = 61.196 = 61 \) (nearest whole number) [B1]

15ci. Slant height of removed part = \( \sqrt{2^2 + 0.5^2} \)

= \( \sqrt{4.25} \)

= 2.0616 (to 5sf)

Remaining curved surface area

= \( (3.142 \times 1.9606 \times 5) - (3.142 \times 0.5 \times 2.0616) \) [M1]

= 27.562 cm² (to 5sf)

= 27.6 cm² (to 3sf) [A1]

Or

Remaining curved surface area

= \( (3.142 \times \left[ \frac{12}{3.142} \div 2 \right] \times 5) - (3.142 \times 0.5 \times \sqrt{4.25}) \) [M1]

= 26.761 cm² (to 5sf)

= 26.8 cm² (to 3sf) [A1]
15cii. Total surface area to be painted
\[ = 27.562 + (3.142 \times 0.5^2) + (3.142 \times 1.9606^2) \] [M1]
\[ = 40.425 \text{ cm}^2 \text{ (to 5sf)} \]
\[ = 40.4 \text{ cm}^2 \text{ (to 3sf) } [A1] \]

Or

Total surface area to be painted
\[ = 26.761 + (3.142 \times 0.5^2) + (3.142 \times \left( \frac{12}{3.142} \div 2 \right)^2) \] [M1 for addition of 3 parts]
\[ = 39.004 \text{ cm}^2 \text{ (to 5sf)} \]
\[ = 39.0 \text{ cm}^2 \text{ (to 3sf)} [A1] \]

16a. \( p = -9 [B1] \)

16b. P: 2
C: 1 (smooth curve)

[Minus 1 mark for no label of axis or curve]
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 and working 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.

This document consists of 11 printed pages.

Setter: E.Liow

NANYANG GIRLS' HIGH SCHOOL
1. Arrange the following numbers in ascending order.

\[ 3.2 \times 10^{-16}, -32 \times 10^{-15}, 0.32 \times 10^{-17}, -3.2 \times 10^{-13} \]

Answer: ______________________________________ [2]

2. Solve the following pair of simultaneous equations:

\[ 3x - y = 10 \]
\[ \frac{x}{2} + 2y = 6 \]

Answer: \( x = \) _____; \( y = \) _____ [3]
3. One cubic box of length 40 cm contains 4000 SG50 commemorative coins. A truck container with dimensions 2.5 m by 6 m by 2.5 m is used to deliver the coins to the packing center. Find the maximum number of coins that can be delivered each time. Leave your answer in standard form.

Answer: ___________ coins [2]

4. Given that \( p = 2 \times 10^6 \) and \( q = 1.62 \times 10^{12} \), evaluate each of the following without the use of a calculator. Express your answers in standard form.

(a) \( 8p \)

(b) \( \frac{p^2}{q - p} \)

Answer: (a) ___________ [1]
(b) ___________ [3]
5. The diagram below shows the Total Variable Cost and Total Income graphs of a company producing product X.

The Total Variable Cost includes expenses such as electricity bills, material costs, etc.

(a) Find the gradient of the line representing the Total Variable Cost and explain its significance.

The Total Cost incurred by the company comprises of the Total Variable Cost and the Fixed Cost. The Fixed Cost is $500 and includes expenses such as insurance fees, rental fees, etc.

(b) (i) On the graph provided above, draw the line representing the Total Cost for $0 \leq \text{number of Product X} \leq 1400$. Label your graph “Total Cost”. [1]

(ii) State the Total Cost incurred by the company when 800 Product X are produced.

(iii) Hence, conclude whether the company is making a profit or loss when 800 Product X are produced.

Answer: (a) Gradient = __________;

Significance: ____________________________________________________________________ [2]

(b) (ii) $\text{________}$ [1] (iii) ____________________________________________________________________ [1]
6. The graph of \( y = x \) and the point \((-3, 2)\) are plotted as shown below. On the axes below, sketch the graphs of the following given equations and, for each case, indicate the intercepts with the axes clearly. Label each graph clearly with its equation.

(a) \( x = -4 \), \[1\]

(b) \( y + x + 1 = 0 \), \[2\]

(c) \( y = k + kx \), where \( k > 1 \). \[2\]

7. (a) Given that \( b(3a - b) = \frac{ac}{b} \), express \( a \) in terms of \( b \) and \( c \).

(b) State the range of values of \( x \) for the following equation to be defined.
\[
\frac{1}{x\sqrt{x + 1}} = \frac{1}{x + 1}
\]

Answer: (a) \[3\]

(b) \[2\]

[Turn Over]
8. Simplify the following expressions leaving your answers in the simplest factorized form.

(a) \[ \frac{1}{2x-1} - \frac{3}{4x-2} + \frac{2}{4x^2 - 4x + 1} \]

(b) \[ \frac{3a^2 - 5ab - 2b^2}{b^2 - 9a^2} + \frac{ab - 3a - 2b^2 + 6b}{3} \]

Answer: (a) 

(b) 

9. Simplify the following, giving your answers in positive indices only.

(a) \( \left( \frac{a^3}{27b} \right)^2 \times \frac{b}{(-a)^2} \)

(b) \( \frac{(a^{-2}b^2c^0)^2}{5a^3c^2} \times \sqrt{100b^{-8}} \)

(c) \( \frac{3^{2x+1} - 2(9^x)}{3^x} \), where \( x > 1 \)

Answer: (a) ____________________ [3]

(b) ____________________ [3]

(c) ____________________ [2]

[Turn Over]
10. A solid cuboid has dimensions \((9 - x)\) m by \(x\) m by 2 m. The graph representing its total volume, 
\[ y = (18x - 2x^2) \text{ m}^3 \], against \(x\) m is shown below.

(a) Find the value of \(m\) given that the points \((2, n)\) and \((m, n)\) lie on the curve.

(b) State the significance of the point \((4.5, 40.5)\) on the above graph.

(c) Find the equation of the straight line that must be drawn on the above graph to solve 
\[ x^2 - \frac{21}{2}x + 15 = 0. \]

(d) Another cuboid with \(x\) m as one of its sides has a total volume of \(y = (30 - 3x)\) m\(^3\). By inserting the straight line \(y = 30 - 3x\) onto the graph above, find the value of \(x\), where \(x < 5\), when the two cuboids have the same volume.

Answer: (a) \(m = \text{_________} \) [1]

(b) 

(c) \(\text{_________} \) [2]

(d) \(\text{_________} \) [2]
11. The following is a pair of simultaneous equations:

\[ x^2 - py^2 = 0 , \]
\[ x - 2y = 0. \]

(a) If \( x = p + 1 \) and \( y = q \), is the solution set of the above simultaneous equations, find the values of \( p \) and of \( q \).

(b) Write down a linear equation such that it has

(i) an infinite number of solutions with \( x - 2y = 0 \),

(ii) no solution with \( x - 2y = 0 \).

