SINGAPORE CHINESE GIRLS' SCHOOL
Preliminary Examination
Secondary Four

CANDIDATE NAME					
CLASS	4			INDEX NUMBER	

BIOLOGY

5158/02

Paper 2 Theory

Tuesday **1 August 2017** **1 hour 45 minutes**

READ THESE INSTRUCTIONS FIRST

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

Section A
Answer **all** questions.

Section B
Answer **all** questions, the last question has a choice of parts to answer.
The use of an approved scientific calculator is expected, where appropriate.

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	/50
Section B	/30
Total	/80

This question paper consists of 29 printed pages.

Section A
Answer all the questions.
Write your answers in the spaces provided.

1 **(a)** Name a constituent of a diet that is [1]

(i) absorbed without digestion, ...

(ii) never absorbed. .....

Fig. 1.1 is a diagrammatic representation of the small intestine containing three types of food molecules, **A**, **B** and **C** before they have been fully digested.

Fig. 1.1 also shows a lacteal and a capillary, both not drawn to scale.

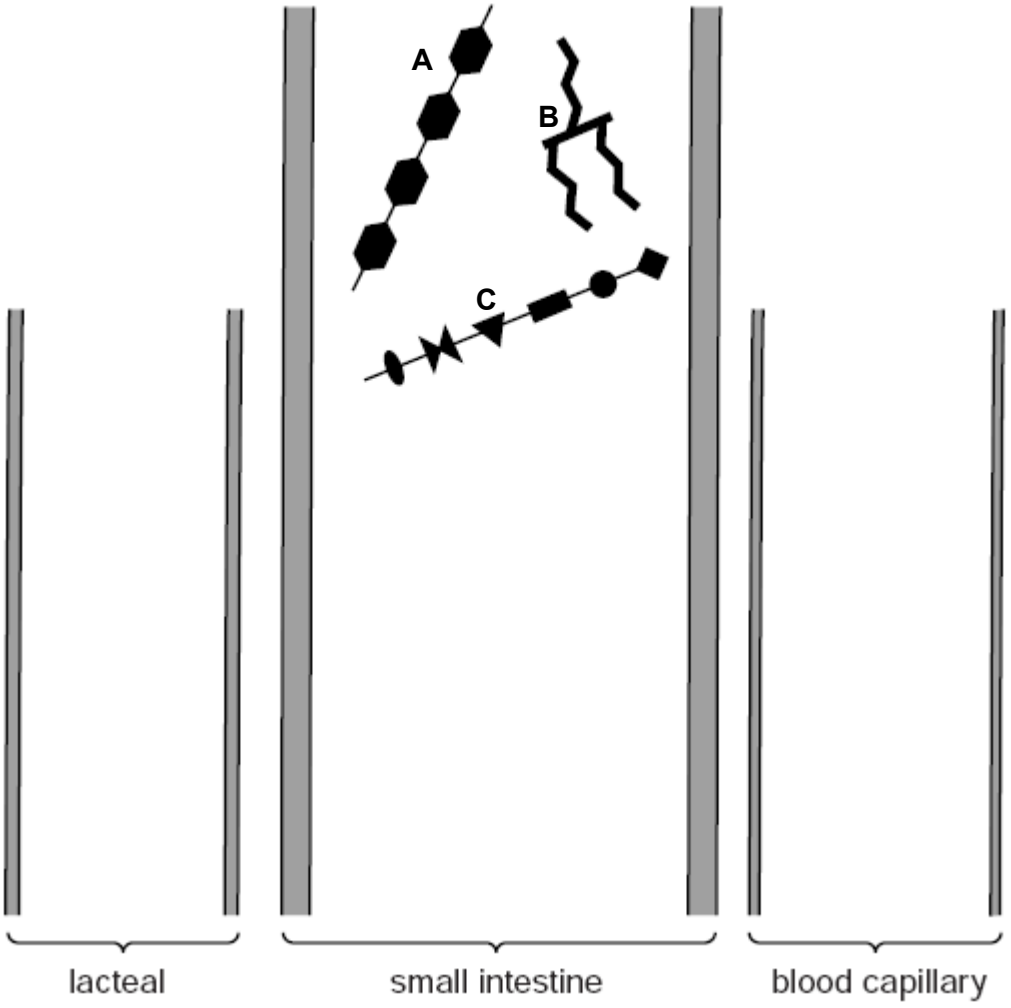

Fig. 1.1

(b) On Fig. 1.1, draw and label the molecules as they would appear after they have been fully digested and then absorbed by the lacteal and by the blood capillary. [1]

(c) Some of these molecules travel directly to the liver.

