2015 Sec 4 Biology

Examguru

1	St. Margaret's Secondary School
2	Anglo-Chinese School (Barker Road)
3	Zhonghua Secondary School
4	First Toa Payoh Secondary School
5	Temasek Secondary School
6	Saint Patrick's School

Founded 1842

ST. MARGARET'S SECONDARY SCHOOL

Preliminary Examinations 2015

CANDIDATE NAME

CLASS REGISTER NUMBER

BIOLOGY **5158/01**

Paper 1 Multiple Choice **2 Sep 2015**

Secondary 4 Express **1 hour**

Additional Materials: Multiple Choice Answer Sheet

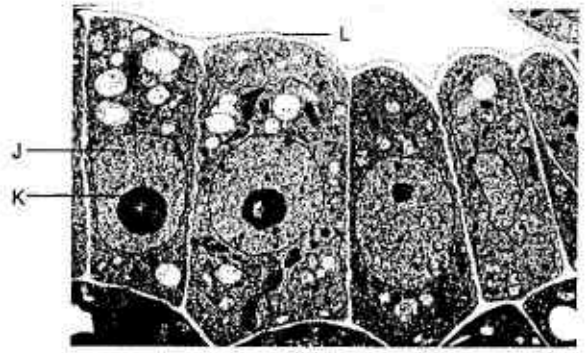
READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and register number on the cover page and on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers A, B, C and D.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

1 J, K and L are structures found in plant cells placed under an electron microscope.

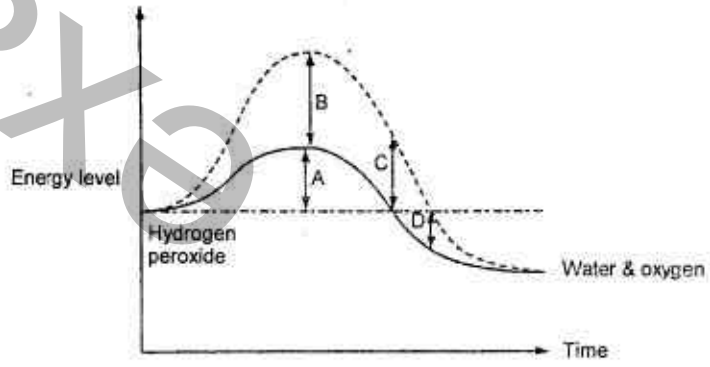


Adapted from http://www4.uwsp.edu

Which option identifies structures J, K and L correctly?

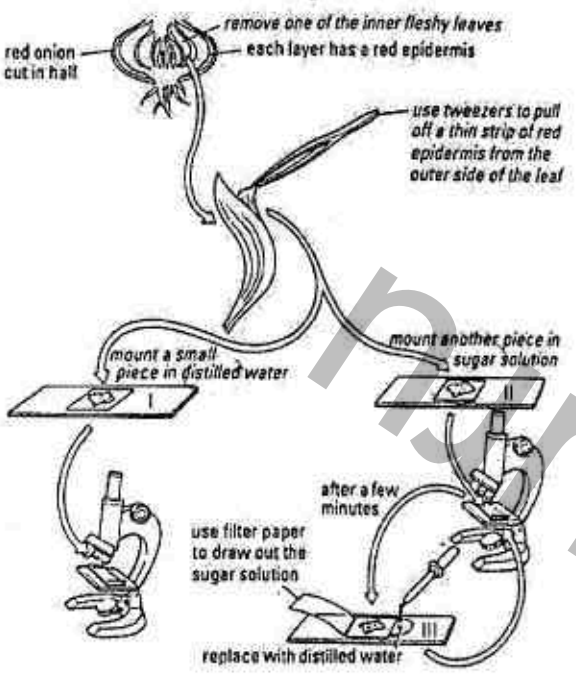
	J	K	L
A	Cytoplasm	Nucleus	Cell Wall
B	Cytoplasm	Nucleus	Upper Epidermis
C	Nucleoplasm	Nucleolus	Cell Wall
D	Nucleoplasm	Nucleolus	Upper Epidermis

2 The graph shows the energy level when hydrogen peroxide is broken down into water and oxygen, in the presence and absence of enzyme catalase.



What is the difference in activation energy of the reaction when the catalase enzyme is present and when it is absent?

3 The diagram shows the procedure to prepare slides containing onion epidermis soaked in different liquids. I, II and III represent the slides which were prepared and set aside for 10 min before being observed under the microscope.

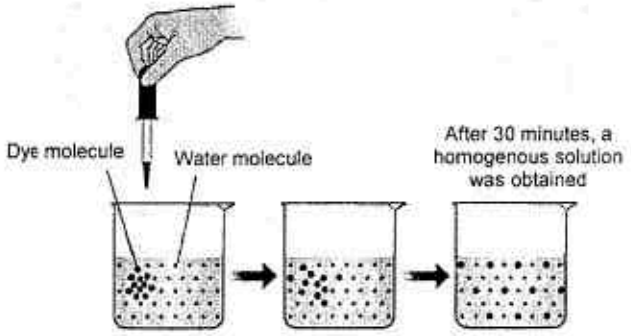


Taken from http://www.nuffieldfoundation.org

Which option accurately describes the cells under slides I, II and III?

	I	II	III
A	Plasma membrane not visible	Plasma membrane not visible	Plasmolysed
B	Plasma membrane not visible	Plasmolysed	Plasma membrane not visible
C	Plasmolysed	Plasma membrane not visible	Plasma membrane not visible
D	Plasmolysed	Plasma membrane not visible	Plasmolysed

4 The diagram shows a drop of ink being added to a beaker of water. After 30 minutes, a homogenous solution was obtained.



Adapted from solarwiki.ucdavis.edu

Students X, Y and Z made some comments about the observation.

X: The change is due to water moving through osmosis.
Y: The change can occur faster if the temperature is higher.
Z: If two drops of dye were added, the homogenous solution would be obtained in less than 30 minutes.

Which students are correct?

A X and Y only
B X and Z only
C Y and Z only
D X, Y and Z

For questions **5** & **6**, refer to the table which compares the nutritional component between cow's milk and human milk.

Nutritional Component	cow's milk/ %	human milk/ %
Water	87.6	87.4
Protein	3.3	1.6
Carbohydrate	4.3	6.98
Fat	4.5	3.75
Vitamin A (IU/ 100 g)	180	189.9
Vitamin C (mg/ 100 g)	1.6	4
Niacin	0.1	0.2

5 Based on the data provided, which of the statements is correct?

A Cow's milk has about twice the amount of protein content compared to human milk.
B Cow's milk has more Vitamins A and C than human milk.
C Human milk is more diluted than cow's milk.
D Human milk is more fattening than cow's milk.

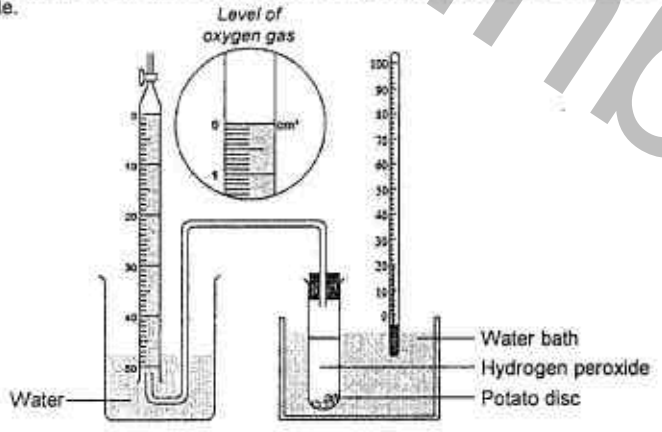
6 Researches have been carried out to determine if the type of milk provided to babies, human milk (breast milk) or cow's milk (formula), will affect brain development of babies. The following is extracted from an article published by Brown University on June 6, 2013.

"A new study by researchers from Brown University finds more evidence that breastfeeding is good for babies' brains ... The research found that by age 2, babies who had been breastfed exclusively for at least three months had enhanced development in key parts of the brain compared to children who were fed formula exclusively or who were fed a combination of formula and breast milk ..."

Based on the nutritional component of cow's milk and human milk, what is a reasonable explanation for the findings made?

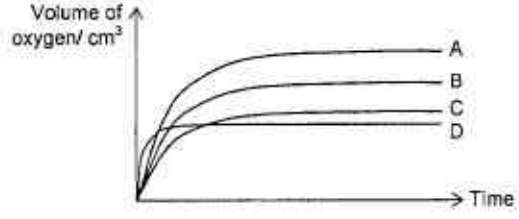
A Addition of hot water to prepare formula milk for babies had destroyed the essential components for brain development.
B Human milk has the right composition of nutrients for brain development in babies.
C Since there is less water present in human milk, there are more useful solutes for the brain development.
D Vitamin A is the most essential component for brain development in babies.

For questions **7** and **8**, refer to the diagram which shows the experimental setup whereby oxygen gas, produced from the decomposition of hydrogen peroxide, is collected in an inverted burette.



Adapted from www.focuseducational.com

7 The volume of oxygen produced at 20 °C, 30 °C, 40 °C and 50 °C was measured at every minute interval for five minutes. The results for each temperature are represented in the graph.

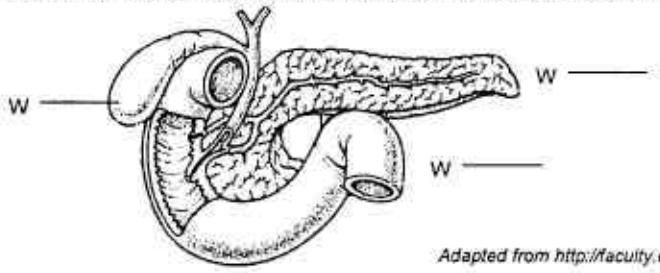


Which of the graph (**A**, **B**, **C** or **D**) represents the results for the experiment at 50 °C?

8 Which of the statements about the experiment is **false**?

A Oxygen gas is collected due to displacement of water.
B The surface area of the potato discs is a constant variable in the experiment.
C The rubber bung holding the delivery tube must be fixed tightly to the boiling tube containing hydrogen peroxide.
D The water bath is used to maintain the pH of the experiment.

For questions **9** and **10**, refer to the diagram which shows part of the digestive system.



Adapted from http://faculty.ccri.edu/

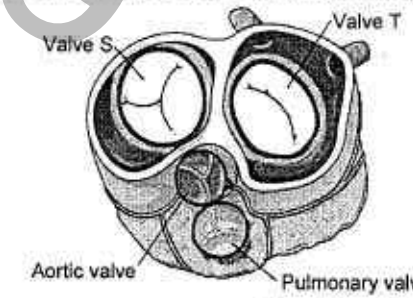
9 The diagram shows that the

A gall bladder and pancreas share a common duct.
B gall bladder releases bile into the small intestines.
C jejunum is a long, tubular structure.
D pancreas is an endocrine and exocrine gland.

10 Which of the options describes the structure(s) correctly?

	Structure(s)	Description
A	W	Produces bile which emulsifies fats
B	X	Able to detect changes in blood glucose concentration
C	Y	Absorbs mainly water from undigested food
D	W and X	Are part of the digestive canal as they are involved in digestion

For questions **11** and **12**, refer to the diagram which represents the cross-section of a human heart.



Adapted from http://www.heart-valve-surgery.com/

11 Both the pulmonary valve and aortic valve are semi-lunar valves which comprises of three cusps. Which of the following statements is correct?

A Aortic valve lies between the right ventricle and the pulmonary artery.
B Blood passing through the aortic valve is high in carbon dioxide level.
C Blood passing through the pulmonary valve is at a high pressure.
D Pulmonary valve prevents the backflow of blood into the atrium.

12 Valves S and T are atrioventricular valves. Which of the following identifies S and T correctly?

	S	T
A	Bicuspid valve	Semi-lunar valve
B	Bicuspid valve	Tricuspid valve
C	Semi-lunar valve	Tricuspid valve
D	Tricuspid valve	Bicuspid valve

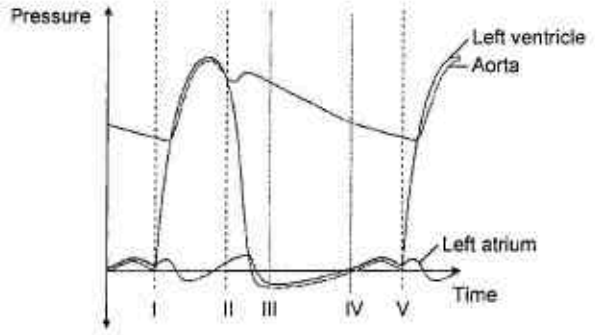
13 The diagram shows an advertisement appealing for blood donation.

Taken from http://blog.vinova.sg/

The advertisement states that Type A* blood stocks are low in the blood bank. Which option explains why blood type A* can be donated to the group of recipients?

	Suitable recipient(s) of blood type A*	Reason
A	A*	The recipients do not produce antibodies against the donated blood cells.
B	B*	The recipients' red blood cells contain surface antigens A.
C	A* and B*	The recipients do not produce antibodies against the donated blood cells.
D	A* and O*	The recipients' red blood cells contain surface antigens A.

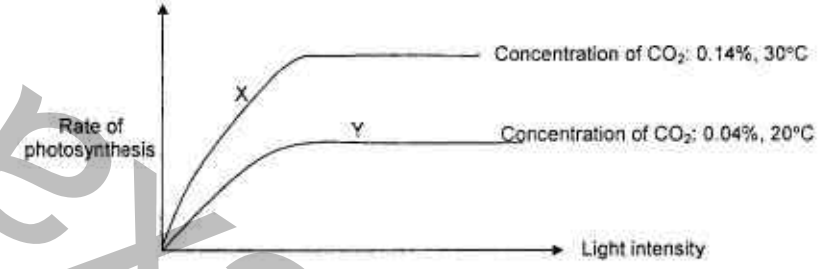
14 The graph shows the change in the blood pressure observed in the left atrium, left ventricle and aorta.



At which points are the bicuspid valve open?

A I and II
B I and V
C II and III
D III and IV

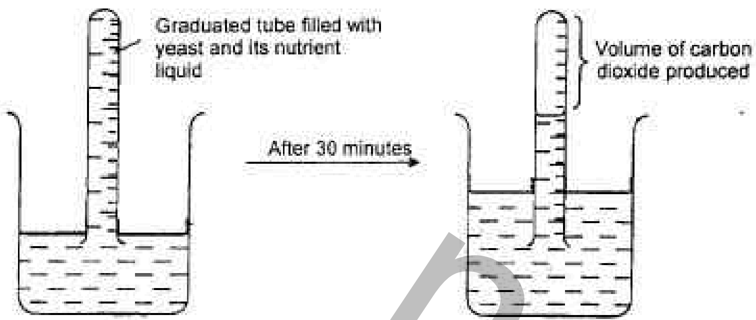
15 The graph shows how the rate of photosynthesis in a plant varies with light intensity at two different carbon dioxide concentrations and temperatures.



Based on the graph, what are the limiting factors at points X and Y?

	X	Y
A	Concentration of CO_2	Temperature
B	Light intensity	Chlorophyll availability
C	Light intensity	Concentration of CO_2
D	Temperature	Light intensity

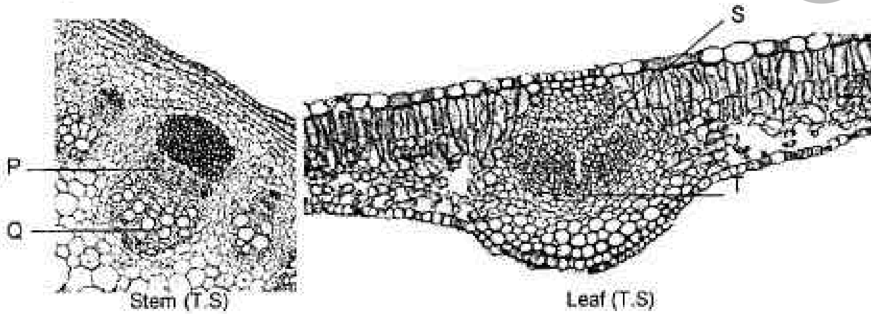
16 The diagram shows an experiment which tracks the volume of carbon dioxide produced when yeast is incubated in different nutrient liquids, of the same volume, for 30 minutes. The volume of carbon dioxide collected represents the rate of respiration of yeast which is a microorganism that lives naturally in fruits.



Which liquid nutrient will yield the highest volume of carbon dioxide?

A Coconut oil
B Egg albumin
C Glucose
D Starch

17 The diagram shows two micrographs taken from the stem and leaf of two different dicotyledonous plants.



Adapted from http://www.doctortee.com/ *Adapted from www.studyblue.com*

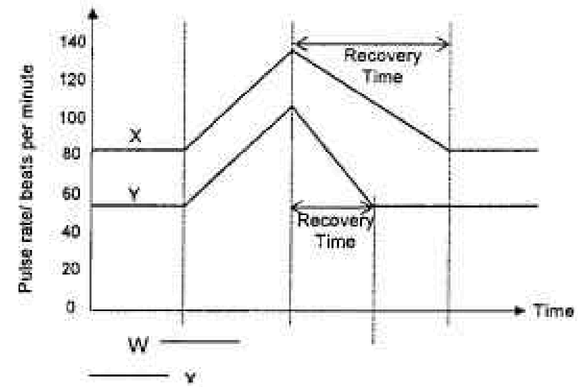
Which option states the structures that contain relatively high mineral content on a sunny day?

A P and Q
B P and S
C Q and S
D S and T

18 The table compares photosynthesis and anaerobic respiration in human. Which option (A, B, C or D) is **incorrect**?

	Feature	Photosynthesis	Anaerobic Respiration
A	Carbon dioxide	Used	Produced
B	Occurs in	Green Plants	All living things
C	Part involved	Chloroplasts	Cytoplasm
D	Oxygen	Produced	Not produced

19 The graph represents the pulse rate of two men (X and Y) before, during and after exercise.



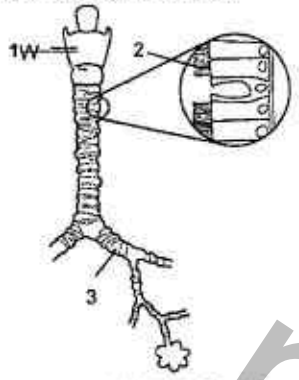
Some comments were made about the graph.

I X and Y had different pulse rate before exercise.
II X is fitter than Y.
III Y takes a longer time to recover from the exercise.
IV The rate of increase in pulse rate in X and Y is the same during exercise.
V This experiment aims to compare pulse rate of different individuals.

Which statements are **incorrect**?

A I and II
B I and IV
C II and III
D II, III and IV

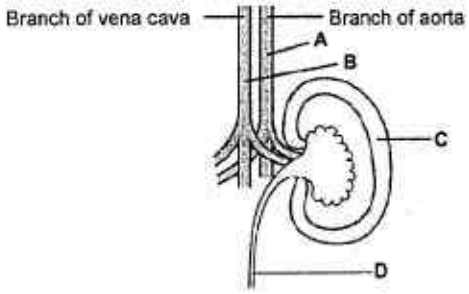
20 The diagram shows some structures in the thorax.



Which option identifies the structures labelled 1, 2 and 3 correctly?

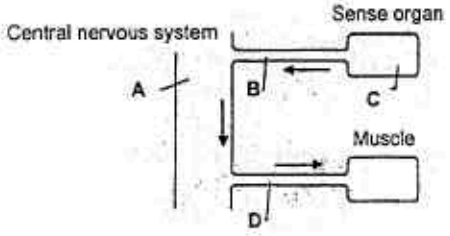
	1	2	3
A	larynx	bronchus	bronchiole
B	larynx	cilia	bronchus
C	trachea	bronchus	bronchiole
D	trachea	cilia	bronchus

21 The diagram shows a simplified human urinary system.

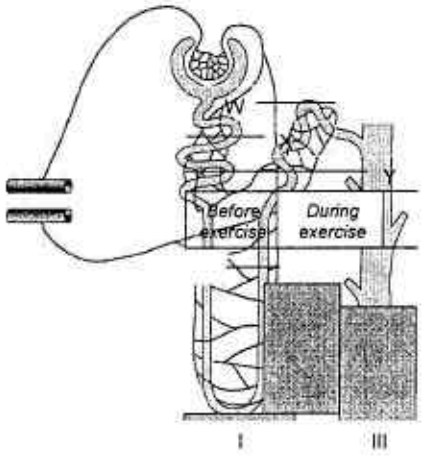


In which region (**A**, **B**, **C** or **D**) is urea is most concentrated?

22 The diagram represents a reflex arc in the nervous system of a mammal. Which region contains the axons of the motor neurones involved in the response?



23 The diagram shows a nephron and the associated blood vessels.

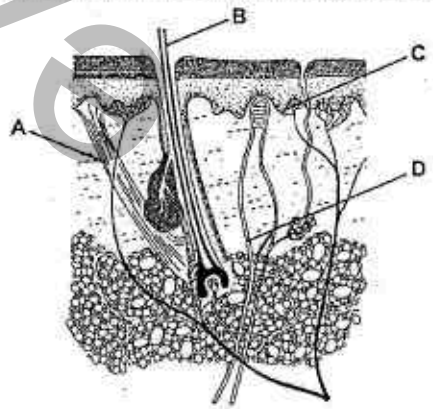


What option describes I, II and III correctly?

	I	II	III
A	ADH controls salt reabsorption	Water reabsorbed here	Salt not reabsorbed here
B	ADH controls water reabsorption	Water reabsorbed here	Salt reabsorbed here
C	Water reabsorbed here	Salt reabsorbed here	ADH controls water reabsorption
D	Water reabsorbed here	Salt not reabsorbed here	ADH controls salt reabsorption

ADH: Antidiuretic hormone

24 A person walked into a very cold room. Shortly afterwards the hairs on his skin were raised. Which structure (**A**, **B**, **C** or **D**) is involved in the first stage of this reflex?

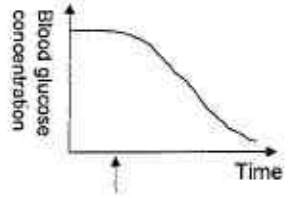


25 Which of the options is **not** an example of homeostasis?

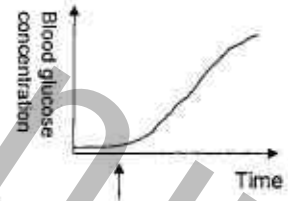
A Blood pressure lowered when kidney excrete excess water
B Blood sugar concentration regulated by hormones
C Body cooling down to 36.9 °C after exercise
D Lens changing in curvature when looking at objects

26 Which graph (**A**, **B**, **C** or **D**) represents the level of blood glucose concentration in response to insulin secretion (represented by ↑)?

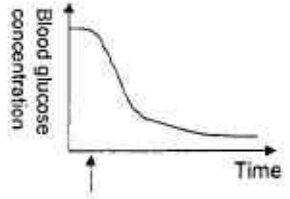
A



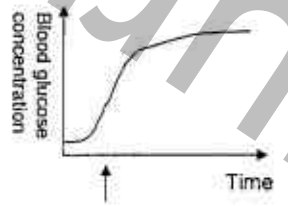
B



C



D



27 The diagram shows a calendar where a woman marked the day when her menstruation ended with a cross.

March

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
		1	2	×3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

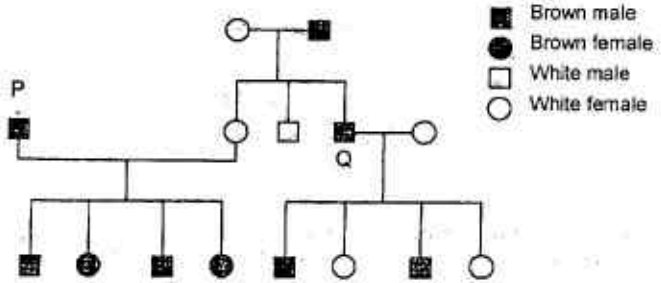
When will she most likely have her next menstruation?

A 7th March
B 26th March
C 27th March
D 31st March

28 What is the chance of a couple, who are both heterozygotes, of blood group A and B to produce a baby boy of blood type AB?

A 0.125
B 0.25
C 0.5
D 1.0

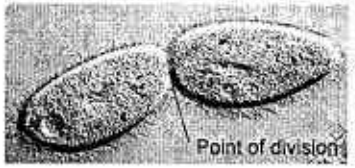
29 The chart shows the inheritance of coat colour in mice. The allele for brown coat, B, is dominant to the allele for white coat, b.



What are the most likely genotypes of the individuals P and Q?

	P	Q
A	BB	BB
B	BB	Bb
C	Bb	BB
D	bb	Bb

30 The micrograph shows *Paramecium*, a unicellular organism, undergoing cell division.



Adapted from www.nikonsmallworld.com

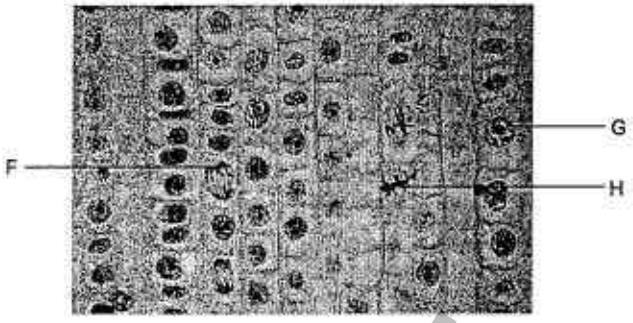
Paramecium undergoes cell division to form

A different gametes.
B identical gametes.
C new cells.
D new tissues.

31 A mature cell is found to contain 20 chromatin threads in a non-dividing stage. Which of the following states the correct number in one cell during the stated stage of mitosis?

	Number of pairs of homologous chromosomes during prophase	Number of chromatids during prophase	Number of daughter chromosomes after cytokinesis
A	10	40	10
B	10	40	20
C	20	40	10
D	40	40	20

32 The electron micrograph shows some cells from onion root tip.



Adapted from raleighncs.blogspot.com

Which option correctly identifies the stage of nuclear division in the cells?

	F	G	H
A	Anaphase	Metaphase	Prophase
B	Anaphase	Prophase	Metaphase
C	Metaphase	Prophase	Telophase
D	Metaphase	Telophase	Prophase

33 The following is extracted from "Molecular Biology of the Cell":

"Only about one nucleotide pair in a thousand is randomly changed every 200,000 years. Even so, in a population of 10,000 individuals, every possible nucleotide substitution will have been "tried out" on about 50 occasions in the course of a million years, which is a short span of time in relation to the evolution of species. Much of the variation created in this way will be disadvantageous to the organism and will be selected against in the population. When a rare variant sequence is advantageous, however, it will be rapidly propagated by natural selection. Consequently, it can be expected that in any given species the functions of most genes will have been optimized by random point mutation and selection."

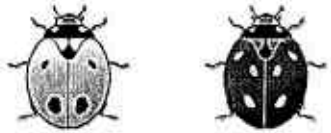
"Much of the variation created in this way" refers to

A breeding.
B mutation.
C radiation.
D replication.

34 A DNA molecule and a mRNA molecule both contain

A a nitrogenous base called uracil.
B double-stranded polymers.
C sequences of bases.
D the same sugar.

35 The diagram shows two distinct forms of beetle. The difference between them is controlled by a single gene. The allele for the black form is dominant to the allele for red.



red form with black spots

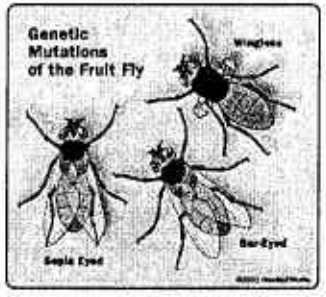
black form with red spots

What kind of variation is shown by the beetle? Why?

A Continuous variation because it is controlled by genes.
B Continuous variation because there are two forms.
C Discontinuous variation because it is controlled by genes.
D Discontinuous variation because the two forms are distinct.

36 The following is an extract from "Evolution" by Ruth Moore.

"... Muller put hundreds of fruit flies in gelatin capsules and bombarded them with X-rays. The irradiated flies were then bred to untreated ones. In 10 days thousands of their offspring were buzzing around their banana-mash feed, and Muller was looking upon an unprecedented outburst of man-made mutations. There were flies with bulging eyes, flat eyes, purple, yellow and brown eyes. Some had curly bristles, some no bristles..."



Taken from http://science.howstuffworks.com/life

Which of the following statements about the observations made is correct?

A Flies that are bred in an artificial environment will develop new traits.
B Mutations fuel the process of evolution by providing new genes in the gene pool of a species.
C Radiation leads to the development of new phenotypes, hence leading to changes in the genotypes of flies.
D Random changes in flies occur due to natural selection.

37 A species of *Poecilia* fish exists along a river between two countries. A dam is built across which split two sides of the river. This split results in the formation of an upper river and a newly formed lake. This provides a separate resource for the two countries.

After more than 40 years later, the *Poecilia* fish in the river and lake are found to be phenotypically different from each other. Which of the following hypothesis best explains the above observation?

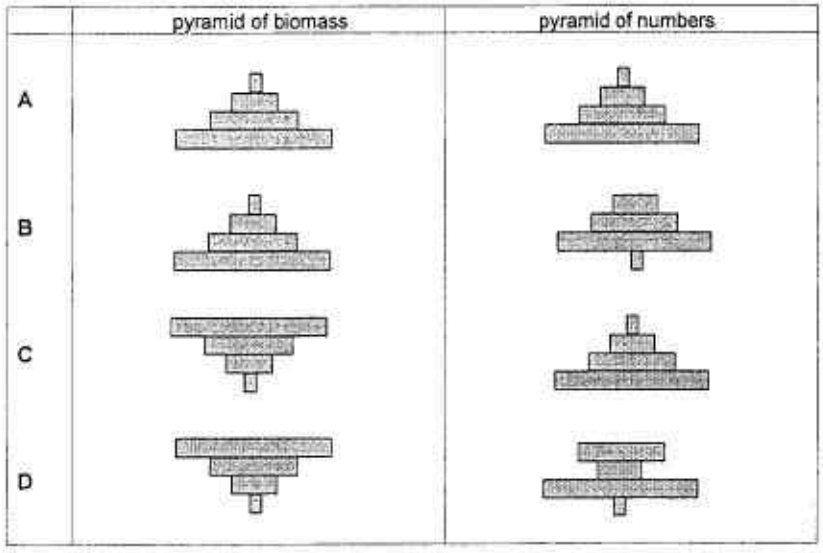
A Mutations occurred in the fish found in both the river and lake due to the introduction of human elements.
B The dam resulted in different environmental conditions and the river fish mutated to adapt to the new environment in the lake.
C The dam resulted in different environmental conditions formed between the lake and the river and natural selection selected the type of river fish best fit for the respective environments to survive.
D There is random mating between the river and lake fish and natural selection selected for the best-fit organisms in both populations.

38 The table shows the quantities of pesticides that accumulate in four populations, each at different trophic levels in a food chain. Which population (**A**, **B**, **C** or **D**) is most likely herbivores?

Population	Quantity of pesticides per unit mass
A	0.02
B	200
C	10
D	1600

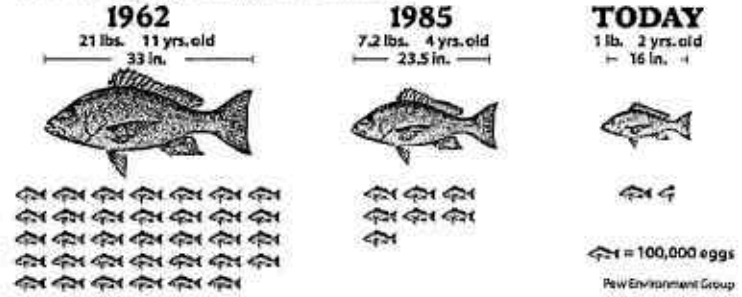
39 Consider the food chain: Tree → caterpillar → birds → snakes

Which of the following correctly illustrates the pyramid of biomass and pyramid of numbers?



40 This following is extracted from *"Overfishing 101: The Importance of Rebuilding Our Fish Populations Without Delay" by Lee Crockett, 2011.*

"Fishery managers are required by law to prevent overfishing and to help populations recover so that they increase to a size that will support the largest sustainable catch — a goal that benefits everyone."



Which of the following is the best way to restore the population of red snapper?

A Control the mesh size of the net
B Control the size of fishing ships
C Increase the price of red snapper
D Regulate the fishing period

ST. MARGARET'S SECONDARY SCHOOL

founded 1842

Preliminary Examinations 2015

CANDIDATE NAME

CLASS REGISTER NUMBER

BIOLOGY **5158/02**

Paper 2 **21 Aug 2015**

Secondary 4 Express **1 hour 45 minutes**

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

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

Section A
Answer **all** questions in the spaces provided.

Section B
Answer all **three** questions, the last question is in the form either/or.
Write your answers on the lined paper provided and, if necessary, continue on separate writing paper.
The number of marks is given in brackets [ ] at the end of each question or part question.
The use of an approved scientific calculator is expected, where appropriate.

For Examiner's Use	
Paper 1	/40
Paper 2: Section A	/50
Paper 2: Section B *9 E / O (Circle one)*	/30
Total	/120
Parents' Signature	

This document consists of 16 printed pages.

For Examiner's Use

12

Section A

Answer **all** questions in this section in the spaces provided.
The total mark for this section is 50.

1 *"Cancer is a disease of the cells which are the body's basic building blocks. The body constantly makes new cells to help us grow, replace worn-out tissue and heal injuries. Normally, cells multiply and die in an orderly way. Sometimes cells don't grow, divide and die the usual way. This may cause blood or lymph fluid in the body to become abnormal, or form a lump called a tumour."* *Cancer Council, Victoria*

Fig. 1.1 shows how cancer develops.

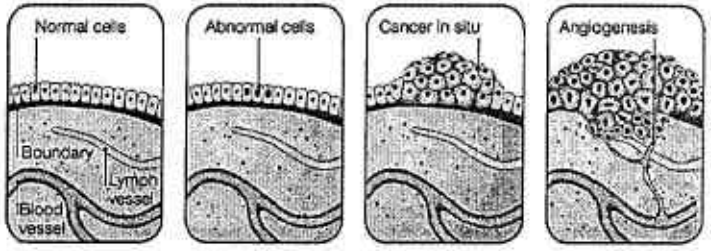


Fig. 1.1

Taken from http://www.cancervic.org.au/about-cancer/what-is-cancer

(a) (i) Name the structure which controls cell division.

..... [1]

(ii) Which organelle contains the structure named in (i)?

..... [1]

(b) Based on the text and **Fig 1.1**, suggest the effects of cancer on the liver.

.....

.....

.....

.....

.....

..... [3]

Total: [5]

For Examiners' Use

2 Fig. 2.1 shows a villus in human and details of the epithelium of the villus.

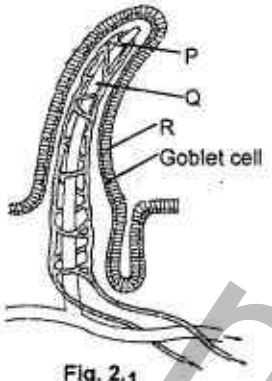


Fig. 2.1

Adapted from Higher Human Biology with Answers (2nd Edition)

(a) Identify Q and R.

Q: .....

R: ..... [2]

(b) (i) How does the structure of a villus contribute to the function of the small intestine?

.....

.....

.....

.....

..... [3]

(ii) P contributes to the function stated in (i). Describe another function of P in the villus.

.....

..... [1]

(c) Goblet cells secrete mucus. Explain the purpose of the mucus.

.....

..... [1]

Total: [7]

For Examiners' Use

3 In mammalian blood, carbon dioxide (CO_2) is transported largely in the form of the bicarbonate ion (HCO_3^-). CO_2 produced in cells moves into capillaries and then into red blood cells where it is converted to bicarbonate ions by the action of the enzyme carbonic anhydrase. The bicarbonate ions produced in the red blood cells move back into the plasma. These events are summarised in Fig. 3.1.

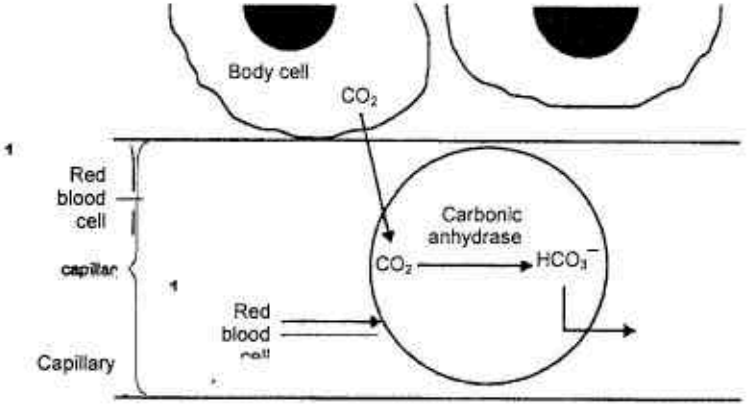


Fig. 3.1

(a) Red blood cell contains a chemical which allows it to transport oxygen. Name the chemical.

..... [1]

(b) Name a cellular process occurring in mammalian tissues that produces carbon dioxide.

..... [1]

(c) Explain how this conversion of carbon dioxide to bicarbonate ions in red blood cells assists the removal of carbon dioxide from body cells.

.....

.....

..... [2]

For Examiners' Use

(d) In plants the enzyme carbonic anhydrase can also assist the reverse of the reaction described, that is the conversion of bicarbonate ions into carbon dioxide.

$$H^+ + HCO_3^- \rightarrow CO_2 + H_2O$$

Chlorella is a type of alga found in fresh and salt water. In many of these environments, bicarbonate ions may be common. Chlorella photosynthesises to produce carbohydrates for energy. When carbon dioxide is in high concentration, Chlorella produces little carbonic anhydrase. In an experiment Chlorella cells were transferred from water with a high concentration of carbon dioxide to water with a low concentration of carbon dioxide. Light and temperature were kept constant and a high concentration of bicarbonate ions was provided. **Fig. 3.2** is the graph that represents the results of the experiment.

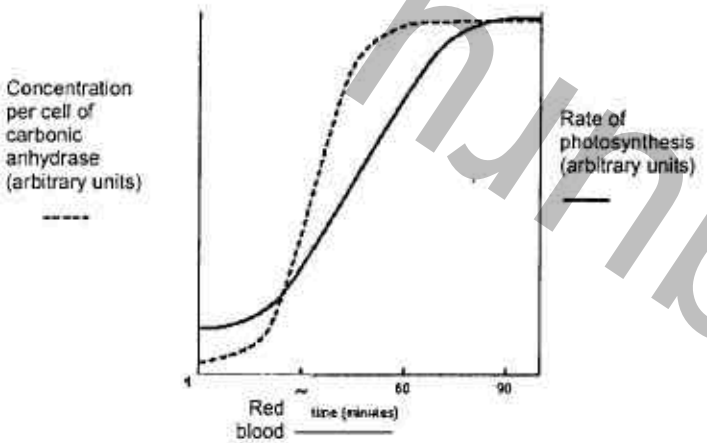


Fig. 3.2

(i) Based on the above information, describe the effect of an increase in the carbonic anhydrase concentration have on the rate of photosynthesis and suggest an explanation for the constant rate of photosynthesis after 90 minutes.

.....

.....

..... [2]

(ii) Carbonic anhydrase has an optimum pH of 8.5. Predict and explain the effect on the activity of this enzyme if the pH were reduced to 4.0.

.....

.....

..... [2]

Total: [8]

For Examiners' Use

4 A student uses a plant with variegated leaves to investigate photosynthesis. She places the plant in a dark place for 24 hours. She attaches black paper to both sides of a leaf as shown in **Fig. 4.1**.

