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Candidate Name	Class	Register Number
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CHANGKAT CHANGI SECONDARY SCHOOL

Preliminary Examination 2019

Subject : Science(Biology)
Paper No : 5078 / 1
Level : Secondary 4 Express
Date : 4 September 2019
Duration : 1 hour
Setter : Ms Amanda Ng

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Write your name, class and register number in the spaces provided at the top of this page.

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

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 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.

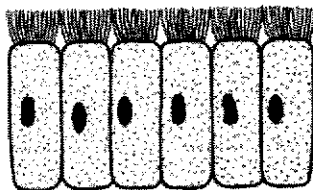
For Examiners' Use	Marks
Paper 1	/ 40
Personal Target	Actual Grade
Parent's / Guardian's signature	

This document consists of **10** printed pages including the cover page

[Turn over

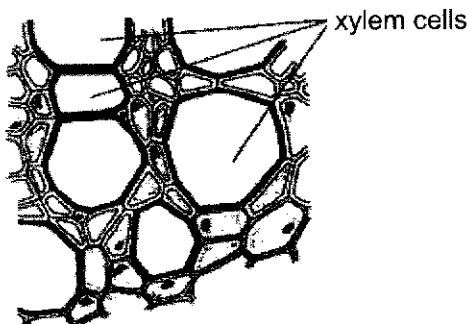
2

- 21 The diagram shows a sample of material taken from an organism.



Which level of organisation does the sample show?

- A cell
 - B organ
 - C organ system
 - D tissue
- 22 The diagram below shows the cross-section of some xylem cells.



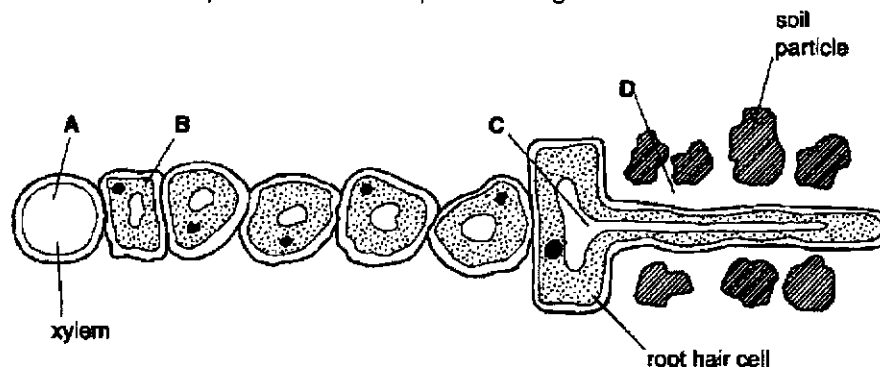
Which structures can be seen in the xylem cells?

	cell membrane	cell wall	cytoplasm
A	✓	x	x
B	x	✓	x
C	✓	✓	✓
D	x	✓	✓

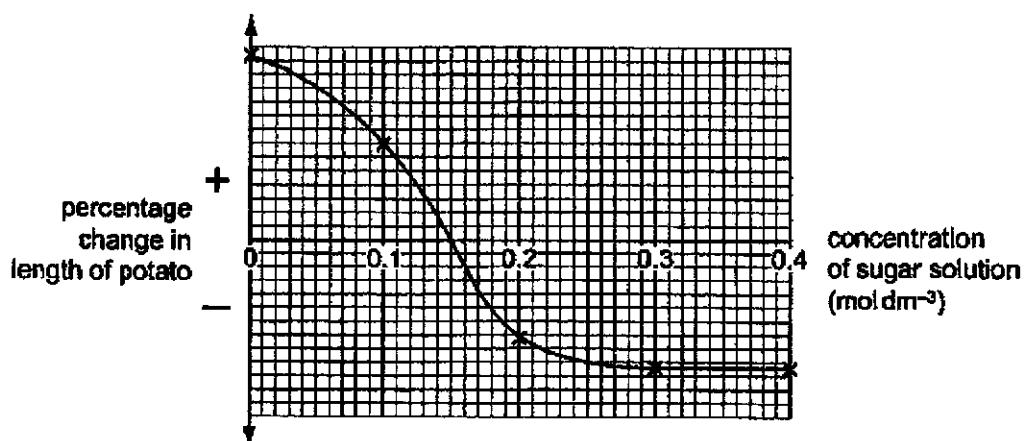
3

- 23 The diagram shows part of a plant root in the soil. The root is absorbing water.

At which labelled point is the water potential highest?



- 24 Five pieces of equal size and shape are cut from a potato. The pieces are then placed in sugar solutions of different concentrations. After two hours, the change in length of each potato is measured. The results are shown in the graph.



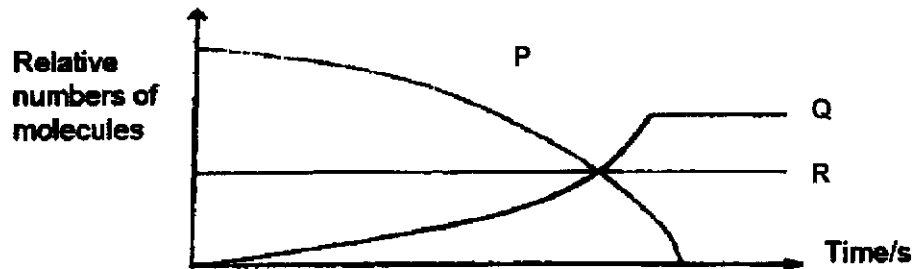
Which concentration(s) of sugar solution has the same water potential as the potato?

- A 0.15 mol dm^{-3}
- B 0.1 mol dm^{-3}
- C 0.2 mol dm^{-3}
- D 0.3 mol dm^{-3} and 0.4 mol dm^{-3}

[Turn over

4

- 25 The graph below records the change in relative numbers of molecules for an enzyme-catalysed reaction.



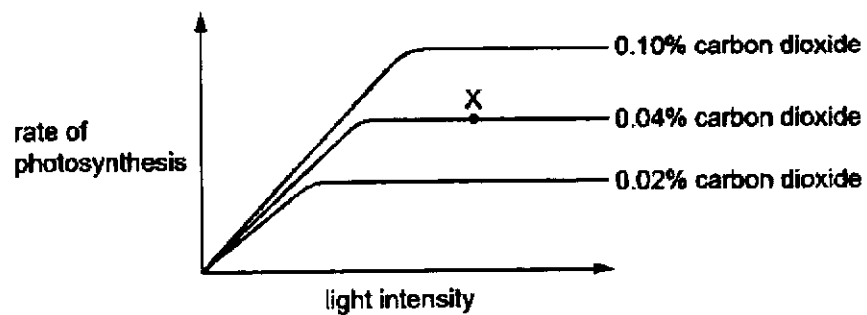
Which of the following is correct?

	P	Q	R
A	enzyme	product	substrate
B	product	substrate	enzyme
C	product	enzyme	substrate
D	substrate	product	enzyme

- 26 The temperature of an enzyme-controlled reaction is increased by 10°C . How does this affect the rate of reaction?

- A It always increases the rate.
- B It always decreases the rate.
- C It may increase or decrease the rate.
- D It has no effect on the rate.

- 27 The graph shows how the rate of photosynthesis of a plant changes with light intensity, at three different carbon dioxide concentrations. In each case the temperature is 15°C .

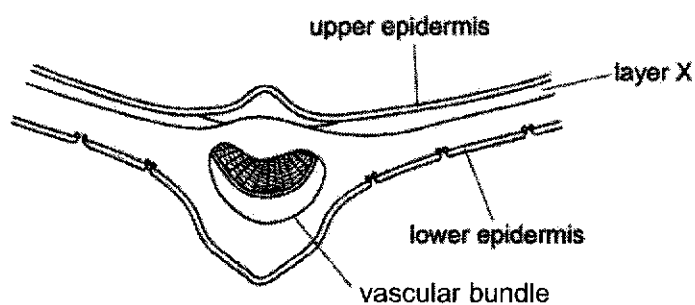


What is the limiting factor for the rate of photosynthesis at point X on the graph?