Name two molecules and explain how they are transported to the liver. [2]

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(d) Describe how **A** is completely digested by named enzymes in the small intestine. [2]

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[Total : 6m]

2 Fig. 2.1 shows a large jar in which plants are growing.

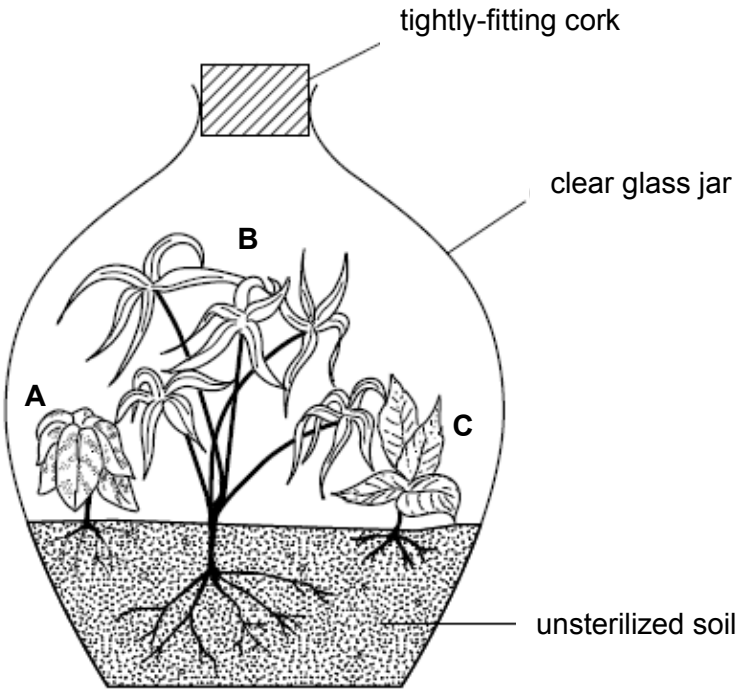

Fig. 2.1

This jar provides an environment in which plants can carry out photosynthesis without adding water or removing the tightly-fitting cork to allow air to enter.

(a) State the word equation for photosynthesis in the space below. [1]

(b) Describe how the plants in Fig. 2.1 obtain water in the jar. [2]

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(c) Suggest a reason, apart from limited carbon dioxide, why the plants in the jar show only very limited growth compared with similar plants growing under natural conditions. [1]

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(d) State an advantage of using unsterilized soil for the plants. [1]

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[Total : 5m]

3 Fig. 3.1 shows changes in the volume of blood in the left ventricle.

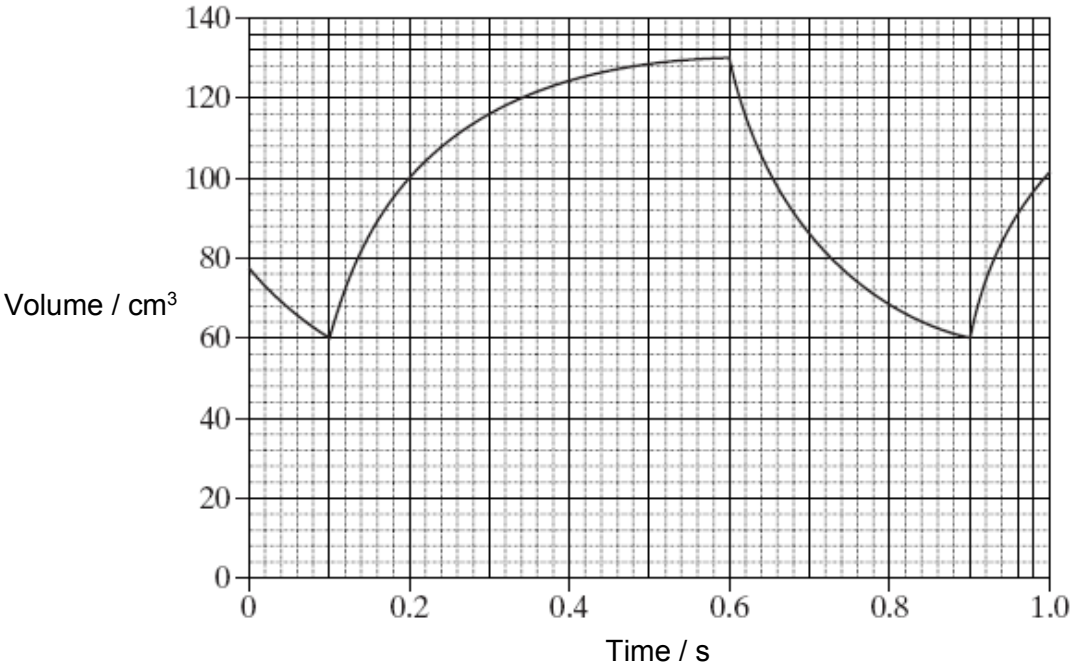

Fig. 3.1

(a) Between which times is the left atrium contracting? [1]

……

(b) Using information from Fig. 3.1, calculate the number of heart beats per minute. Show your working. [1]

……

(c) On Fig. 3.1, label the point 'X' where the 'lub' sound of the heart is produced. [1]

Table 3.1 shows the rate of blood flow to some organs when a person is at rest and during a period of vigorous exercise.