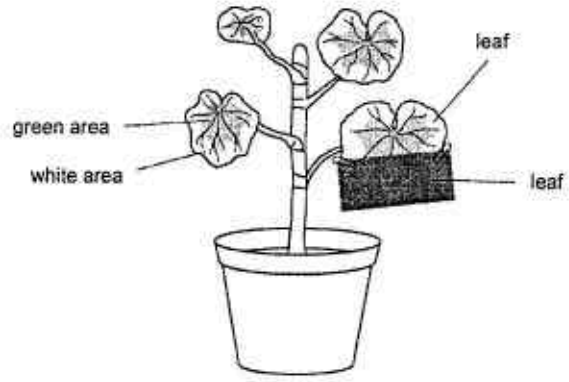


Fig. 4.1

The plant was left in bright light for 24 hours and then the cover was removed from the leaf. The leaf shown in **Fig. 4.2** was tested for the presence of starch.

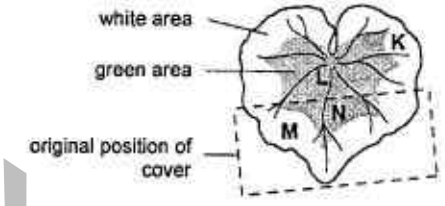


Fig. 4.2

(a) Write a word equation for photosynthesis.

..... [1]

(b) (i) Name the pigment that is found in area L, but not in area K.

..... [1]

(ii) Name the organelle which contains the pigment named in (i).

..... [1]

(c) Suggest why the student places the plant in the dark for 24 hours at the start of the experiment.

.....

..... [1]

(d) (i) Which areas of the leaf, as shown in **Fig. 4.2**, would contain starch after 24 hours? Indicate ✓ (for starch present) or ✗ (for starch absent) in the table.

Area	Starch
K	
L	
M	
N	

[2]

(ii) Give reasons for your answer for area M.

.....

.....

..... [2]

Total: [8]

For Examiners' Use

5 **Fig. 5.1** is a graph that shows the changes in genetic (DNA) content in a single cell during the mitotic cycle.

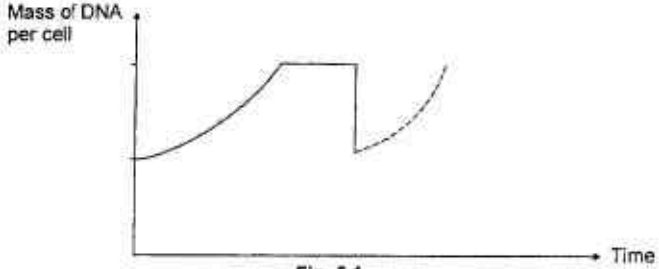


Fig. 5.1

(a) Mark on the horizontal axis of **Fig. 5.1**, with letter A, the period when interphase is taking place. Explain your answer.

.....

..... [2]

(b) Mark on **Fig. 5.1**, with letter B, the point when mitosis begins. Explain your answer.

.....

..... [2]

(c) Mark on **Fig. 5.1**, with the letter C, the point when cytokinesis is taking place. Explain your answer.

.....

..... [2]

(d) Continuing from the end of the dotted line on **Fig. 5.1**, draw a line that represents the cycle of meiosis which resulted in the formation of a zygote. On the graph, clearly label the following processes on the horizontal axis.

- the period of meiosis I
- the period of meiosis II
- the point gametes are formed
- the point when a zygote is formed [2]

(e) Compare mitosis and meiosis.

.....

.....

.....

.....

..... [3]

Total: [11]

For Examiners' Use

6 Three populations, X, Y and Z, in a small lake are linked in a food chain. **Fig. 6.1** shows the changes in size of these populations over a period of time.

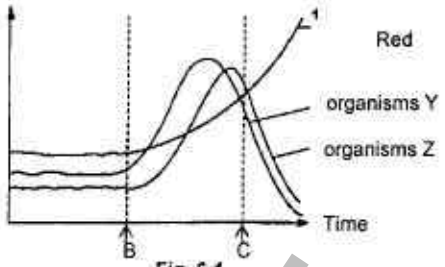


Fig. 6.1

(a) Using the information in **Fig. 6.1**, state

(i) if the producer is X, Y or Z; .....

(ii) the trophic level of organisms Z in the food chain ..... [2]

(b) Suggest what may have entered the lake at time B. Explain your answer.

.....

.....

.....

.....

..... [3]

(c) Explain how the change in the size of the population of bacteria after time C is related to the size of the plant population.

.....

.....

.....

.....

..... [3]

(d) **Fig 6.2** is a graph that shows the concentration of oxygen in the same lake before time B. Complete the graph to show how the oxygen concentration will change over the same period shown in **Fig 6.1**. [1]

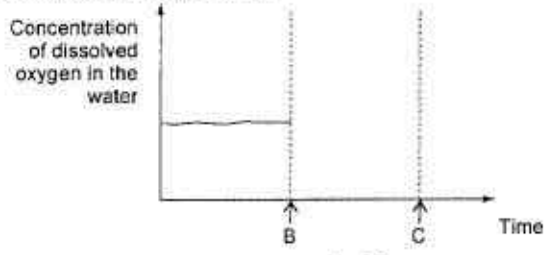


Fig 6.2

Total: [9]

For Examiners' Use

Section B

Answer **three** questions.
Question 9 is in the form of an **Either / Or** question.
Only one part should be answered.

7 In an experimental set-up, a plant is watered with water radioactively labelled with isotope ^{18}O. The plant is then placed in a sealed chamber and the radioactivity of the air in the chamber is measured over time. **Table 7.1** shows the data that was obtained from the experiment.

Table 7.1

Time/ h	0	1	2	3	4	5	6	7
Radioactivity/ Bq	0.0	10.0	20.0	35.0	48.0	55.0	58.0	60.0

(a) Using the data above, draw a graph on the grid provided to show how radioactivity of the air changes with time.

[4]

16

For Examiners' Use

(b) For this experiment, describe the passage of a radioactively-labelled oxygen atom in water that is used in a plant. Your answer should begin from the point the atom is taken up at the roots to the point where it is released into the atmosphere.

....

....

....

....

....

....

....

....

....

....

....

....

....

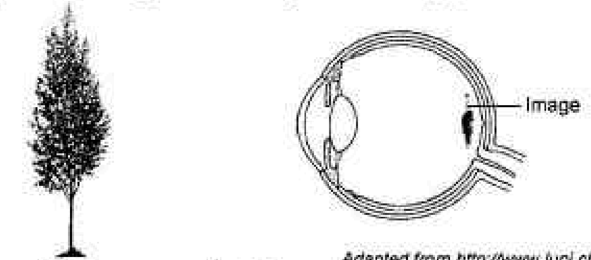
....

.... [6]

[Total: 10]

For Examiners' Use

8 **Fig. 8.1** represents an image of a tree being formed in the eye (*not drawn to scale*).



Tree

Fig. 8.1

Adapted from http://www.lupl.ch/Schools/bio/

(a) The tree is located 30 m away from a person. Describe how the image of the tree can be focused in his eye.

....

....

....

....

....

....

....

....

....

.... [5]

(b) Describe the nervous pathway that allows the image to be focused.

....

....

....

....

....

....

....

....

....

.... [5]

[Total: 10]

For Examiners' Use

EITHER

9 (a) Viruses lack organelles and thus are unable to replicate. **Fig. 9.1** shows how a virus, containing a strand of DNA, replicates using the mechanisms in a cell (host cell).

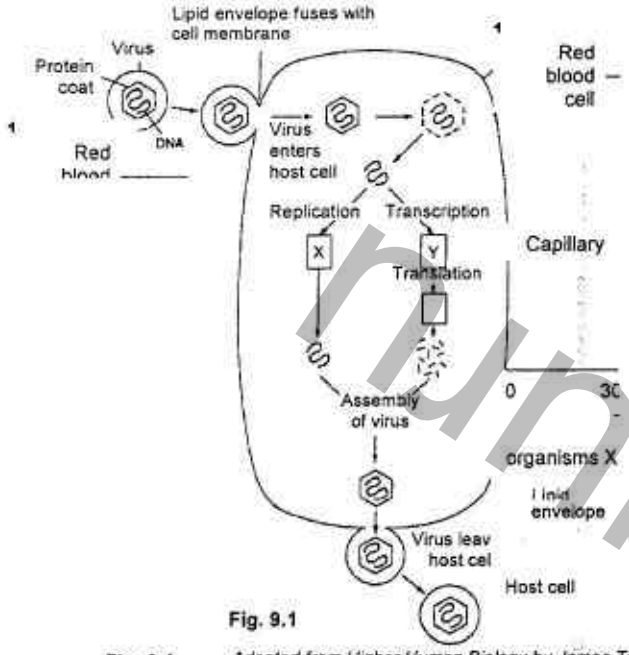


Fig. 9.1

Fig. 9.1 *Adapted from Higher Human Biology by James Torrance*

Based on the information provided in **Fig. 9.1**, describe how the virus makes use of its host cell to reproduce. Identify structures X, Y and Z in your answer.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) Polydactyl is a rare condition that causes the development of extra fingers. The condition is caused by a dominant allele. **Fig. 9.2** shows the inheritance of polydactyl in a family.

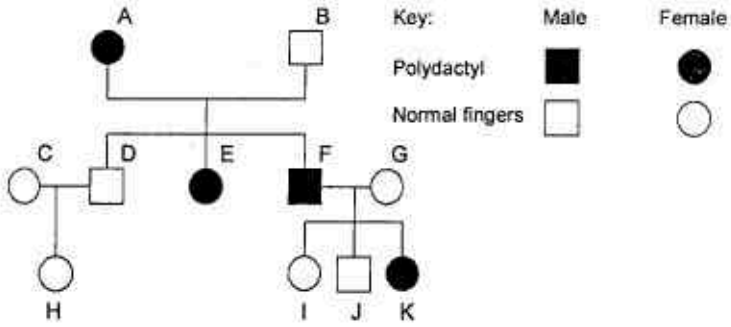


Fig. 9.2

Use appropriate symbols to explain the genotypes of A, B and K.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

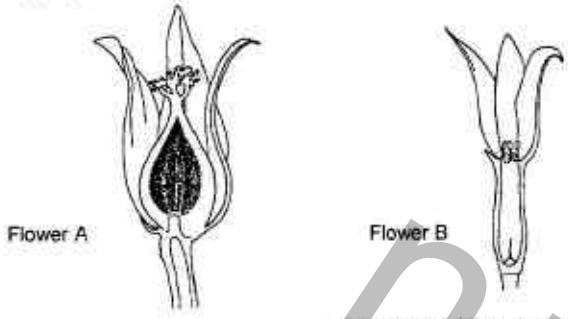
.....

..... [6]

[Total: 10]

OR

9. **Fig. 9.3** shows the cross-section of flowers A and B (*not drawn to scale*), obtained from two different papaya plants.



Taken from http://www.biology-resources.com

Fig. 9.3

Papaya plants can exist as male or female forms. Male papaya plants produce male flowers which do not have no ovary but possess stamens. The female flowers can bear fruits.

(a) Explain why female flowers can bear fruits, but not the male flowers.

.....

.....

.....

.....

.....

..... [3]

(b) Are papaya flowers pollinated by insects or wind? Explain your choice of answer.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(c) Based on the information provided, which flower (A or B) is most likely a female flower. Explain your choice of answer.

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

MARKING SCHEME
St. Margaret's Secondary School

Examinations: Preliminary Examinations
Year: 2015
Level/ Stream: 4 Express
Subject: Biology (5158)

Paper 1

1	C	11	C	21	D	31	B
2	B	12	D	22	D	32	B
3	B	13	A	23	C	33	B
4	C	14	D	24	C	34	C
5	A	15	C	25	D	35	D
6	B	16	C	26	A	36	B
7	D	17	C	27	C	37	C
8	D	18	A	28	A	38	C
9	A	19	C	29	B	39	B
10	B	20	B	30	C	40	B

Paper 2

Section A (50 Marks)

1a. i. Deoxyribonucleic Acid/ Chromatin/ Chromosomes [1] ***[A: "DNA"]***
ii. Nucleus [1]

1b. ***Total: [3]***
- Blood or lymph fluid in the body become abnormal/ form lumps / tumours [1].
- Blood vessels grow towards the cancer cells. ***OR*** More blood is channelled towards the cancer cells [1].
- Liver cells receive less nutrients and oxygen **OR** remove more toxins produce by cancer cells [1].

2a. Q: Lacteal [1] ***[A: "lymphatic capillary"]***
R: Epithelial cell [1]

2b. i. ***[1] each. Any 3. Total: [3]***
- The (inner) surface area of the small intestine is increased for absorption by the elongated / finger-like structure of the villus.
- This surface area is further increased with the presence of microvilli on the epithelium of the villus.
- The thin/ one cell thick wall / epithelium of the villus allows for quick diffusion of nutrients into the bloodstream.
- Many capillaries are present in a villus to help carry away absorbed nutrients quickly/ to maintain concentration gradient for nutrients absorption.
- The epithelial cells contain numerous mitochondria to provide energy for active transport for absorption of nutrients.

ii. ***[1] each. Any 1. Total: [1]***
- Bloodstream at P provides the cells in the villus/ small intestine with oxygen.
- Bloodstream at P removes carbon dioxide from the cells in the villus/ small intestine.

2c. ***[1] each. Any 1. Total: [1]***
- Mucus lined the gut/ intestine to reduce friction as food travels through it.
- Mucus protects the intestinal wall against the acidic chyme.
- Mucus protects the intestinal wall against the alkaline digestive juices.
- Mucus protects the intestinal wall against digestion of proteases (enzymes).

3a. Haemoglobin [1]
3b. Aerobic respiration [1]
3c. This **reduces the concentration** of carbon dioxide in the **blood**; [1]
In this way carbon dioxide can continually diffuse into the red blood cell/ blood plasma, maintaining a **concentration gradient** for removal of carbon dioxide from body cells [1].

3d. i. Increase in carbonic anhydrase concentration increases the rate of photosynthesis [1]. After the 90 minutes, the concentration of carbonic anhydrase is a constant, indicating that the concentration of carbon dioxide cannot increase further for a higher rate of photosynthesis. **Concentration of carbon dioxide continues to be a limiting factor** for photosynthesis [1]. (R: light or temperature becomes the limiting factor)
ii. Enzyme activity will decrease/ reduce [1] as enzymes are denatured/ enzymes lose their active sites [1] in pH extreme to their optimum.

4a. carbon dioxide + water $\xrightarrow[\text{light}]{\text{Chlorophyll}}$ glucose + oxygen (+water)
All substrates, products and conditions present [1]

4b. i. Chlorophyll [1]
ii. Chloroplast [1]

4c. To destarch the plant/ to remove starch [1]

4d. i. All correct: [2], 2 correct: [1]

Area	Starch
K	✗
L	✓
M	✗
N	✗

ii. Area M: As the area is not exposed to light [1] and does not possess chlorophyll/chloroplast [1], it cannot photosynthesise and form starch.

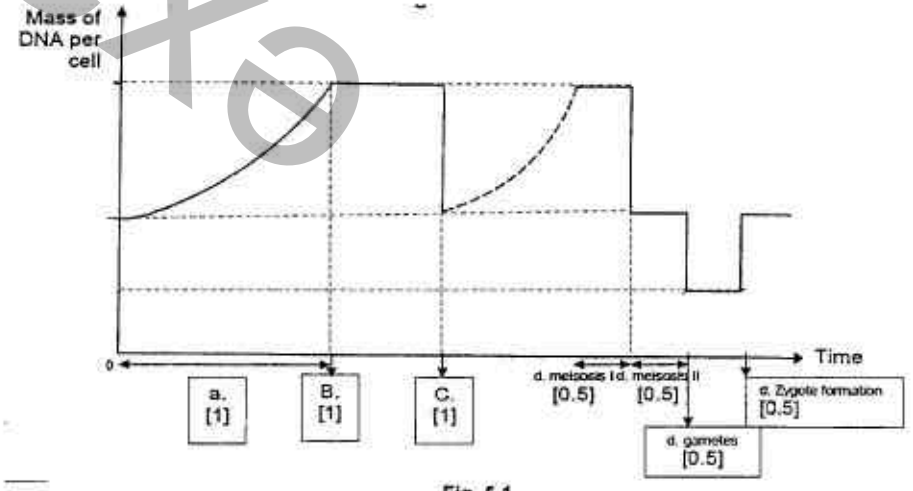


Fig. 5.1

5a. ***[1] each. Any 1. Max: [1]***
- There is a one fold increase in the mass of genetic material.
- Mass of genetic material/ DNA has doubled due to DNA replication

5b. ***[1] each. Any 1. Max: [1]***
- Amount of genetic material is at the highest level [1] before dropping.
- Mass of genetic material has doubled.

[R: "Mass of genetic material has increased" or "Mass of genetic material stays constant"]

5c. ***[1] each. Any 1. Max: [1]***
- Mass of genetic material has returned to the original level [1].
- Mass of genetic material has reduced.

5e. ***Any 2 pairs of the fllwg differences. [1] each pair. Max: [2]***

Feature	Mitosis	Meiosis
Occurrence	Body cells/ Cells growth, repair and undergo replacement	Cells of gonads/ Formation of gametes
Daughter cells and parent cells	Identical	Different from each other
No. of daughter cells formed	2	4
Amount of genetic material in daughter cells compared with that in parent cell	2n (Diploid)	n (Haploid)
Pairing of homologous chromosomes (Synapsis Formation)	Does not occur	Occurs
Crossing over	Does not occur	Occurs
No. of nuclear/ cytoplasmic division	One	Two

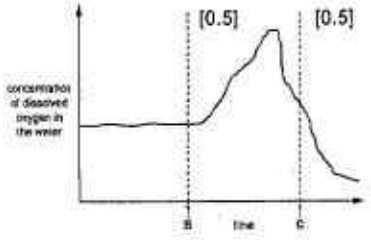
[1] each. Any 1. Max: [1]
- Both require replication of genetic material (interphase) before occurring.
- Both allow for genetic information to be passed on to new cells.
- Both involve 4 stages prophase, metaphase, anaphase and telophase
- Both refer to the process of nuclear division which occurs during cell division.

6a. i. Y [1]
ii. 2 [1]

6b. Fertilisers/ nitrates [1] ***[P: Additional wrong answers]***
There are nutrients [1] that allow plants/ algae grow rapidly [1].

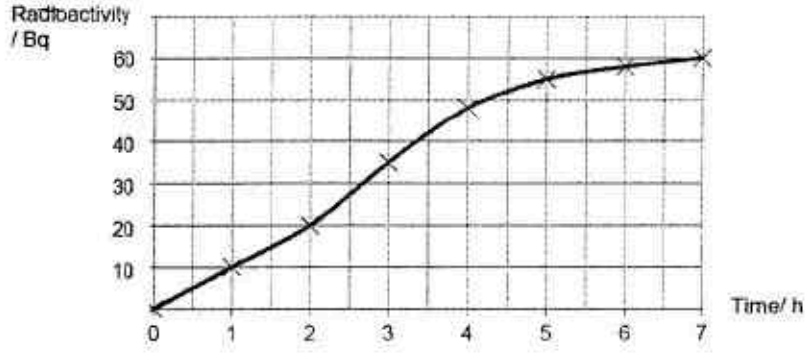
6c. ***Total: [3]***
- Submerged plants die as they lack light to photosynthesize/ make food [0.5].
- This increases the population of decomposers/ bacteria and fungus [1]
- in the water as decomposition occurs [0.5]
- aquatic organisms/ plants are killed [0.5]
- due to lack of oxygen for respiration [0.5]

6d.



Section B (30 Marks)

7a.



[1] each. Total: [4]
- Vertical axis labelled as "Radioactivity" & Horzontal axis labelled as "Time"
- Units labelled on vertical axis: "Bq" & on Horzontal axis: "h"
- All points plotted correctly
- Smooth & best fit curve which occupies ≥1/2 of grid

7b. ***[0.5] each. Max: [6]***
- ***Needs to be mentioned at least once. If not, minus [1]***
- Water, containing radioactively-labelled **oxygen***, enters root hair cells via **osmosis**
- as water potential in the soil is higher than in the root hair cells;
- In the roots, water moves from one cell to the adjacent cell towards the xylem by osmosis (marks given once only)
- In the stem, water is drawn up the xylem by root pressure, capillary action and transpiration pull.
- At the leaves, water enters the mesophyll cells by osmosis.
- Water leaves mesophyll cells to form a film of moisture outside the mesophyll cells.
- Water evaporates into water vapour that accumulates in the intercellular air spaces.
- Water vapour, containing radioactively-labelled oxygen*, diffuses out of the leaves to the atmosphere through stomata
- Water is used by mesophyll cells during photosynthesis
- producing oxygen gas with radioactivity.
- Radioactive oxygen gas diffuses out of the leaves.

8a. ***[1] each. Total: [5]***
- Light rays reflected from the tree enters the eye, through the pupil.
- Ciliary muscles relax,
- causing the suspensory ligament to become taut.
- This leads to the lens being pulled to become thin/ less convex.
- Light rays reflected from the tree will be focused on the retina to produce a clear image ***OR*** Clear image is formed on the retina. ***[R: "Refracted onto the retina"]***

8b. ***[0.5] each. Total: [5]***

- Blur image is formed on the retina. ***[R: "Clear image formed on the retina"]***
- photoreceptors/ light sensitive cells/ rods and cones are stimulated
- Impulses travel through the sensory neurones,
- via the optic nerve,
- towards the relay neurones
- in the brain / optic centre
- the brain interprets the information
- After crossing synapses
- impulses are transmitted by motor neurones
- to the effector/ ciliary muscles

Either

9a. ***[0.5] each. Total: [4]***

- X: Viral genome/ DNA/ chromatin thread/ chromosomes
- Y: mRNA (formed from viral genome)
- Z: Peptone/ polypeptide
- Upon entering the host cell, the virus formed new copies of its genome/ DNA/ X
- through replication.
- The virus formed components of its protein coat
- through transcription and translation.
- Viral genome and protein coat then assemble to form the virus particles which will then leave the cell.
- Virus pinches off the host cell/ forms a vesicle to leave the host cell.

9b. P: Dominant allele for polydactyly p: Recessive allele for normal fingers [0.5]
[A: Other letters used as long as big letters are used to represent allele for polydactyly and corresponding small letters for normal fingers]

Person	Genotype	Explanation
A	Pp [1]	A has polydactyly [0.5]. A has contributed allele p to for D to have normal fingers [0.5].
B	pp [1]	B does not have polydactyly [0.5]. *OR* B has normal fingers [0.5]
K	Pp [1]	K has polydactyly [0.5]. K has received allele p from G [0.5].

Or

9a. ***[0.5] each. Total: [3]***

- When pollination occurs,
- pollen produced by male flowers land on the stigma.
- Through pollen tube formation, male gametes are guided to the female gametes
- in the ovule,
- found in the ovary.
- where fertilisation occurs to produce seeds that are part of fruits.

9b. Papaya flowers are pollinated by insects [1].
[1] each. Any 3. Max: [3]

- Funnel-like shape of flower forces insects to squeeze its way through it to collect nectar
- Petals are (relatively) large to attract insects
- Stamens/ Filaments are not pendulous or Stamen does not protrude from the flower.
[R: "Non pendulous anthers"]
- Stigma does not protrude from the flower.
[R: "Nectar guides" as they are not prominent in the drawing.]

9c. ***[1] each. Total: [3]***

- A is the female flower.
- It bears an ovary. ***[R: "Ovule(s)"]***
- It bears structure that resembles stigma. ***[R: "Lacks anther/ stamen"]***

This question paper consists of **19** printed pages.

Anglo-Chinese School
(Barker Road)

PRELIMINARY EXAMINATION 2015

SECONDARY FOUR EXPRESS

BIOLOGY PAPER 1

5158/1

TIME: 1 HOUR

INSTRUCTIONS TO CANDIDATES:

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name and index number on the answer sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the one you consider correct and record your choice in **soft pencil** on the separate answer sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

Additional Materials provided by the School:

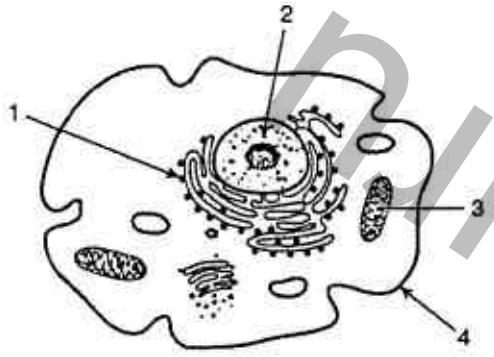
Answer Sheet

1. Which structures are found in human sperm cell?

	haploid nucleus	mitochondria	nuclear membrane
A	✓	✓	✗
B	✓	✗	✓
C	✗	✓	✓
D	✓	✓	✓

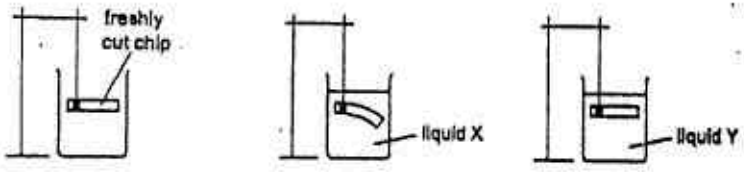
Key: ✓ – structure present ✗ – structure absent

2. Which of the following statement is true?



A Structure 1 is most active in a growing child.
B Structure 2 is present throughout the life cycle of a cell.
C Structure 3 requires light to carry out its function.
D Structures 2 and 4 control the movement of water into the cell.

3. The diagram shows a freshly cut potato strip, a potato strip suspended in liquid **X**, and a potato strip suspended in liquid **Y**.



What are the identities of liquids **X** and **Y**?

	liquid X	liquid Y
A	concentrated sugar solution	dilute sugar solution
B	dilute sugar solution	concentrated sugar solution
C	pure water	concentrated sugar solution
D	pure water	dilute sugar solution

4. The table shows the mass of four nutrients, **P**, **Q**, **R** and **S**, absorbed by the roots of a plant in the presence and absence of oxygen in one hour.

Nutrient	Mass absorbed in the presence of oxygen / g h^{-1}	Mass absorbed in the absence of oxygen / g h^{-1}
P	0.7	0.6
Q	2.5	1.2
R	3.6	3.2
S	4.8	0.8

Which of the following conclusion can be made from the data?

A Nutrients P and R are mainly absorbed by diffusion.
B Nutrients P, Q, R and S are absorbed through both diffusion and active transport.
C Nutrients Q, R and S are mainly absorbed by active transport.
D Nutrients Q and S are absorbed through active transport only.

5. A molecule contains sulphur and phosphorus. Which of the following could it be?

A a carbohydrate
B a fatty acid
C a protein
D a reducing sugar

6. Some statements of water are listed below.

(i) Water cools the surface from which is evaporates.
(ii) Water is a solvent for many chemicals.
(iii) Water is involved in metabolic reactions.
(iv) Water is incompressible

Which of the following statements above describe properties of water that make it suitable to use in the blood transport system?

A (i) and (ii)
B (i), (ii) and (iii)
C (ii) and (iii)
D (ii), (iii) and (iv)

7. Four students were asked to design an investigation to determine the effect of pH on the activity of an enzyme.

Which table shows the most appropriate design?

A

test tube	contents	pH	temp /°C
1	E	3	20
2	E	7	20
3	E	12	20
4	S	3	20
5	S	7	20
6	S	12	20

B

test tube	contents	pH	temp /°C
1	E + S	3	20
2	E + S	7	20
3	E + S	12	20
4	DW +S	3	20
5	DW +S	7	20
6	DW +S	12	20

C

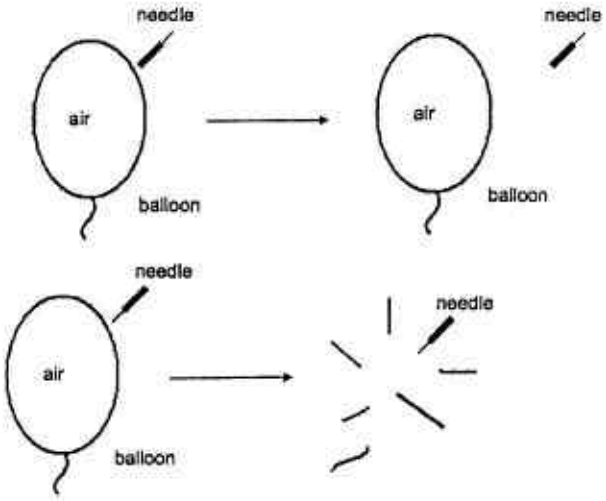
test tube	contents	pH	temp /°C
1	E + S	3	10
2	E + S	7	20
3	E + S	12	30
4	S	3	10
5	S	7	20
6	S	12	30

D

test tube	contents	pH	temp /°C
1	E + S	7	10
2	E + S	7	20
3	E + S	7	30
4	DW +S	7	10
5	DW +S	7	20
6	DW +S	7	30

E = Enzyme S = Substrate DW = Distilled Water

8. The diagram shows an example of a biological model used to illustrate an enzymatic reaction.



Which characteristic(s) of enzymes is/are displayed by the diagram above?

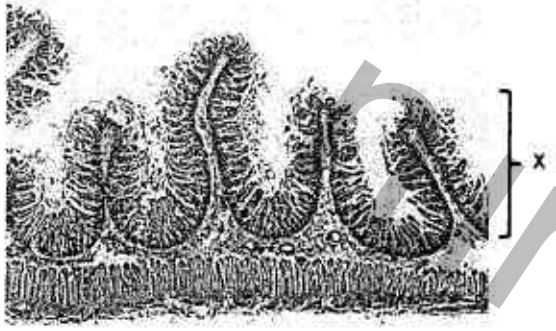
(i) ability to catalyse reversible reactions
(ii) presence of active site
(iii) specificity

A (i) and (ii) only
B (i), (ii) and (iii) only
C (ii) and (iii) only
D (iii) only

9. Which of the following is not an effect of excessive consumption of alcohol?

A damage to liver
B faster reaction times
C reduced self control
D slurred speech

10. The diagram below shows a photomicrograph which shows part of a section of the alimentary canal.

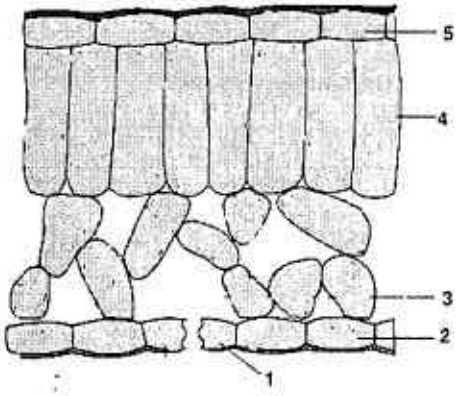


Which of the following are functions of structure **X**?

(i) absorb fatty acids and glycerol
(ii) absorb glucose and amino acids
(iii) increase surface area for absorption
(iv) sweep food along the alimentary canal

A (i) and (ii) only
B (i), (ii) and (iii) only
C (i), (ii) and (iv) only
D (iii) and (iv) only

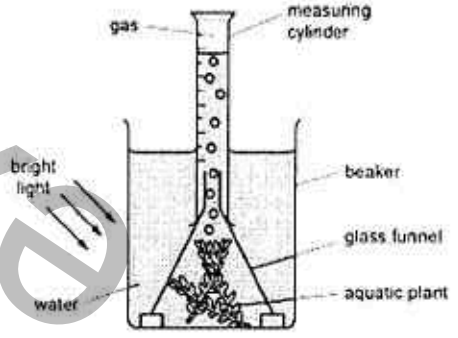
11. The diagram below shows a transverse section of a leaf.



Which cells are directly affected by the presence of light?

A 1, 2, 3, 4
B 1, 3, 4
C 2, 3, 4
D 2, 3, 4, 5

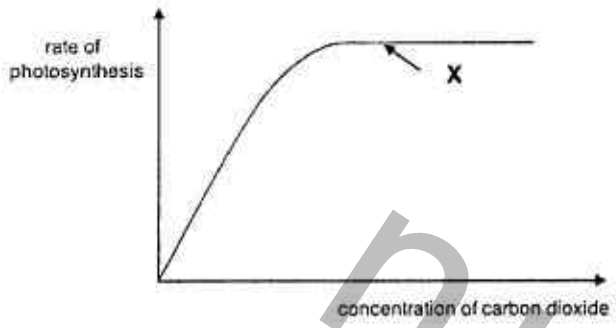
12. The figure shows an experiment carried out to investigate the effect of light intensity on the rate of oxygen production in aquatic plants.



Which two factors must be kept constant during this investigation?

A the amount of water in the beaker and height of measuring cylinder
B the size of aquatic plant and duration of exposure to light
C the size of aquatic plant and the amount of gas in the measuring cylinder
D the size of beaker and funnel

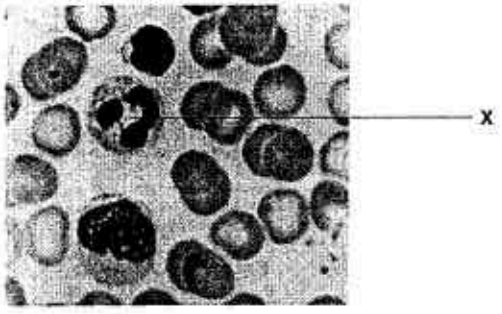
13. The following graph shows the changes in photosynthetic rate of a plant when carbon dioxide concentration increases.



Which is not a limiting factor at **X**?

A amount of chlorophyll in the leaf
B light intensity
C concentration of carbon dioxide
D temperature

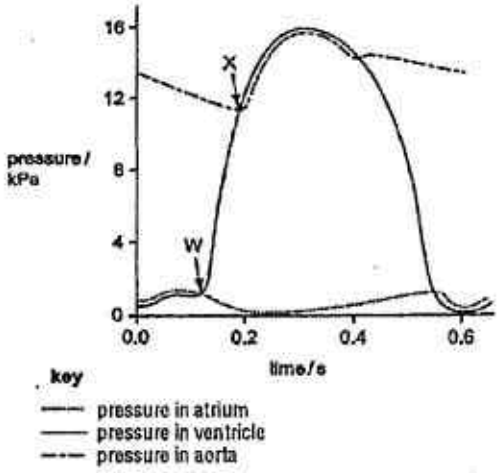
14. The photograph shows blood cells as seen under the microscope.



Newly born babies generally have elevated levels of blood cell **X**. Which of the following would be the best explanation for this?

A Nitrogenous waste products need to be removed from their bodies at a faster rate.
B The blood needs to clot so that the point at which the umbilical cord is cut can heal quickly.
C They are more susceptible to infections.
D They require a greater ability to transport oxygen since now they have to breathe on their own.

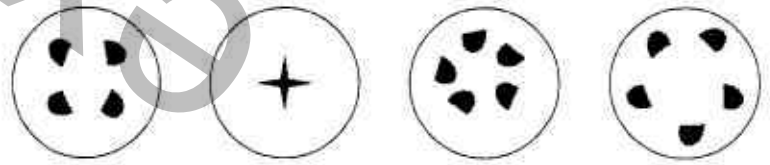
15. The diagram shows the pressure in the left side of the heart during a single heart beat.



Between points **W** and **X**, are the following valves open or closed?

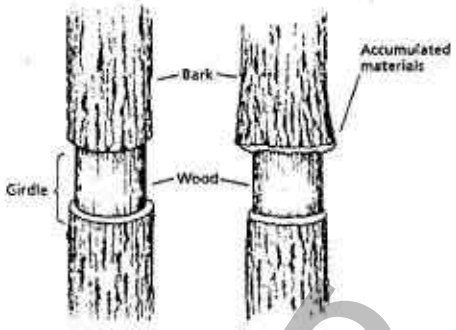
	atrio-ventricular	semi-lunar
A	closed	closed
B	closed	open
C	open	closed
D	open	open

16. A dicotyledonous plant is exposed to radioactive $^{14}CO_2$ for 4 hours. Thin sections were cut across the stem and root and these sections were put on photographic films. Which of the following correctly represents the distribution of radioactivity in the stem and in the root?



	root	stem
A	P	R
B	P	S
C	Q	R
D	Q	S

17. A ringing experiment was carried.

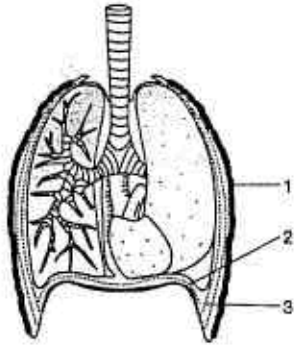


After a few weeks, a swelling formed above the ring. Which of the following is/are the explanation(s) for the appearance of such a swelling?

(1) The cut area absorbed moisture directly from the damp atmosphere that cause it to swell.
(2) The ringing action stimulated the active cell division around the cut area to repair the wounded tissues.
(3) The removal of the phloem caused the downward translocated nutrients to be accumulated above the ringed region thus enhanced active growing of cells.

A (1) only
B (2) only
C (2) and (3) only
D (3) only

18. The diagram shows a human thorax in vertical section. Structures 1 and 2 are two different sets of muscles and structure 3 is the thoracic cavity.



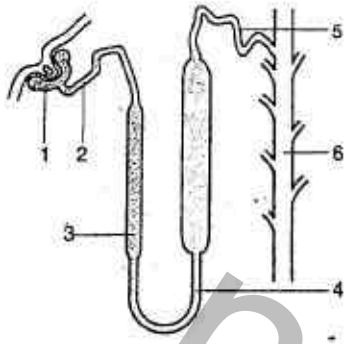
Which of the follow occurs so that inspiration can take place?

	muscle 1	muscle 2	pressure at 3
A	contract	contract	reduced
B	contract	relax	increased
C	contract	relax	reduced
D	relax	contract	increased

19. Which of the following shows the end products of anaerobic respiration in yeast and in the muscles of man?

	yeast	muscles in man
A	carbon dioxide and ethanol	lactic acid
B	carbon dioxide and ethanol	lactic acid and water
C	ethanol and lactic acid	lactic acid
D	ethanol and lactic acid	lactic acid and water

20. The diagram shows a nephrone.



In a healthy person, which structure would contain the most amino acids?

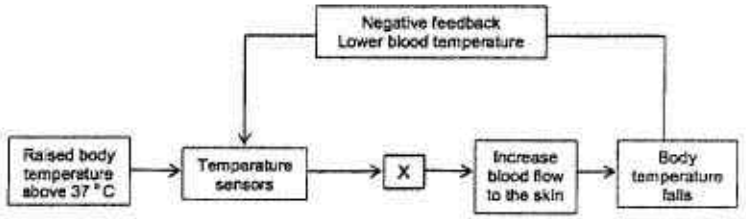
A 1 and 2
B 3 and 4
C 4 and 5
D 5 and 6

21. The table gives the events involved in the secretion and action of anti-diuretic hormone (ADH). Which row is correct?

	water level in blood relative to normal	amount of ADH produced relative to normal	amount of water reabsorbed by kidneys
A	+	–	+
B	+	+	+
C	–	–	–
D	–	+	–

Key: + = increased; – = decreased

22. The diagram below shows a feedback loop to regulate our body temperature.



Which of the following structures constrict at point **X**?

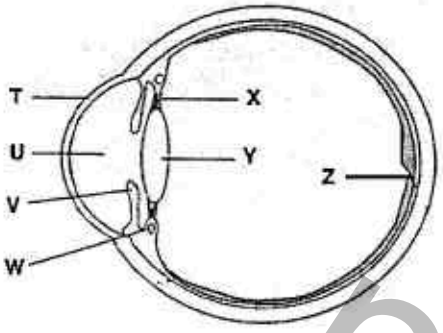
A arterioles
B artery
C capillaries near the skin
D shunt vessels

23. The femoral nerve in humans connects the brain with the tissues of the thigh and leg, including the muscles and skin. When a doctor injects a local anaesthetic that targets this nerve, a person cannot feel pain or move his leg properly.

Which of the following conclusions can be made?

A The femoral nerve contains only sensory neurones.
B The femoral nerve contains only motor neurones.
C The femoral nerve contains both sensory and motor neurones.
D The femoral nerve contains sensory, relay and motor neurones.

24. The diagram below shows the cross section of the human eye.



Which of the following structures are involved in changing the pupil size under bright light?