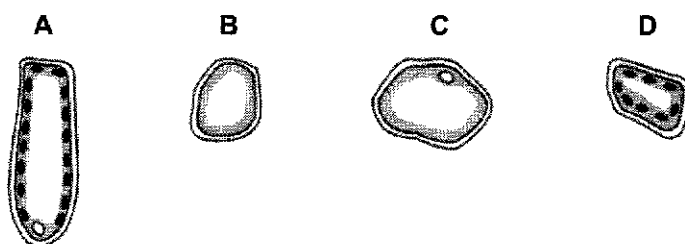
- A Amount of water
- B Carbon dioxide concentration
- C Light intensity
- D Temperature

5

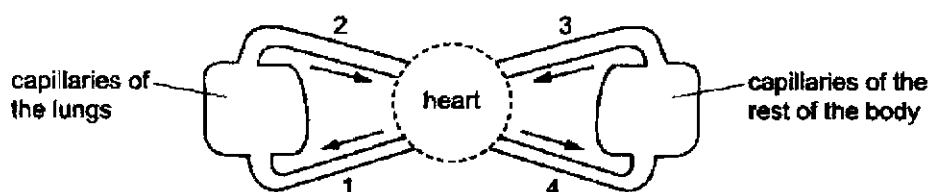
- 28 The diagram shows a cross-section of part of a leaf.



Which type of cell is found in layer X?



- 29 The diagram shows a circulatory system.



Which vessels carry oxygenated blood?

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

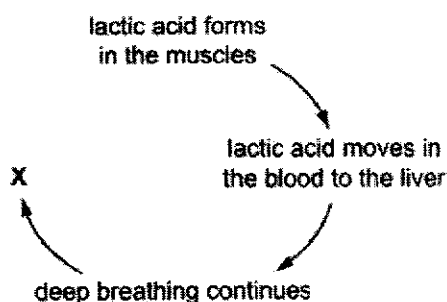
- 30 What happens to the heart valves when the ventricles contract?

	atrioventricular valves	semilunar valves
A	close	close
B	close	open
C	open	close
D	open	open

[Turn over

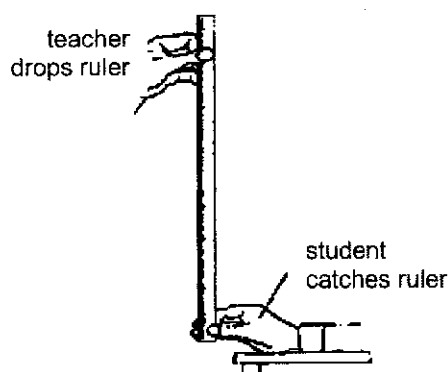
6

- 31 After a race, athletes experience oxygen debt. The diagram shows how the oxygen debt is removed.



What happens at X?

- A aerobic respiration of glucose
 - B anaerobic respiration of glucose
 - C breakdown of lactic acid in the presence of oxygen
 - D breakdown of lactic acid in the presence of carbon dioxide
- 32 The reaction time of a student is found by measuring the distance a ruler falls before it is caught by the student. A teacher drops a ruler as shown in the diagram below.



Which path is taken by nerve impulses from the students' eyes to the muscles of his hand?

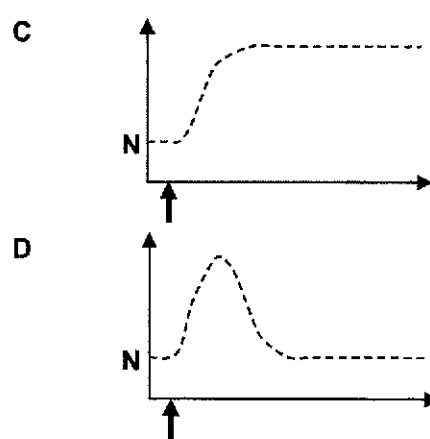
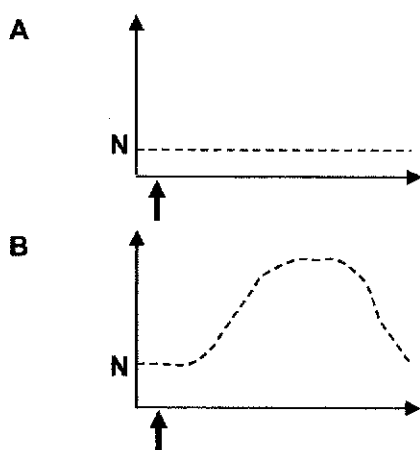
- A optic nerve → retina → spinal cord → brain → spinal nerve → hand muscles
- B optic nerve → retina → spinal cord → spinal nerve → brain → hand muscles
- C retina → optic nerve → brain → spinal cord → spinal nerve → hand muscles
- D retina → optic nerve → spinal nerve → brain → spinal cord → hand muscles

7

- 33 What would be the pupil size and lens shape of a person reading a mobile phone text message in a brightly-lit room?

	pupil size	lens thickness
A	large	thin
B	large	thick
C	small	thick
D	small	thin

- 34 Which of the following graphs most accurately represents the insulin level in the blood of a healthy person after a meal of desserts?
(N is the normal level of insulin; ↑ indicates the time of the meal)



[Turn over

8

- 35 The diagram shows the menstrual cycle of a woman with a regular 28-day cycle during the month of September.

Menstruation occurred on 2nd to 6th September.

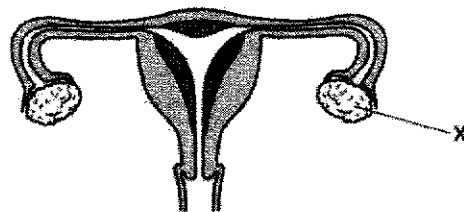
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

Which of the following explains why fertilisation **cannot** take place if sperms are released into the vagina on 8th September?

- A The uterus lining is shed during menstruation.
- B The egg is washed out of female uterus by the menstrual flow.
- C Sperms can survive in the female reproductive system for only 3 or 4 days.
- D Sperms must be released into the vagina only after ovulation has occurred.

- 36 The diagram shows the female reproductive system.

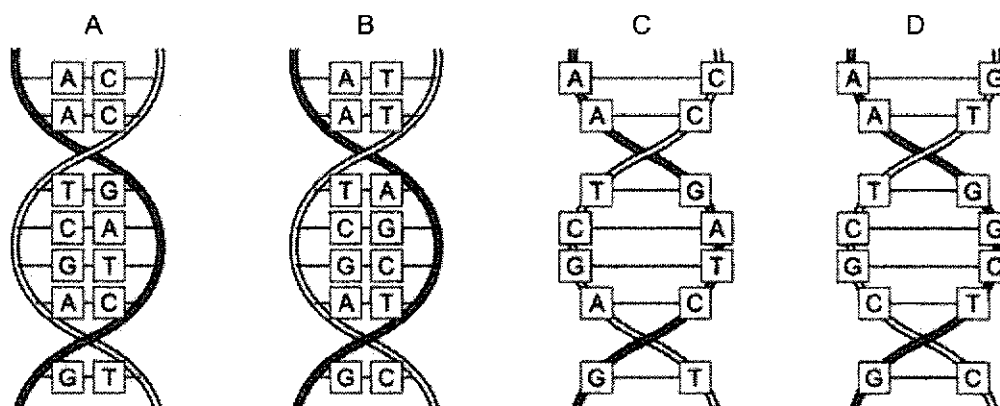
What is the function of the part labelled X?



- A gamete production and hormone secretion
- B zygote production and hormone secretion
- C gamete production only
- D hormone secretion only

9

37 Which diagram shows the structure of DNA?



38 In fruit flies, the allele for grey body, G, is dominant over the allele for black body, g.

The result of a mating between two flies is shown.

(parents) grey-bodied fly × black-bodied fly

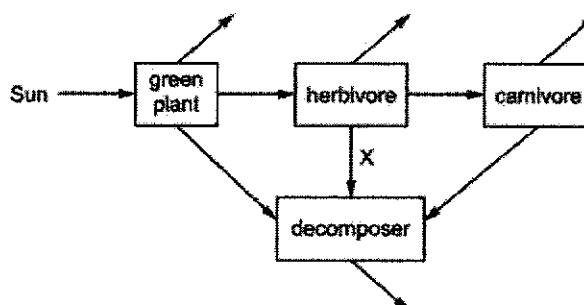
↓

(offspring) 33 grey-bodied flies + 38 black-bodied flies

What were the genotypes of the parents?