Table 3.1

Organ	Rate of blood flow / cm^3 $minute^{-1}$	
	at rest	**during exercise**
Skeletal muscles	1 000	16 000
Kidney	1 200	1 200
Brain	750	
Heart muscle	300	1 200

(d) Suggest a value for the rate of blood flow to the brain during exercise. [1]

……

(e) Using information from Table 3.1, calculate the ratio of the rate of blood flow into the coronary arteries during exercise to the rate flowing into these arteries at rest. [1]

……

[Total : 5m]

4 Table 4.1 shows the relative thickness of layers in the walls of an artery and a vein.

Table 4.1

Layer in wall	Thickness / μm	
	artery	vein
Endothelium	20	20
Smooth muscle	490	240
Elastic tissue	370	240
Connective tissue	120	120

(a) Using information from Table 4.1, explain why a vein may be described as an organ. [1]

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(b) Use information from Table 4.1 to suggest the thickness of a capillary wall. [1]

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(c) Explain how the elastic tissue in the wall helps to even out the pressure of blood flowing through the artery. [1]

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Fig. 4.1 shows part of a capillary and some of the cells surrounding it.

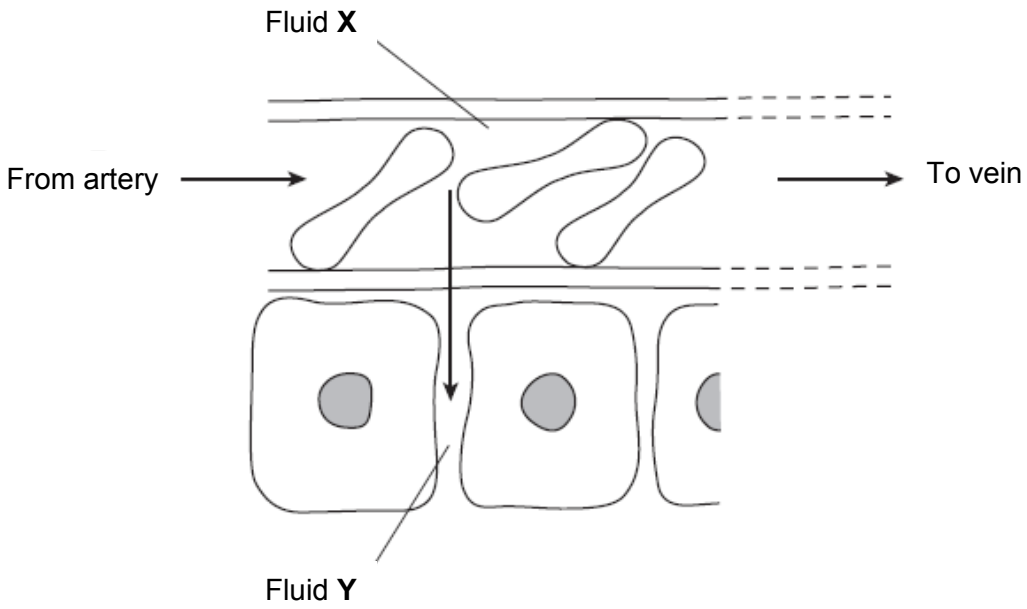

Fig. 4.1

(d) Describe the transfer of materials between Fluid **X** and Fluid **Y**. Identify **X** and **Y** in your answer. [2]

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[Total : 5m]