A T and V
B U and W
C V and Z
D X and Y

25. Which of the following is not a characteristic of adrenaline?

A It decreases blood pressure.
B It increases breakdown of glycogen to glucose.
C It increases rate of breathing.
D It is produced when a person is frightened.

26. The following statements describe reproduction in plants.

(i) Offspring are genetically different.
(ii) Offspring are genetically identical.
(iii) Requires only one parent.
(iv) Requires two parents.
(v) Sex cells are fused together

Which of the statements describe a method of reproduction in plants that allows rapid colonization of a habitat?

A (i), (iii)
B (i), (iv), (v)
C (ii), (iii)
D (ii), (iv), (v)

27. The table shows the various stages of a rapeseed flower, *Brassica napus*.

Stage	Petals	Stigma	Pollen availability	Nectary
1	partically open	not receptive	high	hidden
2	fully open	receptive	high	partially hidden
3	beginning to droop	receptive	high	available
4	drooping	not receptive	low	available
5	falling	not receptive	none	available

Which of the following is correct?

	pollination can take place on the flower	bees are attracted to the flower	likely time of day
A	stages 1, 2 and 3	stages 1 & 2	morning
B	stages 1, 2 and 3	stages 2, 3, 4 & 5	evening
C	stages 2 and 3	stages 1 & 2	evening
D	stages 2 and 3	stages 2, 3, 4 & 5	morning

28. Which of the following regarding the functions of sepals, petals, and anthers in an insect-pollinated flower is correct?

	sepals	petals	anthers
A	attraction	protection	storage
B	attraction	protection	support
C	protection	attraction	storage
D	protection	attraction	support

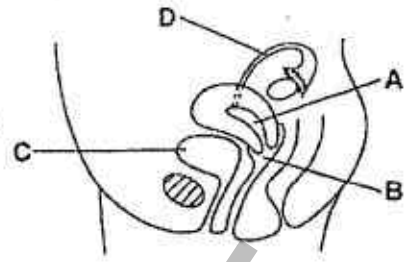
29. The diagram shows three consecutive months of a calendar, May, June and July.

13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
1	2	3	4	5	6	7
8	9	10	11	12	13	14

If a woman first realizes that she is having her period on 29th of May, during which of the following times would she be most likely to conceive?

A 14th to 17th May
B 28th to 31st May
C 11th to 14th June
D 25th to 28th June

30. The diagram shows part of the female urino-genital system. Where are sperm deposited during intercourse?



31. Which of the following correctly shows the events that occurs in the stages of a cell cycle?

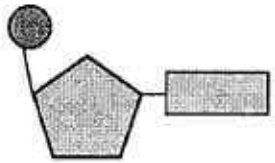
	DNA replication	Breakdown of nuclear membrane	Division of centromere
A	interphase	prophase	anaphase
B	interphase	prophase	metaphase
C	prophase	interphase	anaphase
D	prophase	interphase	metaphase

32. The flower colour in a plant is determined by a single gene. The diploid number of the plant is 24.

How many copies of this gene are present at each pole of the spindle in telophase I?

A 1
B 2
C 12
D 24

33. The figure below represents a biological molecule.



Which of the following is the correct identity of the molecule represented?

A DNA molecule
B nucleotide
C sugar-phosphate backbone
D triglyceride

34. DNA extracted from the nuclei of octopus cells is found to comprise 18% adenine. What percentage of the bases of guanine?

A 18
B 32
C 36
D 64

35. Which of the following can result in an increase in the rate of mutation?

(i) ultra-violet rays
(ii) radiation
(iii) mustard gas

A (i) only
B (i) and (ii) only
C (i) and (iii) only
D (i), (ii) and (iii)

36. In a genetic experiment using smooth and wrinkled peas, results showed that the allele for smooth peas was dominant and that for wrinkled peas was recessive. 250 hybrid plants that were heterozygous were crossed and 6000 smooth peas were gathered in the F1 generation. What is the likely number of wrinkled peas gathered?

A 1500
B 2000
C 3000
D 4500

37. Farmers crossed two breeds of cattle, the Jersey from Europe and the Sahiwal from South Africa. For many generations, the farmers picked out the offspring with the highest milk yields to breed the next generation.

Which of the following best describes this process?

A artificial selection
B discontinuous variation
C evolution
D natural selection

38. "In the natural world, there are very few food chains that consist of many trophic levels." Which of the following correctly explains this statement?

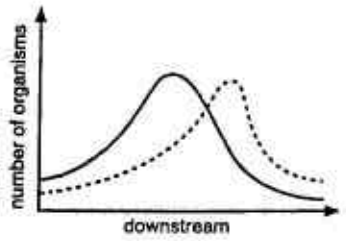
A As the trophic level increases, the number of organisms decreases. Top predators therefore need to spend more energy to hunt for preys.
B Energy is lost at each transfer in a food chain.
C The biomass of preceding trophic level is insufficient to support the top predators.
D There is competition of space between the different populations, hence a habitat cannot support too many trophic levels.

39. Why is energy flow through ecosystems non-cyclical in nature?

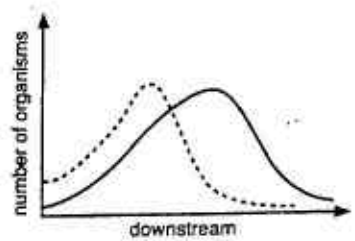
A Energy is locked in the higher trophic levels and cannot be returned to the ecosystem
B Energy is lost to the surroundings as heat energy cannot be re-used.
C Some of the energy is broken down into other forms that cannot be re-used.
D The primary source of energy for most ecosystems is the sun.

40. A large amount of nitrogenous fertilizer leaches into a stream. Which of the following graphs shows the likely changes in the population of algae and bacteria down the stream?

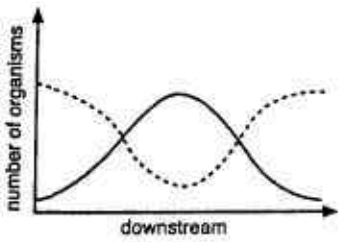
A



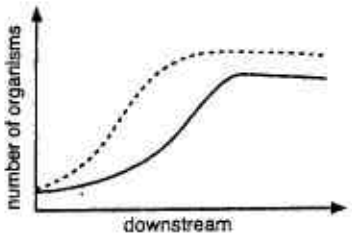
B

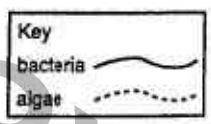


C



D





End of Paper

INDEX NO.	

Anglo-Chinese School
(Barker Road)

PRELIMINARY EXAMINATION 2015

SECONDARY FOUR EXPRESS

BIOLOGY PAPER 2

5158/2

TIME: 1 Hour 45 Minutes

READ THESE INSTRUCTIONS FIRST

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

Section A
Answer **all** questions.
Write your answer in the spaces provided on the question paper.

Section B
Answer **all** questions including questions 8, 9 and 10 **Either** or 10 **Or**.
Write your answers on the separate answer paper provided.
At the end of the examination,
1. fasten all your work securely together;
2. write an **E** (for Either) or an **O** (for Or) next to the number 10 in the grid to indicate which question you have answered.

	Marks
Section A	
Section B	
8	
9	
10	
TOTAL	

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

*This question paper consists of **20** printed pages.*

SECTION A (50 marks)

Answer **all** *questions in the spaces provided.*

1. **Fig.1** below shows the relative concentrations of glucose in the hepatic portal vein and the hepatic vein over period of time.

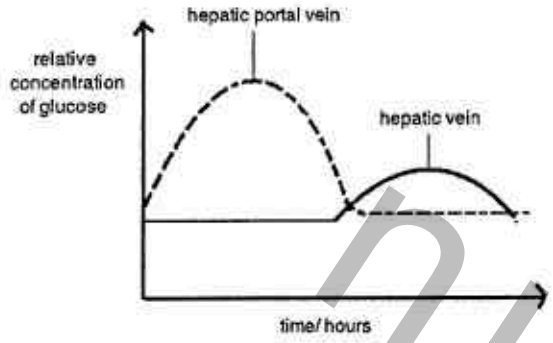


Fig.1

(a) Suggest a reason and explain what could have led to the rise in the concentration of glucose in the hepatic portal vein.

.....

.....

[1]

(b) With reference to part **(a)** above, explain why there was no similar rise in the concentration of glucose in the hepatic vein.

.....

.....

.....

.....

[3]

(c) With reference to **Fig.1**, explain the rise in concentration of glucose in the hepatic vein in the later hours.

.....

.....

[1]

[Total: 5]

2. **Table 2** shows the clearance time of some substances for a patient undergoing kidney dialysis.

Table 2

Substance in blood	Units	Concentration in blood		
		Time = 0 h	Time = 0.5 h	Time = 6 h
Urea	mg/l	176	144	126
Creatinine	mg/l	3.4	2.7	2.5
Glucose	mg/l	134	128	138
Potassium	mg/l	4.3	4.1	4.1
Sodium	mg/l	143	137	135
Chloride	mg/l	108		107

(a) Complete **Table 2** to show the estimated concentration of chloride at time = 0.5 h. [1]

(b) Calculate the average hourly rate at which urea is removed from the blood of the kidney dialysis patient.
Show your working.

Average hourly rate = ...[2]

(c) Explain the results when t = 6 h for potassium.

.....

.....

.....

[2]

(d) The table did not show the concentration of proteins in blood. Predict how the trend of proteins would look like between t = 0 h to t = 6 h. Give a reason for your answer.

.....

.....

[1]

(e) During each treatment, a patient has to undergo dialysis for a few hours. Suggest one way the time can be shortened. Explain your answer.

.....

.....

.....

[2]

[Total: 8]

3. When looking at objects far away, people who are suffering from myopia (short-sightedness) will register a blurred image.

(a) On **Fig. 3(a)**, draw a simple ray diagram to show how light from an object 10 metres away falls on the retina of a person suffering from myopia.

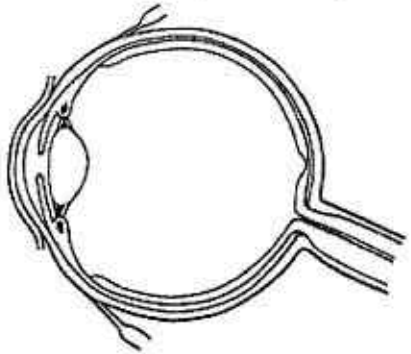


Fig. 3(a)

[2]

(b) Contact lenses are commonly used to improve vision for patients who are suffering from myopia. On **Fig.3(b)**,

(i) draw a simple contact lens at the correct position of the eye and

(ii) draw another ray diagram to show how the same object forms a sharp image with the aid of the contact lens.

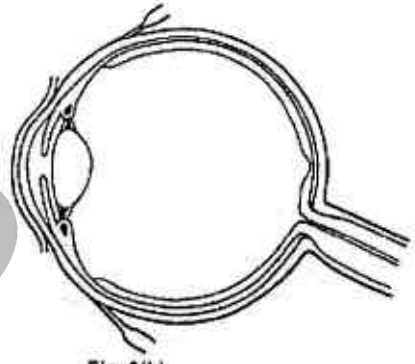


Fig. 3(b)

[2]

(c) Proper cleansing of the lenses have to be done regularly to ensure that dirt and protein build up is prevented. When excess dirt and protein is built up in the lenses, the user might feel extreme pain and irritation in the eyes.

(i) Describe how the brain senses the pain and irritation caused by dirt and protein build up.

.....

.....

.....

.....

(ii) To ease the pain, one can wash the contact lens with cleansing solution. Suggest and explain one possible ingredient of contact lens cleansing solution.

.....

.....

[4]

(d) The cornea is not supplied with blood vessels. When contact lenses are worn continuously for many hours, cells of the cornea become damaged.

Suggest and explain why.

.....

.....

.....

.....

[3]

[Total: 11]

4. **Figure 4a** shows a diagram of a developing mammalian fetus and part of the uterus wall.

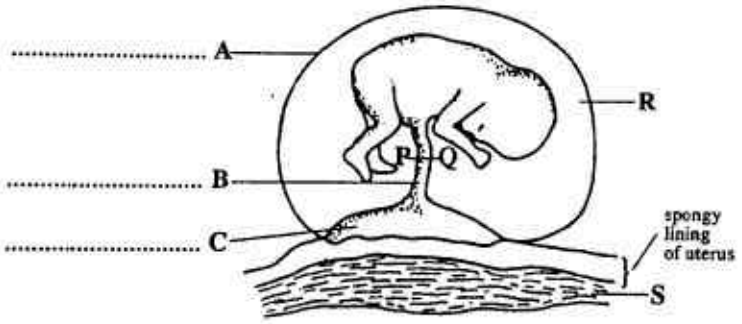


Figure 4a

(a) On the diagram, label structures **A**, **B** and **C**. [3]

(b) State one function of **R** during pregnancy.

.....

.....

[1]

(c) State another function of structure **C** other than exchange of substances between the maternal blood and the fetal blood.

.....

.....

[1]

Figure 4b shows a section through structure **B** taken at **P – Q**.

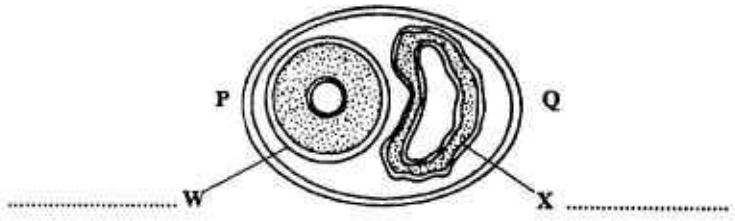


Figure 4b

(d) On the diagram, label **W** and **X**. [1]

(e) Complete the table to describe how vessels **W** and **X** are involved in the nutrition, excretion and gas exchange of the fetus. You should leave the cell blank if the vessel does not play any role in any of the functions.

	Vessel **W**	Vessel **X**
Nutrition		
Excretion		
Gas exchange		

[3]

[Total: 9]

5. **Fig. 5** shows the inheritance of coat colour in a family of rats. Coat colour is determined by 2 alleles. The allele that codes for black coat, represented by **B**, is completely dominant over the allele that codes for white coat, represented by **b**.

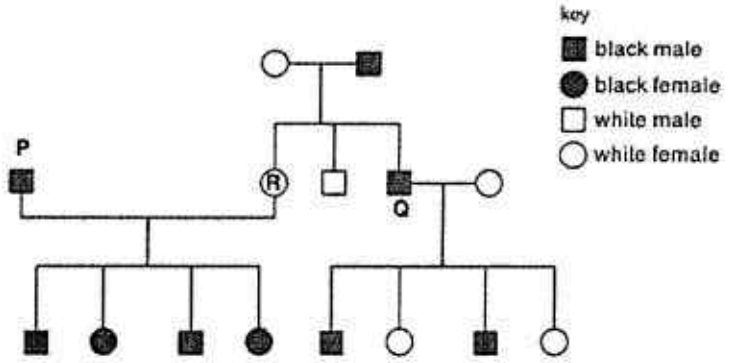


Fig. 5

(a) (i) Determine the genotype of rat **Q**.

.....

(ii) Explain your answer.

.....

.....

.....

.....

[3]

(b) (i) Using a genetic diagram, predict the phenotypic ratio of the offspring of **P** and **R**, if **P** was heterozygous.

(ii) Give one possible reason for the difference in the observed ratio in **Fig. 5** to the expected ratio predicted by the genetic diagram.

.....

.....

(iii) Calculate the probability of an offspring from the above cross being a female black rat.

.....

[6]

[Total: 9]

6. **Figure 6** shows part of a food web that is found in the ocean.

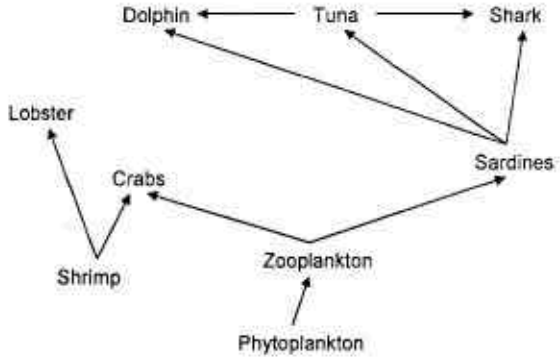


Figure 6

(a) Name the top predator(s) in this food web.

.....

[1]

(b) In the space below, sketch a pyramid of biomass of a food chain that involves 4 trophic levels.

[1]

(c) Shrimps are not producers in this food web. Suggest how they obtain their need for energy and nutrients.

.....

.....

[1]

(d) Lobsters were over-hunted by fishermen. Based on the food web, there should be less sardines. However, the population of sardines was not affected. Suggest a reason for this.

.....

.....

[1]

(e) Describe how the ocean acts as a carbon sink.

.....

.....

.....

.....

[3]

(f) Recent studies have suggested that sharks act as carbon sink. Suggest a reason for this conclusion.

.....

.....

[1]

[Total: 8]

SECTION B (30 marks)
Answer **three** questions.

Question 9 is in the form of an **Either/Or** question. Only one part should be answered.

7 **Figure 7** shows an experimental set-up where a cut leafy shoot was placed in a boiling tube of water and a layer of paraffin oil was added on the water surface.

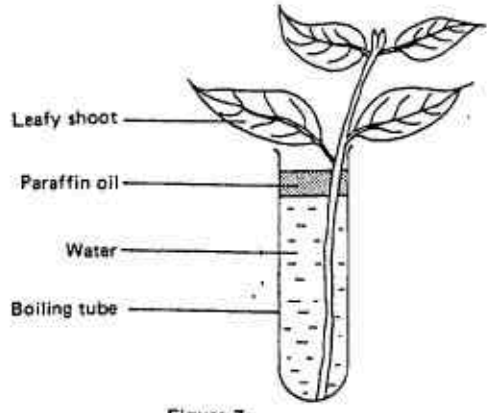


Figure 7

The whole set-up (**A**) was weighed and left to stand in a windy place. The set-up was re-weighed every 4 hours thereafter over a 24 hour period.

Another 3 similar set-ups (**B** to **D**) was prepared by using leafy shoots of similar size and same number of leaves as that of set-up **A**. However, the leaves were treated differently. The following results were obtained.

Set-up	Treatment on leaves	Weight of set-ups (g)						
		0 hr	4 hr	8 hr	12 hr	16 hr	20 hr	24 hr
A	No treatment	60	56	52	48	44	40	36
B	Upper leaf surface smeared with Vaseline	62	60	58	56	54	52	50
C	Lower leaf surface smeared with Vaseline	62	61	60	59	58	57	56
D	Both leaf surfaces smeared with Vaseline	64	64	64	64	64	64	64

(a) State the purpose of smearing the leaf surfaces with Vaseline.

.....

.....

[1]

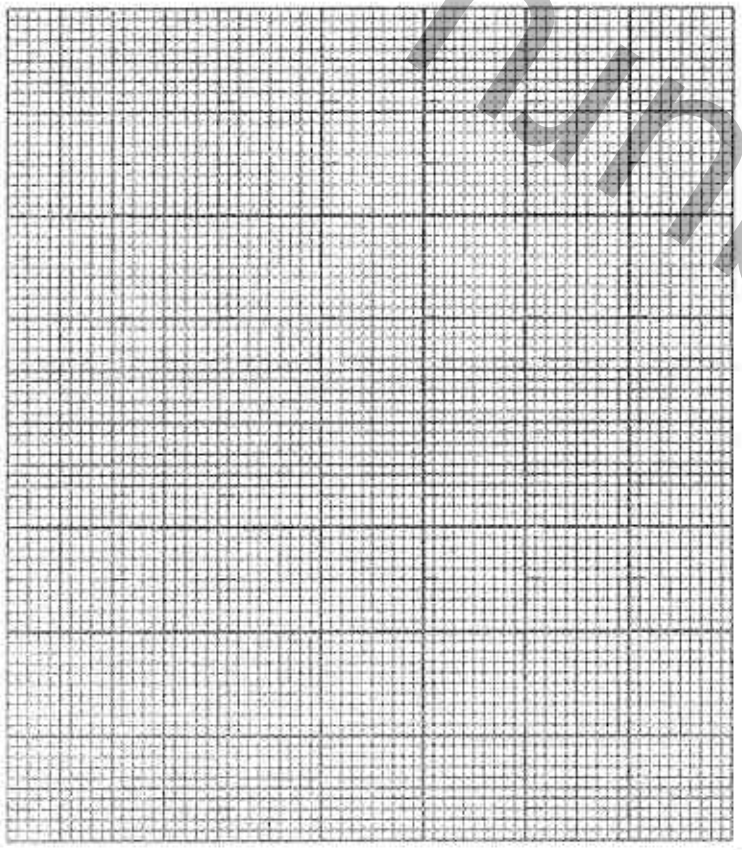
(b) Name and define the biological process demonstrated by this experiment.

.....

.....

[1]

(c) In the grid below, plot all four graphs on the same axes to show the weight of set-ups **A – D** over time.



[4]

(d) Explain the results for set-ups **A** and **D**.

.....

.....

.....

.....

.....

[2]

(e) What conclusion can be drawn from the set-ups **B** and **C**? Explain your answer.

.....

.....

.....

.....

[2]

(f) Predict the appearance of the curves if the experiment was conducted inside a cupboard. Explain your answer.

.....

.....

.....

.....

[2]

[Total: 12]

8. (a) Define *hormone*.

.....

.....

.....

.....

[3]

(b) Describe how blood glucose is regulated in a healthy person.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[5]

[Total: 8]

9 Either

(a) Describe how carbon dioxide is transported from the tissues to the lungs.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[6]

(b) State the characteristics of, and describe the role of, the gas exchange surface in humans.

[4]

[Total: 10]

9 Or

(a) Describe with examples, the differences between continuous variation and discontinuous variation.

[4]

(b) Explain how one species may evolve to form two distinct species.

[6]

[Total: 10]

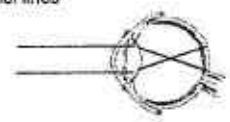
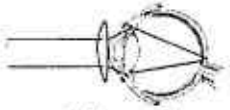
End of Paper

ACS

Answers Biology Preliminary Examination 2015

1. D
2. A
3. A
4. A
5. C
6. D
7. B
8. D
9. B
10. B
11. B
12. B
13. C
14. C
15. A
16. B
17. C
18. A
19. A
20. A
21. D
22. D
23. C
24. C
25. A
26. C
27. D
28. C
29. C
30. B
31. A
32. B
33. B
34. B
35. D
36. B
37. A
38. B
39. B
40. D

Q1a	Person could have just eaten a meal high in carbohydrates, so glucose was absorbed in the small intestine and transported away by the hepatic portal vein.	1m
Q1b	The hepatic portal vein leads to the liver,	1m
	where excess glucose is converted into glycogen for storage.	1m
	After blood has been processed by the liver, it is transported to the heart by the hepatic vein, hence blood there contains less glucose and hence no similar rise in the concentration of glucose.	1m
Q1c	At a later time, the rest of the glucose that has not been converted to glycogen will leave the liver and enter the hepatic vein to cause concentration of glucose to rise. Or At a later time, blood glucose in the body decreases, causing glycogen to be converted to glucose and released from the liver to the rest of the body via the hepatic vein.	1m

Q2a	Accept 107 to 108	1m
Q2b	Rate = 50/6 = 8.33	1m
	Correct units = mg/dl h^{-1}	1m
Q2c	The bath fluid contains the same concentration of mineral salts	1m
	No net movement of these substances	1m
Q2d	Trend should show a straight horizontal line/constant Proteins are too large to pass through the tubing, hence no change in concentration	1m
Q2e	Increase the number of coils of cellophane tubing	1m
	Larger surface area to speed up diffusion of urea	1m
Q3a (Not in syllabus)	-parallel lines - light rays merge before retina 	1m
Q3b (Not in syllabus)	 - contact lens outside cornea - line rays refracted outwards by lens and focuses onto retina	

Q3ci	The presence of dirt particles causes impulses to be sent by the receptors in the eye,	1m
	These impulses travel along the sensory neurone,	1m
	through relay/intermediate neurones	1m
	and finally to the brain and pain is sensed.	1m max 3
Q3cii	Protease to break down the proteins/ isotonic salt solution to wash away the dirt or build up of foreign particles. (similar to tear contents)	1m
Q3d	Contact lenses block of oxygen molecule from reaching and diffusing into the cells of the cornea,	1m
	This leads to decreased respiration	1m
	And lack of energy	1m
	~~Bacteria buildup in between the cornea and lens could also damage the eye~~	1m max 3m
Q4a	A: Amnion/ Amniotic sac B: Umbilical cord C: Placenta	1m 1m 1m
Q4b	R is the amniotic fluid that protects the fetus against mechanical injury as it cannot be compressed	1m
	Supports and cushions the fetus	1m
	Acts as a shock absorber	1m
	Buoys up the embryo to allow it to move freely	1m Any one
Q4c	Produces hormones (oestrogen and progesterone)	1m
Q4d	W: umbilical artery X: umbilical vein	1m

Q4e		Vessel W X	Vessel X W	
	Nutrition	Transports dissolved food substances such as glucose from placenta to fetus		1m
	Excretion		Carries metabolic waste such as urea from fetus' blood to placenta	1m
	Gaseous exchange	Transport oxygen from the mother's blood to the fetus' blood	Transport carbon dioxide from the fetus' blood to the placenta	1m
Q5ai	Bb /heterozygous			1m
Q5aii	Q has a **white coat parent,** which must have the genotype **bb**, thus Q must inherit **one allele of b**. or Q produced **white coat offspring** which must have the genotype **bb**, which must have **inherited one allele b from Q**			1m
	Q must also have the dominant allele B since it is black in colour or something like this was accepted : the black male must be genotype Bb or BB.			1m

Q5b	Parental phenotypes: Black coat x White coat Parental genotypes: **Bb** x **bb** Gametes: **B** **b** **b** **b** Fertilisation Offspring genotypes: **Bb** **Bb** **bb** **bb** Offspring phenotypes: Black coat, White coat Phenotypic ratio: 1 Black coat : 1 White coat	4m
Q5b(ii)	The phenotypic ratio derived from the genetic diagram is a **theoretical** ratio based on a mathematical model but fertilization is a random process affected by chance. Or Sample size too small	1m

Q5b(iii)	0.5 *0.5 = 0.25	
Q6a	Dolphins and sharks	1m
Q6b	Correct labels for tropic levels of phytoplankton, zooplankton, sardines and tuna + correct shape (pyramid with a slightly smaller base)	1m
Q6c	They scavenge/feed on decaying matters	1m
Q6d	Crabs feed on the surface of the seabed while sardines feed in the waters, so there is no direct competition for zooplankton. OR High replacement rate/reproduction rate of zooplankton, so competition for food is not an issue	1m
Q6e	Oceans store carbon for an indefinite period.	1m
	Carbon dioxide dissolves in sea water.	1m
	Carbon dioxide used by aquatic plants, algae, corals and phytoplankton in photosynthesis.	1m
	Carbon compounds buried in sea bed in the form of fossil fuels like oil and natural gas	1m
		Max of 3
Q6ef	Sharks store huge amounts of carbon in their bodies. When they die, they sink to the bottom of the ocean and are consumed by scavengers.	1m
Q7a	Prevents loss of water from the leaves	1m
Q7b	Transpiration. Transpiration is the loss of water vapour from the aerial parts of the plant.	1m
Q7c	Scale (> half the page)	1m
	Axes with correct units	1m
	Plots and each graph labelled correctly	1m
	Lines of best fit	1m
Q7d	Set-up A has the greatest drop from 60 g to 36 g as transpiration took place at both upper and lower leaf surfaces	1m
	Set-up D did not lose any mass and maintained at a mass of 64 g as water vapour cannot escape from the leaf surfaces as they are completely sealed by Vaseline	1m
Q7e	Lower surface loses more water than upper surface as the drop in weight in set-up B is greater (12 g) than in set-up C (6 g)	1m
	Lower surface has more stomata/thinner cuticle/no stomatal hair (any one)	1m
Q7f	Curves A, B and C will rise to be almost parallel with curve D.	1m
	In darkness, stomata closes as photosynthesis does not take place, hence no transpiration occurs which result in minimal water loss.	1m
Q8a	A hormone is a chemical substance that is produced in minute quantities by an endocrine gland.	1m
	It is transported via the blood stream,	1m
	to target organ where it exerts its effects	1m
Q8b	When blood glucose concentration is too high, it is detected by the islets of Langerhans of the pancreas,	1m
	causing it to release insulin into the blood stream	1m
	to convert excess glucose into glycogen	1m
	to be stored in the liver.	1m
	When blood glucose is too low, it is detected by the islets of Langerhans of the pancreas, causing it to release glucagon into the blood stream	1m
	to increase the conversion of glycogen into glucose.	1m
Q9Ea	As tissue cells respire, carbon dioxide is evolved. Carbon dioxide diffuses into the blood and into the red blood cells due to the presence of a concentration gradient.	1m
	Carbon dioxide dissolves in the water in the red blood cells to form carbonic acid, and then dissociates to hydrogencarbonate/ bicarbonate ions	1m
	This is catalyzed by the enzyme carbonic anhydrase.	1m
	Most of the hydrogencarbonate/ bicarbonate ions will diffuse back into the plasma	1m

	and carried to the lungs	
	Carbonic anhydrase will catalyze the backward reaction and hydrogencarbonate/ bicarbonate ions are converted to water and carbon dioxide in the red blood cells	1m
	Carbon dioxide will diffuse out of the blood into the alveoli to be exhaled out to the external environment.	1m
	$H_2O + CO_2 \Leftrightarrow H_2CO_3 \Leftrightarrow H^+ + HCO_3^-$	1m
		Max of 6
Q9Eb	The alveolar walls are one-cell thick to allow gases to diffuse across them quickly	1m
	Numerous capillaries are closely wrapped around outside of the alveoli/Close to an efficient transport system to facilitate gaseous exchange of oxygen and carbon dioxide	1m
	They are kept moist to stop the cells from drying up and to facilitate diffusion of gases	1m
	There are numerous alveoli to provide a large surface area for a lot of oxygen to diffuse across at the same time	1m
9Oa		1m for each pt.

Discontinuous Variation	Continuous Variation
Brought about by one or only a few genes	Brought about by the combined effects of many genes
Expression of the phenotype is distinct, with no intermediates formed	Expressions of the phenotype is over a spectrum, from one end to the other end, with intermediates present
Not affected by changes in the environment	Affected by changes in the environment
Genes do not show additive effect	Genes show additive effect

	ABO blood group in man and ability to roll tongue (accept any other correct answer)	Height, weight, skin colour(accept any other answer)	
9Ob	Genetic variation causes phenotypes of individuals to be different.		1m
	Some allele combinations are better suited to live in environment.		1m
	Higher success for these individuals in reproduction.		1m
	Gives an example of an environmental factor that acts as a force for natural selection		1m
	States that natural selection will select individuals with the best combination of genes.		1m
	States that overtime, overall phenotype for groups can be very different, leading to them not being able to reproduce with each other.		1m
	Example of answer: Variation results in individuals displaying a wide range of phenotypes in a population, these individuals therefore do not have equal chances of survival in their environment. Some individuals possess allele combinations that make them more suited to live in their environment. These individuals hence are more successful in reproduction, passing on their successful alleles to offspring. Sometimes, a single species separates into groups that occupy different niches in the same environment. This means that each group is subjected to different prey, different predators, etc.		

	Different set of alleles would be successful under differing conditions and natural selection would select for individuals with the best phenotype for a particular environment. Overtime, the overall phenotype of one group would become very different from another. Their genetic information might differ so much so that they cannot reproduce with each other, forming two separate species.	

ZHONGHUA SECONDARY SCHOOL
Preliminary Examination 2015

CANDIDATE NAME ( )

CLASS

BIOLOGY **5158/01**

Paper 1 Multiple Choice **16 September, 2015**

Secondary 4 Express **1 hr**

Set by: **Ms Rozianna / Mr Tan Li Chun**

Vetted by: **Mr Desmond Chong**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, index number and class on the OTAS Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer all questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the one you consider correct and record your choice in soft pencil on the separate OTAS Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

This document consists of **20** printed pages, including this cover page.

1 Which statement best describes the features of a root hair cell that aids in its function?

A It has many mitochondria to aid in active transport of water across the plasma membrane.

B It has chlorophyll to aid in release of energy for active transport of materials across the plasma membrane.

C It has a long projection to allow a larger surface area to volume ratio for exchange of materials.

D It has a selective permeable cell wall to maintain a concentration gradient.

2 A cell is found to contain a large amount of smooth endoplasmic reticulum. What is the cell producing in large amount?

A lipids

B proteins

C enzymes

D carbohydrates

3 Which option is an example of active transport?

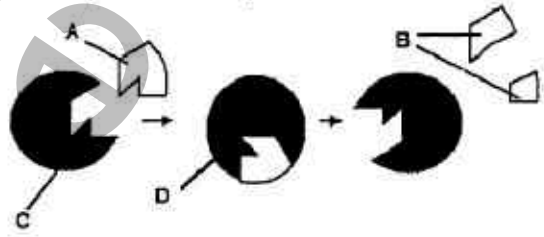
A movement of carbon dioxide into the mesophyll layers in the leaves of plants

B movement of glucose during absorption at villi of the intestine

C movement of ions in the xylem

D movement of water into root hair cells

5 The diagram shows the process of an enzymatic reaction.



Which structure (**A**, **B**, **C** or **D**) is an enzyme?

6 A detergent company claims that its new range of clothes detergent is cost saving. The following are some of its claims.

- More effective at lower temperature
- Less detergent needed
- More effective against grease stains

Among the new ingredients added is the introduction of a lipase and an emulsifier into the formulation.

Which option best describes the function of the lipase and emulsifier?

	lipase	emulsifier
A	faster digestion of fats at lower temperature; recycled at the end of reaction	dispersion of fats to increase its surface area
B	activation energy is raised so that the lipase and fats can collide with each other frequently	faster digestion of fats at lower temperature
C	dispersion of fats to increase its surface area	faster digestion of fats at lower temperature; recycled at the end of reaction
D	faster digestion of fats at lower temperature, destroyed at the end of reaction	dispersion of fats to increase its surface area

7 Which of the following is least likely to increase rate of transpiration in a plant?

A increase air movement

B increase sunlight intensity

C increase temperature

D increase humidity

8 A study was done to study the density of stomata on the upper and lower surfaces of various plants from different environments. The results of the study are shown below.

plant species	stomata intensities / mm^{-2}	
	upper surface of leaf	lower surface of leaf
X	34	5
Y	14	18
Z	14	32

Which of the following best identifies the environment that plant X, Y and Z originates from?

	X	Y	Z
A	floating aquatic environment	desert environment	rainforest
B	floating aquatic environment	rainforest	desert environment
C	rainforest	floating aquatic environment	desert environment
D	desert environment	rainforest	floating aquatic environment

9 An hour before his regular evening run Dave decided to consume a fully ripe banana which contains a high content of starch and simple sugars. Which statement best explains why Dave does so?

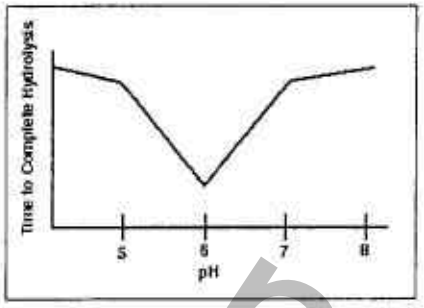
A The rapid absorption of starch and simple sugars allows for energy needs to be met rapidly.

B The slow absorption of starch and simple sugars allows for continual supply of source of energy during the run.

C Digestion of simple sugars allows slow absorption of the simple sugars to provide energy during the run while direct absorption of starch provides an immediate source of energy.

D Digestion of starch allows slow absorption of glucose to provide energy during the run while direct absorption of simple sugars provides an immediate source of energy.

10 The graph shows the relative time taken for enzyme X to complete hydrolysis of a specific substrate.



What could enzyme X be?

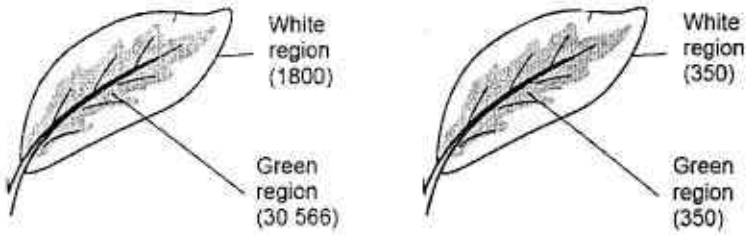
A trypsin

B salivary amylase

C pepsin

D pancreatic lipase

11 A plant with variegated leaves was exposed to radioactive carbon dioxide ($^{14}CO_2$). Leaf **O** is exposed to light and leaf **P** is kept in the dark. At the end of the experiments, radioactivity of the leaves tissues were measured (in arbitary units) and the results were shown below.



Which statement best explains the results observed at the white region of the leaf **O**?

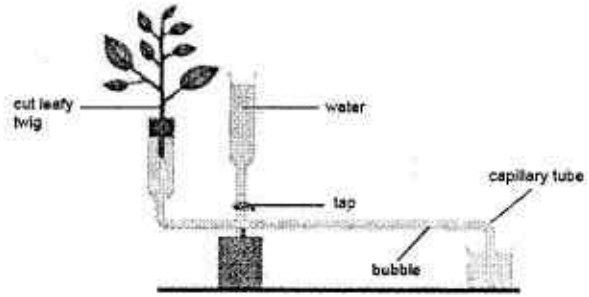
A Photosynthesis occurs slowly in the white region due to the absence of chlorophyll.

B Products of photosynthesis diffuse from the green region to the white region.

C Photosynthesis occurs rapidly in the white region causing the radioactivity to rise.

D Radioactive carbon dioxide diffuses and accumulates in the white region of the leaf.

12 The diagram shows a potometer.



Which conditions will show the fastest movement of the bubble in the capillary tube?

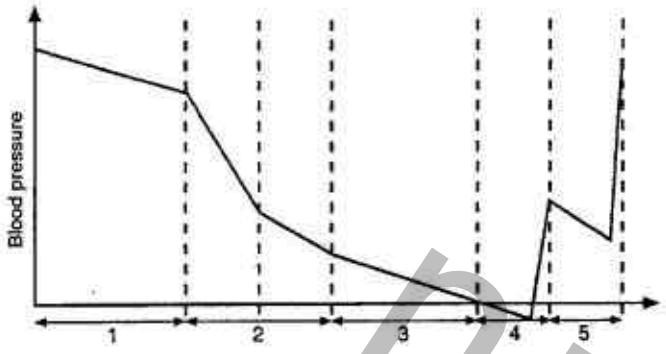
A low light intensity, still air, high humidity

B high light intensity, still air, low humidity

C high light intensity, windy, low humidity

D low light intensity, still air, low humidity

13 The graph shows the blood pressure in various blood vessels in the human circulatory system.



Which option correctly identifies the blood vessels?

	1	2	3	4	5
A	arteries	capillaries	veins	vena cava	pulmonary artery
B	arteries	pulmonary artery	capillaries	veins	vena cava
C	arteries	pulmonary artery	vena cava	capillaries	veins
D	arteries	vena cava	pulmonary artery	veins	capillaries

14 Which valve opens when the heart chamber that produces the highest blood pressure contracts?

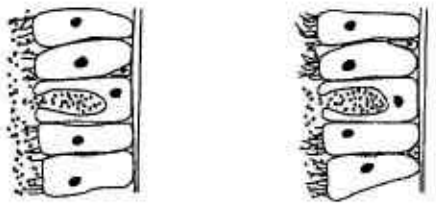
A the right atrioventricular valve

B the left atrioventricular valve

C the pulmonary semi-lunar valve

D the aortic semi-lunar valve

15 The diagram shows the bronchus lining of a smoker and non-smoker.



smoker non-smoker

Why is it harder for the smoker to remove mucus from his respiratory tract?