Answer: (a) ________________ [5]
(b) (i) ________________ (ii) ________________ [2]
12. In the diagram shown below, $ABC$ is a triangle. The points $M$ and $P$ are on $AB$ and $BC$ respectively, such that $PM$ is parallel to $CA$. The points $N$ and $Q$ are on $AB$ and $AC$ respectively, such that $QN$ is parallel to $CB$. $NQ$ and $MP$ meet at the point $X$, such that $QXPC$ is a rhombus.

(a) Name a triangle which is similar to $\triangle MNX$.

(b) What type of triangle should $\triangle NXM$ be, for it to be similar to $\triangle QXP$?

(c) Given $XN : QN : CB = 3 : 4 : 5$.

   (i) Prove that $\triangle ANQ$ and $\triangle MBP$ are congruent. State the geometrical reasons and the case of congruence clearly. [2]

   (ii) If $\triangle QXP$ and $\triangle NXM$ are indeed similar, state the ratio $QP : MN$. 


Answer:
(a) ____________ [1]
(b) ____________ [1]
(c)(ii) ____________ [1]

END OF PAPER
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(-3.2 \times 10^{-13}, -32 \times 10^{-15}, 0.32 \times 10^{-17}, 3.2 \times 10^{-16})</td>
</tr>
</tbody>
</table>
| 2 | \(3x - y = 10\) \((1)\)  
\[ \frac{x}{2} + 2y = 6 \] \((2)\)  
\[2(1) + (2) : \]  
\[2(3x) + \frac{x}{2} = 2(10) + 6\]  
\[13x = 26\]  
\[x = 4\]  
Sub \(x = 4\) into \((1)\), \(3(4) - y = 10\)  
\[y = 2\]  
**Alternative method**  
\(3x - y = 10\) \((1)\)  
\[\frac{x}{2} + 2y = 6\] \((2)\)  
From \((1)\) : \(y = 3x - 10\) \((3)\)  
Sub \((3)\) into \((2)\) :  
\[\frac{x}{2} + 2(3x - 10) = 6\]  
\[13x = 26\]  
\[x = 4\]  
Sub \(x = 4\) into \((3)\), \(3(4) - y = 10\)  
\[y = 2\]  
| 3 | Maximum of boxes that can be packed into the truck container  
\[= \frac{2.5 \times 6 \times 2.5}{0.4 \times 0.4 \times 0.4}\]  
\[\approx 6 \times 15 \times 6\]  
\[= 540\]  
Maximum number of coins that can be delivered each time |
4(a) \[ 8p = 8(2 \times 10^{10}) = 16 \times 10^{10} = 1.6 \times 10^{11} \]

4(b) \[ \frac{p^2}{q-p} = \frac{(2 \times 10^{10})^2}{1.62 \times 10^{12} - 2 \times 10^{10}} = \frac{4 \times 10^{20}}{4 \times 10^{20}} = \frac{1.62 \times 10^{12} - 0.02 \times 10^{12}}{1.6 \times 10^{12}} \]

5(a) Gradient = \[ \frac{420}{800} = 0.525 \]

Significance: For each product X being produced, $0.53 (2d.p) of variable cost was made.

5(bi) Line drawn is parallel to Total Variable Cost line with \[ y \text{-int} = 500 \]

5(bii) \[ 420 + 500 = 920 \]

5(biii) loss

6

(a) \[ x = -4 \]

(c) \[ y = k + kx, k > 1 \]

(b) \[ y + x + 1 = 0 \]
### 7(a)

\[
b(3a - b) = \frac{ac}{b}
\]

\[
3a - b = \frac{ac}{b^2}
\]

\[
3a - \frac{ac}{b^2} = b
\]

\[
a \left(\frac{3b^2 - c}{b^2}\right) = b
\]

\[
a = \frac{b^3}{3b^2 - c}
\]

**Alternative method:**

\[
b(3a - b) = \frac{ac}{b}
\]

\[
3ab^2 - b^3 = ac
\]

\[
3ab^2 - ac = b^3
\]

\[
a(3b^2 - c) = b^3
\]

\[
a = \frac{b^3}{3b^2 - c}
\]

### 7(b)

\(x \neq 0\) and \(x > -1\)

(Alt) \(-1 < x < 0\) or \(x > 0\)

### 8(a)

\[
\frac{1}{2x-1} - \frac{3}{4x-2} + \frac{2}{4x^2 - 4x + 1}
\]

\[
= \frac{1}{2x-1} - \frac{3}{2(2x-1)} + \frac{2}{(2x-1)^2}
\]

\[
= \frac{2(2x-1) - 3(2x-1) + 2(2)}{2(2x-1)^2}
\]

\[
= \frac{5 - 2x}{2(2x-1)^2}
\]

### 8(b)

\[
\frac{3a^2 - 5ab - 2b^2}{b^2 - 9a^2} + \frac{ab - 3a - 2b^2 + 6b}{3}
\]

\[
= \frac{(a - 2b)(3a + b)}{(b - 3a)(b + 3a)} \times \frac{3}{(a - 2b)(b - 3)}
\]

\[
= \frac{3}{(b - 3a)(b - 3)}
\]
**9(a)**

\[
\left( \frac{a^3}{27b} \right)^2 \cdot \frac{b}{(-a)^2} = \frac{a^2}{9b^3} \times \frac{b}{a^2} = \frac{1}{b^3}
\]

**9(b)**

\[
\frac{(a^{-2}b^3c^0)^2}{5a^3c^2} \times \sqrt{100b^{-8}} = \frac{a^{-4}b^6}{5a^3c^2} \times 10b^{-4} = \frac{2b^2}{a^7c^2}
\]

**9(c)**

\[
\frac{3^{2x+1} - 2(9^x)}{3^x} = \frac{3(3^{2x}) - 2(3^{2x})}{3^x} = \frac{3^{2x}}{3^x} = 3^x
\]

**10(a)**

\[m = 7\]

**10(b)**

The maximum total volume is 40.5 m³ when \(x = 4.5\).

**10(c)**

\[x^2 - \frac{21}{2}x + 15 = 0\]
\[2x^2 - 21x + 30 = 0\]
\[30 - 3x = 18x - 2x^2\]
\[y = 30 - 3x\]

**10(d)**

Line drawn passes through (0, 30) and (10, 0).