5 Fig. 5.1 shows how the branch of a small apple tree varied in diameter over a 24-hour period.

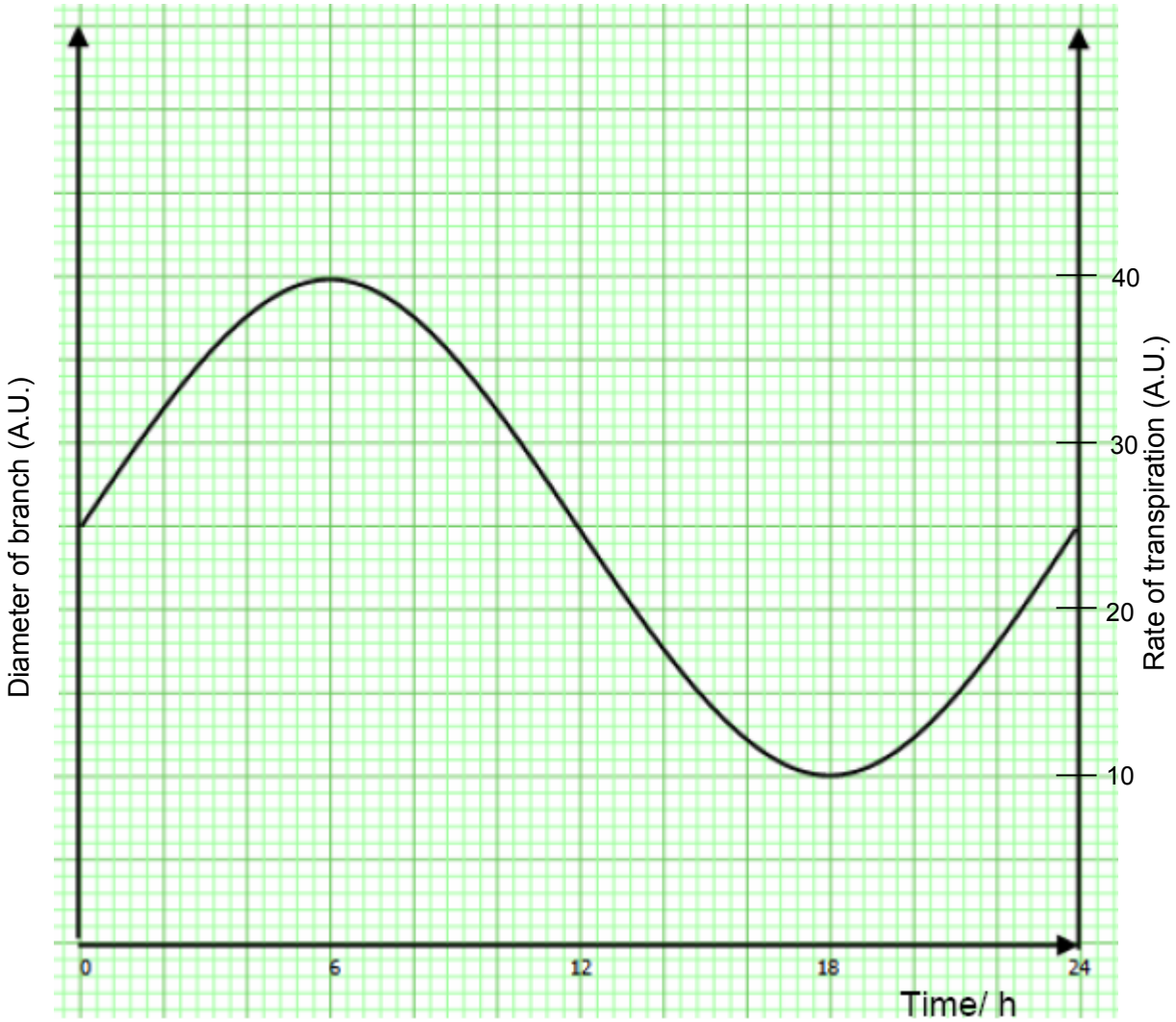

Fig. 5.1

(a) Using the data given in the table below, draw a curve on the grid above to show how rate of transpiration of the apple tree varied over the same 24-hour period. [1]

Time / h	Rate of transpiration / arbitrary units (AU)
0	24
6	5
12	30
18	40
24	25

(b) Suggest a reason for the changes in the rate of transpiration between the 6th and 18th hour period. [1]

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……

(c) With reference to Fig. 5.1, describe the effect of transpiration on the diameter of the branch. [1]

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[Total : 3m]

6 Fig 6.1 is a micrograph of a section of the pancreas responsible for the secretion of hormones.

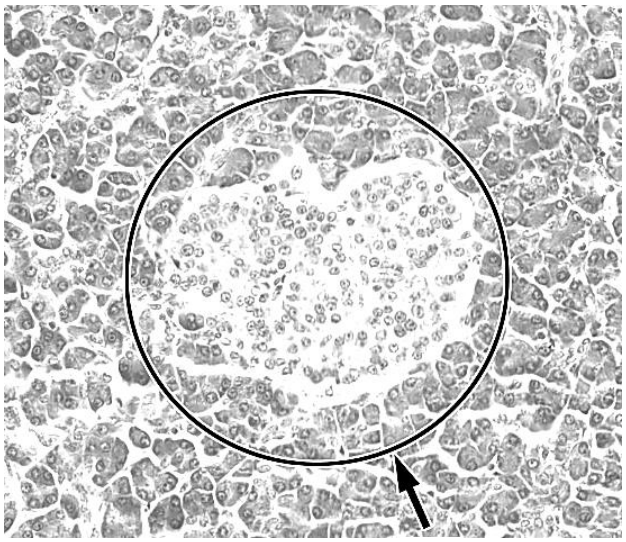

Fig 6.1

(a) Suggest the identity of the cells in circle **A**. [1]

……

(b) With reference to Fig. 6.1, describe in detail how these cells carry out a function in maintaining a constant, internal environment. [3]

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……...