- A Gg × gg
- B Gg × Gg
- C GG × gg
- D GG × Gg

39 The diagram shows energy flow through an ecosystem.



In what form is energy transferred at X?

- A chemical
- B heat
- C kinetic
- D light

[Turn over

10

- 40 In the food chain below, the population of snakes is halved owing to a viral disease.

grass → locusts → snakes → eagles

What effect does this have on the other members of the food chain?

	grass	locusts	eagles
A	decrease	increase	decrease
B	decrease	increase	increase
C	increase	decrease	Increase
D	increase	decrease	decrease

- End of Paper -

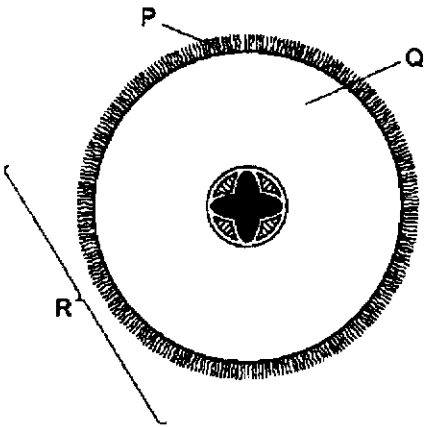
4E 2019 PRELIM Sc Bio answers

21	22	23	24	25	26	27	28	29	30
D	B	D	A	D	C	B	A	D	B
31	32	33	34	35	36	37	38	39	40
C	C	C	D	C	A	B	A	A	A

[Turn over

A 0°C B 27°C ¹² C 40°C D 65°C

The diagram shows a section through a root.

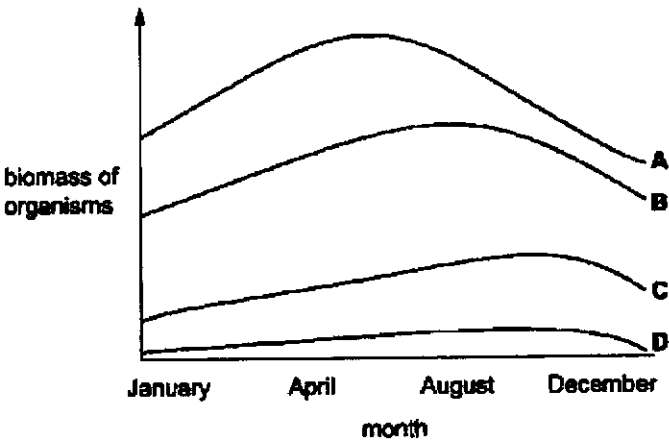


Which are the levels of organization of the labelled structures?

	cell	organ	tissue
A	P	Q	R
B	P	R	Q
C	Q	R	P
D	R	Q	P

The graph shows changes in biomass of different organisms in an ecosystem over a 12 month period. Each line represents a different trophic level.

Which line represents the herbivores? B

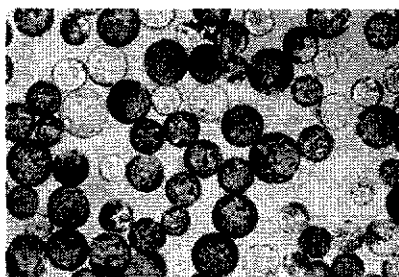


13

Which plants are most likely to adapt successfully to climatic change in their environment?

- A plants that grow rapidly
- B plants that reproduce asexually
- C plants that are cross-pollinated
- D plants that do not rely on wind-pollination

The following diagram shows protoplasts, plant cells with their cell walls removed.

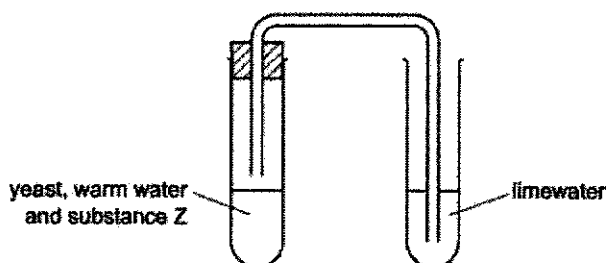


What happens if plant protoplasts are placed in distilled water?

- A They get larger and become turgid.
- B They get larger and burst.
- C They get smaller and become plasmolysed.
- D They get smaller and shrivel up.

The following set-up is used to investigate if respiration has occurred. A white precipitate is formed in limewater if respiration has occurred.

When yeast, warm water and substance Z were put into a test-tube, A white precipitate is formed in limewater turned cloudy after a while.



What is substance Z?

- A Ethanol
- B Glucose
- C Nitrogen
- D Oxygen

[Turn over

14

Which row describes the genetic code in DNA?

what forms the genetic code what the DNA codes for

- A sequence of amino acids sequence of bases
 B sequence of amino acids sequence of proteins
 C sequence of bases sequence of amino acids
 D sequence of bases sequence of proteins

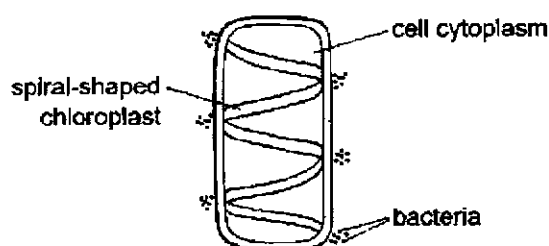
32 Which row describes the genetic code in DNA?

	what forms the genetic code	what the DNA codes for
A	sequence of amino acids	sequence of bases
B	sequence of amino acids	sequence of proteins
C	sequence of bases	sequence of amino acids
D	sequence of bases	sequence of proteins

Which structures must be present in a cell for osmosis to take place? A cell (sap) vacuole and cell wall B cell wall and cell membrane C chloroplast and cytoplasm D cytoplasm and cell membrane

12 Which chemical reaction takes place in the stomach? A Proteins are digested by protease. B Proteins are digested into fatty acids. C Starch is digested into amino acids. D Starch is digested by lipase.

17 The diagram shows a cell with groups of bacteria around its edge.



The bacteria move to areas of high oxygen concentration.

Which process in the cell causes the bacteria to form these groups?

- A** digestion
B photosynthesis
C reproduction
D respiration

15

- 30 A short-toed animal was crossed with a long-toed animal of the same species. All the offspring had short toes. One of these offspring was crossed with another long-toed animal of the same species.

Which ratio of short-toed to long-toed animals should be expected?

- A 1:1 B 2:1 C 3:1 D 4:1

- 31 Which types of variation can be inherited?

	variation caused by genes	variation caused by the environment
A	✓	✓
B	✓	x
C	x	✓
D	x	x

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0610/13/M/J/12

- 32 Which diagram shows the flow of energy in an ecosystem?

A Sun → plants → animals → bacteria

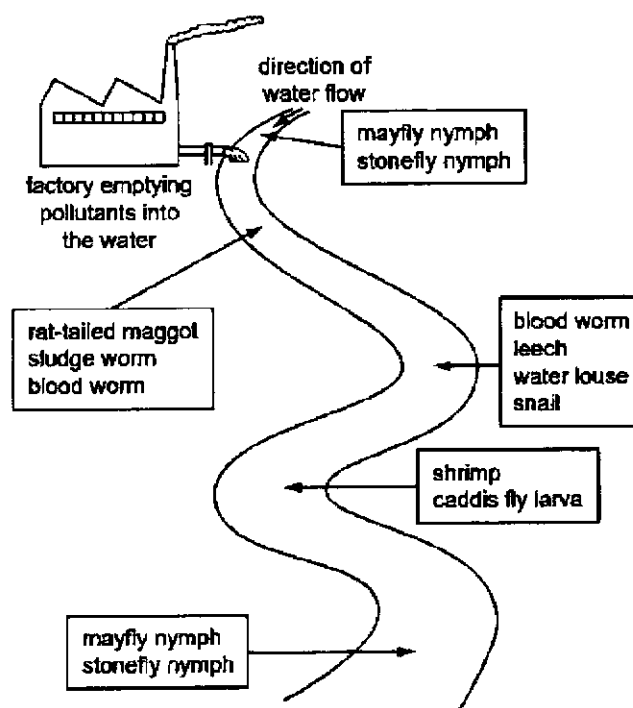
B Sun ↔ plants ↔ animals ↔ bacteria

C Sun → plants ↔ animals ↔ bacteria

D Sun → plants → animals → bacteria


[Turn over

- 35 The diagram shows the results of a survey on the types of animals found along a stretch of river near to a factory.