Accept \(x = 1.6\) to 1.8
### 11(a)

\[ (p + 1)^2 - pq^2 = 0 \quad \text{(1)} \]
\[ (p + 1) - 2q = 0 \quad \text{(2)} \]

From (2), \( q = \frac{p + 1}{2} \quad \text{(3)} \)

Sub (3) into (1), \( (p + 1)^2 - \frac{p(p + 1)^2}{4} = 0 \)

\[ (p + 1)^2 \left[ 1 - \frac{p}{4} \right] = 0 \]
\[ p = -1 \text{ or } p = 4 \]

From (3),
If \( p = -1, q = 0 \)
If \( p = 4, q = 2.5 \)

Alternative method:

\[ (p + 1)^2 - pq^2 = 0 \quad \text{(1)} \]
\[ (p + 1) - 2q = 0 \quad \text{(2)} \]

From (2), \( p = 2q - 1 \quad \text{(3)} \)

Sub (3) into (1), \( (2q)^2 - (2q - 1)q^2 = 0 \)

\[ q^2 (5 - 2q) = 0 \]
\[ q = 0 \text{ or } q = 2.5 \]

From (3),
If \( q = 0, p = -1 \)
If \( q = 2.5, p = 4 \)

### 11(b)

(i) accept any \( nx - 2ny = 0 \), where \( n \neq 0 \)
(ii) accept any \( x - 2y = n \), where \( n \neq 0 \)

### 12(a)

\( \Delta ANQ \) or \( \Delta MBP \) or \( \Delta ABC \)

### 12(b)

Isosceles / Equilateral triangle
| 12(ci) | \( \angle QAN = \angle PMB \) (corr. \( \angle s \), \( AC \parallel MP \))  
|       | \( \angle ANQ = \angle MBP \) (corr. \( \angle s \), \( QN//PB \))  
|       | \( \angle AQN = \angle MXN \) (corr. \( \angle s \), \( AQ//MP \))  
|       | = \( \angle MPB \) (corr. \( \angle s \), \( AN//PB \))  
|       | (*any of the 2 pairs of angles)  
|       | \( QX = CP \)  
|       | \( QN : PB = 4 : 5 - (4 - 3) \)  
|       | = \( 4 : 4 \)  
|       | \( QN = PB \)  
|       | \( \triangle ANQ \equiv \triangle MBP \) (AAS/ASA * depends)  
| 12(cii) | \( QP : MN = 1 : 3 \) |
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 and working on the separate answer paper provided.
4. All working must be written in dark blue or black ink.
5. Omission of essential working will result in loss of marks.
6. 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.
7. 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.
8. 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.

This document consists of 6 printed pages.

Setter: S Lee

NANYANG GIRLS' HIGH SCHOOL
1 (a) The point \((3, k)\) lies on the line \(y = 3x + 1\). Find the value of \(k\). \[1\]

(b) The line \(L_1\) passes through the point \((4, 7)\) and is parallel to the line \(2y - x = 16\). Find the equation of the line \(L_1\). \[3\]

(c) The line \(L_2\) passes through the points \((2, -2)\) and \((2, 7)\). Write down the equation of the line \(L_2\). \[1\]

2 (a) It is given that \(\frac{3x - 1}{4} \leq \frac{7x + 4}{3} < x + 2\frac{2}{3}\).

(i) Solve the inequality. \[4\]

(ii) Hence, list the integer values of \(x\) that satisfy the inequality. \[1\]

(b) Given that \(2 \leq p \leq 7\) and \(-1 \leq q \leq 5\), find

(i) the largest value of \(p - q\), \[1\]

(ii) the smallest value of \(p + q^2\), \[1\]

(iii) the smallest value of \(\frac{q^3}{p}\). \[1\]

3 A delivery van runs \(x\) kilometres on each litre of petrol when it travels up a slope.

(i) Write down, in terms of \(x\), the number of litres of petrol used when the delivery van travels 70 km up the slope. \[1\]

The delivery van runs \((x + 2)\) kilometres on each litre of petrol when it travels down the slope.

(ii) Write down, in terms of \(x\), the number of litres of petrol used when the delivery van travels 70 km down the slope. \[1\]

The delivery van uses 3 litres less petrol to travel down the slope than up the slope.

(iii) Using this information, form an equation in \(x\) and show that it reduces to \(3x^2 + 6x - 140 = 0\). \[3\]

(iv) Solve the equation \(3x^2 + 6x - 140 = 0\), giving both answers correct to two decimal places. \[3\]

(v) Hence, calculate the total volume of petrol used when the van travels 70 km up the slope and 70 km down the slope. \[2\]
4 The quadratic curve \( y = ax^2 + bx + 23 \) cuts the y-axis at point \( A \) and it passes through the points \((1, 13)\) and \((5, 13)\).

(i) Write down the coordinates of point \( A \). [1]
(ii) Find the equation of the line of symmetry of the curve. [2]
(iii) Find the value of \( a \) and of \( b \). Hence, explain with a reason whether the curve has a maximum or minimum turning point. [5]
(iv) The line \( y = k \) meets the curve \( y = ax^2 + bx + 23 \) at only one point. Find the value of \( k \). [2]

5 The diagram shows two escalators, \( AC \) and \( AD \), in a shopping centre.

The escalator \( AC \) of length 16 m leads to the 1st Floor while the escalator \( AD \) of length 22 m leads to the 2nd Floor.

Given that the straight line \( BCD \) is perpendicular to the horizontal basement \( AB'E \) and \( \angle BAC = 30^\circ \), find

(i) the height between the basement and the 1st floor, [2]
(ii) the height between the 1st floor and the 2nd floor, [4]
(iii) \( \angle DAC \). [2]
6 The diagram shows three kitchen containers.

\[
\begin{array}{c}
\text{Coffee} \\
10 \\
\text{Tea} \\
\text{Spice} \\
6
\end{array}
\]

Each container is a cylinder and the containers are geometrically similar.
The bases of the Coffee and Spice containers have diameters of lengths 10 cm and 6 cm respectively.

(a) Calculate the ratio

\[
\frac{\text{volume of the Spice container}}{\text{volume of the Coffee container}}.
\]

Hence, find the volume of the Spice container if the volume of the Coffee container is 980 cm\(^3\). \[3\]

(b) Given that the surface area of the Tea container is \(\frac{9}{16}\) of the surface area of the Coffee container, evaluate

\[
\frac{\text{Surface area of the Spice container}}{\text{Surface area of the Tea container}}.
\]

[3]

7 At the National Day Parade, a parachutist descended from a helicopter (not shown in the diagram). When he was at point \(P\), he began to descend vertically at a constant speed of 7 m/s towards point \(Q\) on the parade ground. To record the descent, an automated motorized video-camera was placed at point \(C\) on the parade ground; 100 m away from point \(Q\). The angle of depression of \(C\) from \(P\) was 60°.

\[
P
\downarrow
\angle QSP \approx 60°
\]

(i) Calculate the time taken for the parachutist to reach the parade ground. \[3\]

(ii) Given that in the descent, it took 10 s for the parachutist to reach point \(S\), calculate the angle of elevation of \(S\) from \(C\). \[3\]
Singapore aims to be a test-bed for micro-wind technology generating electricity with low wind speeds. A wind power station is proposed to be erected in a 250 m by 250 m horizontal field at Pulau Ubin and some wind towers will be built. Each wind tower has three rotor blades and the length of each blade is 40 m.

(a) According to building regulations, the minimum distance between two wind towers, measured from the foot of one tower to another, has to be five times the length of a rotor blade.

An engineer made a suggestion on how to arrange five wind towers $W_1$, $W_2$, $W_3$, $W_4$ and $W_5$, in the square field. The arrangement is shown in the diagram below.

![Wind Tower Diagram](image)

Explain why the engineer's suggestion does not meet the building regulations. Support your answer with working. 