(c) Some forms of diabetes are caused by an inability to secrete insulin and can be controlled by regular injections of insulin. Most of this insulin is now produced using genetically modified *Escherichia coli*.

List two advantages of using this type of insulin, rather than the insulin obtained from animal sources. [1]

……...

……...

[Total : 5m]

7 Before birth, the baby's temperature is maintained by the amniotic fluid.

Premature babies have the following characteristics :

- smaller in size
- have thin skin with prominent blood vessels
- have a poorly developed shivering response

In cold climates, it is necessary to keep the premature baby warm in an incubator.

(a) Explain how each characteristic makes it necessary for the baby to be kept warm in an incubator.

(i) smaller size [1]

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(ii) thin skin with prominent blood vessels [1]

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(iii) poorly developed shivering response [1]

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(b) In addition, the baby may be wrapped in aluminium foil. Suggest how this method keeps the baby warm. [1]

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[Total : 4m]

8 Fig. 8.1 shows drawings of a cell at various stages in mitosis.

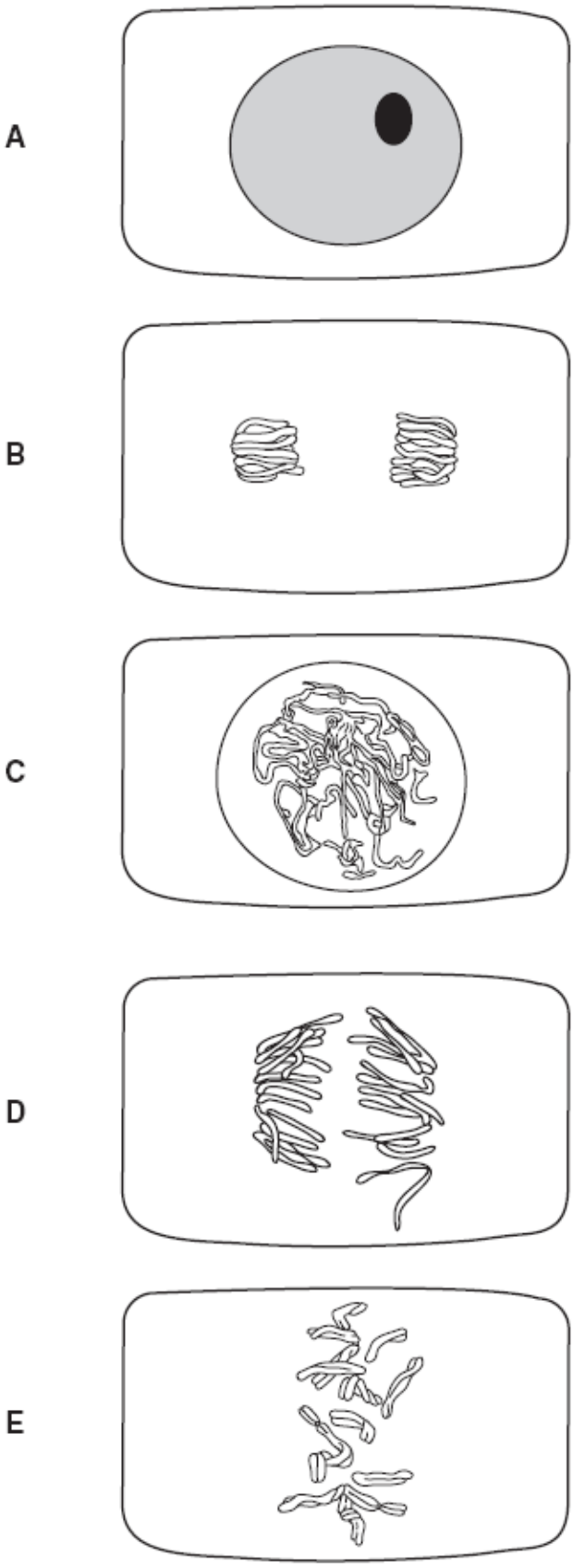

Fig. 8.1

(a) List the letters shown in Fig. 8.1 in the order in which these stages occur during a mitotic cell cycle. [1]

……..

(b) With reference to Fig. 8.1, explain what is happening in stage

(i) **A**, [1]

……

……

(ii) **D**. [1]

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(c) State the importance of mitosis in the growth of a multicellular organism, such as a flowering plant or a mammal. [1]

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Fig. 8.2 is a diagram drawn from a photomicrograph of an animal cell undergoing meiosis.