Which of the following animals lives in the most polluted water?

- A blood worm
- B caddis fly larva
- C leech
- D stonefly nymph

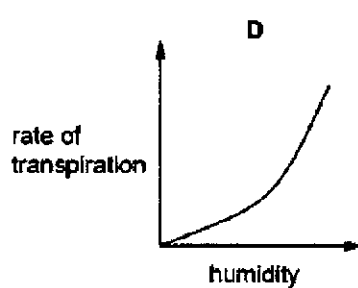
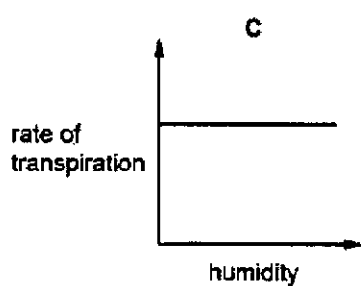
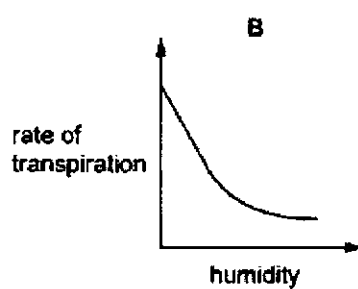
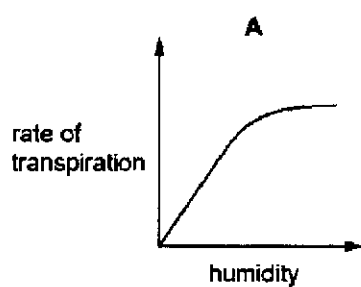
- 36 During aerobic respiration glucose is broken down.

This process recycles

- A carbon only.
- B carbon and water.
- C energy only.
- D water only.

17

Which graph shows most clearly what will happen to the rate of transpiration as humidity increases?



[Turn over

Candidate Name	Class	Register Number
----------------	-------	-----------------



CHANGKAT CHANGI SECONDARY SCHOOL

Preliminary Examination 2019

Subject : Science (Biology)
Paper No : 5078/4
Level : Secondary 4 Express
Date : 28 August 2019
Duration : 1 hour 15 minutes
Setter : Ms Amanda Ng

INSTRUCTIONS TO CANDIDATES

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

Write your name, class and register number in the spaces at the top of this page.

Section A

Answer **all** questions.

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

Section B

Answer any two questions.

Write your answers in the spaces provided.

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

For Examiner's Use	Marks
Section A	/ 45
Section B	/ 20
Total	/ 65
Personal Target	Actual Grade
Parent's / Guardian's signature	

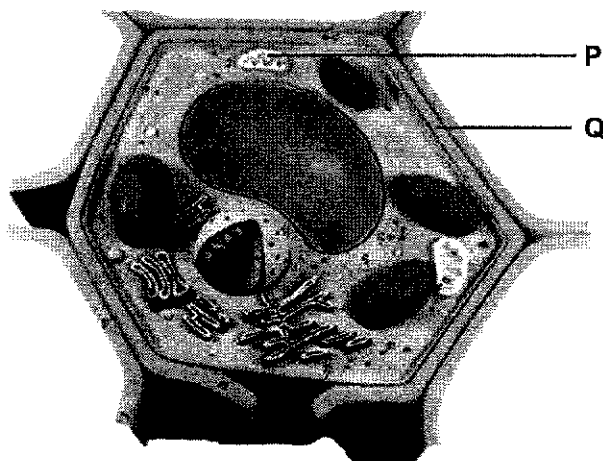
This Question Paper consists of **14** printed pages, including the cover page.

[Turn over

Section A [45 marks]

Answer all questions in the spaces provided.

- 1 Fig. 1.1 shows a plant cell model.

**Fig. 1.1**

- (a) Complete the following table by identifying the structures labelled **P** and **Q** in **Fig. 1.1**, and name the carbohydrates found in each structure.

Structure	Name	Carbohydrate found
P		
Q		

[4]

- (b) Sugars can react with nitrates to form amino acids, which are combined to form proteins for the synthesis of new protoplasm.

- (i) State where proteins are synthesised in the cell.

.....[1]

- (ii) Suggest an explanation for why nitrates are necessary for protein synthesis in plants but not for fats.

.....

.....[1]

- (iii) Name the process by which carbon compounds are transferred from one organism to another.

.....[1]

[Total: 7 marks]

3

- 2 **Fig. 2.1** shows the stomata opening at different times of the day and under different conditions - normal, very dry soil and an experimentally created low carbon dioxide environment.

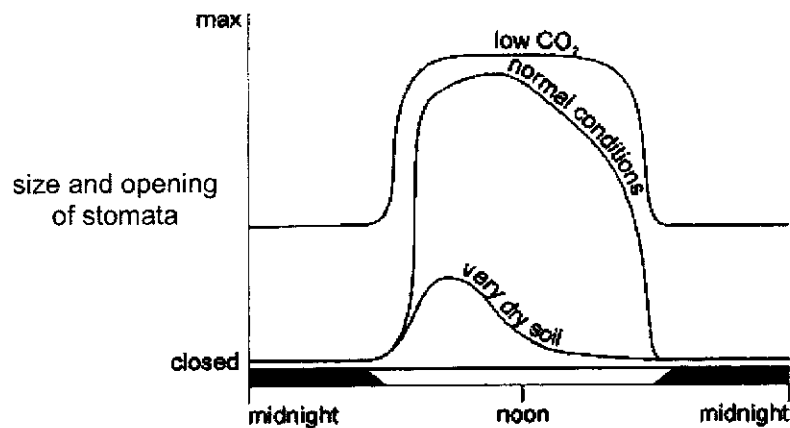


Fig. 2.1

Lower carbon dioxide concentration in the leaf than the atmospheric air results in the stomata opening.

- (a) Describe and explain the changes in carbon dioxide concentration that leads to the stomata opening under normal conditions in **Fig. 2.1**.

.....

.....

.....

.....

.....

.....

.....[4]

- (b) (i) State the difference in the stomata opening in very dry soil conditions compared to normal conditions in **Fig. 2.1**.

.....

.....[1]

- (ii) State and explain the advantage of the difference in the stomata opening in very dry soil conditions.

.....

.....

.....[2]

[Turn over

4

- (iii) In very dry soil conditions, wilting may occur in the day. State how wilting occurs.

.....
[1]

[Total: 8 marks]

- 3 Fig. 3.1 shows the process of blood clotting when a blood vessel is broken.

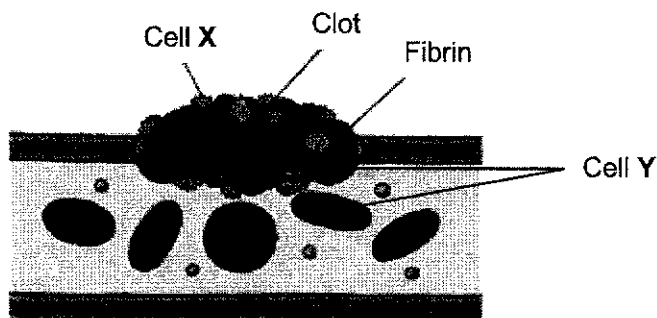


Fig. 3.1

- (a) (i) Name Cell X in Fig. 3.1.

.....[1]

- (ii) State the importance of the blood clotting process.

.....[1]

- (iii) Describe two ways in which Cell Y is structurally adapted to its function.

.....

[2]

Fig. 3.2 shows the change in numbers of lymphocytes, a type of white blood cells, following a human immunodeficiency virus (HIV) infection that was not treated.