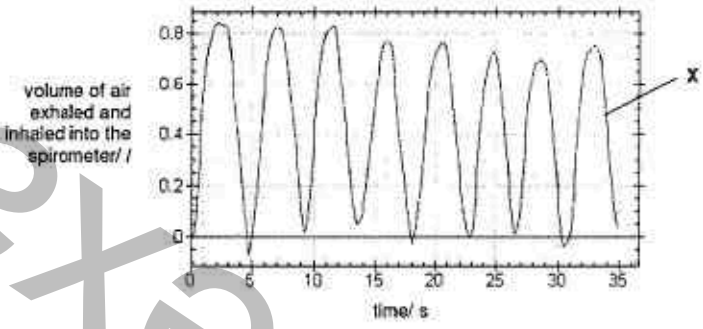
A The non-smoker produces more mucus than the smoker.

B The non-smoker has a lot more epithelial cells than the smoker.

C A significant number of cilia are damaged in the smoker's epithelial cells.

D The smoker's epithelial cells have burst.

16 The diagram shows the results of an experiment of a man's inhalation and exhalation of a spirometer. A spirometer measures the volume of air moving into and out of the spirometer during inhalation and exhalation.



What is happening to the diaphragm and external intercostal muscles at point X?

A Both the diaphragm and external intercostal muscles are contracting.

B Both the diaphragm and external intercostal muscles are relaxing.

C The diaphragm is relaxing and external intercostal muscles are contracting.

D The diaphragm is contracting and external intercostal muscles are relaxing.

17 The table shows substances moving between tissues and their surrounding capillaries.

substance	into the capillaries from the tissues	out of the capillaries into the tissues
oxygen		✓
carbon dioxide	✓	
amino acids		✓
urea	✓	

key
✓ = does pass

Which of the following part of the body does these tissues belong to?

A alveolus

B ileum

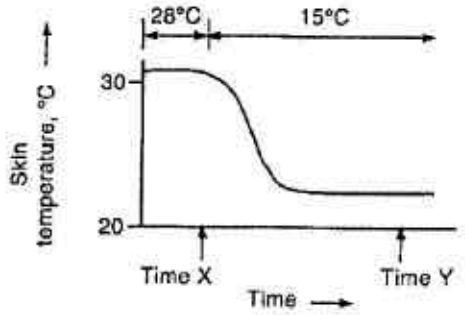
C kidney

D liver

18 In an experiment, the relative concentration of various substances in urine and renal vein is measured. Which option shows the correct results?

	urine		blood in renal vein	
	urea	glucose	urea	glucose
A	high	low	low	high
B	high	high	high	high
C	low	low	low	high
D	low	high	high	low

19 The graph shows John walking from a place of 28°C to a place of 15°C.



Which statement is incorrect?

A The core body temperature will be the same as the skin temperature at time Y.

B The metabolism rate of John starts to increases at time X.

C John experiences pale skin at time Y.

D Shivering occurs at time Y.

20 Which statement best describes a negative feedback?

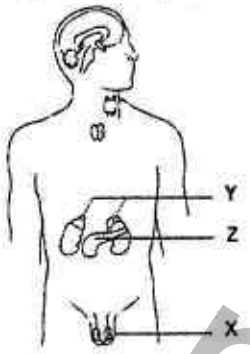
A It always causes a further increase the change in body parameter.

B It always causes a further decrease the change in body parameter.

C It always maintains the change in body parameter.

D It always revert the change in body parameter back to normal level.

21 The diagram shows some of the major endocrine glands in a human male.



Which endocrine organ(s) secrete(s) hormone that affects blood glucose concentration?

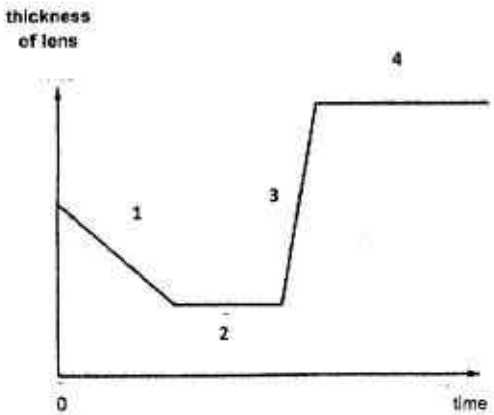
A Z only

B X and Y only

C X and Z only

D Y and Z only

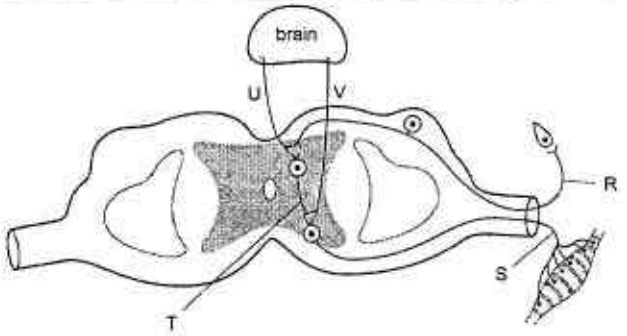
22 The graph shows the changes in the thickness of the lens when a man looked at an object which remained stationary, moved towards or away from him.



in which stage was the object moving away from the observer?

A 1 B 2 C 3 D 4

23 The diagram shows possible routes for transmission of nerve impulses.



What is the route taken by an impulse during a spinal reflex action?

A U → R

B V → S

C S → T → R

D R → T → S

24 Which statement about the sperm is incorrect?

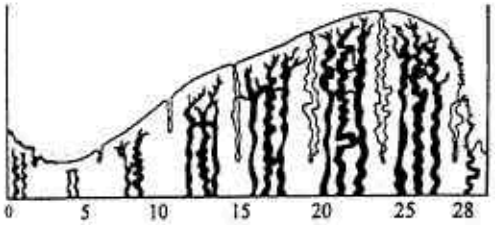
A Energy to move the flagellum originates in the middle piece.

B The cell can unite with an ovum resulting in the production of a new organism.

C The acrosome contains half the normal number of chromosomes.

D The head may contain mutated genes.

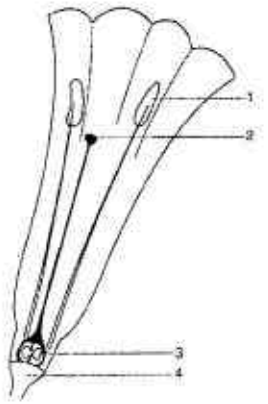
25 The diagram shows the variation in thickness of the endometrium throughout a menstrual cycle of a healthy female.



Which stage of the menstrual cycle would the levels of oestrogen and progesterone surge?

	surge in oestrogen	surge in progesterone
A	days 1 to 5	days 15 to 20
B	days 5 to 10	days 1 to 5
C	days 5 to 15	days 15 to 25
D	days 15 to 25	days 5 to 15

26 The diagram shows a section through a flower.

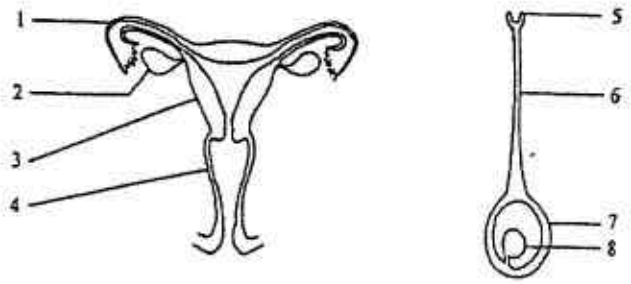


In which structures are haploid nuclei formed?

A 1 and 2 B 1 and 3

C 2 and 3 D 2 and 4

27 The diagram shows the human female reproductive system and the carpel of a flower.

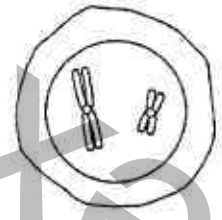


Which option shows the correct matching of the labelled structures?

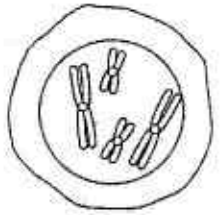
	structures	function
A	1 and 8	site of fertilization
B	2 and 7	site where offspring is formed
C	3 and 7	supply of food and oxygen to the embryo
D	4 and 5	protection of male gamete

28 A cell containing two sets of chromosomes divides by meiosis. Which diagram shows prophase II?

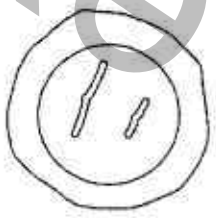
A



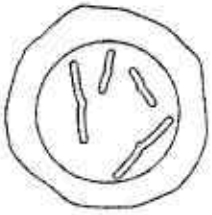
B



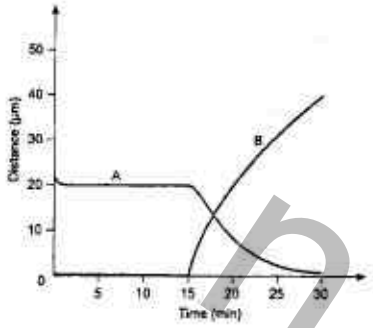
C



D



29 The graph illustrates the movement of a chromatid within a cell during mitosis. Curve A shows the distance between the centromere of a chromatid and the pole that it was approaching. Curve B shows the distance between the centromeres of this chromatid and its sister chromatid. On the time scale, zero (0) marks the beginning of the time when the chromosomes of the cell line up at the equator.



At what time will anaphase begin?

A 1 min

B 15 min

C 17 min

D 20 min

30 The following list gives some features of the processes of artificial selection and genetic engineering.

I The organism's genotype is altered.
II The new variety can make a substance previously only made by a different species.
III The process involves working with many generations of the organism over a long period of time.
IV The gene for the useful characteristic is transferred from one species to another.

Which of the above features refer to genetic engineering and artificial selection?

	genetic engineering	artificial selection
A	I, II and IV	III
B	I, III and IV	I and II
C	II and IV	II and III
D	I, II, III and IV	I, II and III

31 Five different amino acids (numbered 1 to 5) form the following sequence in part of a polypeptide chain.

1 → 2 → 3 → 4 → 2 → 5 → 3

This is the list of messenger RNA codons with their corresponding amino acids.

amino acid 1	UGU	amino acid 4	UAG
amino acid 2	GAU	amino acid 5	AAG
amino acid 3	CAC		

Which one of the following DNA base sequences could provide the code for the given section of polypeptide?

A ACACTTGTGATGCTATTCGTG

B ACACUAGUGAUGCUAUUCGUG

C ACACTAGTGATGCTAAACGTG

D ACACTAGTGATCCTATTCGTG

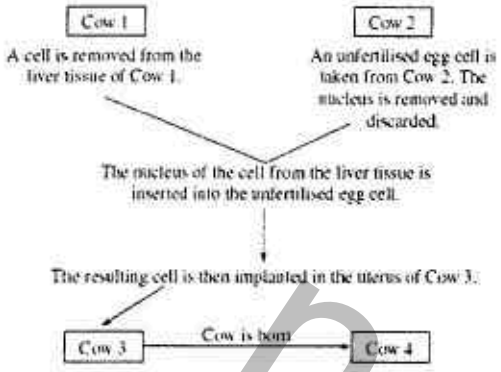
32 The table shows the results of mapping 100 nucleotides on a single strand of DNA.

nucleotide	quantity
adenine	22
cytosine	20
guanine	47
thymine	11

How many thymine nucleotides will there be on the strand of DNA that is complementary to this strand?

A 11 **B** 20 **C** 22 **D** 33

33 The diagram shows a scientific procedure carried out on cows.



Which cows are genetically identical?

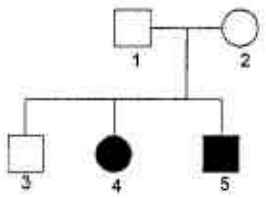
A cow 1 and cow 3

B cow 1 and cow 4

C cow 2 and cow 4

D cow 3 and cow 4

34 Hunter's deficiency is a rare autosomal recessive disorder presenting in infancy. 1 in 250,000 people is affected. A carrier is not affected and is observed to be normal. The pedigree diagram shows individual 4 affected with Hunter's deficiency at age of 6 months. Her newborn younger brother, 5, was also diagnosed with the same disease.



What is the probability of her 15 year old brother (number 3) of being a carrier?

A 1 in 2

B 1 in 3

C 1 in 4

D 2 in 3

35 The table shows the blood groups of 4 married couples.

name of couples	blood groups
Mr and Mrs Paulo	A and B
Mr and Mrs Rainer	AB and O
Mr and Mrs Kaur	B and B
Mr and Mrs Yung	O and O

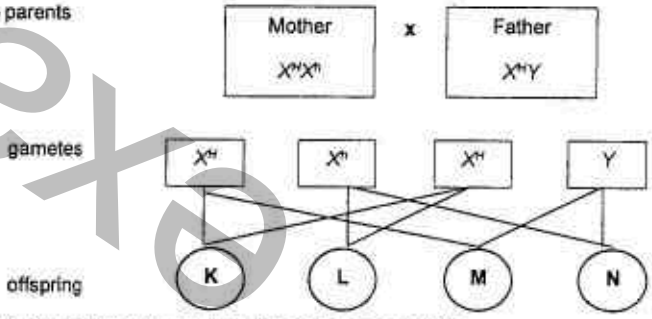
Each couple has a baby. One baby has type **AB** blood, one type **A**, one type **B** and one type **O**. Which couple are the parents of the baby with blood group **A**?

A Mr and Mrs Rainer
B Mr and Mrs Kaur
C Mr and Mrs Yung
D Mr and Mrs Paulo or Mr and Mrs Rainer

36 Which statement is true when a phenotypic ratio of 3:1 is observed?

A Two heterozygotes are mated and two co-dominant alleles are involved.
B Two heterozygotes are mated and two alleles, one completely dominant over the other, are involved.
C A homozygous recessive individual and a homozygous dominant individual are mated.
D Two homozygous dominant individuals are mated.

37 A woman who does not have haemophilia but is a carrier marries an unaffected male.

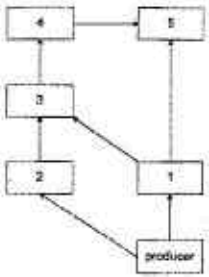


Which statements describe their children correctly?

I K is a normal female.
II L is a female haemophilia.
III M is a normal male.
IV N is a male with haemophilia.

A I and IV only.
B I, II and III only.
C I, III and IV only.
D I, II, III and IV

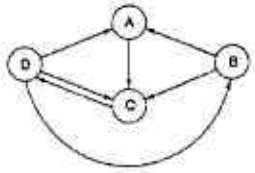
38 The diagram shows a food web.



Which organisms occupy the **same** trophic level?

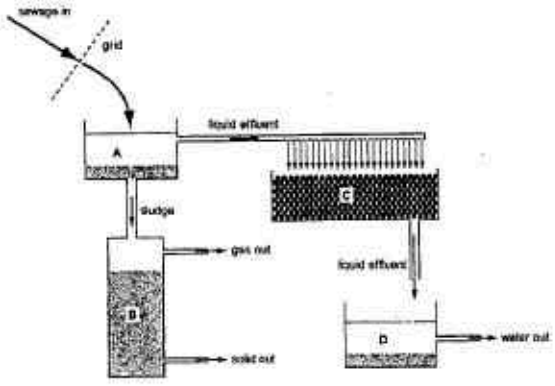
A 3 and 2
B 4 and 1
C 5 and 2
D 5 and 3

39 In the diagram below, arrows represent the movements of carbon compounds in the carbon cycle. The circles represent carbon compounds in animals, decomposers, plants and the atmosphere.



Which circle represents the producer?

40 The diagram shows a sewage treatment process. Which stage involves anaerobic bacteria?



End of Paper

ZHONGHUA SECONDARY SCHOOL
Preliminary Examination 2015

CANDIDATE NAME ( )

CLASS

BIOLOGY **5158/02**

Paper 2 Theory **26 August, 2015**

Secondary 4 Express **1 hr 45 minutes**

Set by: **Ms Rozianna / Mr Tan Li Chun**

Vetted by: **Mr Desmond Chong**

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces at the top of this page and on all separate answer paper used.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

The number of marks is given in brackets [ ] at the end of each question or part question.

All essential working must be shown clearly.

For Examiner's Use	
Section A	
B10	
B11	
B12 E / O	
Total	

This document consists of 18 printed pages, including this cover page.

Section A

Answer **all** the questions.

Write your answers in the spaces provided on the question paper.

62

1 Rapid absorption of nutrients occurs rapidly in the small intestine of the human alimentary canal.

(a) State the differences between active and diffusion.

[2]

(b) Describe how glucose is completely absorbed by the small intestine.

[3]

[Total: 5]

Total marks:

2 In an investigation, a cloudy, white gel containing lipid emulsion was prepared.

The gel was poured into Petri dishes and allowed to set.

Cavities were made in the gel and various liquids were poured into the cavities as shown in Fig. 2.1

- cavity 1 contain lipase
- cavity 2 contain lipase with diluted sodium hydroxide
- cavity 3 contain amylase
- cavity 4 contain pepsin

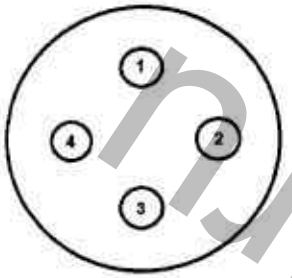


Fig 2.1

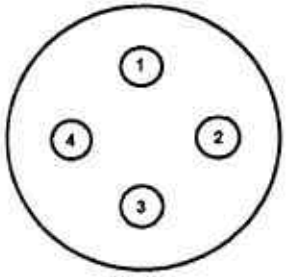


Fig 2.2

(a) After 24 hours, clear areas were observed around the cavities with enzymatic reactions. In Fig 2.2, draw the clear areas around the cavities. [2]

(b) Explain your answer for **2(a)**.

_____

_____

_____ [2]

[Total: 4]

Total marks:	

3 Fig 3.1 shows a desert bush that thrives in a warm dry climate. Branches B and C are of similar size and number of leaves, except that branch B is covered with a transparent bag with an opening to collect water lost through transpiration.

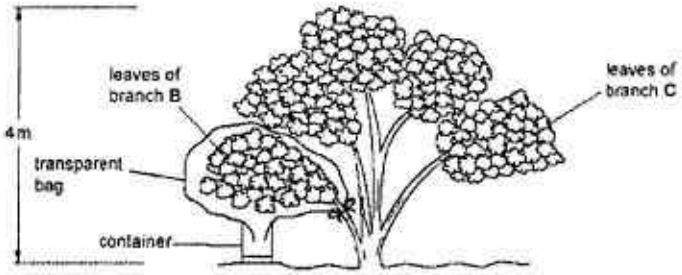


Fig. 3.1

(a) Using information from Fig. 3.1, state and explain the differences in transpiration rate of branch B and C during mid-day.

_____

_____

_____

_____

_____

_____ [3]

(b) State and explain the difference in transpiration rate of branch B if the transparent bag is replaced with a black bag.

_____

_____

_____

_____

_____

_____ [3]

[Total: 6]

Total marks:	

4 Fig. 4.1 shows the changes in blood pressure during the cardiac cycle.

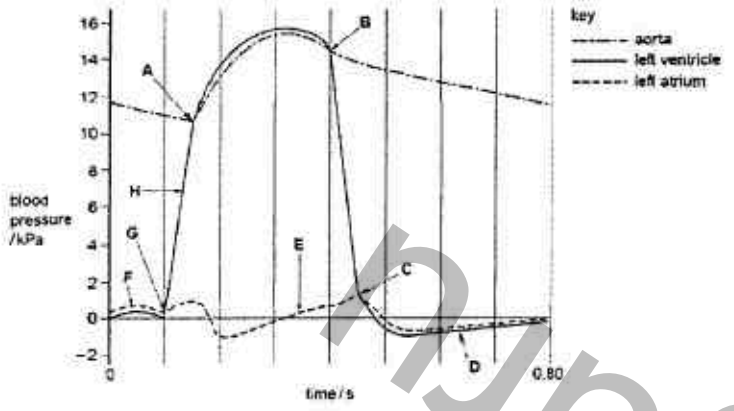


Fig. 4.1

(a) Using Fig. 4.1, identify at which point (**A**, **B**, **C**, **D**, **E**, **F**, **G**, or **H**) does

(i) the left atrioventricular valve closes .....

(ii) minimal blood left in the left ventricle .....

[2]

(b) Describe how carbonic anhydrase helps in transport of carbon dioxide in the human circulatory system.

[4]

[Total: 6]

Total marks:	

5 Fig. 5.1 shows a dialysis machine attached to the arm of a patient whose kidneys had stopped functioning.

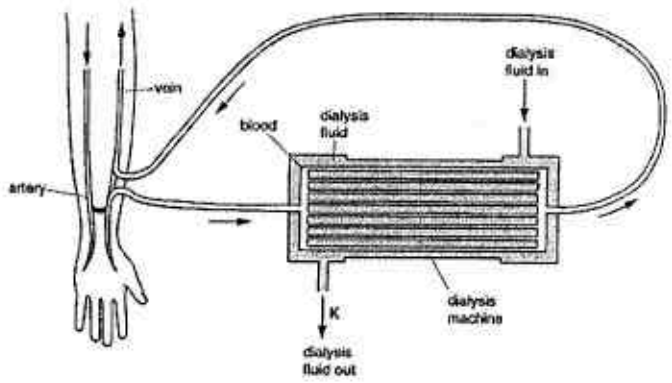


Fig. 5.1

(a) Name two substances that are removed via the dialysis fluid during dialysis.

[1]

(b) Explain why glucose concentration in the dialysis fluid is at the same level as a healthy individual.

[2]

(c) State which hormone is responsible to enhance the retention of water by the kidney.

[1]

[Total: 4]

Total marks:	

6 Fig. 6.1 shows the cross-section of the human eye and a camera.

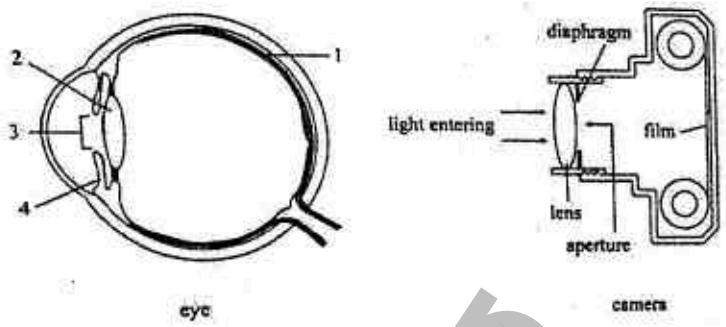


Fig. 6.1

(a) Which structure of the camera does structure 3 in the eye represent?

_____ [1]

(b) Describe how the image formed on the film in camera is similar to the image formed on structure 1.

_____

_____

_____ [2]

(c) "The camera is not an accurate representation of the human eye."

Based on your observation of the diagram, suggest **two** evidences that support the statement above.

_____

_____

_____

_____ [2]

[Total: 5]

Total marks:	

7 Meiosis occurs during the formation of gametes. Fig. 7.1 shows a pair of homologous chromosomes.

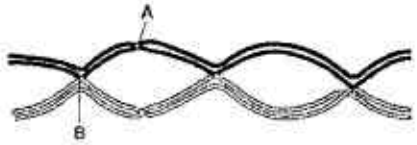


Fig. 7.1

(a) (i) Name structures A and B

_____ [1]

(ii) Explain why two sister chromatids are genetically identical before crossing over, while a pair of homologous chromosomes are not.

_____

_____

_____ [2]

(b) Changes in DNA amount and chromosome numbers were monitored during one cycle of meiosis. Fig. 7.2 shows the results of these processes.

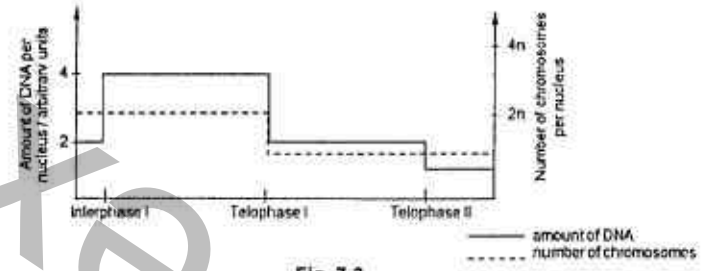


Fig. 7.2

Explain the changes in DNA amount and chromosome number during:

(i) interphase

_____

_____

_____ [2]

Total marks:	

(ii) telophase I

_____

_____

_____ [2]

(c) Explain why DNA amount and chromosome numbers remain constant during anaphase I and II in Fig. 7.2.

_____

_____

_____ [2]

[Total: 9]

8 The four o'clock plant, *Mirabilis jalapa*, can have flowers of three different colours shown in Fig. 8.1.

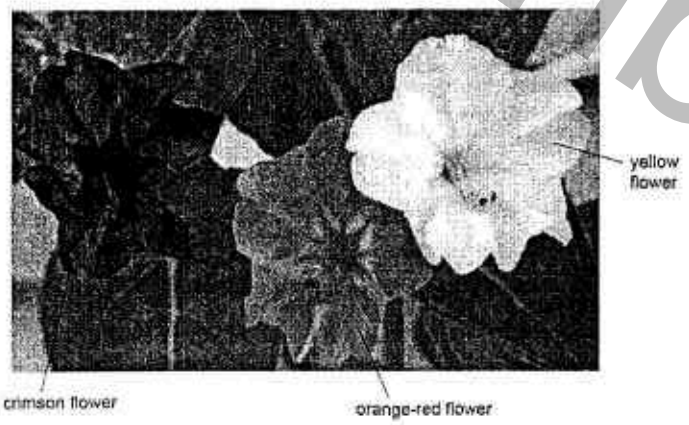


Fig. 8.1

Total marks:	

(a) In cross 1, student crossed some crimson-flowered plants with some yellow-flowered plants. She collected the seeds and all plants that grew from these seeds had orange-red flowers. Use a genetic diagram to explain the results of cross 1.

[3]

(b) The student then carried out two more crosses shown in Table 8.1.

Table 8.1

cross	genotypes of offspring
2 offspring of cross 1 x offspring of cross 1	
3 offspring of cross 1 x crimson-flowered plant	

Complete Table 8.1 by writing the genotypes of the offspring of crosses **2** and **3**, using the same symbols as in the genetic diagram in **8 (a)**.

You may use the space below for any working.

[2]

[Total: 5]

Total marks:	

9 Besides nutrients, other atmospheric elements may enter the ecosystem. Radioactive caesium-137 was released into the atmosphere by atomic bomb tests in 1961. The radioactive substance was deposited in the soil and on the plants. Fig. 9.1 shows the amount of radioactivity found in the tissues of lichens (an alga and fungus growing together), caribou (a member of the deer family) and the Inuit people in the Anaktuvuk Pass of Alaska.

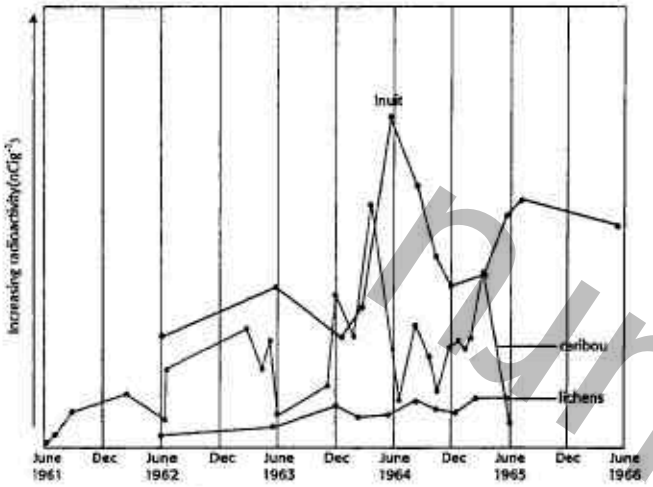


Fig. 9.1

(a) Describe the level of caesium-137 in the Inuit people from June 1962 to December 1964.

.....

.....

.....

[2]

(b) The three organisms form a food chain.

(i) Deduce the trophic level of the Inuit people.

.....

[1]

(ii) Explain your answer in (a)(i).

.....

.....

.....

.....

[3]

[Total: 6]

Total marks: [ ]

Total marks: [ ]

Section B

Answer all **three** questions, the last question is in the form **EITHER / OR**.
Write your answers in the spaces provided.

10 In an experiment, the rate of oxygen production of two different potted plants, **A** and **B** were measured at various light intensities. The conditions for both setup is similar. The results are shown in table 10.1.

Table 10.1

light intensity / arbitrary units	oxygen production / arbitrary units	
	plant **A**	plant **B**
0	0.0	0.0
10	1.2	1.8
20	3.0	3.5
30	4.5	4.5
40	5.5	4.9
50	6.0	5.0
60	5.8	4.9

(a) Plot the data for both plant **A** and plant **B** in the grid provided.

[4]

Total marks:	

(b) With reference to the data, compare and contrast the rate of oxygen production between plant **A** and **B**.

[3]

(c) Which of the potted plants will you choose as an indoor decorative plant? State your reason.

[2]

(d) State a possible limiting factor of photosynthesis for plant **B** at light intensity of 50 arbitrary units.

[1]

[Total: 10]

Total marks:	

11 **Fig. 11.1** shows a marine food web.

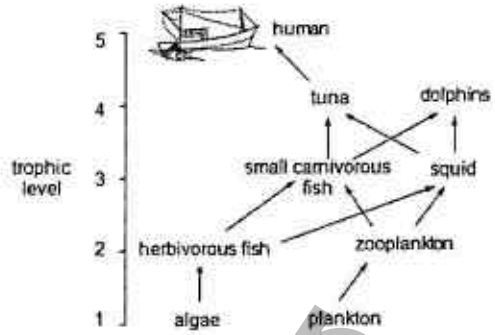


Fig. 11.1

(a) State the producers and describe their roles in the ecosystem.

[3]

(b) Toxic mercury compounds are sometimes dumped into the seas. With reference to Fig. 11.1, explain why the risk of mercury poisoning is much higher when people eat marine fish like tuna compared to smaller fish.

[4]

Total marks:

(c) Marine conservationists are concerned that fish stocks in the sea are decreasing. Describe two measures that can be taken to better manage the fishing grounds in order to ensure there is a sustainable supply of fish for human consumption.

[3]

[Total: 10]

12 EITHER

(a) Compare and contrast how the leaf of plants and the lung of the human respiratory system assist in function of gaseous exchange.

[6]

Total marks:

(b) With reference to oxygen demand and limitations, describe how aerobic and anaerobic respiration aids a runner to complete a 100m sprint.

[4]

[Total: 10]

12 OR

(a) Outline the process of pollination and state the two common vectors used.

[4]

Total marks:

(b) Sexual reproduction is important in plants and humans. In plants, it can occur via self-pollination or cross-pollination.

(i) Suggest which method is better during a period of drought and why.

[2]

(ii) Compare and contrast between a plant's and human's sexual reproduction process from the time after male gametes have been transferred to fertilisation.

[4]

[Total: 10]

Total marks:

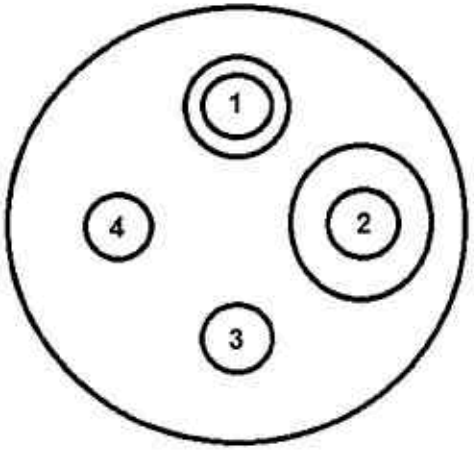
ZHONGHUA SECONDARY SCHOOL
2015 PRELIMINARY EXAMINATION [Answer Key]

4E
Biology

PAPER 1 [40 marks]

1.	C	6.	A	11.	B	16.	A	21.	D	26.	B	31.	D	36.	B
2.	A	7.	D	12.	C	17.	D	22.	A	27.	A	32.	C	37.	C
3.	B	8.	A	13.	A	18.	A	23.	D	28.	B	33.	B	38.	D
		9.	D	14.	D	19.	A	24.	C	29.	C	34.	A	39.	D
5.	C	10.	B	15.	C	20.	D	25.	C	30.	A	35.	A	40.	B

PAPER 2 Section A [50 marks]

Qn	Solutions	Marks
Q1A	Active transport requires energy while diffusion do not; Active transport moves particles against the concentration gradient while diffusion moves particles down the concentration gradient (AW)	1 1
Q1B	Combination of both diffusion and active transport to transport glucose; Diffusion takes place till blood glucose concentration in the capillaries is at equilibrium with concentration in small intestine; Active transport (alone) allows rest of glucose to be absorbed into the capillaries of the microvillus against the concentration gradient.	1 1 1
Q2a	 Circle around lipases 1 mark Larger circle around lipase with sodium hydroxide 1 mark	1 mark each

Q2b	Lipids are digested by lipase in fatty acids and glycerol therefore clear areas are around cavities with lipases Lipase optimal pH is alkaline therefore lipase with sodium hydroxide shows a larger clear area than lipase alone	1 1
Q3A	Branch C will have higher transpiration rate than B; C is exposed windy conditions whereas B has little air movement OR C is exposed to low humidity whereas B has exposed to high humidity in the plastic bag Water vapour concentration gradient between intercellular air space of the leaf and surrounding air is steeper at C than B. Rate of diffusion of water vapour is faster at C than B	1 1 1
Q3B	The rate of transpiration will decrease; Lack of sunlight in the black plastic bag results in photosynthesis to cease; Causing the stomata to become smaller/close as glucose/ potassium ions levels drop.	1 1 1
Q4 a)	i) G ii) B	1 1
(b)	At the muscles, in the red blood cells, Carbonic anhydrase converts the carbon dioxide and water into carbonic acid (H2CO3); Carbonic acid dissociates into bicarbonate ions (HCO3−) and hydrogen (H+) ions; The bicarbonate ion/hydrogen carbonate ion diffuses out of the red blood cell into the plasma; The reverse of the reactions occurs at the lungs. / (fully described)	1 1 1 1
5a	Any two Urea Excess glucose / excess amino acids / excess mineral salts/ excess water	
b	Glucose is small enough to pass through the partially permeable tubing Concentration at equilibrium prevents lost of glucose through diffusion	1 1
C	Antidiuretic hormone	1
6(a)	The aperture	1
6(b)	Small/diminished; Laterally inverted image/ upside down	1 1
6(c)	The human eye has a blind spot while the camera does not. Light enters the camera through lens before passing through aperture while light enters the eye through the pupil before the lens;	Any 2 points (1 m each)

	The thickness of the lens cannot be altered in the lens unlike in the human eye by ciliary muscles; The retina has a wider area of image as compared to the film of camera.	
7(a)i	A: centromere B: chiasma	1
7(a)ii	Sister chromatids are formed as a result of DNA replication, hence they are genetically identical. Homologous chromosomes are from each parent. Although they have genes which determine the same characteristics, they may code for different phenotypes of the same characteristic / contain different allele of the same gene.	1 1
7(b)i	DNA amount increases from 2au to 4au due to DNA replication. Chromosome number remains the same at 2n since there is no separation of homologous chromosomes.	1 1
7(b)ii	DNA amount decreases from 4au to 2au; separation of homologous chromosomes into 2 daughter cells. Chromosome number decreases from 2n to n; separation of homologous chromosomes into 2 daughter cells.	1 1
7(c)	During anaphase I, although the homologous chromosomes separate and move towards the opposite poles, nuclear envelope has not reformed, hence there is no reduction in the DNA amount and chromosome numbers. During anaphase II, although the chromatids separate and move towards the opposite poles, nuclear envelope has not reformed, hence no reduction in the DNA amount and chromosome numbers.	1 1
8(a)	parental phenotypes: crimson flowers × yellow flowers parental genotypes: A^cA^c × A^yA^y gametes: A^c + A^y offspring genotype: A^cA^y offspring phenotype: orange-red flowers	1 1 1
8(b)	cross: 2 offspring of cross 1 x offspring of cross 1 — genotypes of offspring: $A^cA^c : A^cA^y : A^yA^y$ cross: 3 offspring of cross 1 x crimson-flowered plant — genotypes of offspring: $A^cA^y : A^cA^c$	1 1
9(a)	Ref. an increase in the radioactivity from June 1962 to June 1963, Ref. a decrease in radioactivity from June 1963 to Dec 1963; Ref. an increase from Dec 1963 to June 1964 (highest level of radioactivity), Ref. decrease from June 1964 to Dec 1964;	Any 2
9(b)i	Third	1

9(b)ii	Ref. lichens had the lowest level of radioactivity while the Inuit had the highest; The caesium entered the food chain when the caribou fed on the lichens and passed to the Inuit; As the radioactive caesium cannot be excreted, it was stored and accumulated in the tissues and passed along the food chain through feeding	1 1 1
10(a)	Scale – 1 Plot – 1 (allow 1 mistake) Lines – 1 (best fit curves, labelled correctly) Axes – Labelled correctly	4 total
(b)	Below light intensity of 30, plant B shows a higher rate of oxygen production At light intensity of 30, both plants shows the same rate of oxygen production. Above light intensity of 30, plant A shows a higher rate of oxygen production. Between light intensity of 50-60 the oxygen production of both plant A and B is relatively constant (stop increasing) with Plant A showing a higher rate of oxygen production.	1 mark each. Max 3 marks.
(c)	B; B has a higher rate of oxygen production at lower light intensity indicating that it can photsynthesize (linkage must be made) better at lower light intensity while indoors.	1 1
(d)	Carbon dioxide / temperature	1
11(a)	Algae and plankton Able to make their own food via photosynthesize / trap light →chemical energy → make food from inorganic compounds Provide energy in the form of food for all the organisms in the ecosystem	1 1 1
11(b)	Mercury compounds are insoluble/ non-biodegradable/ not excreted out of the body → remain in body tissues/fats of animals Passed from algae → herbivorous fish → small carnivorous fish → tuna during feeding Highest concentration of mercury in tuna due to biomagnification (progressive accumulation of pollutants in the body of animals with each successive trophic levels) Happens because animals in higher trophic levels feed on many more animals (together with the pollutants) in lower trophic level in order to meet their energy needs	1 1 1 1
11(c)	Ban harmful fishing technique: use of dynamite, cyanide, bottom trawling, drift nets Legislation and taxes: fishing output / fishing quota / vessel licensing / limit period of fishing	1 1

EITHER 12 a	**Similarities**			6 marks
	Leaf	Lung	function	
	Air spaces in spongy mesophyll layer	Many small alveolus	Increase SA:V for gaseous exchange	
	Innervated with vascular bundle	Richly supplied blood capillaries	For fast transport of substances to and fro	
	Moisture layer present	Moisture layer present	To allow gases to dissolve to facilitate diffusion	
	Differences			
	Passive exchange of gases into and out of the leaf (via diffusion)	Active inhalation and passive exhalation (unforced)	Mechanism for movement of air in and out of the organ	
	Gaseous exchange effected by opening and closing of stomata (therefore photosynthesis)	Breathing response is mainly automated reflex (cannot will yourself to stop breathing permanently)	Ability to control of movement.	
	1 mark for correct comparision of contrasting characteristic or similarity + 1 mark for corresponding function. Total 3 strands. Must at leaset give similarity and differences or will only score 2 max			
B	In a sprint, There is a huge demand of energy by the muscle tissues for vigorous contrations; The oxygen demand increases for aerobic respiration to release the energy required There is a limit to breathing and heart rate and insufficient oxygen for aerobic respiration to release sufficient energy therefore anerobic respiration releases additional energy (on top of aerobic respiration) to fufill the need for energy by the muscle tissues.			[1] [1] [1] [1]
OR 12 (a)	Pollination is the transfer of pollen grains from anther to mature stigma of the same species Vectors: Wind, insect / bee/ butterfly			1 1 2

12 (b)i	Self-pollination uses less energy/ resources to produce less pollen OR Cross-pollination gives greater genetic variation amongst offspring which might be better adapted to the drought	1 1
12 (b)ii	Similarities Both requires the fusion of male and female gamete to form a diploid zygote. Both requires male gametes to move towards female gamete. Both have large number of male gametes released. Differences	1 1

Plant	Factor	Human	
Pollen tube formed by enzyme digestion through style	Method of movement	Sperms swim up vagina to oviduct	1
Many ovules	No. of female gamete	One egg every cycle	
Double fertilization to form zygote and endosperm	Type of fertilisation	Single fertilization to form zygote	1
Many fertilizations can occur simultaneously	No. of fertilisations in an organism	Naturally only 1 fertilisation	
Ovary	Site of fertilisation	Oviduct / Fallopian tube	

Class	Candidate Name	Register Number

FIRST TOA PAYOH SECONDARY SCHOOL

O-LEVEL PRELIMINARY EXAMINATION 2015

Secondary Four Express

Biology (SPA) **24 August 2015** **5158/02**

Paper 2 **1 hour 45 minutes**

Candidates to answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

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

Section A (50 marks)
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B (30 marks)
Answer **all** the questions.
Write your answers in the spaces provided on the Question Paper.