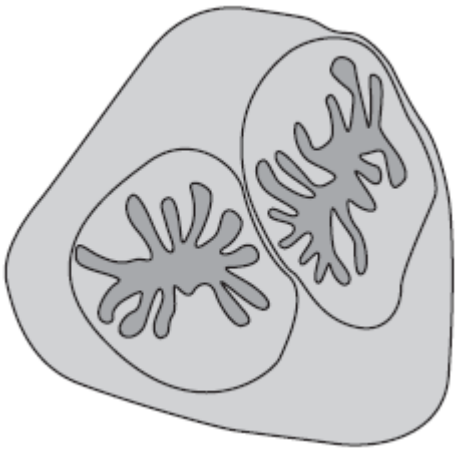

Fig. 8.2

(d) Identify the stage of meiosis shown in Fig. 8.2. [1]

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(e) Explain briefly how meiosis leads to variation within species. [2]

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[Total : 7m]

9 Certain flowering plant species, such as the violet (*Viola odorata)*, produce some flowers that are never open and are self-pollinated.

(a) Suggest two advantages of plants having flowers that self-pollinate. [1]

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Some species of orchids practise mimicry as their flowers look like female bees or wasps. These flowers release a scent that attracts males which then attempt to mate with the flowers.

Fig 9.1 shows *Ophrys scolopax* which is an example of such species.

Fig. 9.1

(b) Explain an advantage of mimicry. [1]

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(c) Describe the sequence of events which occur after the pollen lands on the stigma, until the formation of a fruit. [3]

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[Total: 5m]

10 Fig 10.1 shows the carbon cycle. Each arrow represents a process in the cycle.

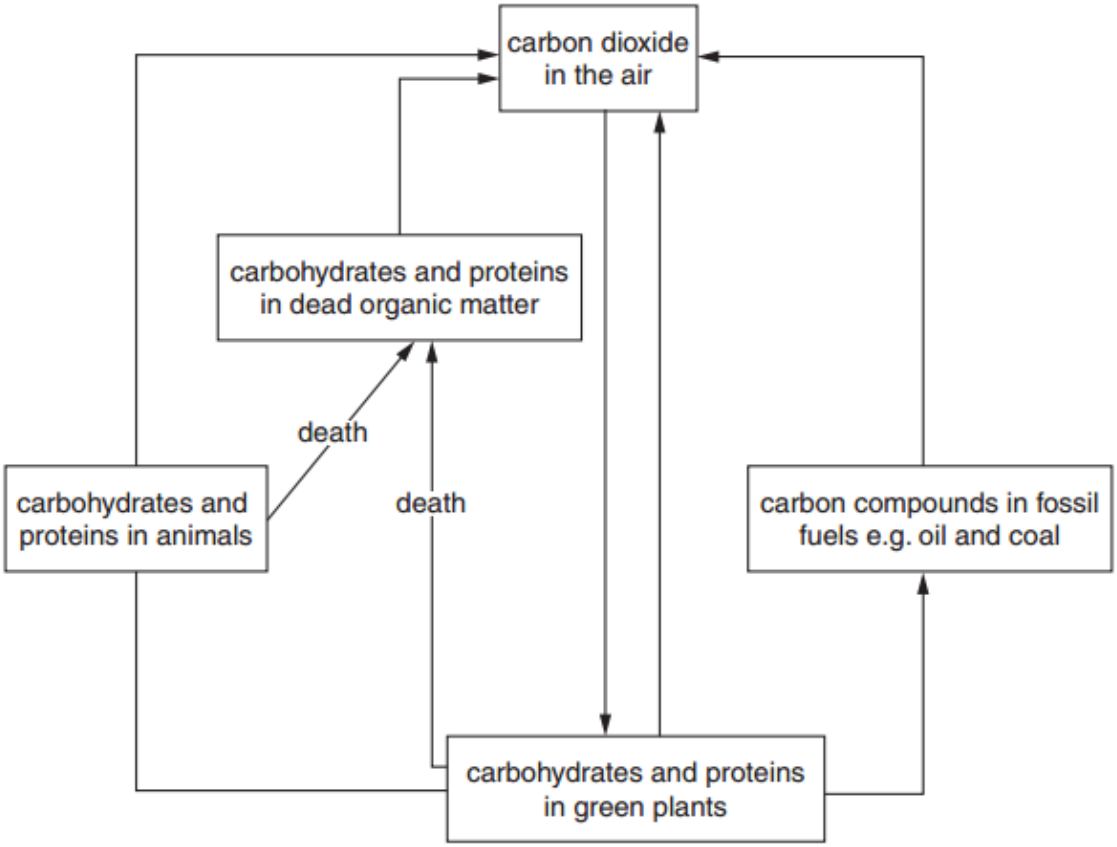

Fig 10.1

(a) On Fig. 10.1, label arrows with suitable letters (provided below) that represent the following processes : [2]

(i) combustion – letter **C,**

(ii) decomposition – letter **D,**

(iii) photosynthesis – letter **P,**

(iv) respiration – letter **R.**

(b) State what is meant by the term *carbon sink*. [1]

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(c) Describe two effects of deforestation that will impact the carbon cycle. [2]

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[Total : 5m]

Section B

Answer **three** questions.