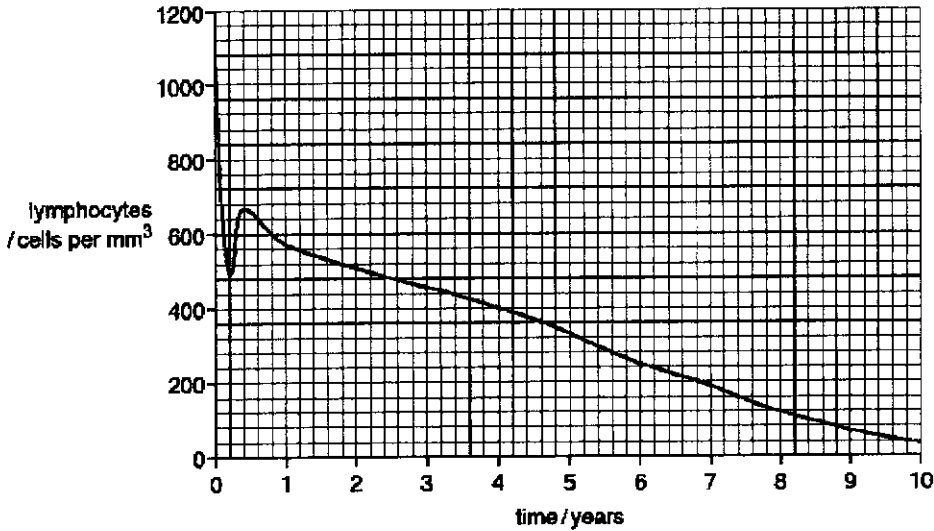


Fig. 3.2

- (b) (i) Describe the changes in lymphocyte numbers in **Fig. 3.2**.
-
-
-
-[2]
- (ii) Using your knowledge of the function of lymphocytes, suggest an explanation for the changes in lymphocyte numbers described in your answer to **(b)(i)** above.
-
-
-
-[2]
- (iii) Infection from HIV has become worldwide. State a possible way in which the spread of HIV can be prevented.
-
-[1]

[Total: 9 marks]

[Turn over

6

- 4 **Fig. 4.1** shows sections of two flowers, **K** and **L**. The two flowers are taken from different plants of the same species.

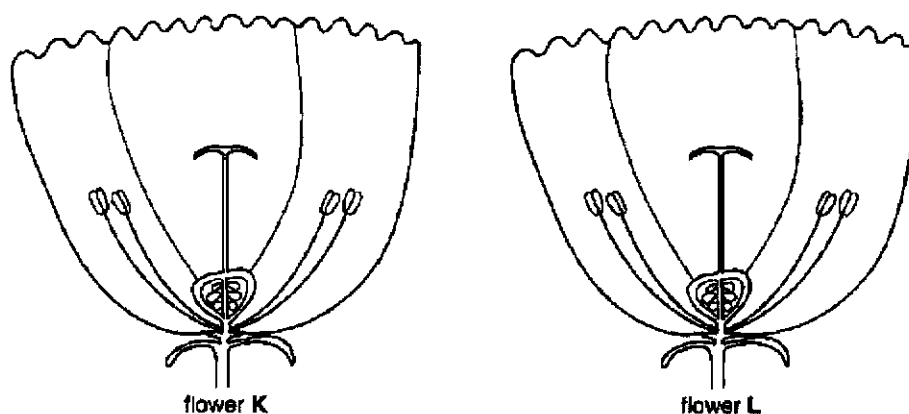


Fig. 4.1

- (a) On flower **L**, name and label the part of the flower that produces the female gamete, ovum. [2]
- (b) (i) On **Fig. 4.1**, draw an arrow to represent the transfer of pollen from flower **K** to flower **L** during cross-pollination. [1]
- (ii) State an advantage of cross-pollination.

.....

.....[1]

- (c) Describe two features visible in **Fig. 4.1** that suggest the flowers are insect-pollinated.

1

.....

2

.....[2]

[Total: 6 marks]

- 5 Apple scab is a disease that infects apple trees.
Fig. 5.1 shows apples from uninfected and infected apple trees.

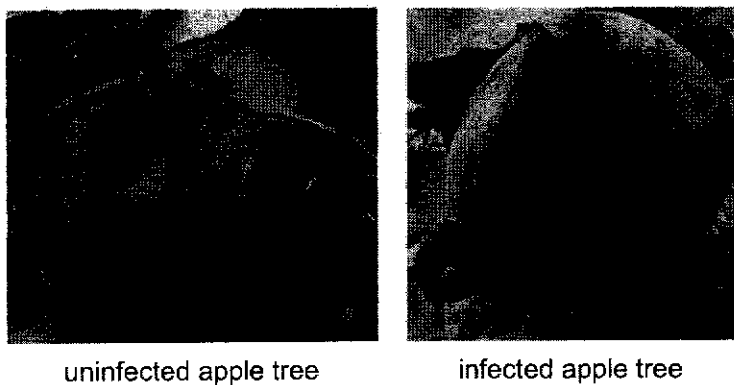


Fig. 5.1

There is a gene that determines whether or not apple trees are resistant to apple scab disease.
There are two alleles for this gene:

- disease-resistant, **R**
- not disease-resistant, **r**

- (a) A farmer did a test cross to identify the genotype of a disease-resistant apple. He got similar number of apples that were disease-resistant and not disease-resistant.

Draw a genetic diagram to explain the results of his test-cross.

[3]

[Turn over

8

- (b) (i) The farmer wanted to breed disease-resistant apple trees. State the parental genotypes of apples he should use to ensure that all generations of his plants would be disease-resistant.

..... and [1]

- (ii) Explain your answer to (i).

.....

 [3]

[Total: 7 marks]

- 6 In Canada, farmers are breeding fish in large nets because the wild stocks of fish are decreasing.

Fig. 6.1 is a diagram of a salmon fish farm in the ocean. The salmon only eats the food provided by the worker.

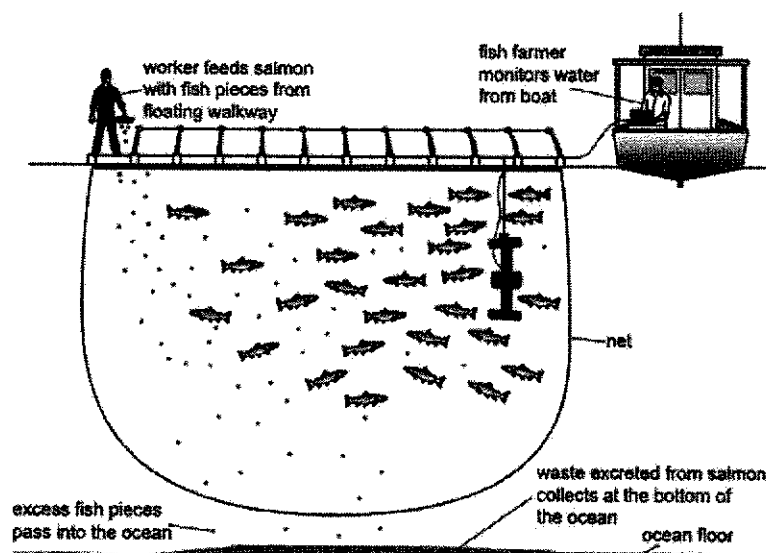


Fig. 6.1

- (a) (i) State the lowest possible trophic level in any of the food chains that the salmon in **Fig. 6.1** belongs to.

..... [1]

9

- (ii) In the ocean, phytoplankton carry out photosynthesis. As they reproduce rapidly, a small biomass appears to support large numbers of zooplankton. The small fish that are fed to the salmon feed on zooplankton.

Construct a fully labelled pyramid of biomass for the food chain described above.

[3]

The bacteria level in the ocean area with the salmon fish farm is found to be as high as the bacteria level in a waterbody contaminated with untreated sewage.

- (b) (i) Explain how the high bacteria levels result from the excess fish pieces and waste excreted from the salmon.

.....

[2]

- (ii) Describe the effects of high bacteria levels on other aquatic plants and animals.

.....

[2]

[Total: 8 marks]

[Turn over]

Section B [20 marks]

Answer any **two** questions from this section.

Write your answers into the spaces provided.

- 7 *Rhabdostyla* lives in freshwater habitats, such as ponds, lakes and rivers.

Rhabdostyla has a contractile vacuole that fills with water and empties at intervals as shown in Fig. 7.1. The contractile vacuole removes excess water.