The use of an approved scientific calculator is expected, where appropriate.
You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.
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.

For Examiner's Use	
SECTION A	
SECTION B	
TOTAL	80

This question paper consists of 15 printed pages.

[Turn over

Section A

Answer **all** questions.
Write your answers in the spaces provided.

For Examiner's Use 76

1 Fig. 1.1 illustrates the relationship between the age of a pig and the activity of the enzymes in its digestive system.

As the pig grows older, its diet is gradually changed from milk to grains and soya bean meal.

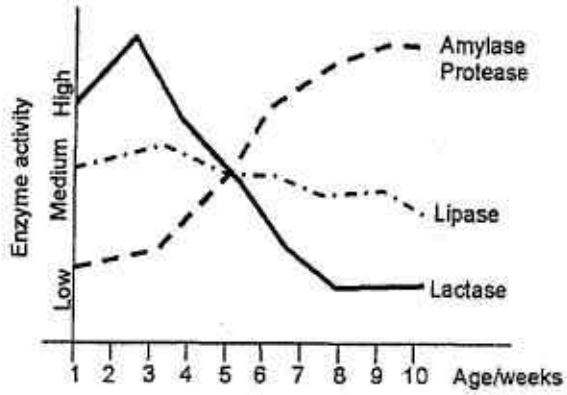


Fig. 1.1

(a) (i) Suggest a suitable diet for a young pig that is less than 3 weeks old.

_____ [1]

(ii) Explain your answer in **(a)(i)**.

_____

_____ [2]

(b) (i) State the changes in the activity of lactase, protease and amylase after week 3.

_____

_____ [2]

(ii) Explain your answer in **(b)(i)** with reference to the pig's diet.

_____

_____

_____ [2]

(c) Suggest why the activity of lipase does not decrease greatly over 10 weeks.

For Examiner's Use

[1]

(d) In Fig. 1.2, label with (i), (ii), (iii) and (iv), where the following enzymes are likely to be found in the pig.

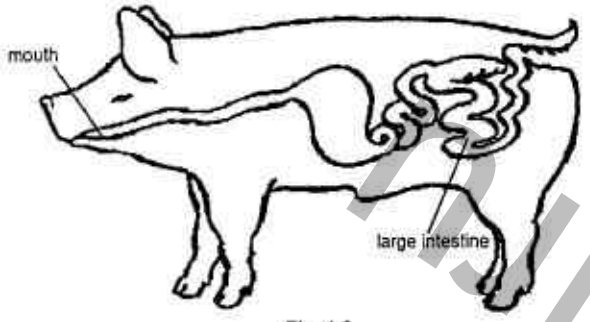


Fig. 1.2

(i) amylase
(ii) protease
(iii) lipase
(iv) lactase

[2]

[Total: 10]

2 Fig. 2.1 shows a picture of a leaf attached to a plant throughout an experiment.

For Examiner's Use

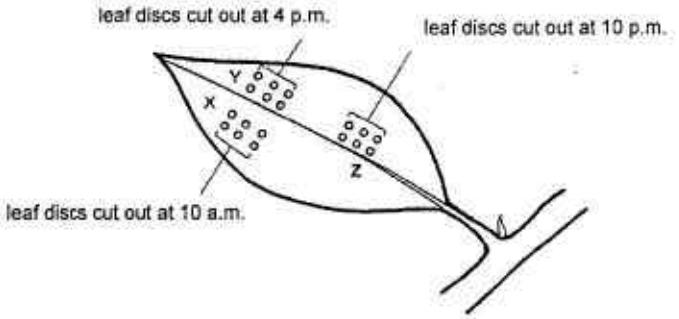


Fig. 2.1

Six discs were cut out from regions **X**, **Y** and **Z** of the leaf at 10 a.m., 4 p.m. and 10 p.m. respectively. The plant may have received some treatment before the discs were cut and likewise the discs too, before their total dry weight is measured. Table 2.2 shows the steps taken in the experiment.

Table 2.2

time	treatment to plant before removing leaf discs	treatment of leaf discs	dry weight of leaf discs (mg)
10 a.m.	exposed to sunlight	killed in steam	186
4 p.m.	exposed to sunlight	none	209
10 p.m.	kept in the dark for 6 hours	none	198

Explain the change in dry weight of leaf discs

(a) between 10 a.m. and 4 p.m.,

[2]

(b) between 4 p.m. and 10 p.m.

[2]

[Total: 4]

3 Fig. 3.1 shows the changes in a portion of blood circulating around the body.

For Examiner's Use

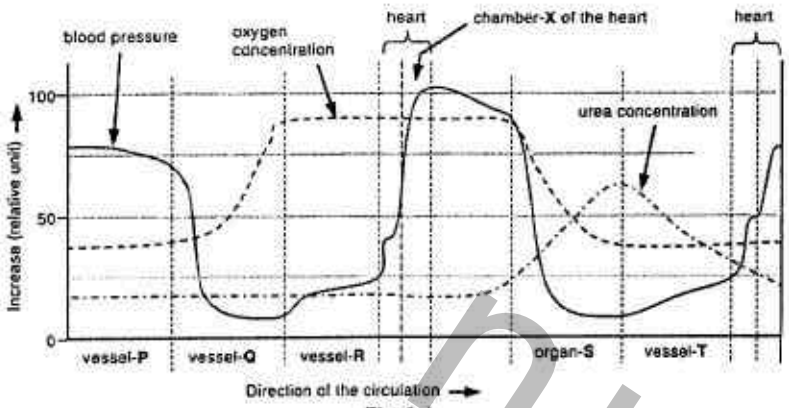


Fig. 3.1

(a) Identify chamber **X** of the heart and explain how you derived at your answer.

chamber X _____

explanation _____

_____ [2]

(b) Identify vessel **P** and explain how you derived at your answer.

vessel P _____

explanation _____

_____ [2]

(c) Name organ **S** and explain how you derived at your answer.

organ S _____

explanation _____

_____ [2]

(d) Explain how vessel **T** ensures that blood flows back to the heart though the blood pressure is very low.

_____ [1]

[Total: 7]

4 When food is eaten, gastric juice is released into the stomach.

For Examiner's Use

The volume of gastric juice released is controlled in the following three ways:

A by nerve impulses sent to the stomach when the food is tasted in the mouth,
B by the stretching of the stomach when it is filled with food,
C by a hormone produced when the food reaches the stomach.

This is illustrated in Fig. 4.1 below.

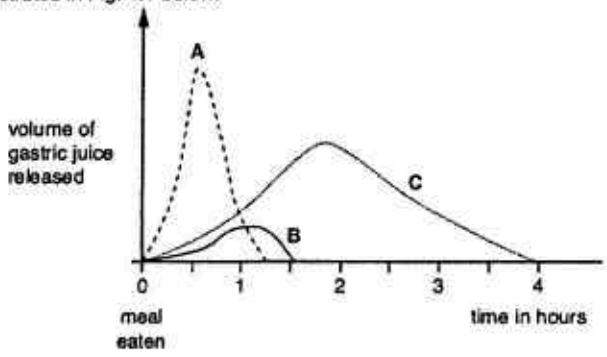


Fig. 4.1

(a) Which of the ways, **A**, **B** or **C**, releases the smallest volume of gastric juice?

_____ [1]

(b) Use information from Fig. 4.1 to describe the differences between the action of nerves and hormones.

_____

_____

_____ [2]

(c) The release of gastric juice as a result of tasting food in the mouth is a reflex action. Describe how this reflex action takes place.

_____

_____

_____

_____

_____

_____

_____ [4]

[Total: 7]

5 The budding yeast, *Saccharomyces cerevisiae*, has both asexual and sexual reproductive cycles. However, the more common mode of reproduction is asexual by budding.

S. cerevisiae can live as either diploid cells or haploid cells. The haploid cells occur in two different mating types: **a** or α. Haploid cells can live indefinitely in the haploid state but if two cells of opposite mating types meet, they can fuse and enter the diploid phase of the cell cycle.

Under harsh environmental conditions, haploid cells will generally die while diploid cells will undergo sporulation, producing four haploid spores in an ascus. Sporulation in yeast is a form of sexual reproduction. When conditions become favourable, the spores germinate producing four haploid yeast cells: two **a** and two α. The life cycle of *S. cerevisiae* is summarized in Fig. 5.1.

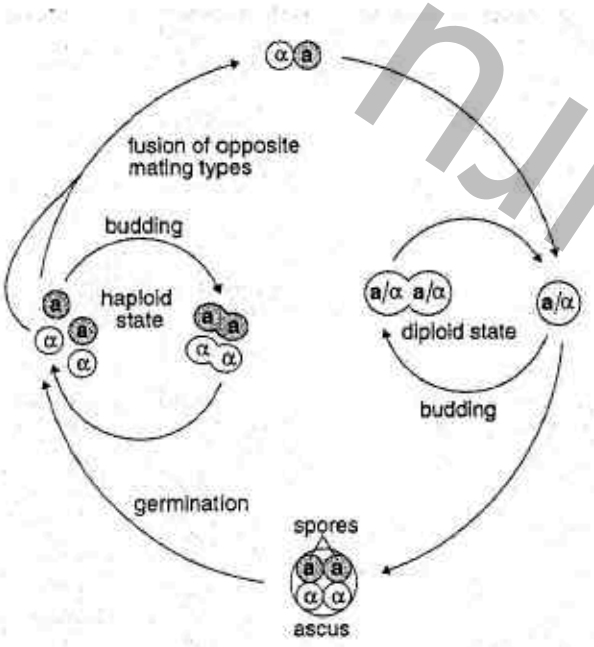


Fig. 5.1

(a) (i) Mark with an **X** on Fig. 5.1 to show where meiosis occurs. [1]

(ii) Mitosis occurs at two phases in the yeast's life cycle.
Mark with a **Y** on Fig. 5.1 to show where mitosis occurs. [2]

(b) A spore contains 16 chromosomes.

How many chromosomes are there in

(i) a diploid cell,

_____ [1]

(ii) a haploid cell?

_____ [1]

(c) Suggest why it is advantageous for an organism to be capable of both asexual and sexual reproduction.

_____

_____

_____ [2]

[Total: 7]

6 One variety of the moth, *Biston betularia*, has pale, speckled wings. A second variety of the same species has black wings. There are no intermediate forms.
Equal numbers of both varieties were released into the woods made up of trees with pale bark.

Examples of these are shown in Fig. 6.1.

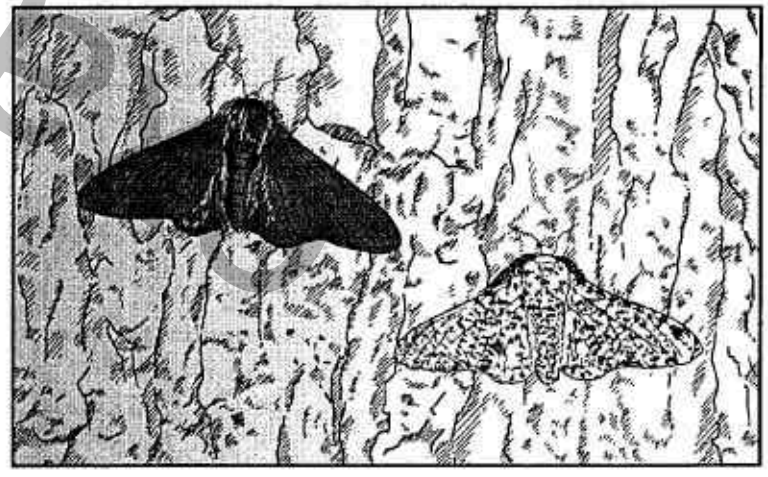


Fig. 6.1

(a) After two weeks, as many of the moths were caught as possible. The results are shown in Table 6.2.

For Examiner's Use

Table 6.2

wing colour of moth	number of moths released	number of moths caught
pale, speckled	100	82
black	100	36

(i) Account for the difference in the number of the varieties of moths caught, in relation to the colour of the bark.

_____

_____

_____ [2]

(ii) Suggest a change that may cause the number of black moths caught to be more than the number of pale speckled moths.

_____ [1]

(b) A scientist experimented and inter-bred two moths of the same phenotype and found out that he was able to get many more pale speckled moths as compared to black moths in the next generation.

(i) Determine the genotype of both moths he inter-bred.

_____ [1]

(ii) Using the letters **G** and **g** to represent the dominant and recessive alleles respectively, construct a genetic diagram to predict the proportion of black-winged moths present in the next generation.

[3]

[Total: 7]

7 A student performed an experiment to find out about the feeding relationships between four different species, **A**, **B**, **C** and **D**. They were separated into four different groups and put into three stoppered bottles. Table 7.1 shows the contents of these bottles at the beginning and the end of one week.

For Examiner's Use

Table 7.1

bottle	contents at the beginning	contents after one week
I	A	disappeared
	C	unchanged
	D	unchanged
II	C	disappeared
	B	unchanged
	D	unchanged
III	A	unchanged
	B	dead
	D	disappeared

(a) Suggest reasons for the following:

(i) the disappearance of species **A** in bottle **I**,

_____ [1]

(ii) the death of species **B** in bottle **III**.

_____ [1]

(b) (i) Construct a food chain to show the feeding relationship of the four species.

_____ [2]

(ii) Which species in the food chain will get the least energy? Explain why this is so.

_____

_____ [2]

(c) If the experiment is performed differently by putting all four species into one bottle, suggest what would be the outcome of the experiment.

_____ [1]

[Total: 7]

Section B

For Examiner's Use

Answer **three** questions.
Question **10** is in the form of an **Either/Or** question.
Only one part should be answered.

8 Fig. 8.1 shows the amount of adrenaline released into the blood and the changes in diameter of two blood vessels.

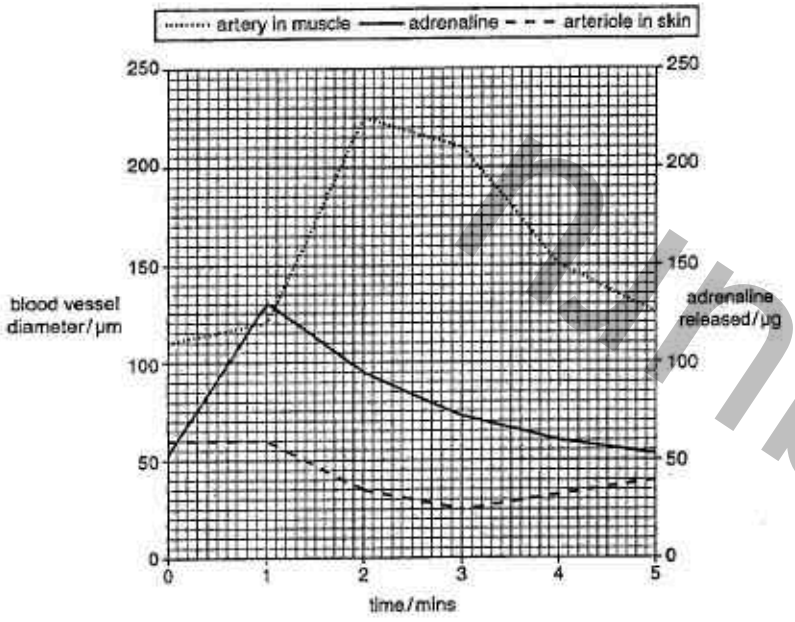


Fig. 8.1

(a) State the meaning of a 'hormone' in terms of adrenaline.

_____

_____

_____

_____ [2]

(b) Suggest what causes the change in the level of adrenaline between 0 to 2 minutes.

_____

_____ [1]

For Examiner's Use

(c) Calculate the maximum change in the diameter of the artery in muscle.

[1]

(d) **(i)** Using the information shown in Fig. 8.1, describe how the adrenaline released affects the diameter of the artery in muscle, as well as the arterioles in the skin between 1 to 2 minutes.

_____

_____

_____ [2]

(ii) Describe and explain how your answer in **(d)(i)** will affect the

skin temperature and

_____

_____

_____ [2]

rate of respiration.

_____

_____

_____ [2]

(e) State **two** reasons why minor cuts may be treated by applying a paste containing a small amount of adrenaline.

_____

_____

_____ [2]

[Total: **12**]

9 (a) Explain how the structure and arrangement of the glomerulus and blood capillaries in the glomerulus ensure the efficient exchange of relevant **named** materials.

For Examiner's Use

[3]

(b) Alcohol is known to inhibit the release of anti-diuretic hormone.
Outline how a regular intake of alcohol could lead to dehydration.

[3]

(c) Predict and explain the relative length of the loop of Henle in a nephron of a camel compared to that of a human.

[2]

[Total: 8]

EITHER

10 (a) Describe the similarities in the adaptations of gaseous exchange surfaces in both plants and animals.

For Examiner's Use

[4]

(b) How do molecules of oxygen from the atmosphere reach the cells of a leaf differ from the way they reach the lungs and cells of the human body?

[6]

[Total: 10]

OR

For Examiner's Use

10 (a) Outline the relationship between chromosomes, genes and DNA.

[3]

(b) Describe the importance of complementary base pairing in gene expression where DNA is used to eventually carry out protein synthesis.

[4]

(c) Explain why there is genetic variation in the offspring through sexual reproduction in plants.

[3]

[Total: 10]

-End of Paper-

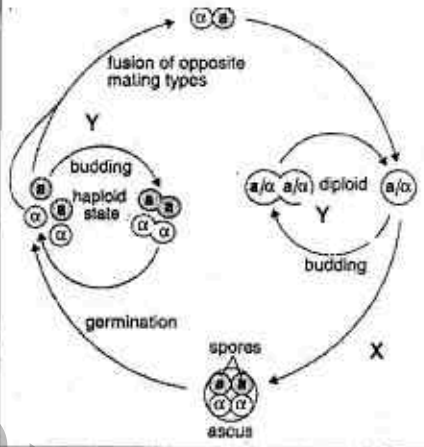
FIRST TOA PAYOH SECONDARY SCHOOL

O-LEVEL PRELIMINARY EXAMINATION 2015
MARKING SCHEME

SECONDARY 4 EXPRESS BIOLOGY (SPA)

PAPER 2 (80 marks)

SECTION A (50 marks)

Question		Answer	Marks
1	a	(i) milk / dairy products	1m
		(ii) The activity of lactase is high to break down the lactose which is found in great amount in the milk; The activity of lipase is medium to break down the fats in the milk;	2m
	b	(i) Lactase activity decreases; while protease and amylase activity increases;	2m
		(ii) **max 2** Protease and amylase activity increases to digest protein and starch respectively present in soyabean meal and grains / Lactase activity decreases indicating less ability to obtain nutrients from milk/ Pig is able to digest solid food (grains) and is less reliant on liquid food (milk);	2m
	c	Initially lipase used to digest fats in milk, later on lipase digests fats in solid food / Amount of fats in diet remains constant	1m
	d	(i) mouth / small intestine (ii) stomach / small intestine (iii) small intestine (iv) small intestine	2m
			Total: 10m
2	a	Dry weight of leaf discs increases because Photosynthesis occurs / Increase in the rate of photosynthesis; Production of more glucose which will eventually be stored as starch;	2m
	b	Dry weight of leaf discs decreases because Photosynthesis has stopped; Stored starch is being converted to glucose; which will be used in respiration	2m
			Total: 4m
3	a	Chamber **X** – Left ventricle; It contains highly oxygenated blood & develops greatest / highest pressure to pump blood throughout the body;	2m
	b	Vessel **P**- Pulmonary artery; It contains blood at very high pressure as it carries blood away from the heart and deoxygenated blood leading to lungs for gaseous exchange to occur;	2m
	c	Organ **S**- Liver; Blood urea concentration increased as a result of deamination of excess amino acids from the liver as the amino acids diffuse into the blood;	2m
	e	Valves are present in vessel T to prevent backflow of blood.	1m
			Total: 7m
4	a	B	1m
	b	Nervous response takes a shorter time to reach its peak (0.5 hours), while hormonal response is slower to reach its peak (1.8 hours); Nervous response is short-lived (1.5 hours), but hormonal response lasts longer (4 hours);	2m
	c	Food in mouth stimulates the tongue / taste buds to produce a nerve impulse; The nerve impulse was transmitted by the sensory neurone to the spinal cord; In the spinal cord, the nerve impulses are transmitted across a synapse to the relay neurone and then across another synapse to the motor neurone; The motor neurone transmits impulse out of spinal cord to gastric glands in the stomach to release gastric juice;	4m
			Total: 7m
5	a		3m
	b	(i) 32	1m
		(ii) 16	1m
	c	This organism will be able to multiply at a very fast rate, reproducing offspring in large numbers by asexual reproduction when conditions are favourable; When conditions become unfavourable, sexual reproduction occurs, allowing genetic variation, leading to species that are better adapted to changes in the environment;	2m
			Total: 7m

Question		Answer	Marks
6	a	(i) More black moths are consumed by their predators; This is because the black moths are not able to camouflage / blend in with the tree bark.	2m
		(ii) The trees were blackened with carbon dust from air pollution;	1m
	b	(i) Both moths have a heterozygous genotype, Gg;	1m
		(ii) Parental phenotype: pale speckled moth × pale speckled moth Parental genotype: Gg × Gg Gametes: G, g × G, g Random fertilisation Offspring genotype: GG, Gg, Gg, gg Offspring phenotype: GG pale speckled, Gg pale speckled, Gg pale speckled, gg black Proportion of black moth: 1/4 or 25%	4m
			Total: 8m
7	a	(i) A was eaten up by C;	1m
		(ii) Species C (source of food) was not available for B;	1m
	b	(i) D → A → C → B;;	2m
		(ii) B; 90% of the energy is lost at every trophic level of the food chain / 10% of the energy is transferred from one trophic level to another;	2m
	c	Only species B will exist in the bottle, while species A, C and D will disappear as there is no predator for B present in the bottle;	1m
			Total: 7m

SECTION B (30 marks)

Question		Answer	Marks
8	a	Adrenaline is a chemical substance produced in minute quantities by the adrenal gland situated above the kidney; Adrenaline is transported in the bloodstream to the liver where it converts glycogen to glucose so that more glucose is available for muscle contraction; Adrenaline is destroyed in the liver and excreted in the kidney; **accept any other possible target organs it is transported to and its effect*	2m max 2
	b	When a person is afraid / angry / anxious / stressed, adrenaline will be secreted by the adrenal glands.	1m
	c	maximum change in diameter of artery = 225 – 110 = 115 μm	1m
	d	(i) As the adrenaline level decreases from 130 to 115μm, the diameter of the artery increases from 120 to 225μm; And the diameter of the arteriole decreases from 60 to 35 μm.	2m
		(ii) Skin temperature will increase; The arterioles in the skin constrict and shunt vessels dilate, causing less blood flow through blood capillaries in the skin, causing the reduction in heat loss by conduction, convection and radiation;	2m
		Rate of respiration increases; The diameter of the arteries increase, causing an increase in blood flow through the arteries to the muscles + oxygen and glucose are transported at a faster rate;	2m
	e	Adrenaline causes arterioles in the skin to constrict, thus channeling less blood to the skin and hence prevent loss of blood due to bleeding from the cut arterioles; Adrenaline also increases the rate of blood clotting to prevent excessive loss of blood.	2m
			Total: 12m
B9	a	• Endothelium wall of capillaries are only one-cell thick to provide a shorter diffusion distance and to facilitate efficient transport of mineral salts and urea to the glomerulus; • Extensive branching of capillaries increases surface area for ultra-filtration of blood to occur effectively; • Partially permeable membrane of glomerulus allows diffusion of mineral salts and nitrogenous wastes to occur quickly; • High pressure of glomerulus due to lumen of afferent arteriole being wider in diameter than lumen of efferent arteriole, leading to faster rate of ultrafiltration;	3m
	b	Less ADH to be released into the blood stream from pituitary gland. • Walls of collecting duct are less permeable to water; • leading to less water being reabsorbed by the kidney tubules. • As a result, more urine is produced and individual becomes dehydrated overtime.	3m
	c	• Loop of Henle is longer in camel. Camel is a desert animal, thus it needs to conserve water. • A longer loop of Henle allows a greater proportion of water to be reabsorbed into the bloodstream.	2m
			Total: 8m

Question		Answer	Marks
B10 (E)	a	• Both gaseous exchange surfaces has a large surface area so that diffusion of gases can take place more efficiently. In plants, the lamina of the leaves is thin and wide, increasing its surface area, so that carbon dioxide can rapidly reach the inner cells of the leaf + In humans, there are many alveoli, which increases surface area for gaseous exchange to occur. • Both gaseous exchange surfaces are lined with a thin layer of moisture. The thin layer of moisture in the alveoli and mesophyll cells allows gases to dissolve quickly before diffusing into or out of the cells. • Both contain large air spaces near the gaseous exchange surfaces. In plants, there are numerous large intercellular air spaces among them to allow rapid diffusion of gases through the leaf. In humans, the alveoli contain air spaces within them, and they are richly supplied with blood capillaries, maintaining the concentration gradient of gases.	any 2 max 4m
	b	• Oxygen from the air diffuses from the outside atmosphere into the air spaces in the leaf, but for human, oxygen from the air enters the lungs through inhalation and is due to the contraction of muscles in the lungs. • Oxygen enters the air spaces in the leaf through the stomata, but it enters the lungs and the alveoli through the nostrils. • Oxygen moves from cell to cell through diffusion in the leaf, but oxygen is transported by red blood cells to all parts of the body. • There is no specialised chemical to carry oxygen in plants, but oxygen binds with haemoglobin in the red blood cells.	any 3 max 6m
			Total: 10m
B10 (OR)	a	• DNA is the chemical/ macromolecule that is made up of two strands of deoxyribonucleic acid wound/ twisted together to form a double helix structure. • Segments of DNA makes up a gene which codes for a polypeptide/ which carries information for making a polypeptide. • The whole DNA strand, coding for thousands of genes, are wound tightly together with proteins like histones to a condense form known as a chromosome.	3m
	b	• During transcription in the nucleus, the DNA strands unzips and one of the DNA strand serves as a template for copying the message over to an messenger RNA/ mRNA molecule. • The mRNA is synthesised from the DNA template/ strand through base pairing. • The mRNA is then carried to the cytoplasm, where it is translated with help of the ribosome and transfer RNA. • The tRNA carrying specific amino acids is able to recognise and pair with the codons on the mRNA by complementary base pairing within the ribosome.	4m
	c	• In the generation of the haploid nucleus, meiosis occurs where crossing over of the chromatids between homologous chromosomes in Prophase I. • Independent assortment of the individual chromosomes of each homologous pair in combination with individual chromosomes of other pairs to form genetically varied haploid male and female nuclei within the anther and ovary. • Random fertilisation between different haploid male and female nuclei further generates greater genetic variability in the zygotes formed.	3m
			Total: 10m

TEMASEK SECONDARY SCHOOL
O Level Preliminary Examination 2015
Secondary 4 Express

BIOLOGY **5158/01**

Paper 1 **1 hour**

Question Booklet

Additional Material: Optical Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the Optical Answer Sheet.

You are **not** required to hand in this booklet.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Optical Answer Sheet.

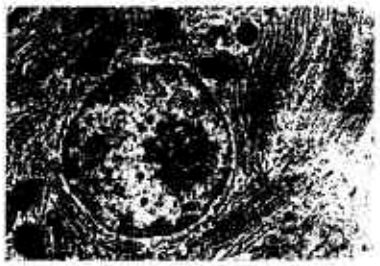
Read the instructions on the Optical Answer Sheet very carefully.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

This document consists of **20** printed pages.

Attempt ALL questions in this section.
Choose the most appropriate answer and shade the corresponding letter on the separate answer sheet provided.

1 The electron micrograph below shows part of a cell. Given the appearance of the cell, what is the likely identity of the cell and appropriate reason for the given identity?



	Identity	Reason
A	skin cell	contains a large nucleus that can carry out DNA replication quickly in preparation for cell division
B	pancreatic cell	contains large amounts of endoplasmic reticulum for synthesis of pancreatic enzymes
C	Cell of hypothalamus	contains large amounts of endoplasmic reticulum for synthesis of ADH
D	pancreatic cell	contains a large nucleus that contain a large number of genes coding for pancreatic enzymes

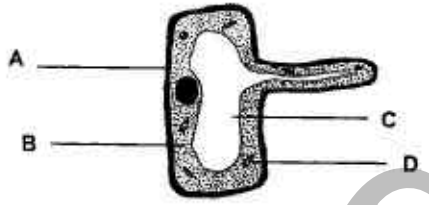
2 Individual cells are usually very small because

A there is a greater concentration of enzymes in smaller cells than in larger cells.
B materials move more efficiently in and out of smaller cells than larger cells.
C the cell membrane encloses the cell and prevents it from increasing in size.
D by osmosis, water enters smaller cells more slowly than it enters larger cells.

3 Which of the following combinations of a type of macromolecule, its function and a component found in the type of macromolecule is incorrect?

	Type of macromolecule	Function	Component found in the type of macromolecule
A	Lipid	Controls cellular metabolism	Fatty acid
B	Protein	Regulates cellular reactions	Amino acid
C	Nuclei acid	Stores information	Nucleotide
D	Polysaccharide	Forms plant cell walls	Monosaccharide

4 The diagram below shows a specialised cell. Which of the labelled structures carry out the following functions below?



	Storage of nutrients and inorganic ions	Site of most of cellular activities
A	C	D
B	C	B
C	D	C
D	A	C

5 The table below shows the ratios of initial mass to final mass of three fresh potato cylinders which have been immersed in sucrose solutions of three different concentrations for 30 minutes:

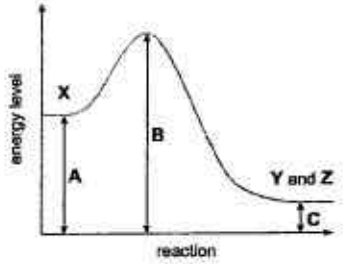
	Solution P	Solution Q	Solution R
Ratio of initial mass to final mass	0.9	1.4	1.2

Which of the following can be deduced from the results?

1 The water potential of the potato cylinders is higher than that of solution P.
2 There is a net movement of water from the potato cylinders to solution Q.
3 Solution Q has a higher sucrose concentration than solution R.

A 1
B 2
C 1 and 3
D 2 and 3

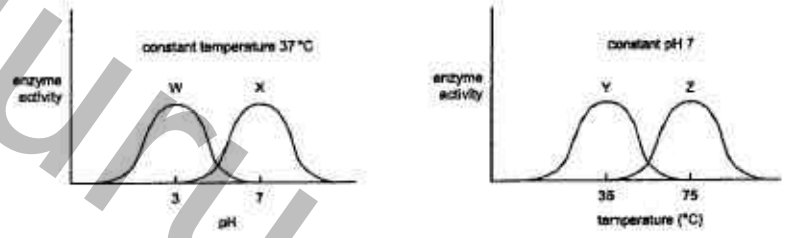
6 The graph below shows the energy changes that occur in the reaction in which molecule **X** breaks down into molecules **Y** and **Z** in the presence of an enzyme.



The activation energy for this reaction is equal to

A A
B A + B
C B - A
D B - C

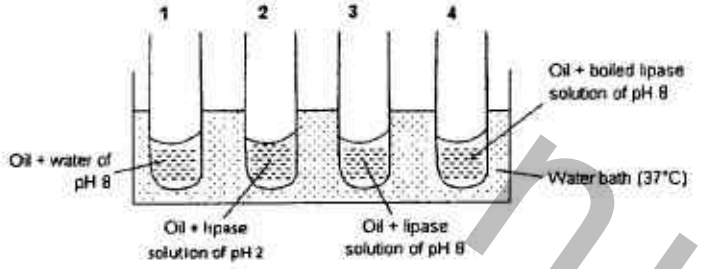
7 The following graphs show the way four enzymes, W, X, Y and Z, change their activity in different pH and temperature situations.



Which one of the following statements about the activity of the four enzymes is true?

A At pH 7, enzyme Y is denatured at temperatures below 20 °C.
B Enzyme Z could be an intracellular human enzyme.
C At pH 3 and a temperature of 37 °C, the active site of enzyme W binds well with its substrate.
D At pH 3 and a temperature of 37 °C, enzyme X functions at its optimum.

8 Four test tubes, 1 to 4, were set up in an experiment shown below. Equal volumes of oil and solution are added to each test tube. The test tubes were incubated for one hour.



Which of the following shows the expected results when the test tubes are subjected to the ethanol emulsion test?

	1	2	3	4
A	Clear	Clear	Cloudy	Clear
B	Cloudy	Clear	Clear	Cloudy
C	Cloudy	Cloudy	Cloudy	Clear
D	Cloudy	Cloudy	Clear	Cloudy

9 Photosynthesis occurs in two stages: the light-dependent and light-independent stages. What does the light-dependent stage involve?

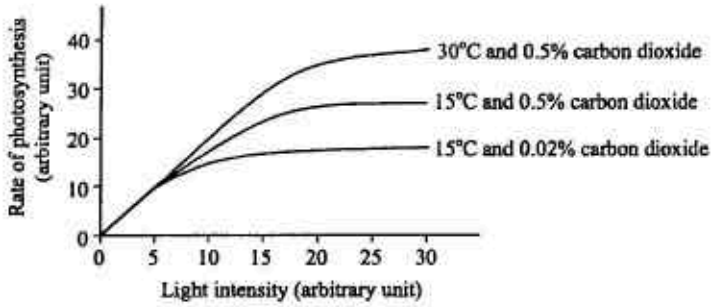
A synthesis of glucose molecules using light energy from the sun

B splitting of carbon dioxide into carbon and oxygen using light energy

C splitting of water into hydrogen and oxygen using light energy

D synthesis of glucose molecules using chemical energy from the light-dependent stage

10 The graph below shows the rate of photosynthesis of a plant at different temperatures and carbon dioxide concentrations when light intensity increases.



Which of the following descriptions about the rate of photosynthesis of this plant can be deduced from the graph?

A Below 3 units of light intensity, light intensity is the factor limiting this plant's photosynthetic rate.

B At 25 units of light intensity and 0.02% carbon dioxide, temperature is the factor limiting this plant's photosynthetic rate.

C At 15 units of light intensity, 15°C and 0.5% carbon dioxide, light intensity is no longer a factor limiting this plant's photosynthetic rate.

D At 25 units of light intensity, 15°C and 0.5% carbon dioxide, this plant's photosynthetic rate doubles when the temperature is doubled.

11 Transpiration is the loss of water from aerial parts of a plant. Which of the following statements describe(s) why transpiration is useful for plants?

1 It gets rid of excess water, protecting cells from bursting.
2 It cools plants down, preventing overheating on sunny days.
3 It enables the mass flow of inorganic nutrients and water up the plant body.

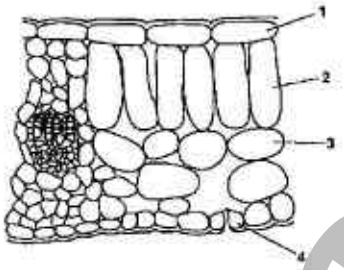
A 1 only

B 1 and 3 only

C 2 and 3 only

D all of the above

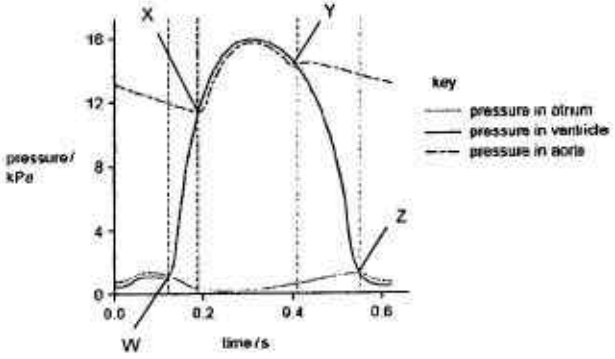
12 The diagram below shows a transverse section of a leaf.



Which layer(s) of cells would turn blue-black in an iodine test after several hours of sunlight?

A 1 only
B 2 and 3 only
C 2, 3 and 4 only
D all of the above

13 The graph shows pressure changes in the left side of the heart during a single heartbeat.



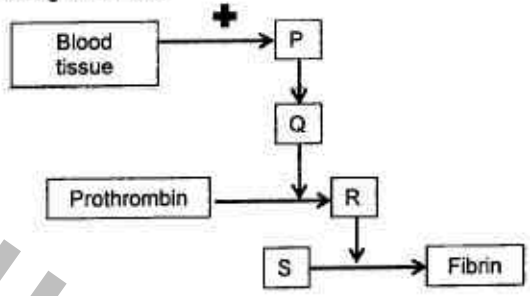
At which points will the 'lub' and 'dub' sounds be produced?

A W and X
B W and Y
C X and Y
D all of the above

14 When the legs are not moved for an extended period of time, the rate of blood flow through the veins is reduced. Which of the following statements best explains this?

A The muscular wall of the veins have to be contracted together with the muscles of the leg to aid in the movement of blood.
B The semi-lunar valves that prevent the backflow of blood are opened by the contraction of leg muscles.
C The thin muscular walls of the veins are unable to withstand high blood pressure and the leg muscles help to prevent them from bursting.
D The veins are located between muscles and the contraction of muscles helps to push blood along.

15 The diagram below illustrates a simple flowchart showing the mechanism of blood clotting in humans.



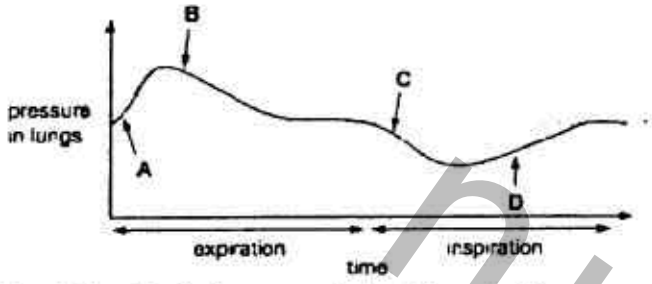
Name P, Q, R and S.

	P	Q	R	S
A	Thrombin	Platelet	Thrombokinase	Fibrinogen
B	Platelet	Thrombokinase	Thrombin	Fibrinogen
C	Thrombin	Thrombokinase	Fibrinogen	Platelet
D	Thrombokinase	Fibrinogen	Thrombin	Platelet

16 Which of the following statements about lactic acid is incorrect?

A After exercise, lactic acid is removed from the muscles and brought to the liver.
B Anaerobic respiration always produces lactic acid.
C An oxygen debt is incurred when lactic acid accumulates in the muscles.
D The build-up of lactic acid in the muscles causes fatigue.

17 The following graph shows the pressure in the lungs in a complete breathing cycle.



At which point does the diaphragm muscles begin to contract?

18 The table shows the results taken from the analysis of a sample of atmospheric air.

	Volume/ cm^3
Complete air sample	100.0
Air sample with carbon dioxide removed	95.1
Air sample with oxygen removed	76.4

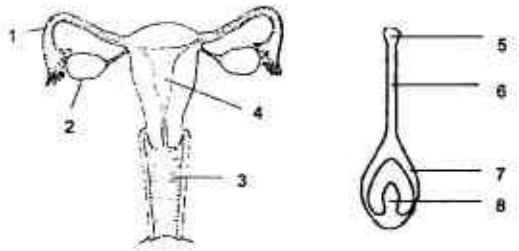
How would the results change if a 100 cm^3 sample of exhaled air was analysed instead?