(b) Singapore wants to estimate the cost savings from generating electricity through this wind station. The formula $C = -10y^2 + 90y - 130$ is used to estimate the cost savings in $C$ million dollars during the first $y$ years of operation.

This formula can be re-written as $C = a(y - n)^2 + m$ where it will take $n$ years to achieve the maximum cost savings of $m$ million dollars. Find the maximum cost savings and the number of years it will take to achieve this.
Bonus Question

9. $\alpha$ and $\beta$ are the roots of the quadratic equation $ax^2 + bx + c = 0$ where $a$, $b$ and $c$ are constants and $a \neq 0$. Showing your working clearly, express the sum of the roots and the product of the roots in terms of $a$, $b$ and/or $c$. [3]

End of Paper 2
### Sec 2 Math EOY 2015 Paper 2 Solution

<table>
<thead>
<tr>
<th>Question</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>( k = 10 )</td>
</tr>
</tbody>
</table>
| 1(b) | \( \text{Gradient of } L_1 \text{ is } \frac{1}{2} \)  
Let the equation of the line be \( y = mx + c \)  
and since the line passes through \((4, 7)\)  
\[ 7 = \frac{1}{2}(4) + c \]  
\[ \therefore c = 5 \]  
Equation of \( L_1 \) is \( y = \frac{1}{2}x + 5 \) |
| 1(c) | \( x = 2 \) |
| 2(a)(i) | \[ \frac{3x-1}{4} \leq \frac{7x+4}{3} < x + \frac{2}{3} \]  
\[ \frac{3x-1}{4} \leq \frac{7x+4}{3} \]  
\[ 9x - 3 \leq 28x + 16 \]  
\[ -1 \leq x \text{ or } x \geq -1 \]  
\[ \frac{7x+4}{3} < x + \frac{2}{3} \]  
\[ 7x + 4 < 3x + 8 \]  
\[ x < 1 \]  
\[ \therefore -1 \leq x < 1 \] |
| 2(a)(ii) | \(-1 \text{ and } 0\) |
| 2(b)(i) | \(8\) |
| 2(b)(ii) | \(2\) |
| 2(b)(iii) | \(\frac{1}{2}\) |
| 3(i) | \(\frac{70}{x}\) |
| 3(ii) | \(\frac{70}{x+2}\) |
### 3(iii) [3 m]

\[
\begin{align*}
\frac{70}{x} - \frac{70}{x+2} &= 3 \\
70(x+2) - 70x &= 3x(x+2) \\
70x + 140 - 70x &= 3x^2 + 6x \\
3x^2 + 6x - 140 &= 0 \text{ (shown)}
\end{align*}
\]

### 3(iv) [3 m]

\[
x = \frac{-6 \pm \sqrt{6^2 - 4(3)(-140)}}{2(3)}
\]

\[
x = \frac{5.904 \text{ or } -7.904}{2}
\]

### 3(v) [2 m]

\[
\begin{align*}
\frac{70}{5.904} + \frac{70}{5.904 + 2} &= 20.7 \text{ litres}
\end{align*}
\]

### 4(i) [1 m]

\((0, 23)\)

### 4(ii) [2 m]

\[
x = \frac{1 + 5}{2}
\]

Line of symmetry is \(x = 3\)

### 4(iii) [5 m]

\[
a + b + 23 = 13
\]

\[
a + b = -10 \quad \cdots (1)
\]

\[
25a + 5b = -10 \quad \cdots (2)
\]

\[
25a + 5(-10 - a) = -10
\]

or \(25a + 5b - 5a - 5b = -10 - 5(-10)\)

\[
20a = -10 + 50
\]

\[
a = 2
\]

From (1), \(b = -10 + 2 = -12\)

Since \(a\), the coefficient of \(x^2\), is positive, the curve has a mimimum turning point.

### 4(iv) [2 m]

When \(x = 3\)

\[
k = 2(3)^2 - 12(3) + 23
\]

\[
\therefore k = 5
\]

### 5(i) [2 m]

\[
BC = 16 \sin 30^\circ = 8 \text{ m}
\]

### 5(ii) [4 m]

\[
AB = 16 \cos 30^\circ \approx 13.86 \text{ m}
\]

\[
BD = \sqrt{22^2 - 13.86^2} \approx 17.09 \text{ m}
\]

\[
CD = 17.09 - 8 = 9.09 \text{ m}
\]
\[ \angle BAD = \cos^{-1} \frac{13.86}{22} \approx 50.95^\circ \]
\[ \angle DAC = 50.95^\circ - 30^\circ \approx 21.0^\circ \text{ or } 20.9^\circ \]

### 6(a) [3 m]

- \[ 6^3 : 10^3 = 27 : 125 \]
- Volume of Coffee container
  \[ = \frac{27 \times 980}{125} \]
  \[ = 211.68 \text{ cm}^3 \]

### 6(b) [4 m]

- Surface area of Spice container:
  \[ \frac{\text{Surface area of Spice container}}{\text{Surface area of Coffee container}} = \left( \frac{3}{5} \right)^2 = \frac{9}{25} \]
  - Surface area of Spice container
    \[ = \frac{9}{25} \times 9 \]
  - Surface area of Tea container
    \[ = \frac{9}{25} \times 16 \]
  - \[ = \frac{16}{25} \]

### 7(i) [3 m]

- \[ \frac{QP}{100} = \tan 60^\circ \]
  - \[ QP = 173.21 \]
  - Time taken \[ = \frac{173.21}{7} \approx 24.7 \text{ s} \]

### 7(ii) [3 m]

- \[ QS = 173.21 - 10(7) \]
  - \[ = 103.21 \]
  - Angle of Elevation of S from C
    \[ = \tan^{-1} \frac{103.21}{100} \approx 45.9^\circ \]

### 8(a) [3 m]

- \[ \frac{\sqrt{250^2 + 250^2}}{2} \approx 177 \]
  - Since 177 < 200, the engineer's suggestion does not meet the building requirements.

### 8(b) [4 m]

- \[ -10(y^2 - 9y) - 130 \]
  - \[ = -10(y^2 - 9y + 4.5^2 - 4.5^2) - 130 \]
  - \[ = -10(y - 4.5)^2 + 72.5 \]
  - It takes 4.5 years to achieve a maximum cost
<table>
<thead>
<tr>
<th></th>
<th>savings of (72.5) million dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>((x - \alpha)(x - \beta) = x^2 - (\alpha + \beta)x + \alpha \beta)</td>
</tr>
<tr>
<td></td>
<td>(x^2 - (\alpha + \beta)x + \alpha \beta = x^2 + \frac{b}{a}x + \frac{c}{a})</td>
</tr>
<tr>
<td></td>
<td>(\therefore \alpha + \beta = -\frac{b}{a})</td>
</tr>
<tr>
<td></td>
<td>(\alpha \beta = \frac{c}{a})</td>
</tr>
</tbody>
</table>
Mathematics 4048/01
Paper 1

Friday 2 October 2015
1 hour 15 minutes

Candidates answer on the Question Paper.

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.
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 are NOT ALLOWED in this paper.

Give answers in degrees to one decimal place.
For π, use 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 50.