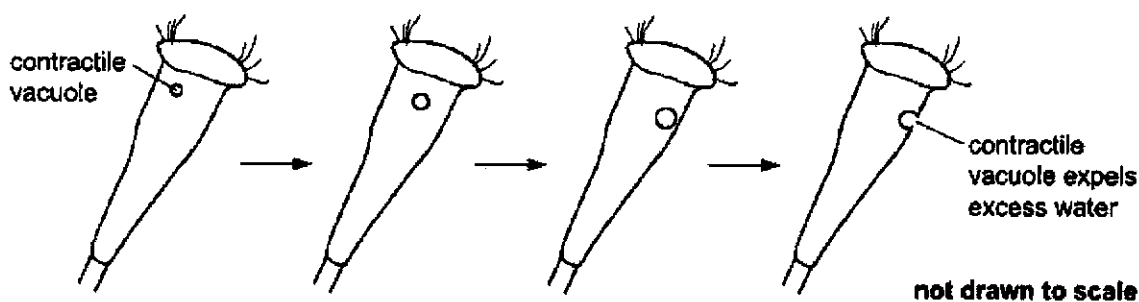


Fig. 7.1

- (a) Explain, using the term osmosis, why *Rhabdostyla* needs to remove excess water.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

- (b) Predict if contractile vacuoles would be found in single-celled organisms with cell walls. Explain your answer.

.....

.....

.....

.....[2]

In an investigation, individual *Rhabdostyla* organisms were placed into different concentrations of sea water. The rate of water excreted by the contractile vacuole of each organism was determined. The results are shown in **Fig. 7.2**.

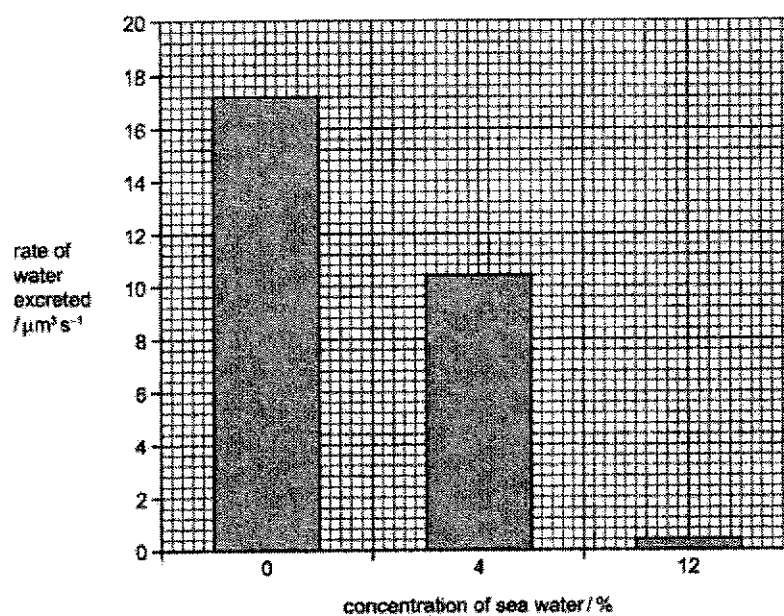


Fig. 7.2

(c) Describe and explain the results shown in **Fig. 7.2**.

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 10 marks]

[Turn over

- 8 Three enzymes, **P**, **Q** and **R**, were extracted from different regions of the alimentary canal of a mammal. The effect of pH on the activity of the enzymes was investigated at 40°C. The results are shown in **Fig. 8.1**.

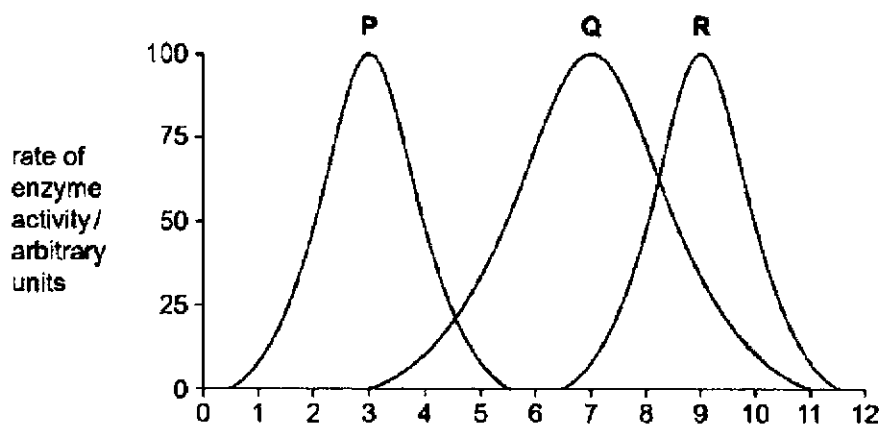


Fig. 8.1

- (a) (i) State in which part of the alimentary canal enzyme **P** is found in.
[1]
- (ii) State a possible identity of enzyme **R**.
[1]
- (iii) Using the lock and key hypothesis, describe and explain the effect of pH on the rate of enzyme activity of **Q**.

[4]

- (b) Some baby food is manufactured by pre-digesting food containing carbohydrates, fats and proteins with enzymes.

With reference to **named** digestive enzymes, suggest and explain why enzymes are added to manufacture baby food.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 10 marks]

9 Cigarette smoke contains carbon monoxide and nicotine.

- (a) (i) Describe and explain how nicotine is harmful to smokers, especially for people with fatty substances deposited in the inner surface of the coronary arteries.

.....

.....

.....

.....

.....

.....[3]

- (ii) With reference to the properties of carbon monoxide, explain why it is recommended that pregnant women do not smoke.

.....

.....

.....

.....[2]

[Turn over

Candidate Name Answers	Class	Register Number
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CHANGKAT CHANGI SECONDARY SCHOOL

Preliminary Examination 2019

Subject : Science (Biology)
Paper No : 5078/4
Level : Secondary 4 Express
Date : August 2019
Duration : 1 hour 15 minutes
Setter : Ms Amanda Ng

INSTRUCTIONS TO CANDIDATES

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

Write your name, class and register number in the spaces at the top of this page.

Section A

Answer **all** questions.

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

Section B

Answer any two questions.

Write your answers in the spaces provided.

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

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

For Examiner's Use	Marks
Section A	/ 45
Section B	/ 20
Total	/ 65
Personal Target	Actual Grade
Parent's / Guardian's signature	

This Question Paper consists of **16** printed pages, including the cover page.

[Turn over

CCSS 4E Sc Bio Prelim 2019 Answers

Section A [45 marks]

Answer all questions in the spaces provided.

- 1 Fig. 1.1 shows a plant cell model.

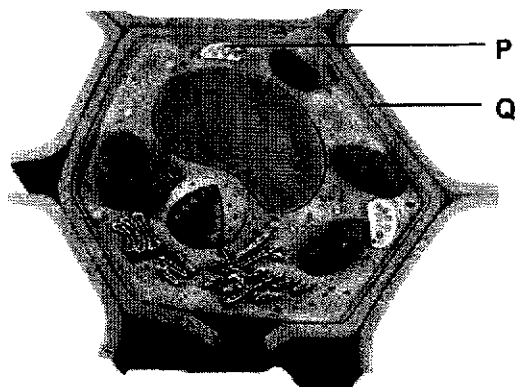
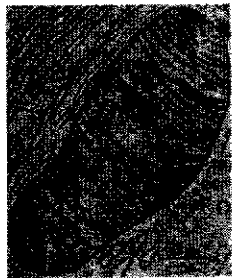
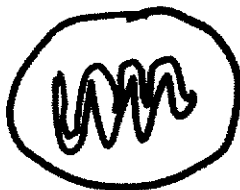


Fig. 1.1

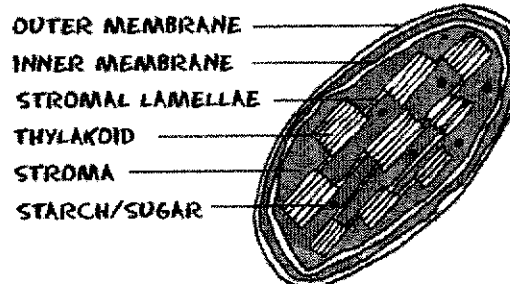
- (a) Complete the following table by identifying the structures labelled **P** and **Q** in Fig. 1.1, and name the carbohydrates found in each structure.