A The volume of air sample with carbon dioxide removed would be lower.
B The volume of air sample with carbon dioxide removed would remain the same.
C The volume of air sample with oxygen removed would be lower.
D The volume of air sample with oxygen removed would remain the same.

19 What would be a likely consequence if progesterone is lacking in a particular adult female?

A Levels of the oestrogen would be higher than normal.
B Luteinising Hormone may not be secreted to initiate ovulation.
C The uterine lining might not be sufficiently stable to support an implanted embryo.
D There would be no significant effect since the functions of both oestrogen and progesterone overlap.

20 The diagrams show a human female reproductive system and the carpel of a flower.



Which of the following statements about the identified parts is true?

A Parts 1 and 6 have ciliated lining to assist the movement of male gametes.
B Parts 2 and 8 are sites where meiosis takes place.
C Parts 4 and 7 provide nourishment during embryonic development.
D Tissues in 3 and 6 will be digested to allow male gametes to enter.

21 A student decides to study the impact of removing certain flower parts on fruit formation in species X.

He chooses three separate plants that are growing in the same plot under uniform conditions. The data is shown in the table below.

Plant	Part removed	Impact on fruit formation
1	Anther	30% less fruit formed than average plant in the plot
2	Stigma	No fruit formed
3	Petal	No significant impact

Which of the following conclusions is not consistent with the above data?

A Anthers and stigmas are crucial in sexual reproduction in species X.
B Pollen grains are probably unable to germinate if they land on other parts of the carpel besides the stigma.
C Species X relies completely on cross-pollination.
D Species X is likely to be wind-pollinated.

22 The table shows the results of some tests on body fluids P, Q and R.

Body fluid	Test		
	Chloride	Reducing Sugar	Protein
P	+	+	+
Q	+	+	–
R	+	–	–

Where are P, Q and R taken from?

	P	Q	R
A	Glomerulus	Loop of Henle	Collecting duct
B	Bowman's capsule	Loop of Henle	Collecting duct
C	Glomerulus	Bowman's capsule	Distal convoluted tubule
D	Loop of Henle	Distal convoluted tubule	Collecting duct

23 Which of the following examples of negative feedback is incorrect?

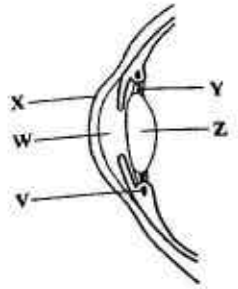
A A cessation of shivering when body temperature has increased back to normal.

B A decrease in the production of sweat when body temperature has decreased back to normal.

C A reduction in the secretion of antidiuretic hormone when the water potential in blood has increased back to normal.

D A reduction in the secretion of insulin when blood glucose concentrations have increased back to normal.

24 The diagram shows a section of a human eye focused on a near object.



Which part(s) will change such that light falls onto the fovea sharply when the person looks at a distant object?

A Z only

B V, Y and Z

C X, and Y

D X, Y and Z

25 Adrenaline is sometimes given to patients. In which of the following conditions would the administration of adrenaline be useful?

1 low heart rate
2 low blood sugar
3 low water potential

A 2 only

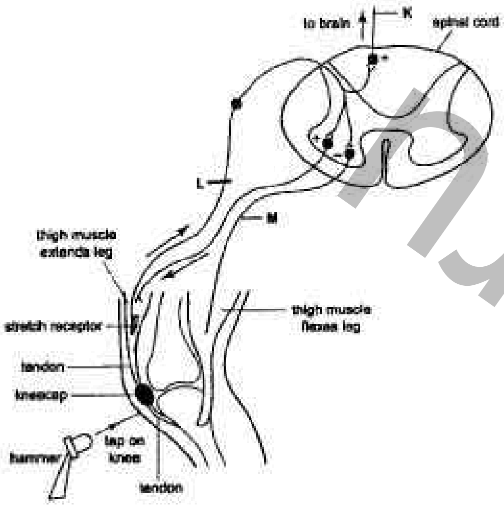
B 1 and 2 only

C 2 and 3 only

D All of the above

26 When muscle fibres are stimulated, the muscle contracts. The gentle tapping of a tendon stimulates stretch receptors. The response to this stimulation is a 'knee jerk' reflex action. That is, the leg suddenly straightens.

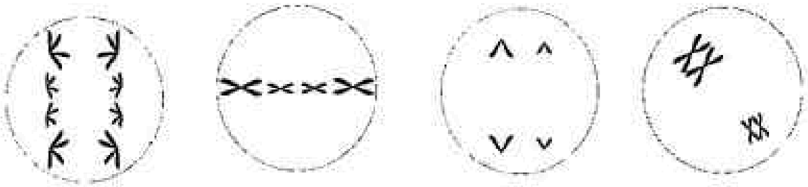
The pathway involved is shown in the diagram below.



Examination of this pathway reveals that

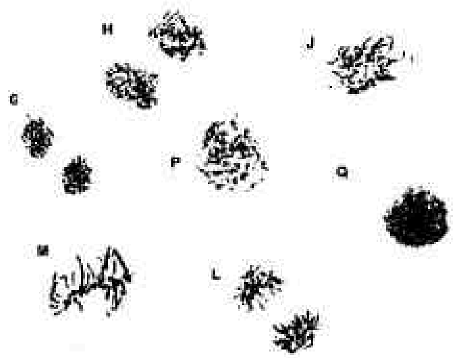
- **A** Inhibition of neurone M will allow the leg to bend.
- **B** Injury to neurone L is unlikely to affect the knee jerk response.
- **C** Cutting the neurone at point L has no effect on the knee jerk response.
- **D** Stretching of the tendon in one knee initiates the response in the other knee.

27 Which one of the following diagrams represents a cell that has a diploid number of 4 and is undergoing mitosis?



A B C D

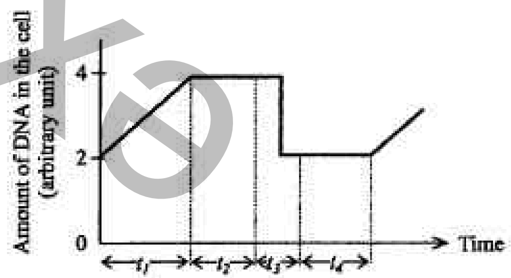
28 The following images show plant cells from a tissue that is undergoing mitosis.



The order of the cells in a single mitotic phase would be

- **A** Q H J P L G M.
- **B** Q P J M L G H.
- **C** P Q M G J L H.
- **D** P G L M J Q H.

29 Which of the following statements correctly describes the event that is taking place in the respective time period?



- **A** During t_1, the nuclear membrane disappears.
- **B** During t_2, the homologous chromosomes pair up.
- **C** During t_3, the homologous chromosomes separate.
- **D** During t_4, the synthesis of cell organelles takes place.

30 The ABO blood group system of humans is an autosomal trait that has three alleles as follows.

I^A : protein A on red blood cells

I^B : protein B on red blood cells

I^O : no protein on red blood cells

In this system, four different blood groups exist. They are groups A, B, AB and O. In a family of four children, each child has a different blood group with respect to this gene. The phenotypes of the parents must be

A A and B.

B AB and O.

C B and AB.

D O and B.

31 Flamingos are birds that live by lakes. The feather colour of flamingos may vary from white to pink to red. To investigate the inheritance of feather colour, a scientist performed the following crosses and recorded the feather colour of all the offspring when one year old. The diet of the offspring was also recorded.

Cross	Feather colour of parents	Feather colour of all one-year-old offspring	Diet of offspring
1	white × white	white	aquatic plants
2	red × white	white	aquatic plants
3	white × white	pink	algae and crustaceans
4	red × white	pink	algae and crustaceans

Based on this information, a correct conclusion would be that

A white feather colour is recessive to red feather colour.

B both the parents in cross 1 must be homozygous for white feather colour.

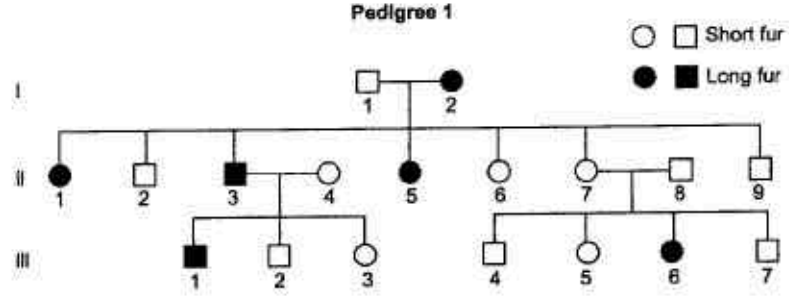
C the feather colour of flamingos is influenced by their environment.

D two parents, both with pink feather colour, would produce one-year-old offspring with only pink feather colour.

Questions 32 and 33 relate to the following information.

Fur length in rabbits is controlled by a single autosomal gene, where a dominant allele causes short fur and a recessive allele causes long fur. Pedigree 1 below shows the inheritance of fur length in a family of rabbits.

Pedigree 1



32 What is the probability that individual II-4 is a heterozygote for short fur?

A 0

B 0.50

C 0.75

D 1

33 Which one of the following individuals could be used to conduct a test cross with individual III-5?

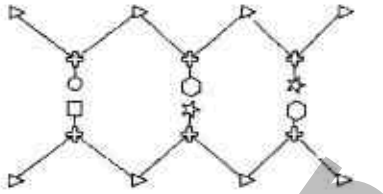
A II-2

B II-7

C III-1

D III-6

34 Refer to the following diagram, which shows a segment of DNA:



Which one of the following combinations identifies the symbols shown in the diagram above?

	✣	△	⬡	☆	○	□
A	phosphate	sugar	guanine	cytosine	adenine	thymine
B	sugar	phosphate	thymine	adenine	cytosine	guanine
C	sugar	phosphate	cytosine	thymine	guanine	adenine
D	phosphate	sugar	adenine	guanine	thymine	cytosine

35 Maize plants have been genetically modified to contain a gene which produces toxins to kill pests of plants. Which of the following arguments is not a valid reason for opposing the widespread use of this genetically modified plant?

A The inserted gene could cause mutations to occur in other parts of the plant chromosome.

B The inserted gene could become incorporated into the genome of weeds growing nearby.

C There is a risk that the modified chromosomes could cause the chromosomes in the cells of the consumers' body to mutate.

D Beneficial insects may inadvertently get killed.

36 Refer to the following table, which shows **mRNA codons** for amino acids:

First base in sequence ↓	Second base in sequence				Third base in sequence ↓
	U	C	A	G	
U	phenylalanine phenylalanine leucine leucine	serine serine serine serine	tyrosine tyrosine — —	cysteine cysteine tryptophan —	U C A G
C	leucine leucine leucine leucine	proline proline proline proline	histidine histidine glutamine glutamine	arginine arginine arginine arginine	U C A G
A	isoleucine isoleucine isoleucine methionine	threonine threonine threonine threonine	asparagine asparagine lysine lysine	serine serine arginine arginine	U C A G
G	valine valine valine valine	alanine alanine alanine alanine	aspartic acid aspartic acid glutamic acid glutamic acid	glycine glycine glycine glycine	U C A G

The base sequence **U A U** on

A DNA codes for tyrosine.

B tRNA codes for tyrosine.

C mRNA codes for isoleucine.

D tRNA codes for isoleucine.

37 Which of the following are possible advantages to using bacteria in sewage treatment?

1 Bacteria multiply quickly, thus producing a cheap and abundant source of enzymes.

2 Only one type of bacteria is required to provide the necessary enzymes for different kinds of waste.

3 It is possible to find bacteria that can break down waste under anaerobic or aerobic conditions.

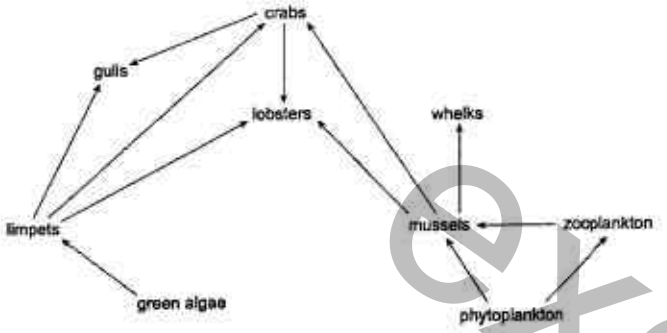
A 1 only

B 2 only

C 1 and 3 only

D All of the above.

The diagram shows a food web in a marine ecosystem. The arrows represent the flow of energy. Use the diagram to answer questions 38 and 39.



38 Which one of the following statements is ***Incorrect***?

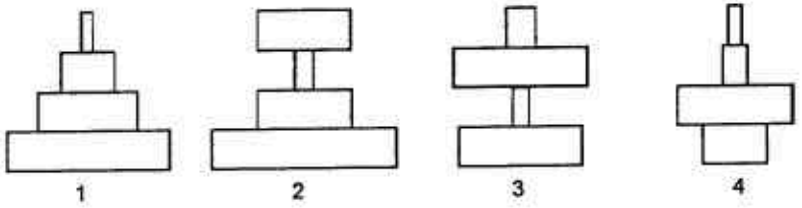
A Crabs belong only to the third trophic level.

B Lobsters belong to both the third and fourth trophic levels.

C Limpets and zooplankton belong to the same trophic level.

D Whelks and gulls both belong to one trophic level.

39 The diagram shows four ecological pyramids.



Which is the pyramid of biomass and which is the pyramid of numbers in this food chain: phytoplankton → zooplankton → mussels → whelks?

	Pyramid of biomass	Pyramid of numbers
A	1	1
B	1	4
C	3	2
D	4	1

40 Inorganic fertiliser is applied each year to fields bordering a lake. The fertiliser runs off into the lake and causes six changes which together make the fish die.

1 Aerobic bacteria feed on dead plants.

2 Algae reproduce faster.

3 Light cannot penetrate the water.

4 Oxygen levels fall.

5 Water becomes green.

6 Underwater plants die.

In which order do the changes take place?

A 2 → 5 → 1 → 6 → 4 → 3

B 2 → 5 → 3 → 6 → 1 → 4

C 3 → 6 → 1 → 4 → 2 → 5

D 4 → 6 → 1 → 2 → 5 → 3

END OF PAPER

Name: _____ Index Number: _____ Class: _____

TEMASEK SECONDARY SCHOOL
O Level Preliminary Examination 2015
Secondary 4 Express

BIOLOGY **5158/02**

Paper 2 **1 hour 45 minutes**

Question and Answer Booklet

Additional Material: Nil

READ THESE INSTRUCTIONS FIRST

Do not open the booklet until you are told to do so.

You are required to **submit this booklet** at the end of the examination.

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, graphs or rough working.

Answer all questions in this section.
Write your answers in the spaces provided.

You are advised to spend no longer than one hour for Section A and no longer than 45 minutes for Section B. The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	/50
Section B	/30
Total	/80

This document consists of **19** printed pages.

SECTION A (50 MARKS)

Answer ALL the questions in this section.

1 A student carried out an investigation on the effect of soaking time on the cleaning ability of a biological detergent.

(a) Which of the following would be part of his procedure for this investigation? [1]

Tick (√) the correct boxes.

	He used different types of cloths.
	He used a range of different temperatures.
	He used a biological detergent only.
	He used a non-biological detergent only.
	He used a range of soaking times.
	He used same type of stains.
	He used different volumes of stain.

(b) Fig.1 shows the results of an investigation into the effectiveness of a detergent at different temperatures.

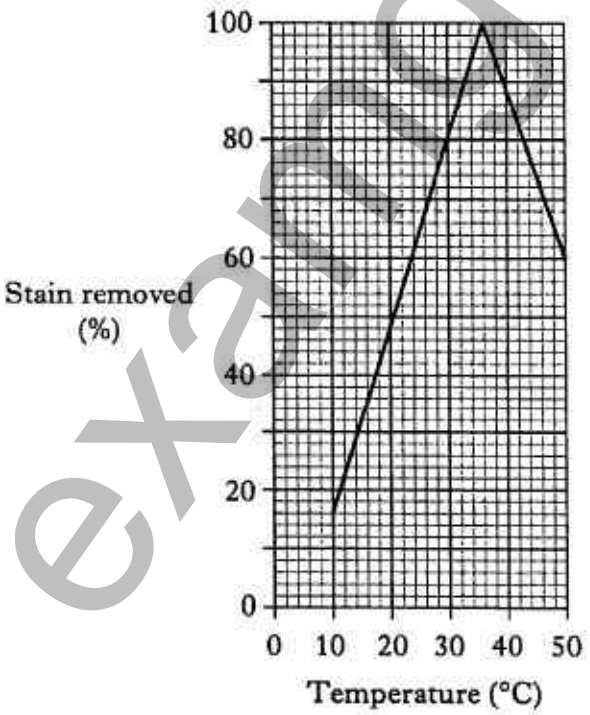


Fig.1

(i) Describe the effect of temperature on stain removal when using this detergent. [2]

.....

.....

.....

(ii) The washing machine has four temperature settings:

10°C 20°C 30°C 40°C

Circle the setting which would produce the best results using this detergent. Explain your answer. [1]

.....

(iii) With reference to Fig. 1, determine how many more times was this detergent more effective when the temperature was increased from 10°C to 30°C? [Show your working] [1]

.....

[Total: 5 marks]

2 Fig. 2.1 shows the blood pressure measured at different points of one blood vessel.

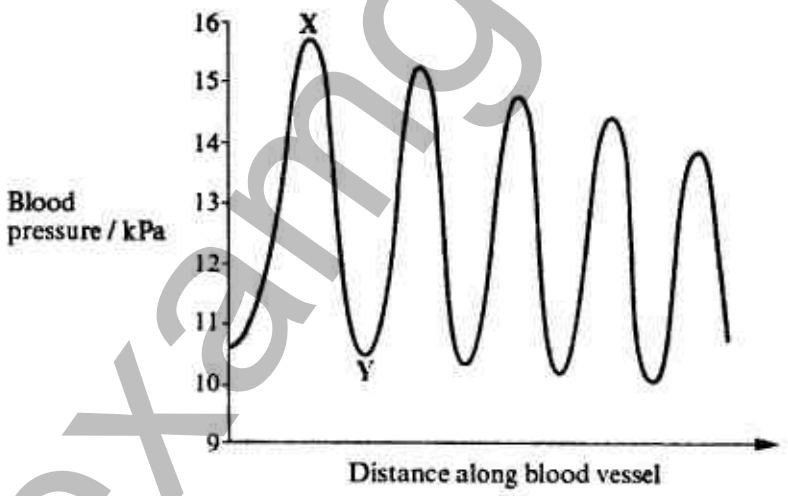


Fig.2.1

(a) (i) Name the type of blood vessel. [1]

.....

(ii) Explain the difference in blood pressure between points X and Y. [2]

.....

.....

.....

.....

Fig. 2.2 shows the external view of a human heart.

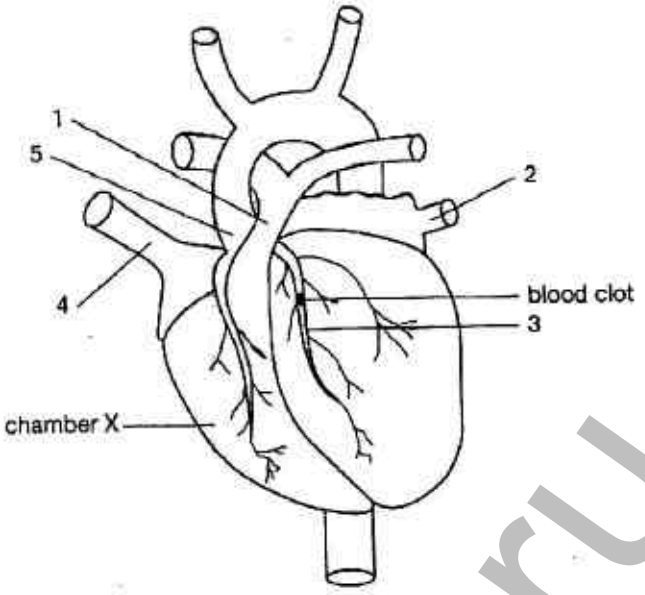


Fig. 2.2

(b) Using the numbers labelled in Fig.2.2, outline the route taken by a red blood cell to travel from chamber X to blood vessel 3.

Include the heart chambers and major organs that the red blood cell has to pass through. [1]

.....

(c) Explain the possible effect of the blood clot in blood vessel 3 on the heart. [2]

.....

.....

.....

.....

(d) Explain why a person who has lost a lot of blood in a car accident may suffer from kidney failure. [2]

.....

.....

.....

.....

[Total: 8 marks]

3 In an investigation of the transport of organic nutrients in plants, one leaf on each of two similar plants was supplied with a jar containing radioactive carbon dioxide, $^{14}CO_2$.

Fig. 3.1 shows the set up. The stem of plant B was ringed below the treated leaf by removing the bark while stem of plant A was not ringed. The plants were allowed to carry out photosynthesis in sunlight for 2 hours.

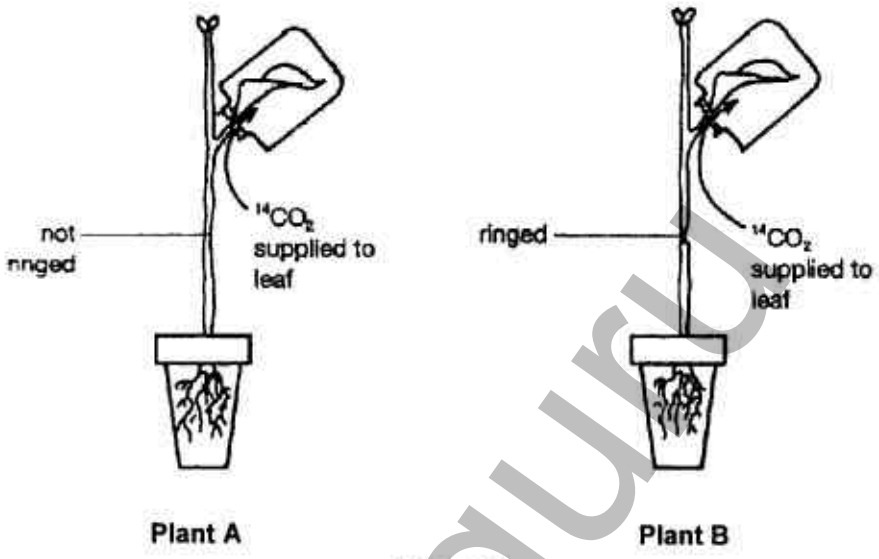


Fig. 3.1

Table 3.2 shows the radioactivity in the treated leaf and in the roots of the two plants after 2 hours in sunlight.

	Radioactivity (ppm)	
Plant	Leaf	Root
A	0.15	0.12
B	0.15	0.00

Table 3.2

(a) Explain why the plants were allowed to photosynthesise for 2 hours. [2]

.....

.....

.....

(b) Name the major compound transported in the plants that contains the radioactive carbon. [1]

.....

(c) Explain why there is no radioactivity in the roots of plant B. [2]

.....

.....

.....

(d) Draw a labelled diagram showing the transverse section of the stem of plant B (above the ringed section). Shade the areas that carry radioactive compounds. [2]

[Total: 7 marks]

4 Fig. 4.1 shows some of the amniotic fluid surrounding a fetus being withdrawn using a syringe.

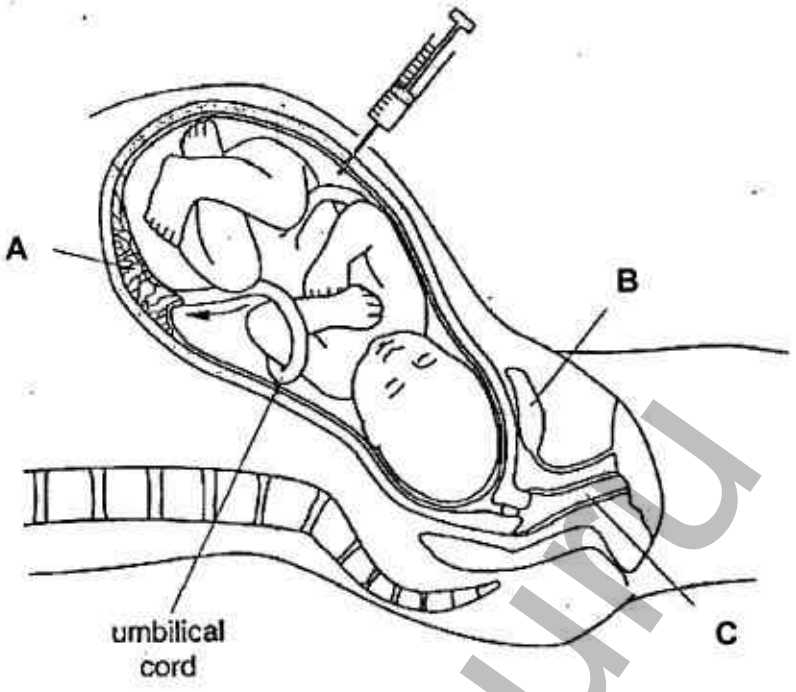


Fig. 4.1

(a) Name structures **B** and **C**. [1]

B: ..... **C:** .....

(b) With reference to the direction of the arrow in Fig.4.1,

(i) state a substance which is carried by the blood in the umbilical cord.

substance: ..... [1]

(ii) name the blood vessel which carries the substance mentioned in **(b)(i)**.

blood vessel: ..... [1]

(c) Explain why the blood vessels between the fetus and the mother are not in direct contact in part labelled **A**. [2]

.....

.....

.....

.....

Fetal cells collected from the amniotic fluid may be analyzed to determine if the fetus suffers from any genetic diseases. Fig. 4.2 shows the karyotype – a photomicrograph of the entire collection of chromosomes - obtained from one of these cells.

Fig. 4.2

(d) It was diagnosed that the fetus has inherited a genetic disorder.

State the condition and explain how this condition arose. [3]

.....

.....

.....

.....

.....

.....

[Total: 8 marks]

5 Fig. 5.1 shows the longitudinal section of an insect-pollinated flower and Fig. 5.2 shows the transverse section of the flower bud of the same species of insect-pollinated flower.

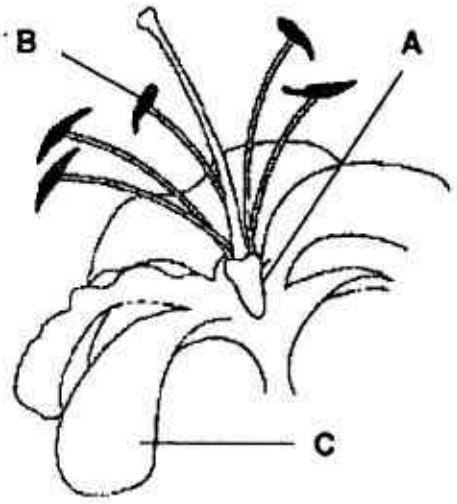


Fig. 5.1

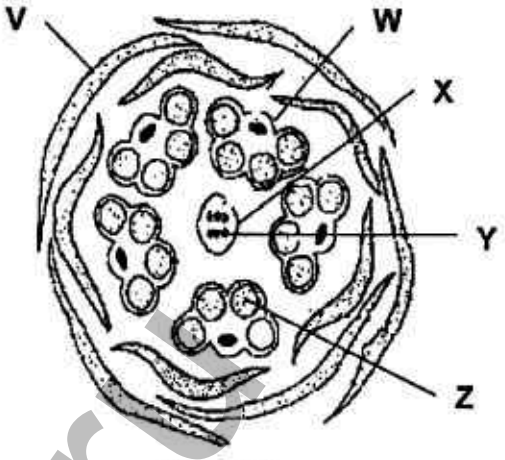


Fig. 5.2

(a) Suggest two possible methods that may be used by this flower to avoid self-pollination. [2]

.....

.....

(b) State and explain one disadvantage of self-pollination. [1]

.....

.....

(c) With reference to Fig. 5.1 only, state one feature that shows the flower is pollinated by insects. [1]

.....

.....

(d) Identify the labelled parts in Fig. 5.2, which are equivalent to parts A, B and C in the Fig. 5.1 respectively. [2]

Parts	Equivalent Parts from Fig. 5.2
A	
B	
C	

(e) Describe how the number of chromosomes in Y and Z differ from the number of chromosomes in cells of structure V. [1]

.....

[Total: 7 marks]

6 **(a)** Two students, Daniel and Laura are revising the topic on DNA and Genetic Engineering. Laura argued that, "DNA and genes are the same.", however, Daniel disagreed.

Who would you agree with? Explain your answer. [2]

.....

.....

.....

.....

(b) Genetically modified organisms (GMO) are organisms whose genetic materials have been altered by human. The most commonly used technology is recombinant DNA technology. The foods produced from genetically modified organisms are called genetically modified foods (GM foods).

Golden rice is one of the GM foods. Betacarotene biosynthesis (BB) genes were inserted into rice genome using recombinant DNA technology. After modification, golden rice can naturally produce beta-carotene, which can be converted into vitamin A later on.

Fig. 6.1 shows the stages involved in the insertion of a BB gene into a bacterium.

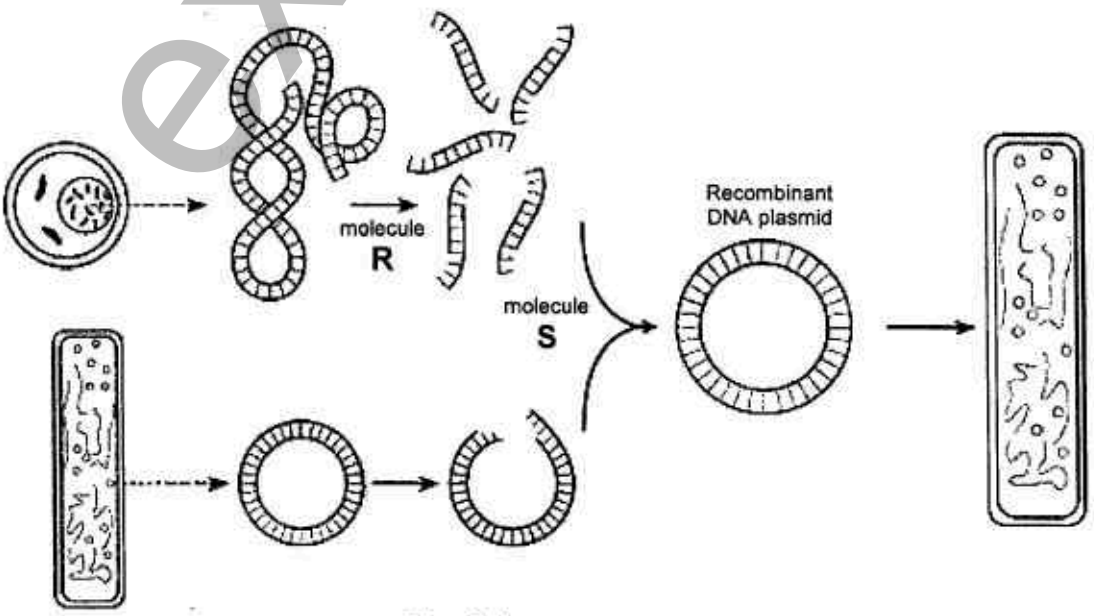


Fig. 6.1

(i) Identify molecules **R** and **S**.

R: ..... **S:** ..... [2]

(ii) Explain why the same molecule R is be used to obtain the Betacarotene biosynthesis gene. [2]

.....

.....

(iii) Give two disadvantages of developing golden rice. [2]

.....

.....

.....

.....

[Total: 8 marks]

7 Read the passage below and answer the questions that follow:

Albinism is a genetic disorder, which can affect all vertebrates, including humans. Affected individuals will appear white since they cannot produce enough melanin pigments in their skin. Albinism occurs when there is a mutation and thus result in the passing down of recessive mutated gene to their offsprings. Albinism can also be found in animals such as birds and reptiles. The survival rate of the animals with albinism is usually very low in nature.

(a) Define the term *Mutation*. [1]

.....

.....

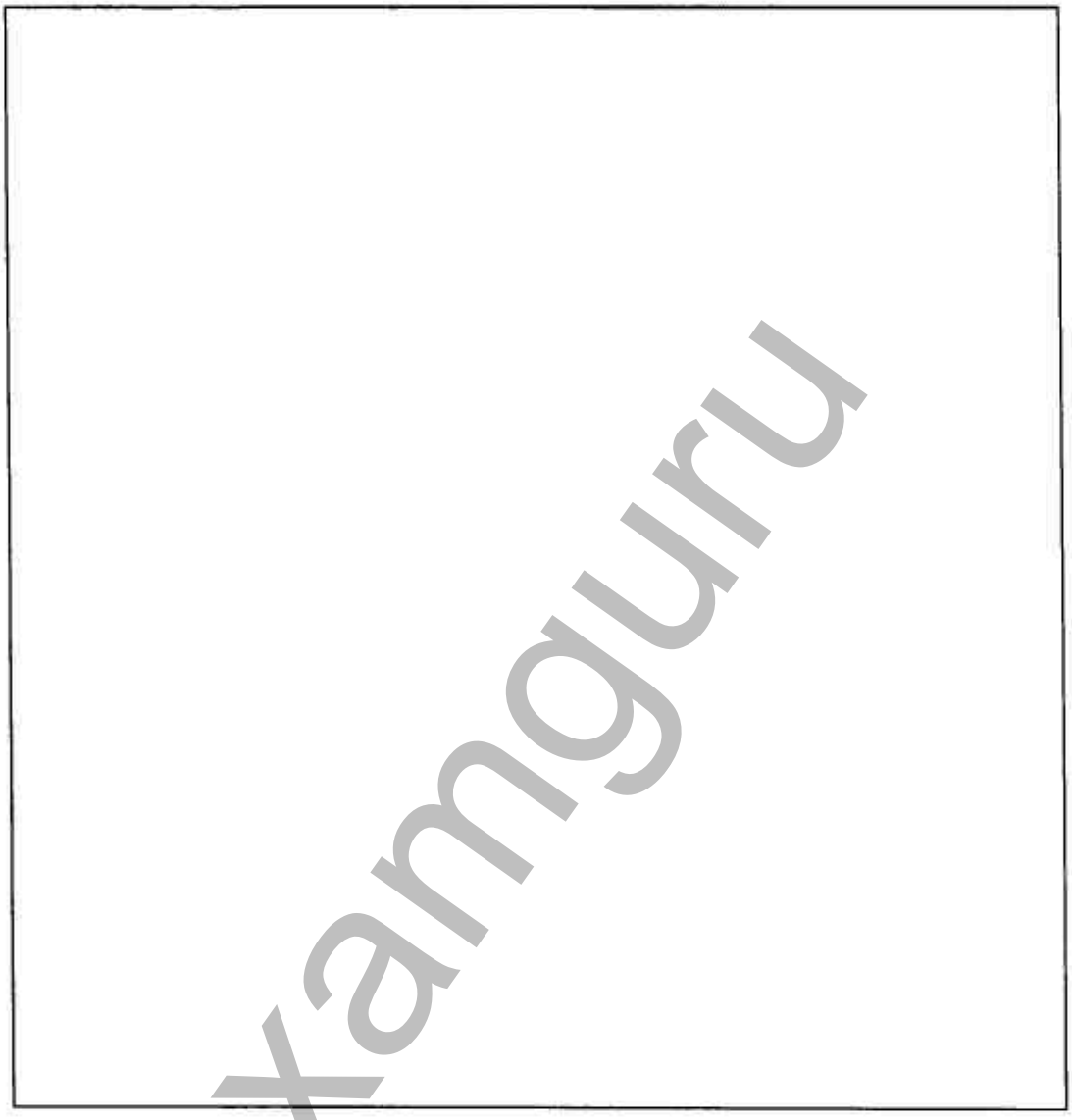
(b) Suggest why is the survival rate of animals with albinism is usually very low in nature. [1]

.....

.....

.....

(c) (i) With the help of a genetic diagram, explain how parents who are normal are able to produce an albino child. [4]



(ii) What is the probability of the parents having a first child who is normal and a second child affected by Albinism? [1]

.....

[Total: 7 marks]

SECTION B (30 MARKS)

Answer THREE questions in this section.
Question 10 is in the format of an EITHER / OR question. Only one part should be answered.

8 Two athletes, R and S, carried out a six-month training programme in preparation for the 2015 SEA games. The fitness of the two athletes was tested on the first day of each month by measuring their rate of oxygen absorption. An increase in fitness is shown by an increase in the rate of oxygen absorption.

The rate of oxygen absorption was measured for each athlete during exercise. Table 8.1 shows the results of these fitness tests.

Month of training programme	Rate of oxygen absorption (cm^3 per kg per min)	
	Athlete R	Athlete S
1	39.0	59.0
2	45.0	62.5
3	50.0	67.5
4	53.0	70.7
5	53.0	70.8
6	53.0	70.8

Table 8.1

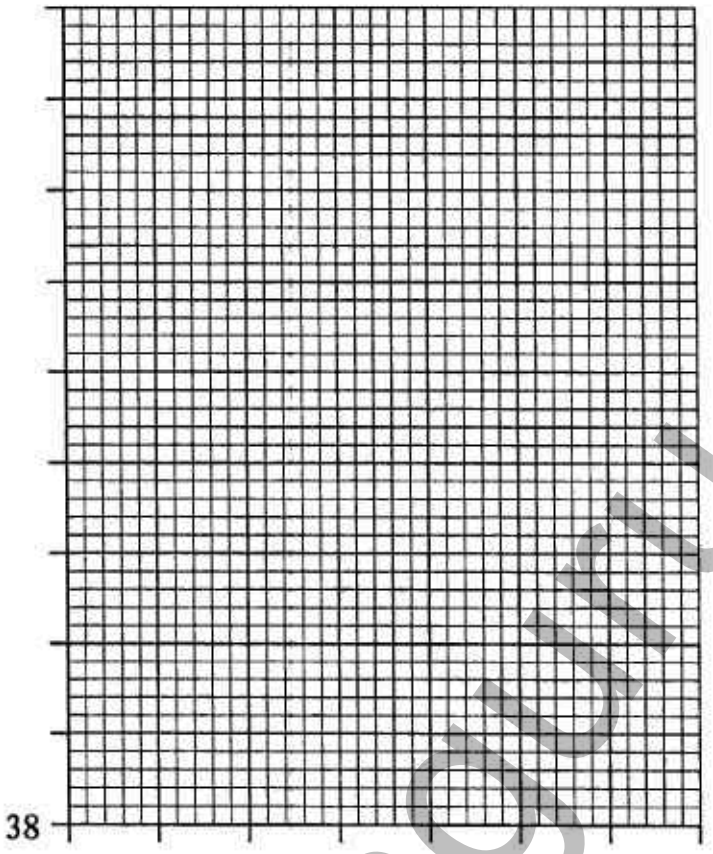
(a) State which athlete has benefitted most from the training programme. Justify your answer. [1]

.....

(b) Calculate the volume of oxygen absorbed per minute by **athlete R** when tested in the 6^{th} month. Athlete R had a mass of 60 kg. [Show your working] [2]

Volume of oxygen absorbed per minute: .....

(c) Construct a **line graph** to show the results for **athlete R**. [3]



(d) From the results, it was concluded that fitness levels improve in the first months of training and then remain constant.

Suggest **one** way in which the reliability of this conclusion could be improved. [1]

.....

(e) Runners who smoke are advised to quit smoking when they train for marathons. Explain the impact of smoking on running. [3]

.....

.....

.....

.....

.....

.....

[Total: 10 marks]

9 The picture shows a modern swordfish.

Ancestors of swordfish had short swords. Modern swordfish have long swords. Swordfish use their swords to injure prey. The injured prey is easier to catch.

The information below shows one theory of how the length of the sword of swordfish changed.

The sword grew longer as each swordfish used its sword more and more. Swordfish reproduced, the longer sword was passed on to its offspring.