Question 13 is in the form of an **Either / Or** question.

Only one part should be answered.

11 Two experiments were carried out to investigate the effect of the removal of liver and kidneys from rats on blood urea concentration.

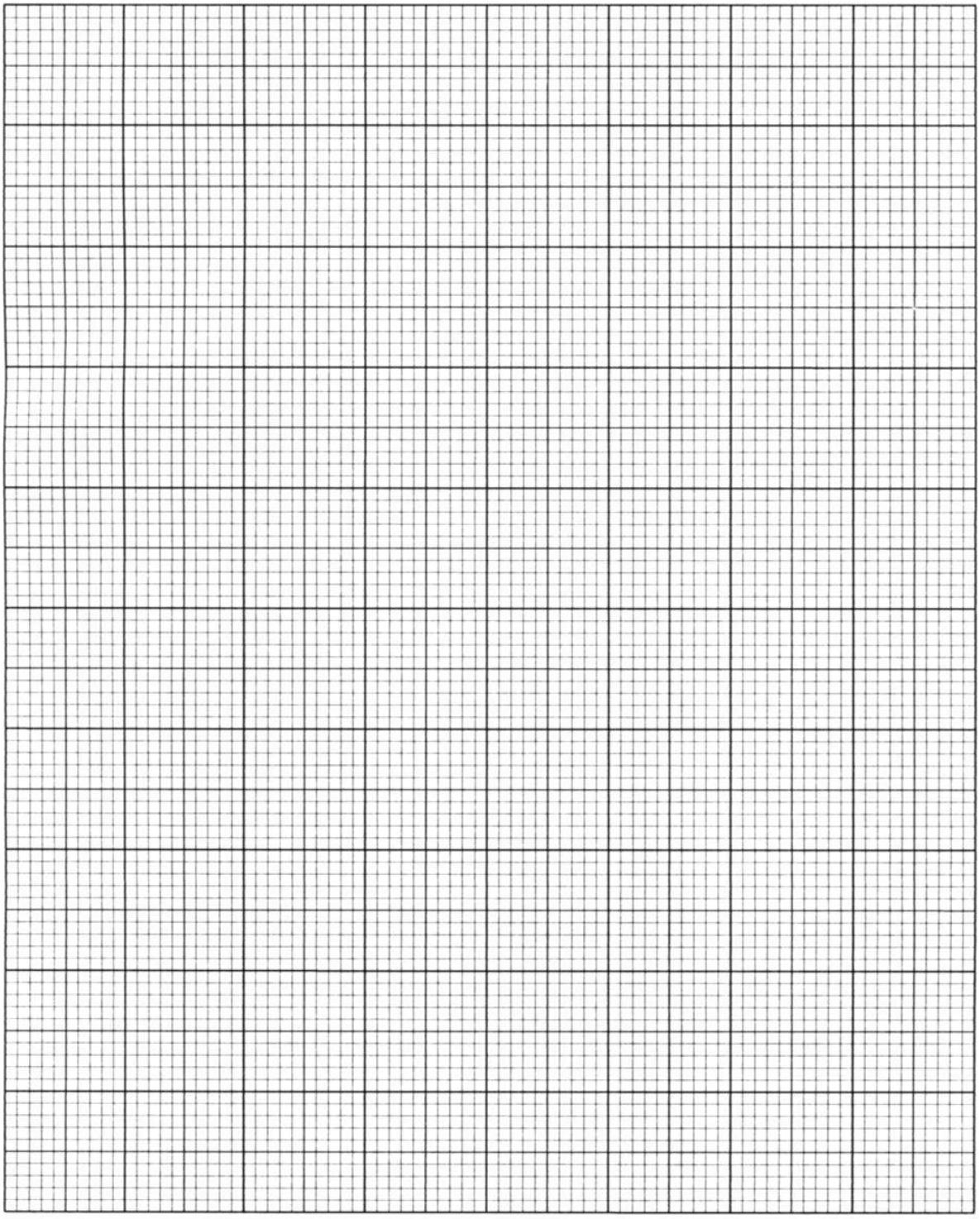
Experiment **A**	kidneys removed at start of experiment	liver removed eight hours later
Experiment **B**	liver removed at start of experiment	kidneys removed eight hours later

The blood urea concentration of the rats was measured from 0 hour to 16 hours. The results are shown in Table 11.1.