Structure	Name	Carbohydrate found
P	Mitochondrion	Glucose (rej: starch as starch is not used in respiration!)
	 <i>Electron micrograph</i>  <i>Drawing</i>	
Q	Cell wall	Cellulose

[4]

Note:

Students commonly confuse the chloroplast with the mitochondrion. Differentiate a chloroplast from a mitochondrion by the denser/darker 'stacks'

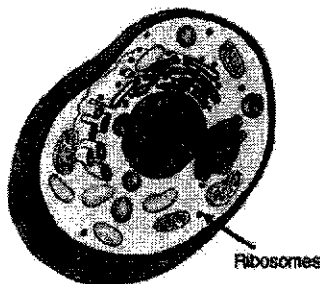


[Turn over]

- (b) Sugars can react with nitrates to form amino acids, which are combined to form proteins for the synthesis of new protoplasm.

- (i) State where proteins are synthesised in the cell.

Ribosomes



Recall: Ribosomes look like 'dots' in a cell diagram

.....[1]

- (ii) Suggest an explanation for why nitrates are necessary for protein synthesis in plants but not for fats.

Recall: Fate of glucose in leaves and that plants 'make their own food', i.e. they carry out photosynthesis and make glucose whereas for humans we eat food containing the different nutrients – carbohydrates, proteins, fats etc.

Nitrates are a source of nitrogen, an element that is found in proteins only but not in sugars and fats. [1]

OR The elements making up fats and sugars are the same – C, H, O so nitrogen is not necessary.

.....[1]

- (iii) Name the process by which carbon compounds are transferred from one organism to another. [Carbon Cycle]

Feeding

.....[1]

[Total: 7 marks]

[Turn over

- 2 Fig. 2.1 shows the stomata opening at different times of the day and under different conditions - normal, very dry soil and an experimentally created low carbon dioxide environment.

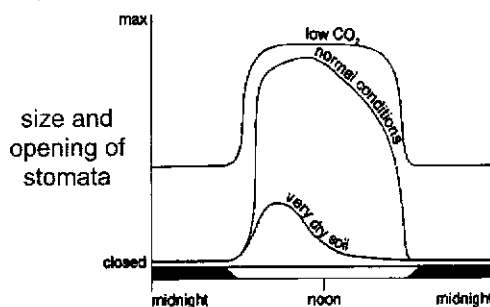


Fig. 2.1

A number of factors such as the turgidity of the guard cells and carbon dioxide concentration lead to the opening and closing of the stomata.

Lower carbon dioxide concentration in the leaf than the atmospheric air results in the stomata opening.

- (a) Describe and explain the changes in carbon dioxide concentration that leads to the stomata opening under normal conditions in Fig. 2.1.

Under normal conditions, the stomata closes at night and opens in the day [1 - describe]

Explanation key points: What causes the CO₂ concentration to change?

- Photosynthesis requires **light** (so only in the **day**)
- **Photosynthesis** uses up **CO₂** (Side note – **respiration occurs ALL THE TIME**)
so CO₂ in the (intercellular air spaces in the) leaf is lower than in the atmosphere
- Comparing **photosynthesis vs respiration** (At night, in which it's just **respiration** only → produces CO₂ so CO₂ increases / is higher in the leaf.)

In the day, the plant carries out photosynthesis [1] which **uses up [1] carbon dioxide at a faster rate than it is produced by respiration [1]** so the carbon dioxide concentration in the intercellular air spaces inside the leaf is lower than the atmospheric air and the stomata opens.

At night in the absence of light, photosynthesis cannot occur but respiration continues to occur, producing carbon dioxide [1]. As such, there is a rapid rise in the intercellular CO₂ concentration in leaves [1] and stomata closes.

.....[4]

- (b) (i) **State** the difference in the stomata opening in very dry soil conditions compared to normal conditions in Fig. 2.1.

The stomata **opens smaller** [1] in the **day** in very dry conditions compared to normal.
.....[1]

- (ii) State and explain the advantage of the difference in the stomata opening in very dry soil conditions.

Advantage: To reduce **loss** of water vapour / decrease water loss [1]

Explanation: In very dry conditions, there is not enough water in the soil for the plant so a smaller stomata size **decreases the rate of transpiration / reduces the volume of water loss through the stomata** [1].

Ans to show understanding that water vapour is also lost through the open stomata

[Turn over

-[2]
 (iii) In very dry soil conditions, wilting may occur in the day. State **how** wilting occurs.

Wilting occurs when the rate of water loss / rate of transpiration exceeds the rate of water absorption [1].

As such, the cells cannot remain turgid / lose turgor pressure [1]/ the cells become flaccid / plasmolysed [1].

Any of the above marking points

Note: TEMPORARY wilting occurs on a very hot day

→ higher temp results in higher rate of transpiration, lose too much water.

Wilting MAY BE REVERSIBLE if the plant cell is not plasmolysed yet.

.....[1]

[Total: 8 marks]

- 3 Fig. 3.1 shows the process of blood clotting when a blood vessel is broken.

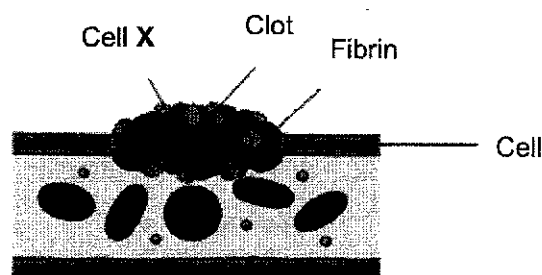


Fig. 3.1

- (a) (i) Name Cell X in Fig. 3.1.

Platelet

.....[1]

- (ii) ~~State the importance~~ of the blood clotting process.

Prevent entry of pathogens/ bacteria [1]

Prevent excessive loss of blood [1]

.....[1]

- (ii) Describe two ways in which Cell Y is structurally adapted to its **function**.

Contains **haemoglobin** that binds **oxygen**. [1]

Circular biconcave shape to increase SA to vol ratio for **faster diffusion of oxygen** into and out of the RBC.[1]

No nucleus and can thus store **more haemoglobin that binds more oxygen**. [1]

.....[2]

[Turn over]

Fig. 3.2 shows the change in numbers of lymphocytes, a type of white blood cells, in a person following a human immunodeficiency virus (HIV) infection that was not treated.

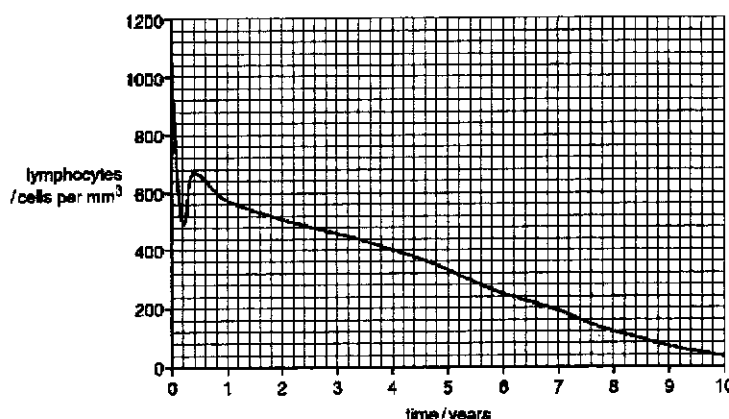


Fig. 3.2

(i) Describe the changes in lymphocyte numbers in Fig. 3.2.

Steep/ sharp decrease in short period of time (about two months / 0.2 years) from about 1000 to 500 cells per mm³ [1]

Slight increase in numbers to 650 to 670 (Accept numbers from >640 to <680) cells per mm³ in about 0.4 year [1]

Gradual decrease over time until 10 years [1] to 40 cells per mm³ at 10 years.

[2]

(ii) Using your knowledge of the **function of lymphocytes**, suggest an explanation for the changes in lymphocyte numbers described in your answer to (b)(i) above.

Stage 1: Acute HIV infection

Within 2 to 4 weeks after infection with HIV, people may experience a flu-like illness—headache, fever, rash. This is the body's natural response to infection. **The immune system in response, tries to attack HIV by producing antibodies (seroconversion).**

There is a large amount of virus in their blood and at this stage, it is contagious. The virus attacks and destroys the infection-fighting CD4 cells of the immune system.