(a) Darwin suggested that evolution is a result of natural selection. Describe how natural selection could result in modern swordfish with long swords developing from ancestors with short swords. [4]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Predatory ocean fish such as tuna and swordfish are common examples of mercury bioaccumulation.

With reference to the food chain shown below,

Phytoplankton → Krill → Pollock → Tuna → Shark

explain how bioaccumulation arises and why it is detrimental to the organisms on the higher trophic level and its environment. [3]

.....

.....

.....

.....

.....

.....

.....

(c) Explain why the ocean gives out less carbon than it takes. [3]

.....

.....

.....

.....

.....

.....

.....

.....

[Total: 10 marks]

10 **EITHER**

(a) Explain why blood must always be screened for blood types before transfusions. [3]

.....

.....

.....

.....

.....

.....

.....

(b) With reference to the skin, blood and epithelial cells of the body, outline how the body is protected from invasion by foreign particles. [7]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[Total: 10 marks]

10 OR

(a) Explain why it is important to drink water daily. [3]

.....

.....

.....

.....

.....

.....

.....

(b) Blood is an important part of the body's internal environment.

Outline the homeostatic mechanisms that regulate blood in terms of its glucose level and water potential. [7]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[Total: 10 marks]

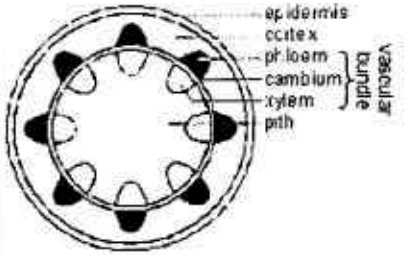
TEMASEK SECONDARY SCHOOL
Preliminary Examinations 2015
Secondary 4 Express Biology

Paper 1 Answers

1	B	11	C	21	C	31	C
2	B	12	C	22	C	32	D
3	A	13	B	23	D	33	C
4	B	14	D	24	B	34	B
5	D	15	B	25	B	35	A
6	C	16	B	26	A	36	D
7	C	17	C	27	B	37	C
8	D	18	A	28	B	38	A
9	C	19	C	29	D	39	D
10	A	20	B	30	A	40	B

Paper 2 Section A (50 marks)

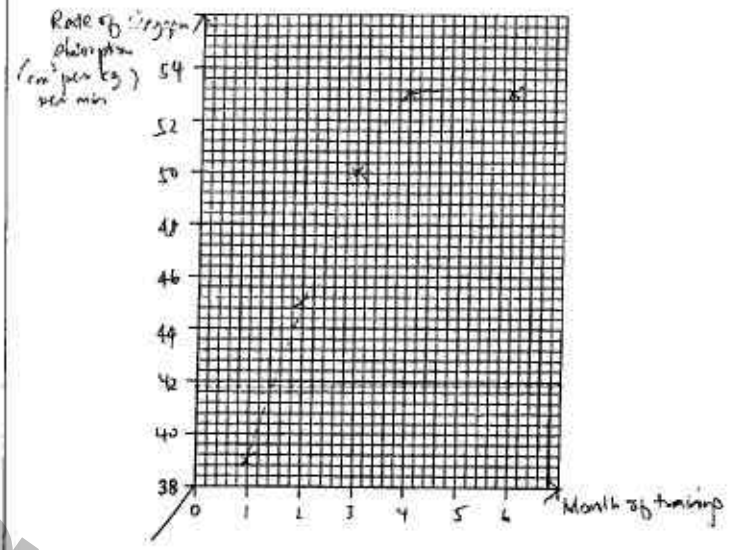
Qn		Marks
1(a)		1 (1 or 0)
√	He used a biological detergent only.	
√	He used a range of soaking times.	
√	He used same types of stains.	
1(b)(i)	As temperature rises from 10 °C to 36 °C, % of stained removed increases. 36 °C is the optimal temperature for stain removal. As temperature increases further, less stain gets removed.	1 1
1(b)(ii)	40 °C The % of stain removed is highest at 40 °C	1
1(b)(iii)	(80 – 16)/ 16 = 4x	1
2(a)(i)	artery	1
2(a)(ii)	blood pressure is higher at point X due to the forceful contractions of the heart muscles which send blood out into the artery at high pressure. whereas At point Y, blood pressure is lower due to stretching of the arterial walls by the elastic fibres when blood passes through.	1 1
2(b)	X, 1, lung, 2, left atrium, left ventricle, 5, 3	1 (1 or 0)
2(c)	Reduced blood flow to heart muscles will send less oxygen and glucose to the heart muscles to provide energy for muscular contractions resulting in heart failure.	1 0.5 0.5
2(d)	Kidney requires a consistent flow of blood to maintain a constant blood pressure to enable ultrafiltration. When there is an excessive loss of blood, this may results in a drop in pressure, thus affecting the removal of waste products/ regulatory function of kidneys.	1 1
3(a)	To allow plants time to absorb $^{14}CO_2$ into the leaves to form glucose via photosynthesis and to spread/ transport the radioactive compounds throughout the plant.	2
3(b)	Sucrose	1
3(c)	Radioactive compounds are transported along phloem tissues, which is blocked by the ringed section.	1 1

3(d)	 Black shaded part – radicactive substances Drawing: 1m (need to label vascular bundle: phloem, cambium, xylem)	2
4(a)	B: urinary bladder C: vagina	0.5 0.5
4(b)	Substances: Urea or carbon dioxide; (Waste products is given 0.5m) Blood vessel: Umbilical artery (Artery is given 0m)	1 1
4(c)	Any 2 of the 3 answers: So that the high blood pressure / sudden surge in blood pressure of mother's blood will not affect the fetus. Different blood group of mother and fetus; if allowed to mix, antibodies in the mother's blood may cause fetal blood cells to agglutinate. A non-continuous system will reduce the chance for toxic substances to be passed to the fetus.	2
4(d)	• Down syndrome/ Trisomy 21 • Non-separation of chromosome number 21 occurred during meiosis/formation of egg (gamete) in the ovary. • This results in one of the eggs having 24 chromosomes/ extra copy of chromosome 21. • When this egg is fertilised, it results in a zygote with 47 chromsomes/ 3 copies of chromosome 21.	1 1 1
5(a)	• Stigmas and anthers mature at the different times • stigmas may be situated some distance away from the anthers/ stigma is situated higher than the anthers.	2

	• open flowers	
5(b)	Less genetic variation in the offspring as compared to cross-pollination; thus they will be less adapted to changes in the environment. OR Probability of harmful recessive alleles being expressed in the offspring is higher, offspring becomes weaker/less resistant to diseases.	0.5 0.5
5(c)	Large and conspicuous petals; Small and compact stigma; Stigma that do not protrude out of the flower; Non-pendulous stamens/ Stamens that do not protrude out of the flower	1
5(d)	A: X B: W C: V	2
5(e)	Y and Z is haploid while V is diploid/ Y and Z have half the number of chromosomes compared to V.	1
6(a)	Laura is wrong: DNA and genes are different DNA contains chains of nucleotides linked together that carries genetic information about an organism, whereas genes are specific sections of a DNA molecule, that codes for specific protein/ trait.	1 1 1
6(b)(i)	R: restriction enzyme S: DNA ligase	1 1
6(b)(ii)	The same enzyme produces the same sticky ends. Complementary sticky ends on donor gene bind with sticky ends of the plasmid.	2
6(b)(iii)	Disadvantages: **Super-weed** The new golden rice crops may interbreed with weeds around the fields, and pass on resistance to herbicides and become a superweed. **Allergies** New proteins in GM food may cause allergies in humans that consume them. **Toxic/ cancer-causing** to people consuming them. This is due to modifying a single gene which could result in alternation of metabolic processes, resulting in the production of toxins not usually found within these plants.	2

	Cost of seeds Engineered crop plants produce seeds that cannot germinate. Farmers have to buy special seeds every year. This poses a serious problem to poorer societies, where farmers are struggling to make a living. *Reject answers that states bioethics concerns/ social classes (eg golden rice will be sold at a very high price).*	
7(a)	Mutation is the spontaneous/sudden change in gene structure/ chromosome or chromosome number.	1
7(b)	Animals with albinism may lose their protective camouflage in the wild/ nature and are therefore unable to hide from their predators/ prey.	1
7(c)	Let A be allele for normal , a be allele for albinism Parents Phenotype: Normal x Normal Parents Genotype: Aa x Aa Gametes: A, a, A, a F1 Genotype: AA, Aa, AA, aa F1 Phenotype: normal, normal, normal, albino Phenotypic ratio: 3 normal : 1 albino	4
7(d)	Probability of 1st child normal and 2nd child albino is ¾ X ¼ = 3/16 = 18.75% (or 0.1875)	1

	SECTION B (30 MARKS)	
8(a)	Athlete R Has Greater gain in rate of oxygen absorption of 14cm^3/kg/min than Athlete S with 11.8cm^3/kg/min	1
8(b)	53 cm^3 x 60 kg x 1 min = 3180 cm^3 / min [correct unit]	2

8(c)	Axis/ Labelled - 1 All points correct - 1 Smooth curve - 1  	3
8(d)	Allow a few more athletes to take part in the fitness programme and then take the average	1
8(e)	**Increases airway resistance** • Tar coats the lungs, reducing the elasticity of the air sacs and resulting in the absorption of less oxygen into the bloodstream. • This Lowers lung capacity and results in shallow breathing or • Smoking also causes chronic swelling of the mucous membranes of the airways, • less oxygen is taken into the lungs, which increases airways resistance; reduces maximum oxygen uptake capacity. **Carbon monoxide** competes with oxygen/ Lowers absorption of oxygen/ reduced physical endurance • Carbon monoxide in smoke competes with oxygen to bind irreversibly with Haemoglobin, this reduces the oxygen carried to the body cells, which is needed for aerobic respiration. • This may then reduce the maximal oxygen uptake capability	3

	developed during exercise training. • With less oxygen to meet the energy demands, this diminishes performance, adds fatigue and reduces endurance Any point [how tar, carbon monoxide affect oxygen uptake]	
9(a)	• Genetic variation exists with the swordfish populations. Some had shorter swords, while others have longer. • When there is a struggle for existence / environmental conditions change, some varieties may be better adapted and are able to survive . • Thus those with longer swords survived, live longer and reproduce to pass on their favourable genes with long swords to their offsprings while the weaker individuals die off (survival of the fittest) • Over time, the swordfish with long swords become the predominant ones in their environment, resulting in evolution of a species over many generations.	4
9(b)	Source, Transfer, Impact: • Mercury is found naturally at very low levels in ocean waters./ It is introduced into the environment by natural events such as volcanic eruptions and forest fires/ or dumped into the sea by industries • Mercury is not soluble in water • It tends to build up over time in organisms that are continually exposed. • E.g. Organisms like phytoplankton first absorbs mercury in ocean waters. • When krill and Pollock eat contaminated organisms, they take in the mercury their prey contained as it is non-biodegradable; and cannot be excreted. • Tuna farther up the food chain are exposed to higher and higher concentrations which becomes toxic and can cause death. When top predators are killed, this upsets the ecological balance.	3
9(c)	• Atmospheric carbon dioxide readily dissolves in water and the oceans provide a huge reservoir of carbon/ acts as a carbon sink. • Dissolved carbon dioxide is used by phytoplanktons and algae for photosynthesis. • Carbonates are formed when carbon dioxide reacts with seawater which eventually form sediments, limestone and rocks; and is stored for a long period of time. • Although underwater organisms respire and give off carbon dioxide,	3

	it is readily absorbed by aquatic plants/ phytoplanktons for photosynthesis • Carbon compounds are also buried in seabed as fossil fuels . Only when fossil fuels / oil are tapped from the seabed, carbon compounds will not be released. [Any 3]	
Either 10(a)	Blood compatibility Each blood type carries different surface antigens and antibodies. If 2 different types of blood type are mixed, agglutination occurs. This results in blood clots, reduces transport of oxygen to body cells for cellular respiration, may result in death. To check for viruses carried / transmitted by blood e.g. HIV that may infect the recipient	3
10(b)	Skin – largest protective organ made of **multiple layers of tissue**, intact, **prevents foreign invades** from entering into blood stream easily Blood – white blood cells (phagocytes and lymphocytes) Lymphocytes - secretes antibodies to clump bacteria together (agglutination), to enable phagocytes to carry out phagocytosis by engulfing, ingesting and digesting bacteria. Platelets – presence of platelets help to trigger a series of reaction to active enzymes(thrombokinase) when there are damaged tissues. This allows insoluble fibrin threads to form, which forms a mesh to trap blood cells, plug wounds and prevent entry of bacteria/ and excessive loss of blood. Ciliated epithelial cells on respiratory tract, traps dust/ mucous secreted traps bacteria, which can be coughed out to rid off bacteria Slits on epithelial cells allow phagocytes to migrate to site of infection to engulf bacteria.	7
Or 10(a)	• Essential component of protoplasm, lubricants, digestive juices and blood • As a solvent/ transport medium in plasma • Maintains water potential in blood plasma, prevents cells from being crenated • Keeps cells hydrated • Water is essential to activate many enzymatic reactions in cells • Helps to regulate body temperature when sweat forms evaporates off, removing latent heat from body. [Any 3]	3

10(b)	When blood glucose level is low, glucagon is secreted from islets of Langerhans in pancreas, stimulates liver to convert stored glycogen to glucose. More glucose is made available to tissues. When blood glucose level is high, this stimulates the islets of Langerhans in pancreas to secrete insulin, which increases permeability of cells to absorb glucose. Liver then converts excess glucose to glycogen and stored it. Thus restores the blood glucose level. When water potential is low in blood plasma, it stimulates the hypothalamus, which in turn stimulates the pituitary gland to secrete more ADH to into blood stream, allows more reabsorption of water at the kidney tubules (collecting duct). This allows water potential in blood plasma to be restored back to normal. When water potential in blood plasma is high (due to a cold day, less water is lost through sweating), this stimulates the hypothalamus, which then stimulates the pituitary gland to secrete less ADH, less water is reabsorbed at the kidney tubules, allowing more urine to be produced and release from the body. This helps to restore the water potential in blood plasma.	7

9. OR

(a) Explain how mutation and natural selection applies to the occurrence of sickle-cell anaemia in human.

[5]

(b) A variety of rice plant has developed pest-resistance through the procedure of transferring a gene from a fungus to a rice plant. The gene allows the plant to produce a toxin that kills grasshoppers.

Outline the steps necessary to transfer the gene from the fungus to the rice plant.

[5]

END OF PAPER

9. **EITHER**

(a) State a circumstance under which adrenaline may be secreted and the main effects it has on the body.

[5]

(b) The human body is controlled by both the nervous system and the endocrine (hormonal) system. Outline the main differences between these two systems.

[5]

8. A student investigated the flow of biomass and energy on a farm in a country where winters are very cold. The farm grows barley to feed the animals, which are kept in sheds where they are not allowed to move very much.

The student investigated the efficiency of this method of producing food for humans.

The student found that an area of 150 m^2 of barley provided 70 kg of animal feed from the barley crop.

Table 8.1 shows the results of the investigation.

area of barley field / m^2	150
energy from the Sun that is available to the barley crop /kJ	45 000 000
biomass of animal feed from the harvested barley crop / kg	70
energy in 70 kg of animal feed / kJ	1 000 000
increase in mass of animals fed 70 kg feed / kg	25
energy in 25 kg meat that is available to humans / kJ	190 000

Table 8.1

(a) **Table 8.1** shows how much energy the barley crop receives from the Sun while it is growing in the field.

Suggest a reason why only a small proportion of that energy is available in the animal feed from the harvested barley.

.....

..... **[1]**

(b) Calculate the energy in the meat that is available to humans, as a percentage of the energy in the animal feed. Show your working.

..... % **[2]**

(c) Using relevant data provided, explain why it is more efficient for humans to gain their food from the first trophic level rather than from the second tropic level.

.....

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

(d) Synthetic nitrogen fertilisers are often used by farmers to improve their barley yield. Explain what may happen if an excess of these fertilisers run into water bodies.

.....

.....

.....

.....

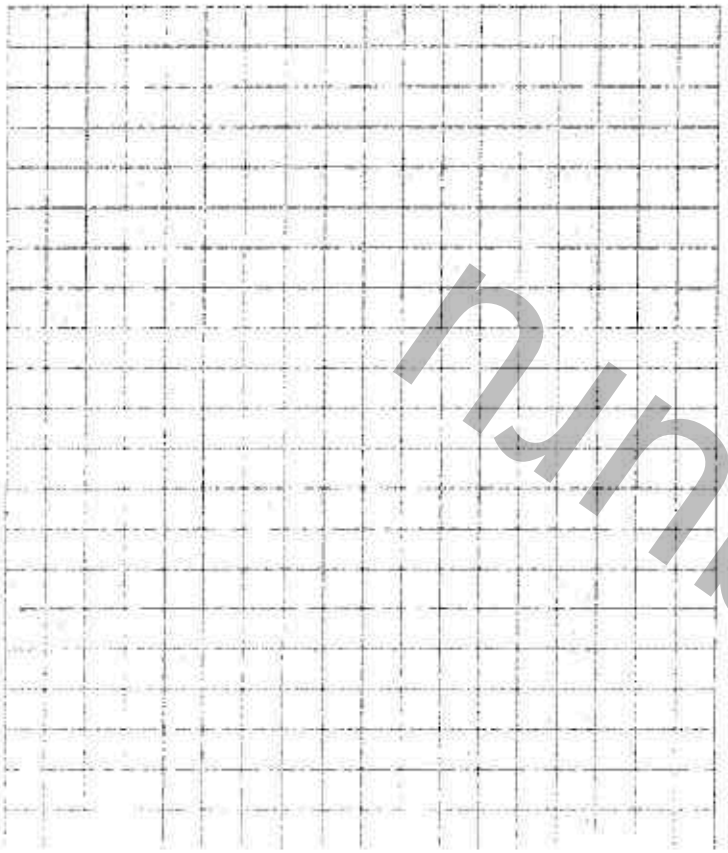
.....

.....

.....

.....

..... **[4]**



[4]

(b) Which **two** crop plants show the greatest difference between rate **X** and rate **Y**?

..... and ..... [2]

(c) The measurements of the rate of photosynthesis (**X**) of the plants when grown outside are means of 10 readings.

Suggest a reason why mean measurements were used.

.....

..... [1]

(d) Suggest **two** factors that were changed when the plants were grown in controlled optimum conditions.

1. .....

2. ..... [2]

(e) The rate of photosynthesis can be measured by:

- calculating the rate per unit area of the leaf

or

- calculating the rate per unit mass of the leaf

Suggest why these measurements may give different results.

.....

..... [1]

(ii) P and Q are all nuclear division processes. State whether each process represents mitosis or meiosis.

P: .....

Q: ..... [2]

(c) The male drones produced from the same queen bee are genetically dissimilar to one another. Explain how the cell division process gives rise to such drones.

.....

.....

.....

..... [2]

(d) A bee breeder is keen to use artificial selection to develop a local colony of mite-resistant bees. He acquires some Russian bees that demonstrate mite-resistance and allows them to cross-breed with a pure-bred strain of local mite-susceptible bees that produce high honey yield. Among the offspring produced, 52% demonstrated mite-resistance while the remaining 48% were mite-susceptible.

The allele for mite-resistance, **B**, is dominant over the allele conferring mite-susceptibility, **b**. (Assume both sexes are diploid for the purposes of this question.)

(i) State the possible genotypes of the parent bees used in the breeding programme.

Russian bees: .....

Local bees: ..... [2]

(ii) The breeder selected the mite-resistant bees among the F1 progeny and allowed them to breed to produce the next generation. State the expected phenotypic ratio of the F2 generation.

..... [1]

END OF SECTION A

SECTION B (30 marks)

Answer **THREE** questions from this section.

Question 9 *is the form of an* **EITHER / OR QUESTION**. ***ONLY ONE PART SHOULD BE ANSWERED.***

7. The rate of photosynthesis in six tropical crop plants was measured when the plants were growing outside normal conditions (rate **X**).

The measurements were repeated again when the plants were grown under controlled optimum conditions in a glasshouse (rate **Y**).

The results are shown in **Table 7.1**.

crop plant	rate of photosynthesis (X) /µmol per m^2 per second	rate of photosynthesis (Y) /µmol per m^2 per second	difference in rate of photosynthesis (Y - X) /µmol per m^2 per second
cassava	13.7	23.1	9.4
eucalyptus	18.4	26.0	7.6
maize	23.4	26.0	2.6
soya bean	18.3	25.1	6.8
sugar cane	24.0	26.8	2.8
sunflower	24.3	31.7	7.4

Table 7.1

(a) Draw a bar chart of the difference (**Y – X**) in the rate of photosynthesis of each plant on the grid found on the next page.

(a) Describe the pathway of nerve impulses, including references to **F** and **G**, to explain how John is able to see the approaching ball.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) (i) Identify neurone **H**.

..... [1]

(ii) Explain your answer to **(b)(i)**.

.....

..... [1]

(c) (i) Complete **Fig. 5.1** by drawing, in their correct positions and labelling, the structures involved to bring about John's response. [1]

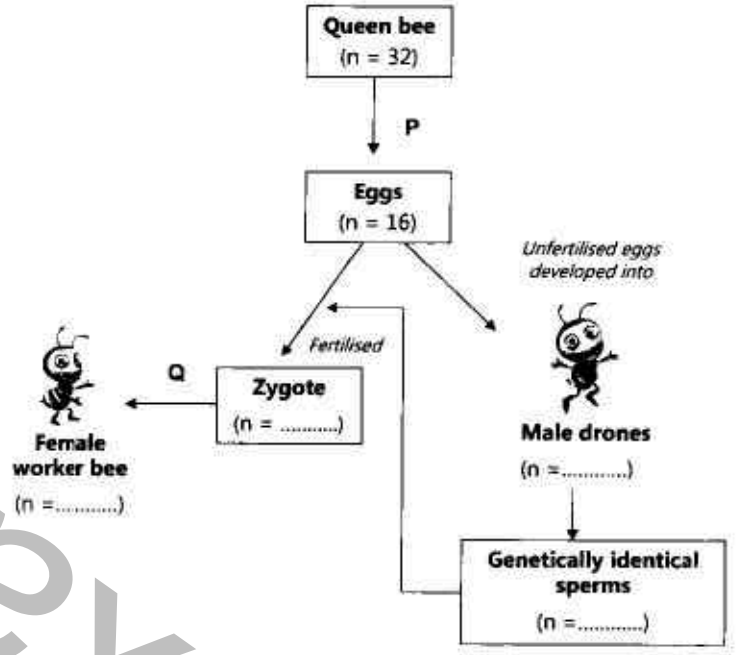
(ii) Add arrows to **Fig. 5.1** to show the pathway of nerve impulses to bring about John's response. [1]

(d) Identify the type of response made by John, when he moves his arm to catch the approaching ball.

..... [1]

6. Within the honey bee population, male drones are haploid while the female worker bees are diploid. Haploid drones produce haploid gametes. The function of the male drones is simply to mate with the queen bee to produce millions of worker bees.

Fig. 6.1 summarises how the male and female bees are produced.



* n – number of chromosomes

Fig. 6.1

(a) Explain what is meant by the term '*haploid*'.

.....

..... [1]

(b) In **Fig. 6.1**,

(i) state the number of chromosomes (n) in the life cycle by completing the blanks. [2]

(c) **Table 4.3** compares the concentration of urea found in the renal artery and in the ureter of 2 persons, **Q** and **R**.

Person	Concentration of urea/ g per 100cm^3		Total volume of urine formed /cm^3	Total amount of urea present in urine/g
	Renal artery	Ureter		
Q	0.04	1.90	250	4.75
R	0.07	2.30	220	

Table 4.3

(i) Complete **Table 4.3** for the total amount of urea present in Person R's urine. [1]

(ii) State one difference in urine composition between Person **Q** and Person **R** and suggest an explanation for this

.....

.....

.....

.....

.....

.....

.....

..... [3]

(d) State **two** general characteristics of the type of chemical substance produced by **X**

.....

.....

.....

..... [2]

5. **Fig. 5.1** shows a section through a mammalian eye, an organ **G** in the nervous system and part of the spinal cord and arm in John.

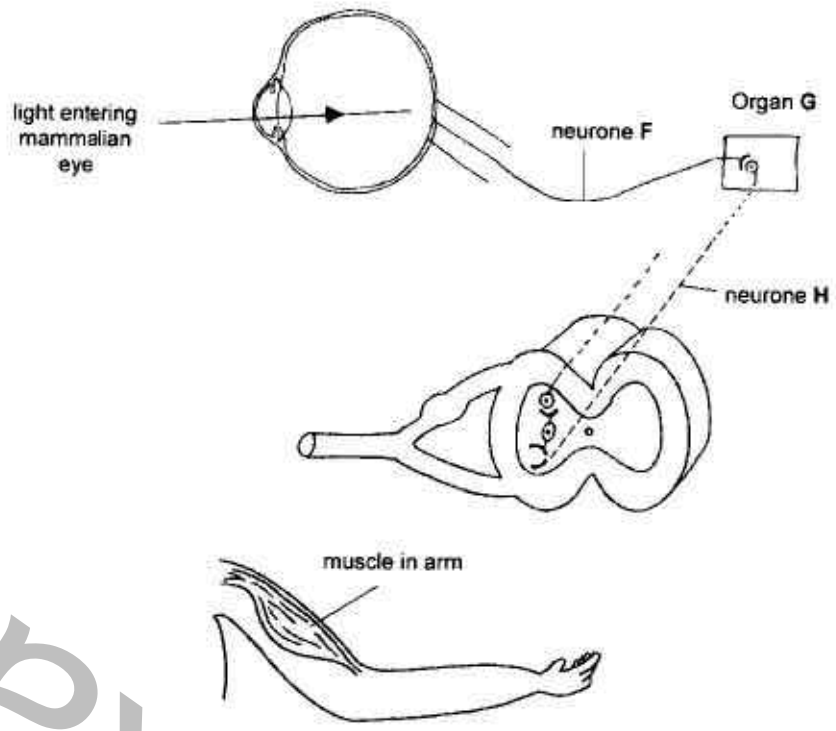


Fig. 5.1

Tom and John were playing a ball. Tom threw a ball towards John, who responded by moving his arm to catch it.

(b) The man who is a smoker noticed that he has been feeling breathless, wheezing and coughing more violently. Explain how a **named** component in tobacco smoke may cause these symptoms.

.....

.....

.....

.....

.....

.....

.....

..... [4]

4. **Fig. 4.1** shows the kidney and some associated structures.

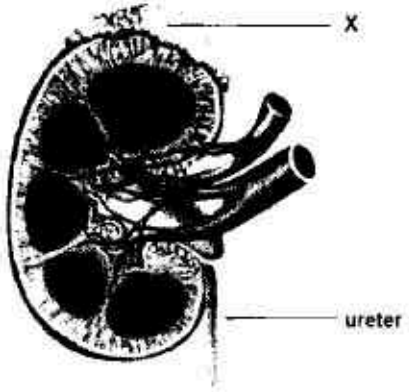


Fig. 4.1

(a) The kidney is involved in excretion. Explain how excretion is different from egestion.

.....

.....

.....

..... [1]

(b) **Fig. 4.2** shows part of the process in the kidney.

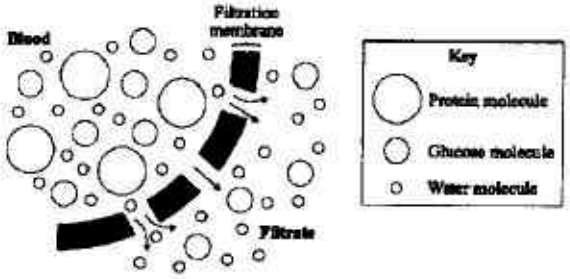


Fig. 4.2

Use information in **Fig. 4.2** and your own knowledge of how the kidney works to explain why the following molecules are not normally present in urine.

(i) Protein molecules

.....

..... [1]

(ii) Glucose molecules

.....

..... [1]

(ii) repeating the experiment with apparatus B

.....

..... [1]

(c) At which light intensity are the stomata fully opened? Explain how you deduce your answer from the graph.

.....

.....

.....

.....

.....

..... [3]

(d) If the water in apparatus **A** is replaced by seawater and left for 3 hours, describe and explain the resulting appearance of the leaves and stem of the shoot.

.....

.....

.....

.....

.....

..... [3]

3. **Fig. 3.1** shows the oxygen consumption of a man during a 30-minute period of vigorous exercise.

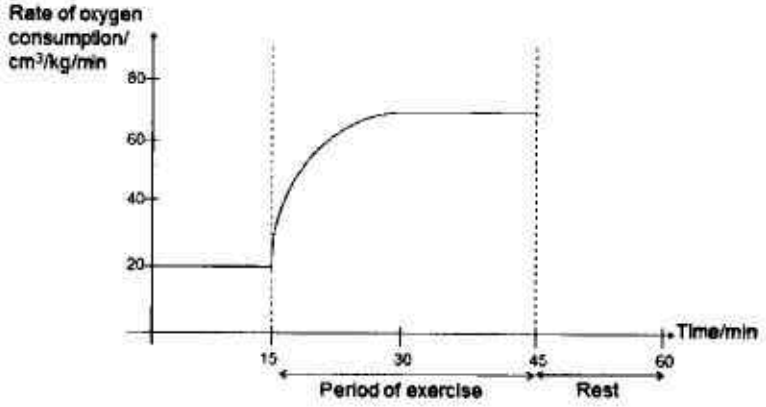


Fig. 3.1

(a) (i) Complete the graph in **Fig. 3.1** to show rate of oxygen consumption during rest. [1]

(ii) Explain your answer in **(a)(i)**.

.....

.....

.....

..... [2]

(c) Suggest how damage to the liver may lead to poor digestion of fats.

.....

.....

.....

..... [2]

2. **Fig. 2.1** shows an experimental setup which measures the rate of water loss from a leafy shoot. Rate of water loss was recorded in the dark and at four different light intensities at hourly intervals. At each light intensity, the apparatus was left for 15 minutes before any measurements were taken.

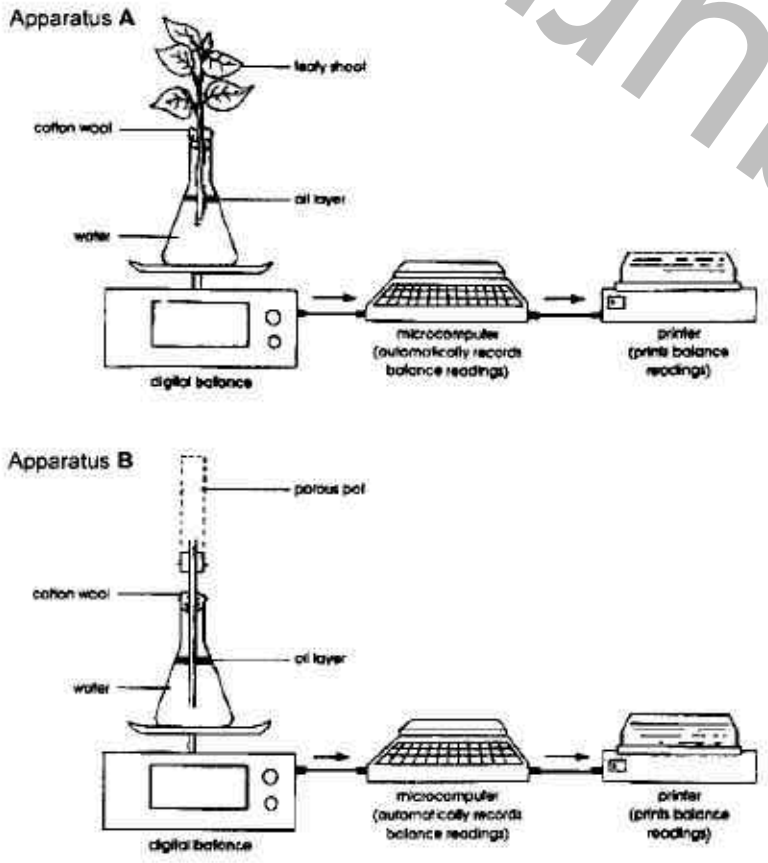


Fig. 2.1

The results obtained from the microcomputer are shown in **Fig. 2.2**.

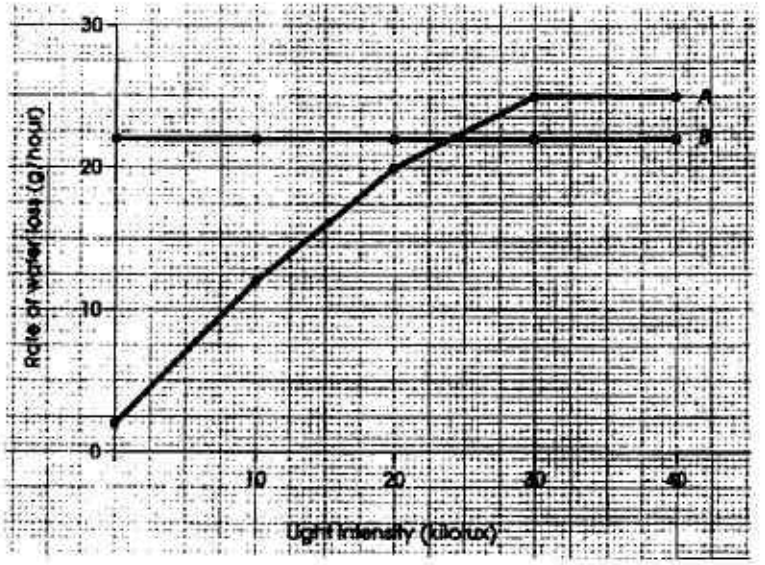


Fig. 2.2

(a) With reference to **Fig. 2.2**, describe the relationship between light intensity and the rate of water loss from the leafy shoot.

.....

.....

.....

..... [2]

(b) Suggest the purpose of :

(i) adding a layer of oil to the water in the flasks,

.....

..... [1]

NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2015

SUBJECT : BIOLOGY (5158) PAPER 2

DATE : 26 AUG 2015

LEVEL : SECONDARY 4 EXPRESS

DURATION : 1 HR 45 MINS

INSTRUCTIONS TO CANDIDATES:

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. This paper consists of **Two (2) Sections**: **Section A** and **Section B**.
2. **Section A:** Answer **ALL** questions. Write your answers in the spaces provided.
3. **Section B:** Answer **ALL** questions.
   Question 9 is an **EITHER / OR QUESTION**. **SELECT ONLY ONE PART OF THIS QUESTION**.
4. **DO NOT DETACH** any sections from this paper.

INFORMATION FOR CANDIDATES:

The number of marks is given in brackets [ ] at the end of each question.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

PAPER 1	/ 40
PAPER 2	
SECTION A :	/ 50
SECTION B :	
Question 7	/ 10
Question 8	/ 10
Question 9 E/O	/ 10
TOTAL	/ 120
GRADE	

Parent's Signature: _____

This paper consists of 22 printed pages, including the cover page.

SECTION A (50 marks)

Answer **ALL** questions in the spaces provided.

1. **Fig. 1.1** shows part of a circulatory system in the abdominal cavity of humans. The arrows indicate the direction of blood flow.

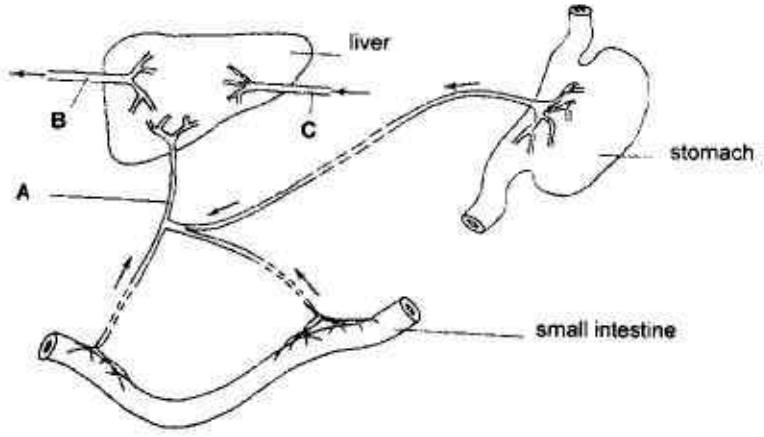


Fig. 1.1

(a) Name the blood vessel **A**.

A: ..... **[1]**

(b) A man has recently eaten a meal containing protein and carbohydrates.

Using only the letters in the diagram, state which of the blood vessels will contain the ***highest*** percentage of:

(i) glucose; .....

(ii) oxygen; .....

(iii) urea. ..... **[2]**

9. OR [10]

(a)
- Sickle cell anaemia is caused by gene mutation / structural change in DNA of a single gene [1/2] [5]
- causes red blood cells to become sickle shaped [1/2] and in not efficient in the transport of oxygen.

(Concept of Normal Allele N is mutated to recessive n)
- Individuals who are homozygous recessive for the mutant allele (nn) are said to suffer from sickle cell anaemia [1/2].
- All the individual's haemoglobin become sickle shaped [1/2]
- and this condition would result in the early death of such individuals [1/2]

- Individuals who are Heterozygous state (Nn) are said to be carrier or have the sickle cell trait [1/2]
- They are naturally resistance to malaria disease [1/2]
- The sickle cell trait gives a selective advantage to such individuals. [1/2]
- By natural selection, they are the ones who could survive better [1/2]
- and multiple in region with malaria disease. [1/2]

(b)
- Identify and isolate the toxin-producing gene on the DNA of the fungus [1/2]. [5]
- using a suitable restriction enzyme [1/2]
- Isolate a circular DNA, a plasmid, from a bacterial cell [1/2]
- and cut it with the same restriction enzyme [1/2]
- Insert the toxin-producing gene into the DNA plasmid [1/2]
- using a DNA ligase enzyme [1/2]
- to join the sticky ends to form a recombinant DNA plasmid. [1/2]
- Treat the recombinant DNA plasmid into the rice plant cell [1/2]
- The transgenic rice plant cells multiply [1/2].
- resulting in multiplication of toxin-producing gene to kill the pests. [1/2]

8. (a) Any one of the following: **[1]** **[10]**

- Not all parts of the plant can be used in the animal feed [1]
- Light transmitted is not absorbed by plants / get reflected [1]
- Plants lose energy through respiration / transpiration / metabolism [1]
- Some of the wheat are diseased / eaten by insects and pests [1]
- When leaves or roots of plant die, energy is passed on to decomposers [1]

(b) Percentage of energy available = 190 000/1 000 000 [1] **[2]**
= 19 % [1]

(c) Max: 3 marks **[3]**

- Barley = producers /1st trophic level
- Animal = primary consumer/ 2nd trophic level
- Energy is increasingly lost between the trophic levels [1]
- Energy is lost through animal respiration / movement / heat / excretion / urine / faeces / egestion. [1]

Data Quoted:

- 1 000 000 kJ passed down from 1st trophic level (barley), but only 190 000 kJ passed down from 2nd trophic level (animal meat). [1]

OR

- Only 19% of energy or 190 000 kJ is transferred from animal meat to humans [1]

OR

- 81 % of energy or 810000 kJ is lost during transfer from animal to humans. [1]

(d) Max: 4 marks **[4]**

- Nitrogen-containing fertiliser provides nutrient for profuse growth of algae [1/2].
- This prevents light from reaching bottom of water [1/2].
- Submerged water plants living deep in water cannot carry out photosynthesis [1/2] due to lack of sunlight and die [1/2].
- Bacteria grow and multiply rapidly [1/2], using up oxygen [1/2] as it decomposes the dead plants [1/2].
- Other marine organisms such as fish die [1/2] due to a lack of oxygen [1/2].