This question paper consists of 10 printed pages.

Setter: Mr Wilson Wee
Vetter: Ms Zoe Pow

[Turn over

We Nurture Students to Think, Care and Lead with P.R.I.D.E.
Answer all the questions.

1 (a) Express 180 as a product of its prime factors.

Answer (a) 180 = .....................  [2]

(b) Given that $504 = 2^3 \times 3^2 \times 7$, find the highest common factor of 504 and 180. Express your answer as a product of its prime factors.

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

2 Given that $a = 5, b = 2, c = -3$ and $d = 8$, evaluate $\frac{3d}{b} - ac^2$.

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

3 Make $a$ the subject of the formula $7a - 3b = 2ac + 8c$.

Answer ................................. [2]
4 (a) Solve the inequality $16 - 4x < \frac{1}{2}x$.

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

(b) Hence, find the smallest possible value of $x$ if

(i) $x$ is an integer,

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

(ii) $x$ is a prime number.

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

5 Simplify the following.

(a) $3 + \frac{5m - n}{3} - \frac{3m}{4}$

Answer (a) ................................. [2]
(b) \[ \frac{x+3}{x-1} \div \frac{2x^2 + 7x + 3}{2x - 2} \]

Answer (b) ................................ [3]

6. Expand and simplify \((x + 3)^2 - (x^2 - 2x + 3)\).

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

7. Factorise the following.
   (a) \(2ab - 6b^2 - ac + 3bc\)

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

(b) \(3x^2 - 75\)

Answer (b) ................................. [2]
8 Solve the simultaneous equations

\[ 2x - 3y = 14, \]

\[ 3x = 4 - 4y . \]

\[ \text{Answer} \quad x = \ldots \quad y = \ldots \quad [3] \]
8 workers can build a tower in 60 days.

(a) How many days will it take to build the same tower if 3 workers were injured?

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

(b) How many workers are required to build 5 towers in 30 days?

Answer (b) ..................... workers [3]
10 A 3 km road is represented by 6 cm on a map.
   (a) Find the scale of the map in the form $1 : n$.

   \[ \text{Answer (a)} \]........................................... [1]

   (b) A park has an area of 27 km$^2$.
       Find the area of the park on the map in cm$^2$.

   \[ \text{Answer (b)} \].............................. cm$^2$ [2]

---

11 A laptop costs $2500. Jonathan buys the laptop under hire purchase. According to the terms of the hire purchase, there is a down payment of 20%. The remaining amount is to be paid in monthly instalments over 4 years at a simple interest rate of 5% per annum. Calculate the monthly instalment that he has to pay.

   \[ \text{Answer} \] $\ldots$ [3]
12 A bag contains 5 red chips, 3 green chips and 6 yellow chips.

(a) Expressing your answer as a fraction in its lowest term, find the probability that
(i) the first chip taken is red.

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

(ii) the first chip taken is not yellow.

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

(iii) the first chip taken is either green or yellow.

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

(b) If the first chip taken is yellow and is not replaced in the bag, find the probability that the second chip taken is green.

Answer (b) .................................. [2]
The table below shows the number of books that a group of people have read over 2 months.

<table>
<thead>
<tr>
<th>Number of books</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>x</td>
<td>2</td>
</tr>
</tbody>
</table>

(a) If the mode is 2, write down the largest possible value of x.

*Answer (a)* \( x = \ldots \ldots \ldots \ldots \ldots \ldots \) [1]

(b) If the median is 2, write down the largest possible value of x.

*Answer (b)* \( x = \ldots \ldots \ldots \ldots \ldots \ldots \) [1]

(c) If the mean is 2, calculate the value of x.

*Answer (c)* \( x = \ldots \ldots \ldots \ldots \ldots \ldots \) [2]
14 In the diagram below,

*Answer (a)*

(a) construct the

(i) angle bisector of $\angle YXZ$, [1]

(ii) perpendicular bisector of $XZ$. [1]

(b) The angle bisector in (a)(i) meets the perpendicular bisector in (a)(ii) at point $P$. Measure the shortest distance of $P$ from $XZ$.

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

End of Paper
### Answer Key for Math 2E SA2 P1 2015

<table>
<thead>
<tr>
<th>Qn</th>
<th>Marking Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>$2^2 \times 3^2 \times 5$</td>
</tr>
<tr>
<td>1(b)</td>
<td>$2^2 \times 3^2$</td>
</tr>
<tr>
<td>2</td>
<td>$-33$</td>
</tr>
<tr>
<td>3</td>
<td>$a = \frac{8c + 3b}{7 - 2c}$</td>
</tr>
<tr>
<td>4(a)</td>
<td>$\frac{5}{9} &lt; x$</td>
</tr>
<tr>
<td>4(b)(i)</td>
<td>4</td>
</tr>
<tr>
<td>4(b)(ii)</td>
<td>5</td>
</tr>
<tr>
<td>5(a)</td>
<td>$\frac{36 + 11m - 4n}{12}$</td>
</tr>
<tr>
<td>5(b)</td>
<td>$\frac{2}{(2x + 1)}$</td>
</tr>
<tr>
<td>6</td>
<td>$8x + 6$</td>
</tr>
<tr>
<td>7(a)</td>
<td>$(a - 3b)(2b - c)$</td>
</tr>
<tr>
<td>7(b)</td>
<td>$3(x + 5)(x - 5)$</td>
</tr>
<tr>
<td>8</td>
<td>$y = -2$</td>
</tr>
<tr>
<td></td>
<td>$x = 4$</td>
</tr>
<tr>
<td>9(a)</td>
<td>96 days</td>
</tr>
<tr>
<td>9(b)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Workers</th>
<th>Days</th>
<th>Towers</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>60</td>
<td>1</td>
</tr>
<tr>
<td>× 5</td>
<td></td>
<td>× 5</td>
</tr>
<tr>
<td>= 40</td>
<td>60</td>
<td>= 5</td>
</tr>
<tr>
<td>× 2</td>
<td>÷ 2</td>
<td></td>
</tr>
<tr>
<td>= 80</td>
<td></td>
<td>= 30</td>
</tr>
</tbody>
</table>

**Answer** 80 workers

<p>| 10(a) | Scale = 1 : 50000 |
| 10(b) | 108 cm² |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>$50</td>
</tr>
<tr>
<td>12(a)(i)</td>
<td>$\frac{5}{14}$</td>
</tr>
<tr>
<td>12(a)(ii)</td>
<td>$\frac{4}{7}$</td>
</tr>
<tr>
<td>12(a)(iii)</td>
<td>$\frac{9}{14}$</td>
</tr>
<tr>
<td>12(b)</td>
<td>$\frac{3}{13}$</td>
</tr>
<tr>
<td>13(a)</td>
<td>3</td>
</tr>
<tr>
<td>13(b)</td>
<td>5</td>
</tr>
<tr>
<td>13(c)</td>
<td>$x = 1$</td>
</tr>
<tr>
<td>14(c)</td>
<td>1.7±0.1 cm</td>
</tr>
</tbody>
</table>
## Marking Scheme for Math 2E SA2 P1 2015

<table>
<thead>
<tr>
<th>Qn</th>
<th>Marking Point</th>
<th>Marks Awarded</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>180</td>
<td>M1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>90</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>$2^2 \times 3^2 \times 5$</td>
<td>A1</td>
<td></td>
</tr>
</tbody>
</table>

#### 1(b)

| 180 | $2^2 \times 3^2 \times 5$ | |
| 504 | $2^3 \times 3^2 \times 7$ | |
| HCF | $2^2 \times 3^2$ | B1 | |

#### 2

\[
\frac{3d}{b} - ac^2 \\
= \frac{3(8)}{2} - 5(-3)^2 \\
= \frac{24}{2} - 5(9) \\
= 12 - 45 \\
= -33
\]

M1 Evaluation of $c^2$ as 9.