Table 11.1

Time / hours	**blood urea concentration / mg per 100 cm^3 blood**	
	Experiment **A**	Experiment **B**
0	10.0	10.0
4	17.0	5.0
8	22.0	2.5
12	21.0	2.0
16	21.0	2.0

(a) Plot a graph of these data in the grid provided on the next page. [3]



(b) Explain the change in blood urea concentration of the rats used in:

(i) Experiment **A** [2]

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(ii) Experiment **B** [2]

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(c) Outline the mechanism of dialysis in the case of kidney failure. [3]

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[Total : 10m]

12 An optometrist tested a patient's eyesight. The first test was a Visual Acuity Test to measure how the patient sees in near and far distances.

(a) Describe how the eye is able to see objects clearly at different distances. [5]

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Another one of the tests performed by the optometrist was a field test. This test examines the sensitivity of the patient's retina to light in different areas of the field of vision.

An optometrist carried out a field test on the patient as follows:

- With one eye covered, the patient stared at the centre of a screen.
- Points of light of varying intensities then appeared briefly on the screen, each in a different area, **A**, **B** or **C**, of the patient's field of vision.
- Each time the patient saw a point of light, she pressed a button to record this using an event-recorder.

The patient did not see every point of light.

Table 12.1 shows the results for one of the patient's eyes.

Each of the areas **A**, **B** and **C** of the patient's field of vision corresponds to an area of her retina. These areas are shown in the photograph of her retina in **Fig 12.1**.

Table 12.1

intensity of point of light / arbitrary units	Number of times out of 5 that the patient detected point of light		
	Area A	Area B	Area C
1 (dim)	0	5	0
2	0	4	0
3	2	5	0
4 (bright)	4	5	0

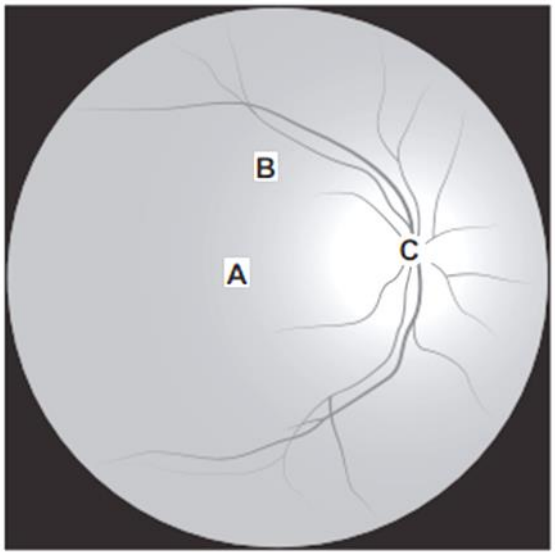

Fig 12.1

(b) Explain the results for Area **C**. [2]

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(c) Area **B** detected points of light at all of the light intensities tested.

Suggest one reason why, at light intensity of 2 units, one of the points of light was not detected. [1]

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(d) The optometrist advised the patient on the importance of using sunglasses with UV protection when he is out in the sun. Suggest an explanation why UV protection in sunglasses is important. [2]

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[Total : 10m]

13 Either

Wolfram syndrome is a genetic disorder caused by the mutation of the CISD2 gene. Children with Wolfram syndrome develop early-onset diabetes and deafness.

(a) Describe how mutation of the CISD2 gene is responsible for Wolfram syndrome.

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…… [2]

Wolfram syndrome is caused by a recessive gene, **n**. The gene for normal condition can be represented by **N**.

A family consisted of two young parents who are normal and three daughters who have the genetic disorder.

(b) Using a genetic diagram, discuss the probability that the next child is a boy without the disorder. [5]

(c) Giving suitable examples, describe the differences between continuous and discontinuous variation. [3]

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[Total : 10m]

13 Or

The picture below shows the white-backed vulture, *Gyps benganalensis*.

Photo credit courtesy of Krzysztof Blachowiak, The Internet Bird Collection

In India, the population of *Gyps benganalensis* has fallen by 97% to an estimated 4000 vultures. This species is now considered to be "critically endangered".

An explanation for the decline in numbers of the species is as follows :

- Vultures feed on carcasses from farm animals which may have been treated with a particular painkiller drug. This drug is known to cause kidney failure in the vultures.
- Farmers continue to use up their stocks of the drug although its sale is being phased out by authorities.
- The drug is non-biodegradable and will remain in the environment.

(a) Calculate the original population of the white-backed vulture.
Show your working. [1]

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(b) With reference to the explanation on the previous page, explain what is meant by the term *'bioaccumulation'* and *'bioamplification'*. [3]

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In an effort to save the vultures, a captive breeding programme has been set-up.

Three centres have been built in India so far, each housing up to 40 vultures. These vultures have been collected from different areas of the Indian subcontinent.

(c) Explain why the decision was made to conserve the species in captivity (*ex situ*) rather than in the wild (*in situ*). [3]

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(d) Outline three reasons why conservation of the white-backed vulture is important. [3]

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End of paper