9. EITHER **[10]**

(a) Max: 5 marks **[5]**

- Adrenaline is secreted during: excitement / fear / worry / anger [1]
- Main effects: to increase the amount of blood glucose [1/2] by speeding up the breakdown of glycogen to glucose in liver and muscle [1/2]
- Increase metabolic rate [1/2] to release more energy during tissue respiration [1/2]
- Increase rate of heartbeat [1/2] and causes a rise in blood pressure [1/2] so that glucose and oxygen are carried faster to muscles [1/2]
- Increase rate and depth of breathing [1/2]
- Constricts arterioles in skin [1/2] causing paleness, channel more blood to muscles [1/2]
- Increase rate of blood coagulation [1/2]
- Cause pupil to dilate [1/2] to enhance vision
- Contract hair muscles [1/2]

(b) [1] for each correct comparison **[5]**

Nervous System	Endocrine System
• Involves nervous impulses (electrical signals)	• Involves hormones (chemical substances)
• Impulses transmitted by neurons	• Hormones transported by blood
• Quick response	• Slow response
• Response short-lived	• Response may be short-lived or long-lived
• May be voluntary or involuntary	• Always involuntary
• Usually localized	• May affect more than one target organ

* n – number of chromosomes

(c)
- crossing over of chromatids of homologous chromosomes during Prophase I of meiosis [1]
- independent assortment of chromosomes during Metaphase I meiosis [1]

[2]

(d) (i) Russian bees – Bb [1]

Local bees – bb [1]

[2]

(ii) 3 mite-resistant : 1 mite-susceptible [1]

[1]

PAPER 2 SECTION B: ESSAY QUESTIONS (30 MARKS)

7.	(a)	• X axis labelled with 6 tropical crop plants. [1] • Y axis labelled difference (Y – X) in the rate of photosynthesis [1] • Appropriately numbered scale [1] • All values accurately plotted [1]	[4]	[10]
	(b)	Cassava [1] and eucalyptus [1]	[2]	
	(c)	Taking the average of several measurements would improve overall accuracy. [1]	[1]	
	(d)	Any 2: Carbon dioxide concentration [1] Temperature [1] Light intensity [1] Volume of water [1]	[2]	
	(e)	Any 1: Leaf thickness varies [1] Lack of proportionality between area and mass. [1]	[1]	

- Weaken and burst partition walls of alveoli [1/2]
- Decrease surface area of alveoli [1/2]
- Reduced gaseous exchange in lungs (breathlessness) [1/2]
- Lungs lose elasticity / become inflated with air (wheezing) [1/2]

4. **(a)**
- Excretion refers to the removal of metabolic wastes produced in body cells. **[1]**
- Egestion refers to the removal of undigested matter from the digestive system.

[9]

(b) (i) Protein molecule is too big to pass through by ultrafiltration. [1] **[1]**

(ii) All glucose molecules are selectively reabsorbed into bloodstream. [1] **[1]**

(c) (i) 5.06 g [1] **[1]**

R produced 220 cm^3 of urine.
R has 2.30 g of urea per 100 cm3 of urine.
Total amount of urea = 220 x 2.30 / 100 = 5.06 g

(ii)
- Urine of person R contain more urea than person Q. [1] **[3]**
  - Person R has eaten a meal higher in protein content than person Q. [1] Excess amino acids deaminated in liver to form urea. [1]

OR

- Volume of urine formed in person R is lower than in person Q. [1]
  - Person R is more dehydrated than person Q [1], more selective reabsorption of water occurred in his kidneys tubules [1], resulting in less water excreted. /
  - Person Q ingested more fluids [1], less selective reabsorption of water occurred in his kidneys tubules [1], resulting in more water excreted.

(d) Any 2 **[2]**

- Produced by endocrine (ductless) gland
- Secreted directed into bloodstream
- Brought to one or more target organs to exert an effect
- Destroyed by liver when no longer required.

5. **(a)**
- Light rays from ball enters the retina [1/2].
- detected by the photoreceptors [1/2].
- Nerve impulses generated [1/2]
- and travels along the sensory neurone (F) [1/2]
- through optic fibre [1/2]
- and then to the relay neurone [1/2]
- in the brain (G) [1/2]
- the brain interprets the nerve impulses to see the ball [1/2]

[4] **[9]**

(b) (i) Relay neurone [1] **[1]**

(ii) Transmits nerve impulses within the central nervous system [1] **[1]**

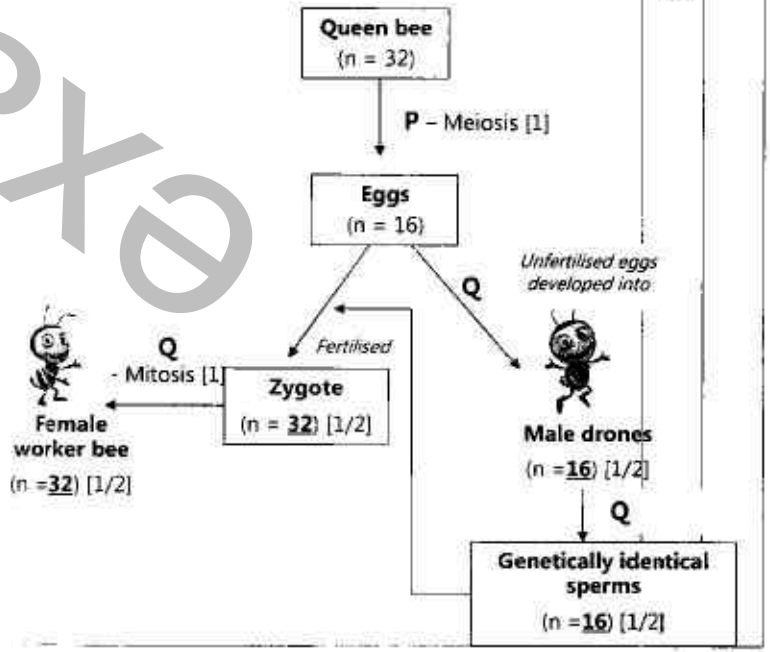
(c) (i) Correct Drawing: [1] **[1]**
Motor neurone along ventral root to muscle + cell body of motor neurone in spinal cord + label Motor neurone

(ii) Correct Direction of arrows: [1] **[1]**
sensory neurone → relay neurone along spinal cord → motor neurone to arm muscle

(d) Voluntary action **[1]**

6. **(a)** Contains half the number of chromosomes as the parent cell **[1]** **[10]**

(b) (i), (ii) **[4]**



ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2015

SUBJECT : BIOLOGY (5158) DATE : 26 AUG, 28 AUG 2015

LEVEL : SECONDARY 4 EXPRESS DURATION : 1 HR 45 MINS, 1 HR

ANSWER SCHEME

PAPER 1: MULTIPLE-CHOICE QUESTIONS (40 MARKS)

1 B	2 A	3 C	4 B	5 B	6 A	7 B	8 C	9 A	10 B
11 B	12 C	13 C	14 D	15 D	16 D	17 C	18 D	19 C	20 D
21 D	22 B	23 C	24 B	25 C	26 A	27 B	28 A	29 D	30 A
31 D	32 C	33 B	34 B	35 C	36 B	37 B	38 A	39 D	40 C

PAPER 2 SECTION A: STRUCTURED QUESTIONS (50 MARKS)

1. (a) A hepatic portal vein [1] [1] [5]

(b) [2]
- All correct. [2]
- Only 2 correct. [1]
- Only 1 correct. [0]

(i) A

(ii) C

(iii) B

(c) [2]
- Damage to the liver may reduce / stop the production of bile. [1]
- As a result, the ingested fats are not emulsified. [1]
- This slows down the digestion of fats by lipases.

2. (a) [2] [10]
- As light intensity increases from 0 kilolux to 30 kilolux, the rate of water loss increases from 2 g/hr to 25 g/hr. [1]
- When the light intensity increases further from 30 kilolux to 40 kilolux, the rate of water loss remains constant at 25 g/hr. [1]

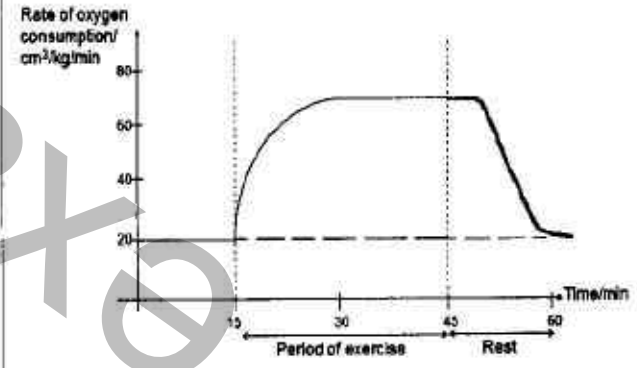
(b) (i) To prevent evaporation of water in the flask which will affect the accuracy of the results. [1] [1]

(ii) To serve as a control. [1] [1]

(c) [3]
- The stomata are fully opened at 30 kilolux. [1]
- As water escapes from the leafy shoot through the stomata in the leaves. [1]
- the rate of water loss from the stomata is the maximum at 30 kilolux [1],
- thus indicating that all the stomata are fully opened.

(d) [3]
- The leaves and stem of the shoot will wilt and droop. [1]
- Seawater has a lower water potential than the cell sap in the cells of the shoot. [1]
- Therefore, water will move from the shoot into the seawater by osmosis [1] causing the shoot to wilt and droop.

3. (a) (i) [1] [7]



(ii) [2]
- to repay oxygen debt [1/2] and
- to remove lactic acid [1/2]
- that is produced during anaerobic respiration [1/2] during period of exercise.
- Rate of oxygen consumption remain high for a period during rest period, before decreasing back to normal [1/2].

(b) Tar / irritant [1] [4]
- Paralyse cilia [1/2]
- Trapped dust particles and mucus cannot be removed (violent couging) [1/2]

38. The table shows some amino acids and their corresponding mRNA triplets (codons).

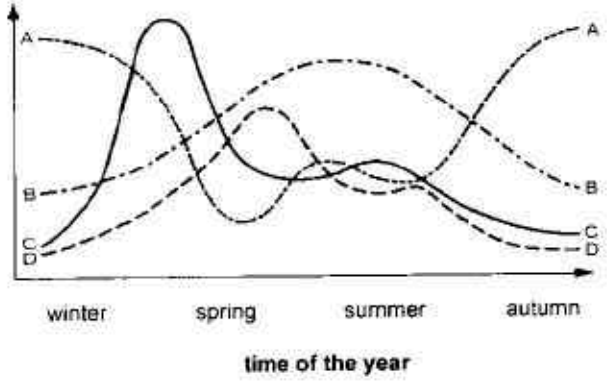
amino acid	mRNA triplet (codon)
phenylalanine	UUU
leucine	CUU
valine	GUC
serine	UCC
cysteine	UGC
alanine	GCU

Which DNA sequence of the template strand would be needed to produce the polypeptide sequence **alanine – leucine – valine – phenylalanine?**

A	CGA	GAA	CAG	AAA
B	CGA	GAA	CAG	TTT
C	GCA	CTT	GTC	AAA
D	GCA	CTT	GTC	TTT

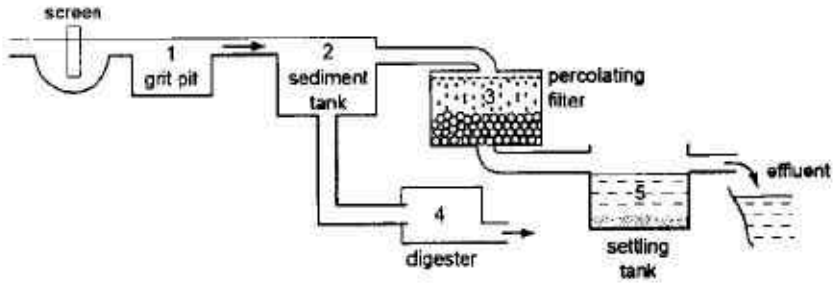
39. The graph shows the annual changes in a lake of the following factors:

- number of producers
- number of primary consumers
- quantity of nutrients
- intensity of light



Which curve represents the number of primary consumers?

40. The diagram shows a sewage treatment plant.



In which parts do aerobic and anaerobic bacteria become most active to help to digest the sewage?

	aerobic bacteria	anaerobic bacteria
A	1	2
B	2	4
C	3	4
D	3	5

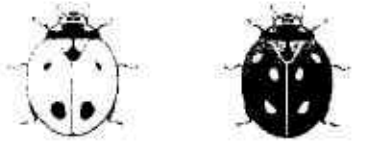
END OF PAPER

34. In a genetics experiment using smooth and wrinkled peas, the results showed that the allele for smooth peas was dominant (**S**) and that for wrinkled peas was recessive (**s**). 250 hybrid plants were crossed and 6000 smooth peas were gathered in the **F2** generation.

What is the likely number of wrinkled peas gathered in the **F2** generation?

A 1500
B 2000
C 3000
D 4500

35. The diagram shows two distinct forms of beetle. The difference between them is controlled by a single gene. The allele for the black form is dominant to the allele for red.



Red form with black spots

Black form with red spots

What kind of variation is shown by the beetle?

A Discontinuous variation because it is controlled by genes.
B Continuous variation because it is controlled by genes.
C Discontinuous variation because the two forms are distinct.
D Continuous variation because there are two forms.

36. The following statements are parts of the theory of evolution by natural selection.

I Only the best adapted individuals survive and pass on their genes.
II More offspring are produced than the environment can support.
III As one generation follows another, the characteristics of the species gradually change.
IV There is a struggle for survival in which some individuals are more successful than others.

What is the correct sequence of statements?

A I, II, III, IV
B II, IV, I, III
C III, I, IV, II
D IV, III, II, I

37. A gene contains 900 deoxyribose sugar which is transcribed and translated to produce a functional protein in a cell.

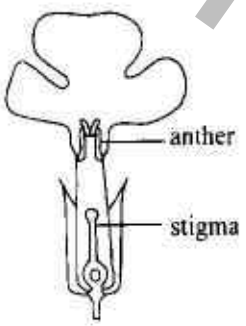
Which of the following shows the correct combination of numbers and structures present in the gene or formed during protein synthesis?

	number of nucleotides	number of mRNA formed	number of codons on the mRNA	number of polypeptide formed
A	900	900	900	900
B	900	1	300	1
C	450	900	900	900
D	450	1	450	1

30. Which statement correctly describes advantages or disadvantages of self-pollination to a plant?

A It needs little pollen but there is a high chance of pollination.
B It needs no agent to transfer pollen but pollination is unlikely.
C It needs a lot of pollen but can happen when a plant is on its own.
D It needs two plants of the same species but there is little variation in the offspring.

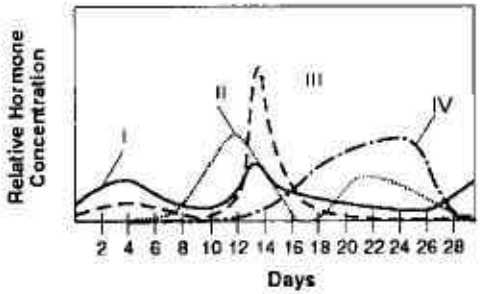
31. The diagram below shows the structure of a flower.



It shows adaptations for _____.

A wind pollination and cross fertilisation
B insect pollination and cross fertilisation
C wind pollination and self fertilisation
D insect pollination and self fertilisation

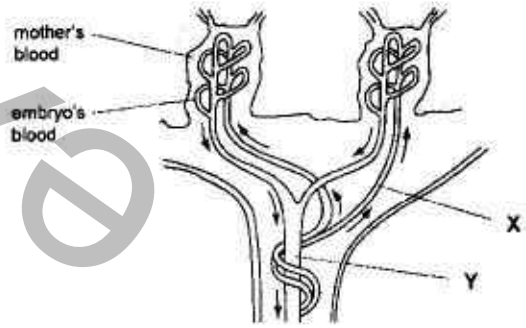
32. The graph below plots the rise and fall of pituitary and ovarian hormones during the human menstrual cycle.



Which of the following represents oestrogen and progesterone?

	oestrogen	progesterone
A	I	II
B	I	III
C	II	IV
D	III	IV

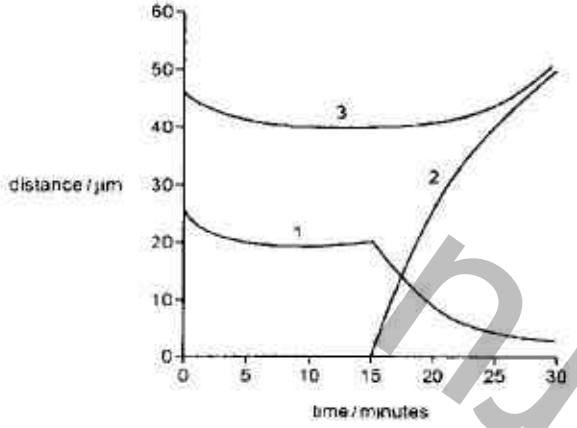
33. The diagram shows how the blood of a human embryo flows close to the mother's blood in the placenta.



Which substances are present at **X** in higher concentrations than at **Y**?

A Carbon dioxide and glucose
B Carbon dioxide and urea
C Glucose and oxygen
D Glucose and urea

27. The graph shows three measurements obtained following metaphase of mitosis.



Which of the following measurements do the curves represent?

	distance between centromeres and poles of the spindle	distance between centromeres of the sister chromatids	distance between the poles of the spindle
A	1	3	2
B	1	2	3
C	3	1	2
D	3	2	1

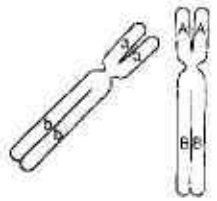
28. How does mitosis contribute in each of the following processes stated below?

Key
✓ = contributes to process

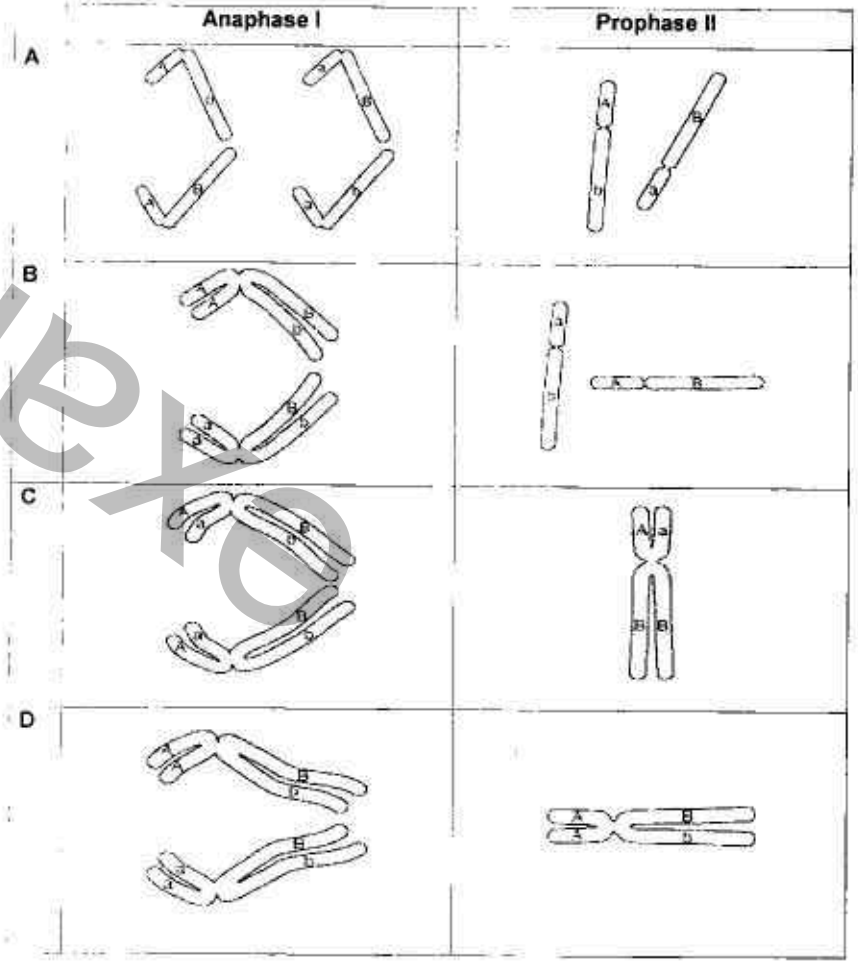
X = does not contribute to process

	Genetic variation	Increase in cell number	Replacement of damaged cells
A	X	√	√
B	√	X	X
C	√	√	X
D	X	X	√

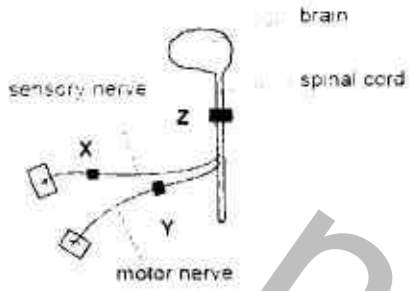
29. The diagram shows two homologous chromosomes in early prophase I of meiosis in an animal cell. Two genes, A/a and B/b, whose loci occur on the homologous chromosomes are also shown.



Which row of diagrams is a possible representation of these chromosomes as they progress from anaphase I to prophase II?



24. The diagram represents a central nervous system. **X**, **Y**, and **Z** show possible sites where the system can be blocked by a local anaesthetic.



Of four men, one had no anaesthetic block and the other three had only one anaesthetic block at **X**, **Y** or **Z**.

One of the men can feel a pinprick on his leg but cannot move it.

Where is the anaesthetic block?

A block is at **X**

B block is at **Y**

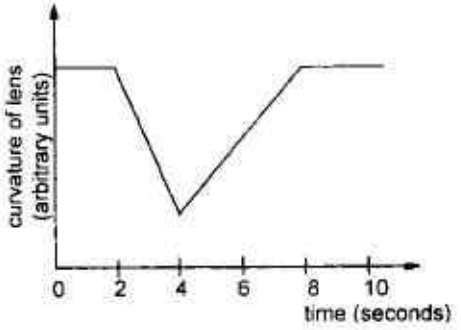
C block is at **Z**

D no block

25. What describes the cone cells of the retina?

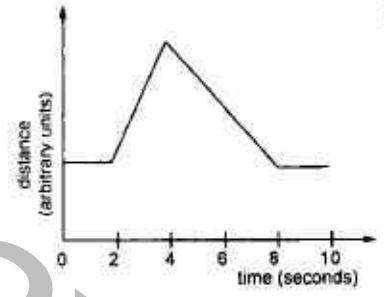
	Region of the retina where most cones are found	Light intensity required for stimulation	Responds to colour
A	edge	bright	yes
B	edge	dim	no
C	yellow spot	bright	yes
D	yellow spot	dim	no

26. The figure shows the changes that occur in the curvature of Mr Cheng's eye lens when focusing on an object for a period of time.

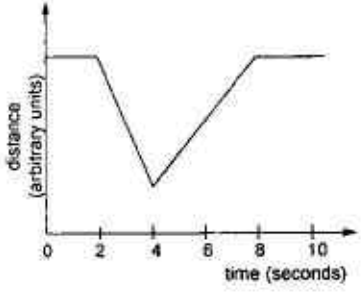


Which of the following graphs correctly shows how the distance of the object varies with time?

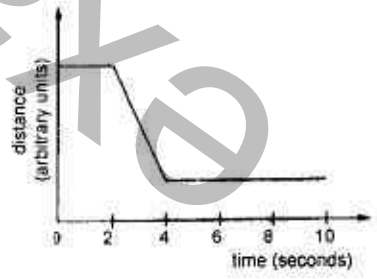
A



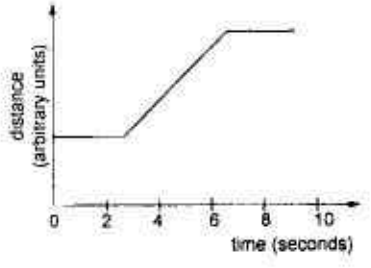
B



C



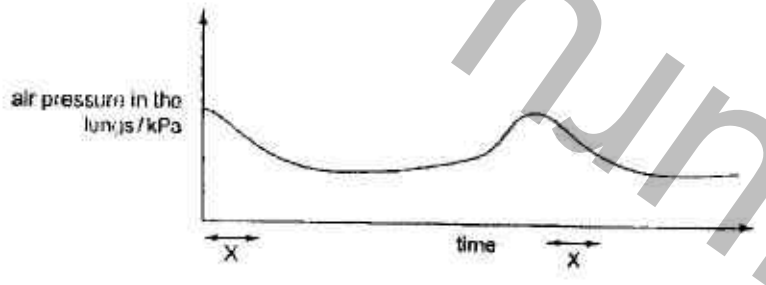
D



18. A person holds his breath for as long as possible but is then forced to breathe out because _____.

A intercostal muscles become tired
B muscles of the diaphragm become tired
C concentration of oxygen in the blood has decreased
D concentration of carbon dioxide in the blood has increased

19. The graph shows changes in air pressure in the lungs during breathing.



What causes the change in air pressure during period **X**?

A decrease in volume of the lungs
B movement of the ribs downwards
C contraction of the diaphragm muscles
D relaxation of the external intercostal muscles

20. In the human excretory system, urea is produced in one organ, filtered from the blood by a second organ and stored inside a third organ before being expelled out from the body. Which organs carry out these three functions?

	Production	Filtration	Storage
A	Kidney	liver	bladder
B	kidney	bladder	ureter
C	bladder	bladder	kidney
D	liver	kidney	bladder

21. Which of these statements correctly describe control by negative feedback?

A An injury to body tissue activates platelets in the blood and these activated platelets release chemicals which activate more platelets.
B During the menstrual cycle, luteinising hormone stimulates the release of oestrogen which in turn stimulates the release of more luteinising hormone.
C The onset of contractions during childbirth causes the release of a hormone, which stimulates further contractions.
D When blood pressure is high, nerve impulses from the brain cause the blood vessels to dilate and blood pressure is reduced.

22. During osmoregulation, which one of the following correctly describes the body's homeostatic response to a large intake of water?

	Organ/ Region stimulated	Hormone secreted	Kidney tubule action	Water absorption
A	Hypothalamus	Less adrenaline	Absorb	Less
B	Hypothalamus	Less ADH	Reabsorb	Less
C	Kidney	More ADH	Reabsorb	More
D	Kidney	More adrenaline	Absorb	More

23. Which of the following comparisons about voluntary actions and reflex actions is incorrect?

	Voluntary Action	Reflex Action
A	not inborn	inborn
B	may involve a stimulus	involves a stimulus
C	we are aware of the action	we are not aware of the action
D	the same stimulus may lead to the different responses	the same stimulus leads to the same response

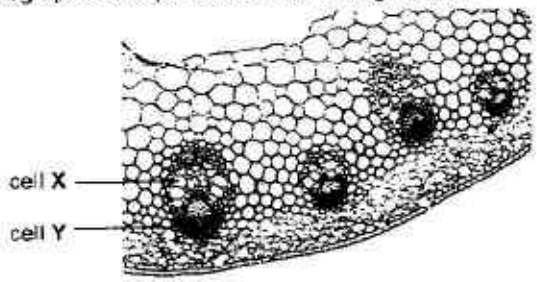
14. The following five events occur during one cardiac cycle in humans.

I	ventricular diastole
II	bicuspid and tricuspid valve forced open
III	blood forced back against bicuspid and tricuspid valve
IV	blood forced back against semi-lunar valve
V	atrial systole

What is the correct sequence of these events?

A III → II → IV → V → I
B IV → I → II → III → V
C V → III → II → I → IV
D V → II → III → I → IV

15. The photomicrograph shows part of a section through a stem.



The contents of cell X and cell Y are each tested with Benedict's reagent and with iodine solution.

What results are expected from the tests?

Key + = positive result
- = negative result

	cell X		cell Y	
	Benedict's reagent	Iodine solution	Benedict's reagent	Iodine solution
A	+	+	-	-
B	+	-	+	+
C	-	+	+	-
D	-	-	-	-

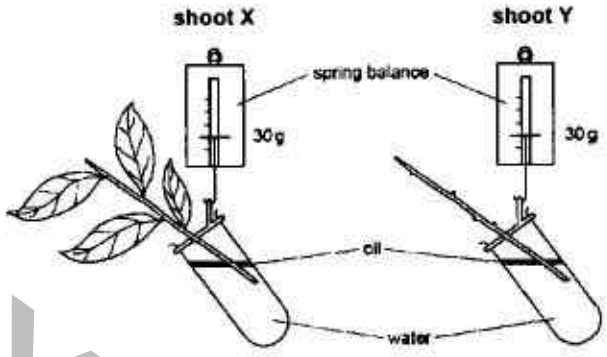
16. An experiment was performed on a young plant using an aphid stylet to measure the rate of translocation in the phloem.

The same plant was then placed in a bell jar and a chemical placed in the bell jar to absorb all the oxygen present. The rate of transport in the phloem decreased and then stopped.

What is the reason for this?

A Translocation occurs only by diffusion.
B Photosynthesis cannot occur in the bell jar.
C Mitochondria in the xylem vessels cease to function.
D Companion cells no longer produce sufficient energy.

17. The diagram shows two shoots at the start of an experiment on transpiration.



What are the likely readings on the spring balances after three days?

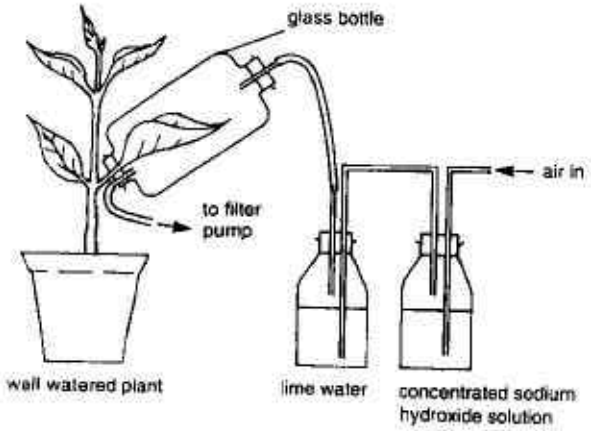
	Shoot X	Shoot Y
A	30 g	30 g
B	30 g	25 g
C	25 g	30 g
D	25 g	25 g

10. The stomach wall produces mucus to cover its inner surface. Which of the following correctly describes the function of the mucus?

I It reduces friction between the food and stomach wall during churning of food.
II It protects the stomach wall from the action of the stomach enzymes.
III It kills harmful bacteria in the food.

A I only
B I and II only
C II and III only
D I, II and III

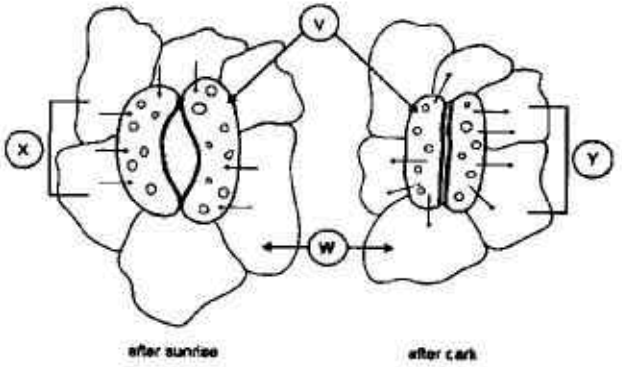
11. The setup below under sunlight to show that a certain condition is necessary for photosynthesis.



Which of the following states the objective of the experiment?

A To show that water and carbon dioxide are necessary for photosynthesis.
B To show that carbon dioxide is necessary for photosynthesis.
C To show that water and sunlight are necessary for photosynthesis.
D To show that water, carbon dioxide and sunlight are necessary for photosynthesis.

12. The following diagram shows a portion of the under-surface of a leaf at two different times of the day.



In the diagram, the arrows indicated by _____.

A label V, point to the non-respiring cells
B label W, point to photosynthetic cells
C label X, show the direction of movement of water molecules
D label Y, show the direction of movement of starch molecules

13. Which of the following explains why a person with blood type **A** cannot donate blood to a person with blood type **O**?

A The antibodies in the blood plasma of blood type **A** would react with the antigens in the blood plasma of blood type **O**.
B The antigens in the blood plasma of blood type **A** would react with the antibodies on the red blood cells of blood type **O**.
C The antigens on the red blood cells of blood type **A** would react with the antibodies in the blood plasma of blood type **O**.
D The antigens on the red blood cells in blood type **A** would react with the antigens on the red blood cells in blood type **O**.

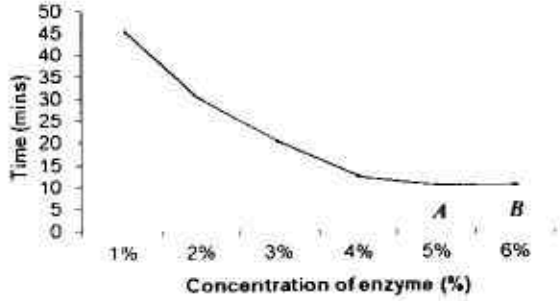
7. Four sugar solutions were tested with a standard Benedict's solution. The table shows the colour of the solutions after testing.

Solution	Colour
1	Green
2	Blue
3	Brick-red
4	Yellow

What is the best interpretation of the results?

	Solution 1	Solution 2	Solution 3	Solution 4
A	0.05% non-reducing sugar	0.1% non-reducing sugar	1.0% non-reducing sugar	0.5% non-reducing sugar
B	0.5% reducing sugar	0.05% non-reducing sugar	1.5% reducing sugar	1.0% reducing sugar
C	1.0% reducing sugar	0.5% reducing sugar	0.05% reducing sugar	0.1% reducing sugar
D	0.05% non-reducing sugar	0.01% non-reducing sugar	1.5% reducing sugar	1.0% reducing sugar

8. The graph shows the relationship between concentration of enzyme and time taken for reaction to complete.



Which of the following statements is **not true** about the region between Points *A* and *B*?

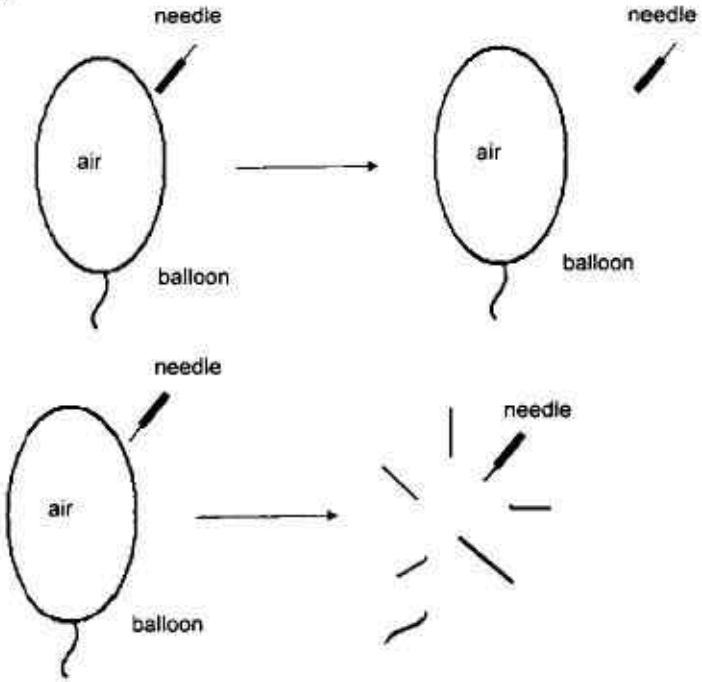
A Temperature is the limiting factor.

B pH of the solution is the limiting factor.

C Enzyme concentration is the limiting factor.

D Substrate concentration is the limiting factor.

9. The diagram shows an example of a biological model used to illustrate enzymatic reaction.



Which of the following characteristic(s) of enzyme is the diagram above trying to illustrate?

1 specificity
2 presence of active site
3 ability to catalyse reversible reactions

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

3. A few leaves of purple cabbage were placed in a beaker of water for 10 minutes. The water remained colourless after the 10 minutes. The beaker was then heated to 100°C for 5 minutes. After the boiling, the water turned purple.

Which of the following best explains this observation?

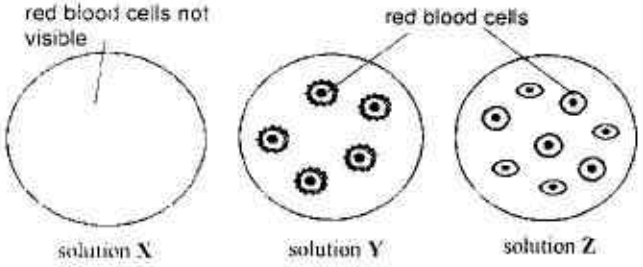
A The pigments gained more kinetic energy upon heating and were able to diffuse out of the leaves quickly, hence the coloured water in just 5 minutes.

B The cell walls were denatured upon heating, allowing the pigment to diffuse into the water.

C During the boiling, the cell membranes were damaged, hence allowing the pigment to diffuse into the water.

D Heating increases the solubility of the pigment, thus colouring the water purple.

4. Jia Jia placed some red blood cells on three different slides containing salt solutions of different concentrations: 0.01 g/dm^3, 1.0 g/dm^3 and 10.0 g/dm^3 respectively. After ten minutes, she observed them under the microscope. This is what she saw



What is the correct concentration of solution **X**, **Y** and **Z** respectively?

	concentration of solution X (g/dm^3)	concentration of solution Y (g/dm^3)	concentration of solution Z (g/dm^3)
A	0.01	1.0	10.0
B	0.01	10.0	1.0
C	1.0	10.0	0.01
D	10.0	0.01	1.0

5. Some blocks of agar blocks were prepared and immersed in beakers filled with 100cm^3 of methylene blue solution. Which of the following blocks would take the shortest time to be stained completely blue?

	dimension of agar block/mm	temperature of methylene blue solution/°C
A	10 × 10 × 10	30
B	10 × 10 × 10	50
C	20 × 20 × 20	30
D	20 × 20 × 20	50

6. The figure shows the chemical reactions in the human body involved in different types of sugar.

Reaction I: glucose + **Q** → sucrose + water
Reaction II: lactose + water → **R** + glucose

Which of the following correctly identifies substances **Q** or **R** and the respective reaction that takes place?

	substance	name	reaction
A	Q	fructose	condensation
B	R	galactose	condensation
C	Q	galactose	hydrolytic
D	R	fructose	hydrolytic

NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2015

SUBJECT : BIOLOGY (5158) PAPER 1

DATE : 28 AUG 2015

LEVEL : SECONDARY 4 EXPRESS

DURATION : 1 HR

INSTRUCTIONS TO CANDIDATES:

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1 There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A, B, C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the separate **OPTICAL ANSWER SHEET**

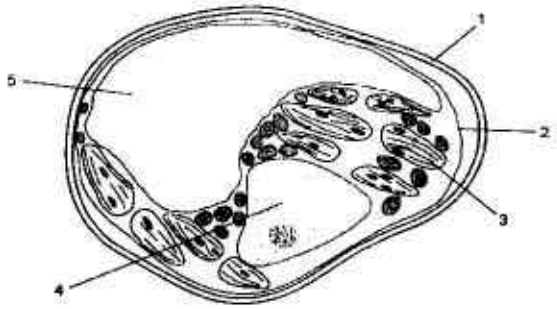
INFORMATION FOR CANDIDATES:

Each correct answer will score one mark. Marks will not be deducted for wrong answers. Any rough working should be done in this booklet. Your total score for Paper 1 will be the number of correct answers given.

This paper consists of 22 printed pages, including the cover page.

Answer **ALL** questions.
Choose the most appropriate answer and shade the corresponding letter on the separate OAS provided.

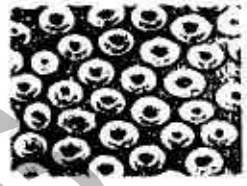
1. The diagram shows a plant cell.



Which features are **not** found in animal cells?

A 1, 2 and 3 **B** 1, 3 and 5
C 2, 3 and 4 **D** 2, 4 and 5

2. The diagram is a photomicrograph which shows some human blood cells dye.



magnification = × 900

Which of the following is an adaptation of these cells?

A The cells are flattened and biconcave to increase surface area to volume ratio for absorption and release of oxygen at a faster rate.
B The cells are anucleated and elastic to increase surface area to volume ratio for absorption of oxygen at a faster rate.
C The cells contain haemoglobin to increase surface area to volume ratio for absorption of oxygen at a faster rate.
D The cells are produced in large numbers in the bone marrow to increase surface area to volume ratio for absorption of oxygen at a faster rate.