#### 3

\[
7a - 3b = 2ac + 8c \\
7a - 2ac = 8c + 3b \\
a(7 - 2c) = 8c + 3b \\
a = \frac{8c + 3b}{7 - 2c}
\]

M1 Factorising the terms containing $a$.

A1
<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4(a)</strong></td>
<td>$16 - 4x &lt; \frac{1}{2}x$</td>
<td>$16 &lt; 4x + \frac{1}{2}x$</td>
<td>$16 &lt; 4\frac{1}{2}x$</td>
<td>$16 &lt; \frac{9}{2}x$</td>
</tr>
<tr>
<td><strong>4(b)(i)</strong></td>
<td>4</td>
<td><strong>B1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4(b)(ii)</strong></td>
<td>5</td>
<td><strong>B1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5(a)</strong></td>
<td>$3 + \frac{5m-n}{3} - \frac{3m}{4}$</td>
<td>$36 + \frac{4(5m-n)}{12} - \frac{9m}{12}$</td>
<td>$\frac{36 + 20m - 4n - 9m}{12}$</td>
<td>$\frac{36 + 11m - 4n}{12}$</td>
</tr>
<tr>
<td><strong>5(b)</strong></td>
<td>$\frac{x+3}{x-1} + \frac{2x^2 + 7x + 3}{2x - 2}$</td>
<td>$\frac{x + 3}{x - 1} \cdot \frac{2x - 2}{2x^2 + 7x + 3}$</td>
<td>$\frac{x + 3}{x - 1} \cdot \frac{2(x-1)}{(x+3)(2x+1)}$</td>
<td>$\frac{2}{(2x+1)}$</td>
</tr>
<tr>
<td><strong>6</strong></td>
<td>$(x+3)^2 - (x^2 - 2x + 3)$</td>
<td>$x^2 + 6x + 9 - x^2 + 2x - 3$</td>
<td>$8x + 6$</td>
<td><strong>M1</strong></td>
</tr>
</tbody>
</table>
### 7(a)

\[ 2ab - 6b^2 - ac + 3bc = 2b(a-3b)-c(a-3b) = (a-3b)(2b-c) \]

- **M1**
- **A1**

### 7(b)

\[ 3x^2 - 75 = 3(x^2 - 25) = 3(x+5)(x-5) \]

- **M1**
- **A1**

### 8

1. \[ 2x - 3y = 14 \] \( \text{--- (1)} \)
2. \[ 3x + 4y = 4 \] \( \text{--- (2)} \)

\( (1) \times 3, \quad 6x - 9y = 42 \) \( \text{--- (3)} \)

\( (2) \times 2, \quad 6x + 8y = 8 \) \( \text{--- (4)} \)

\( (3) - (4), \quad -17y = 34 \)

\[ y = -2 \]

Subtracting eq. (4) from (3).

Subst. \( y = -2 \) into (1),

\[ 2x - 3(-2) = 14 \]

\[ 2x + 6 = 14 \]

\[ 2x = 8 \]

\[ x = 4 \]

- **M1**
- **A1**

### 9(a)

8 workers \( \text{----- 60 days} \)

5 workers \( \text{----- } \frac{8}{5} \times 60 \)

\[ = 96 \text{ days} \]

- **M1**
- **A1**

### 9(b)

<table>
<thead>
<tr>
<th>Workers</th>
<th>Days</th>
<th>Towers</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>60</td>
<td>1</td>
</tr>
<tr>
<td>( \times 5 )</td>
<td>( \times 5 )</td>
<td></td>
</tr>
<tr>
<td>= 40</td>
<td>60</td>
<td>= 5</td>
</tr>
<tr>
<td>( \times 2 )</td>
<td>( \div 2 )</td>
<td></td>
</tr>
<tr>
<td>= 80</td>
<td></td>
<td>= 30</td>
</tr>
</tbody>
</table>

**Answer** 80 workers

- **M1**
- **A1**
### 10(a)

<table>
<thead>
<tr>
<th>3 cm</th>
<th>60000 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 cm</td>
<td>64000 cm</td>
</tr>
</tbody>
</table>

Scale = 1 : 50000

### 10(b)

<table>
<thead>
<tr>
<th>3 km</th>
<th>6 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3 km)²</td>
<td>(6 cm)²</td>
</tr>
<tr>
<td>9 km²</td>
<td>36 cm²</td>
</tr>
<tr>
<td>27 km²</td>
<td>108 cm²</td>
</tr>
</tbody>
</table>

Area scale

### 11

**Down payment**

\[
\text{Down payment} = \frac{20}{100} \times $2500 = $500
\]

**Remaining amt.**

\[
= $2500 - $500 = $2000
\]

**Interest**

\[
\text{Interest} = \frac{2000 \times 5 \times 4}{100} = $400
\]

**Total amt. to be paid for 4 years**

\[
= $2000 + $400 = $2400
\]

**Monthly installment**

\[
\frac{2400}{12 \times 4} = $50\]

### 12(a)(i)

**Probability**

\[
\text{Probability} = \frac{5}{5 + 3 + 6} = \frac{5}{14}
\]
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>12(a)(ii)</td>
<td>Probability = $1 - \frac{6}{14}$ = $\frac{8}{14}$ = $\frac{4}{7}$</td>
</tr>
<tr>
<td>12(a)(iii)</td>
<td>Probability = $\frac{3+6}{14}$ = $\frac{9}{14}$</td>
</tr>
<tr>
<td>12(b)</td>
<td>Probability = $\frac{3}{14-1}$ = $\frac{3}{13}$</td>
</tr>
<tr>
<td>13(a)</td>
<td>3</td>
</tr>
<tr>
<td>13(b)</td>
<td>0 1 1 1 2 2 2 2 3 ....... 3 4 4</td>
</tr>
<tr>
<td>13(c)</td>
<td>$0 \times 1 + 1 \times 3 + 2 \times 4 + 3 \times x + 4 \times 2 = 2$</td>
</tr>
<tr>
<td>14(c)</td>
<td>1.7 ± 0.1 cm</td>
</tr>
</tbody>
</table>
MATHEMATICS

Paper 2

Additional Materials: Graph Paper (1 sheet).

Additional Candidates answer on the Question Paper.

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.
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 $\pi$, use either your calculator value or 3.142, unless the question requires the answer in terms of $\pi$.

At the end of the examination, fasten all your work securely together.
Attach the graph paper at the back of the question paper.
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 50.

This question paper consists of 12 printed pages.

Setter: Mr Ngoh Kia Joon
Vetter: Ms Zoe Pow

We Nurture Students to Think, Care and Lead with P.R.I.D.E.
Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone = \(\pi rl\)

Surface area of a sphere = \(4\pi r^2\)

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

Volume of a sphere = \(\frac{4}{3}\pi r^3\)
1 (a) Evaluate $\frac{17.69^2 - \sqrt{22.11}}{\frac{8}{\pi}}$, giving your answer correct to 1 decimal place.

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

(b) A rectangular pond has a length of 31.356 m and breadth of 17.282 m.

Estimate the area of the pond by rounding off each given dimension to 1 significant number.

Answer (b) .........................m² [1]

2 (a) Results of a recent poll on the support for Winx Football Club in the year 1985 and 2015 are shown below. Both polls were conducted on 100 participants.

Find the percentage decrease in the support for Winx Football Club in 2015 as compared to 1985.

Answer (a) .......% [2]
(b) John came across the following advertisement while he was shopping.

**GAMING CONCEPT STORE**

PS4 console

**Usual Price:** $699  
**Discounted Price:** $499

PS4 games bundle

**Usual Price:** $125  
**Discount:** 15% off Usual Price

(i) Calculate the percentage discount given for the PS4 console.

*Answer (b)(i) .........................%  [2]*

(ii) Calculate the discounted price of the PS4 games bundle.

*Answer (b)(ii) $..........................  [2]*
3 (a) David wishes to deposit $2000 in a bank for 5 years. During his research, two brochures caught his interest.

**SBD Bank**
- 8% simple interest for 1st year
- 4% simple interest for subsequent years

**CBOG Bank**
- 4% compound interest per annum, compounded monthly

(i) Calculate the interest David would earn from SBD Bank at the end of 5 years.

\[ \text{Answer (a)(i)} \quad $\text{......................} \quad [2] \]

(ii) Which bank should David deposit his money to earn the higher interest at the end of 5 years? Show all workings clearly.

\[ \text{Answer (a)(ii)} \quad \text{..........................} \quad [2] \]

(b) During the December holidays, Kalif wishes to bring his family to Malaysia for a short getaway. On that particular day, the exchange rate between Singapore Dollar (S$) and Malaysia Ringgit (RM) was S$1 = RM 2.87.

(i) Given that Kalif changed S$950 in total, find the amount of Malaysia Ringgit he received.
(ii) In Malaysia, Kalif and his family spent a total of RM 1220. Upon return, he decided to change his Malaysian Ringgit back to Singapore Dollar at the rate of S$1 = RM 2.92.

Find the amount of Singapore Dollar he received from the exchange.

---

4 The diagram below shows part of a regular polygon $ABCD...$ and 2 squares $PQCB$ and $RSDC$.

Given that polygon $ABCD...$ has an exterior angle of $45^\circ$, find

(a) the number of sides of polygon $ABCD...$,

(b) $\angle QCR$.

---

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

Answer (b) ........................................ $^\circ$ [2]
5 At 1000, Peter began cycling from Town A towards Town B, which is 85 km away. He cycled for 1 hour 40 minutes and covered a distance of 30 km before stopping to take a rest at a cafe. He spent $x$ minutes in the cafe and before proceeding with his journey. For the rest of the journey, he cycled at an average speed 20 km/h and finally reached Town B at 1545.

Find

(a) Peter’s average speed while traveling from Town A to the cafe, giving your answer in km/h,

\[\text{Answer (a)} \quad \cdots \cdots \cdots \cdots \text{km/h} \quad [2]\]

(b) the time Peter took to travel from the cafe to Town B, giving your answer in minutes,

\[\text{Answer (b)} \quad \cdots \cdots \cdots \cdots \text{min} \quad [2]\]

(c) the value of $x$.

\[\text{Answer (c)} \quad x = \cdots \cdots \cdots \cdots \quad [1]\]
On the return journey, Peter cycled at a uniform speed and took 5 hours to travel from Town B to Town A.

(d) Calculate Peter's speed for the return journey.

Answer (d) ................................km/h  [1]

6 In the diagram below, \( \angle ABD = \angle ADC = 90^\circ \), \( AB = 7 \text{ cm} \) and \( BD = 24 \text{ cm} \).

Find

(a) length \( AD \),

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

(b) \( \angle BCD \).

Answer (b) ..................................^\circ  [2]
In the diagram below, $TP \parallel SR$, $PT = 27$ cm, $RS = 9$ cm and $PS = 32$ cm. $PQS$ and $TQR$ are straight lines.

(a) Prove that $\triangle PQT$ is similar to $\triangle SQR$.

Answer

(b) Find the length of $QS$.

Answer (b) $QS =$ \ldots cm [2]
The Government Service Tax (G.S.T.) charged to a bill before G.S.T. in Country X and Country Y is shown in the graph below.

(a) State the amount of G.S.T. when the bill before G.S.T. in Country X is $200.

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

(b) State the bill before G.S.T. when the G.S.T. charged in Country Y is $19.

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

(c) If Thomas spends $170 before G.S.T., find the difference in the amount of G.S.T. charged between Country X and Country Y.

Answer (c) $......................... [1]
Gong Gong Teahouse sells milk tea with pearls in cups that take the shape of a closed cylinder with height 20 cm and base diameter 5 cm. Each cup of milk tea with pearls is filled to the brim with milk tea and 60 spherical pearls each of radius 0.5 cm.

(a) Calculate the surface area of 1 spherical pearl.

\[ Answer \ (a) \ \text{cm}^2 \ \ \ [2] \]

(b) Calculate the volume of the milk tea in the cup.

\[ Answer \ (b) \ \text{cm}^3 \ \ \ [3] \]
(c) In a special edition, the same volume of milk tea from (b) is poured into an inverted cone of height 30 cm and filled it to the brim. Calculate the radius of the cone.

\[
\text{Answer (c) ................. cm} \quad [2]
\]

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

The table below shows the \( x \) and \( y \) values for the equation \( y = -x^2 - 5x + 4 \).

<table>
<thead>
<tr>
<th>( x )</th>
<th>(-7)</th>
<th>(-5)</th>
<th>(-3)</th>
<th>(-2)</th>
<th>0</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>(-10)</td>
<td>( k )</td>
<td>10</td>
<td>10</td>
<td>4</td>
<td>(-2)</td>
</tr>
</tbody>
</table>

(a) Calculate the value of \( k \). \quad [1]

(b) Taking 2 cm to represent 1 unit on the \( x \)-axis and 1 cm to represent 1 unit on the \( y \)-axis, draw the graph of \( y = -x^2 - 5x + 4 \) for \(-7 \leq x \leq 1\). \quad [3]

(c) Using your graph, find

(i) the coordinates of the maximum point of the graph, \quad [1]

(ii) the value of \( y \) when \( x = -1 \), \quad [1]

(iii) the solution(s) of \( -x^2 - 5x + 4 = 0 \). \quad [1]

End of Paper
## Answer Scheme for 2015 Sec 2 Express Maths SA2 P2

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
</tr>
</thead>
</table>
| 1 | (a) 36.8 (1 dp)  
(b) Area = 600 m² |
| 2 | (a)  
% decrease = \(33\frac{1}{3}\)% or 33.3% (3sf)  
(b)(i)  
% discount = 28.6% (3sf)  
(b)(ii)  
Discounted price = $106.25 |
| 3 | (a)(i)  
Interest (SBD) = $480  
(a)(ii)  
Interest (CBCO) = $441.99 (nearest cents)  
Therefore David should deposit his money in SBD Bank to earn a higher interest.  
(b)(i)  
Amount received = RM 2726.50  
(b)(ii)  
Amount remaining (S$) = SG$515.92 (nearest cents). |
| 4 | (a)  
number of sides = 8  
(b)  
\(\angle QCR = 45^\circ\) |
| 5 | (a)  
Average speed = 18 km/h  
(b)  
Time taken = 165 minutes  
(c)  
\(x = 80\)  
(d)  
Uniform speed = 17 km/h |
| 6 | (a)  
\(AD = 25\) cm  
(b)  
\(\angle BCD = 16.3^\circ\) (1 dp) |
| 7 | (a)  
\(\angle TQP = \angle RQS\) (vert. opp. \(\angle s\))  
\(\angle QPT = \angle QSR\) (alt \(\angle s, PT \parallel RS\))  
\(\angle PTQ = \angle SQR\) (alt \(\angle s, PT \parallel RS\))  
Since all corresponding angles are equal, therefore, \(\triangle PQT\) is similar to \(\triangle SQR\).  
(b)  
\(QS = 8\) cm |
8

(a) $6
(b) $250
(c) $8

9

(a)
Surface area = 3.14 cm$^2$ (3 sf)

(b)
Volume of milk tea = 361 cm$^3$ (3 sf)

(c)
Radius = 3.39 cm (3 sf)

10

(a) $k = 4$

(c)(i) $(-2.5, 10.3)$

(c)(ii) $y = 8$

(c)(iii) $-5.7$ and $0.7$

(b) seen in graph below.
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| 1 | (a) 36.8 (1 dp)  
(b)  
Area = 30 × 20  
= 600 m² | B1 |
| 2 | (a)  
% decrease = \( \frac{60 - 40}{60} \times 100\% \)  
= 33\( \frac{1}{3} \)% or 33.3% (3sf) | M1  
A1 |
|   | (b)(i)  
% discount = \( \frac{699 - 499}{699} \times 100\% \)  
= 28.6% (3sf) | M1  
A1 |
|   | (b)(ii)  
Discounted price = \( \frac{85}{100} \times 125 \)  
= $106.25 | M1  
A1 |
| 3 | (a)(i)  
Interest (SBD) = \( \frac{8}{100} \times 2000 + \frac{4}{100} \times 2000 \times 4 \)  
= $480 | M1  
A1 |
|   | (a)(ii)  
Final Amount (CBCO) = 2000(1 + \( \frac{12}{100} \))^{60}  
= $2441.993  
Interest (CBCO) = 2441.993 - 2000  
= $441.99 (nearest cents)  
Therefore David should deposit his money in SBD Bank to earn a higher interest. | M1  
A1 (Conclusion) |
|   | (b)(i)  
Amount received = 950 × 2.87  
= RM 2726.50 | B1 |
|   | (b)(ii)  
Amount remaining (RM) = 2726.50 - 1220  
= RM 1506.50  
Amount remaining (S$) = \( \frac{1506.50}{2.92} \)  
= SG$515.92 (nearest cents) | M1  
A1 |
4

<table>
<thead>
<tr>
<th>(a)</th>
<th>(b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of sides = ( \frac{360}{45} ) = 8</td>
<td>( \angle QCB = \angle RCD = 90^\circ ) (Given) ( \angle QCR = 360 - 90 - 90 - 135 ) (Angles at a pt) = 45°</td>
</tr>
</tbody>
</table>

5

<table>
<thead>
<tr>
<th>(a)</th>
<th>(b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average speed = ( \frac{30}{2 \frac{1}{3}} ) = 18 km/h</td>
<td>85 - 30 = 55 km ( \frac{55}{20} = 2.75 )h ( = 165 ) minutes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(c)</th>
<th>(d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1545 - 1000 = 5h 45 mins = 345 mins ( x = 345 - 100 - 165 = 80 )</td>
<td>Uniform speed = ( \frac{85}{5} ) = 17 km/h</td>
</tr>
</tbody>
</table>

6

<table>
<thead>
<tr>
<th>(a)</th>
<th>(b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>By Pythagoras theorem, ( AD^2 = 7^2 + 24^2 ) ( AD^2 = 625 ) ( AD = 25 ) cm</td>
<td>( \tan \angle DAB = \frac{24}{7} ) ( \angle DAB = \tan^{-1} \frac{24}{7} = 73.740 ) ( \angle BCD = 180 - 90 - \tan^{-1} \frac{24}{7} = 16.3^\circ ) (1 dp)</td>
</tr>
</tbody>
</table>
\( \angle TQP = \angle RQS \) (vert. opp. \( \angle s \))  
\( \angle QPT = \angle QSR \) (alt \( \angle s, PT \parallel RS \))  
\( \angle PTQ = \angle SRQ \) (alt \( \angle s, PT \parallel RS \))

Since all corresponding angles are equal, therefore, \( \triangle PQT \) is similar to \( \triangle SQR \).

(b)  
\[
\frac{QS}{RS} = \frac{4}{3} = \frac{1}{1}
\]
\[
\frac{QP}{TP} = \frac{32}{4}
\]
\[
PS = 4QS
\]
\[
QS = 8 \text{ cm}
\]

8  
(a) $6  
(b) $250  
(c) $13 - $5 = $8

9  
(a)  
Surface area = \( 4 \times \pi \times 0.5^2 \)  
\[
= 3.14 \text{ cm}^2 \text{ (3 sf)}
\]

(b)  
Volume of cylinder = \( \pi \times 2.5^2 \times 20 \)  
\[
= 125\pi \text{ cm}^3
\]

Volume of 60 pearls = \( \frac{4}{3} \times \pi \times 0.5^3 \times 60 \)  
\[
= 10\pi \text{ cm}^3
\]

Volume of milk tea = \( 125\pi - 10\pi \)  
\[
= 361 \text{ cm}^3 \text{ (3sf)}
\]

(c)  
\[
115\pi = \frac{1}{3} \pi (r)^2 (30)
\]
\[
\text{radius} = 3.39 \text{ cm (3sf)}
\]
(a) $k = 4$
(c)(i) $(-2.5, 10.3)$
(c)(ii) $y = 8$
(c)(iii) $-5.7$ and $0.7$
(b) seen in graph below.