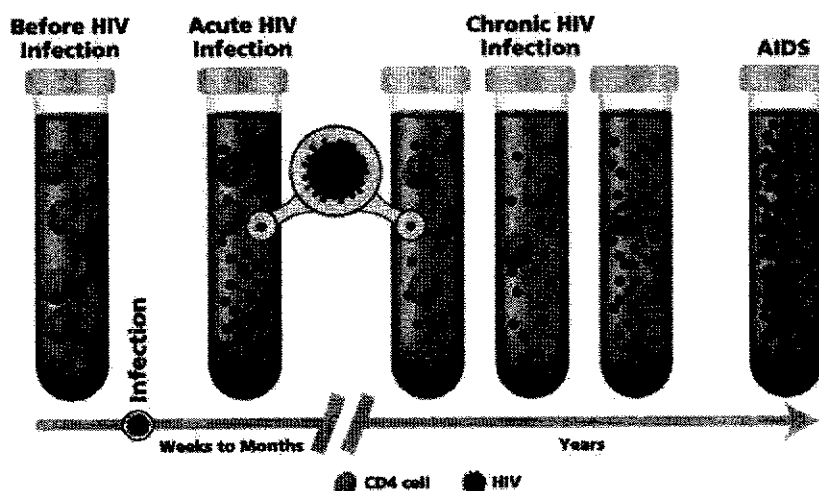
Stage 2: Clinical Latency Period

HIV continues to multiply at very low levels.

Stage 3: AIDS

A person's immune system is severely damaged. They're more likely to get serious infections that the body would otherwise be able to fight off.

HIV Progression



Ref to function of lymphocytes [1]

Lymphocytes **produce antibodies** and the slight increase in lymphocytes may mean that more antibodies are produced to *try* to fight against pathogens.

Explanation for overall decrease in number of lymphocytes [1]

However, as the disease progresses, HIV invades (specific) lymphocytes that coordinate immune response / **HIV destroys lymphocytes [1]** that protects the body from infection.

Note: HIV infects the lymphocytes (particularly T-cells) and slowly destroys them over time. The number of T-cells decreases critically, therefore **a reduced ability to produce antibodies** and the immune system is unable to fight against pathogens effectively.

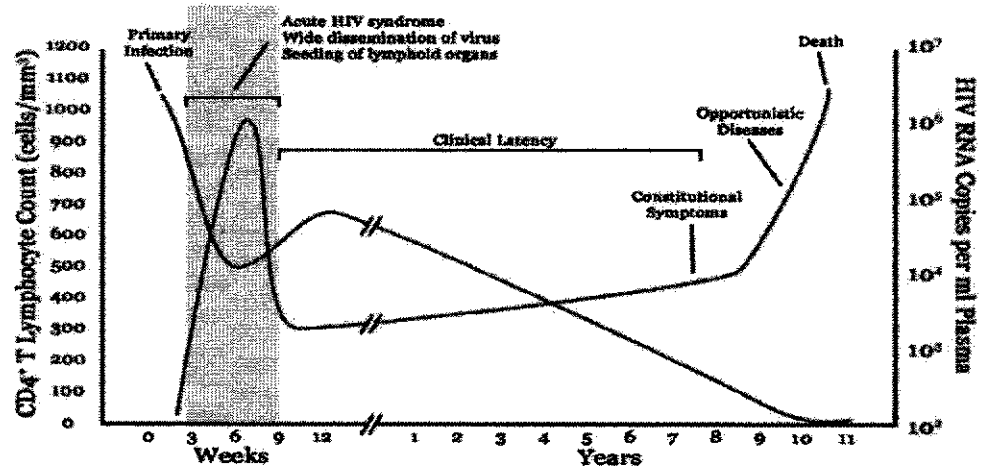
RECAP: <https://www.youtube.com/watch?v=qWSWWPZYGHU> (Biology Fuse School WBC)

[Turn over

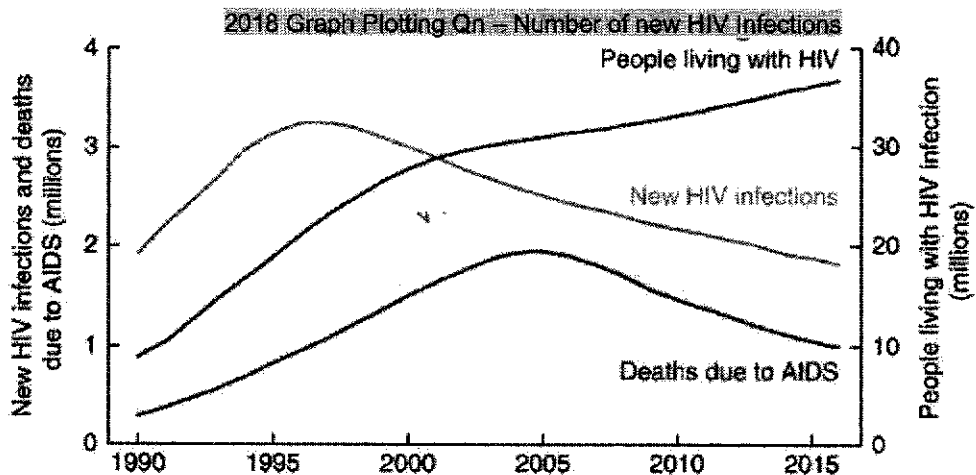
Role of antibodies

- antibodies stop pathogens spreading (in the body)
- antibodies cause pathogens to clump/ agglutinate
- antibodies make it easier for phagocytes to ingest pathogens
- antibodies neutralise toxin(s)/ make toxins harmless

Note: Lymphocytes do not quite 'sacrifice themselves and die' in the process of fighting pathogens/ bacteria and viruses. They mainly produce antibodies.



[2]



Source: J.L. Jameson, A.S. Fauci, D.L. Kasper, S.L. Hauser, D.L. Longo, J. Loscalzo: Harrison's Principles of Internal Medicine, 20th Edition Copyright © McGraw-Hill Education. All rights reserved.

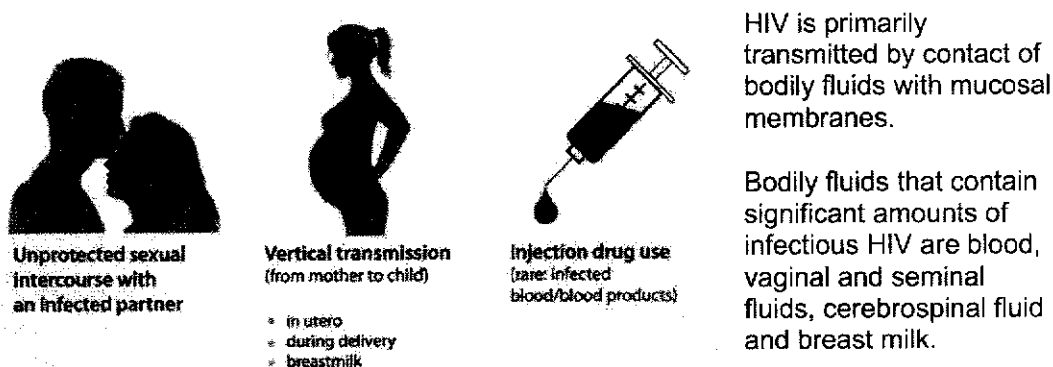
(iii) Infection from HIV has become worldwide. State a possible way in which the spread of HIV can be prevented-controlled. *Similar to 2018 Qn [3]*

- Do not have **sexual** intercourse with an **infected** person. / Do not have multiple **sex** partners / Abstinence from **sex** [1]
- Do not **share hypodermic needles** with an infected person. [1]
- Do not get a **blood transfusion from an infected** person. [1]
- Prevent exposure to hypodermic equipment that may be contaminated with blood (e.g. used for tattooing)
- Using a condom **reduces the risk** of infection [1].

[1]

[Turn over]

How did the patient develop acute HIV infection? What was the primary source from which the infection spread?



The level of HIV present in other bodily fluids, such as sweat, tears, and saliva, is very low.

[Total: 9 marks]

4 Fig. 4.1 shows sections of two flowers, K and L. The two flowers are taken from different

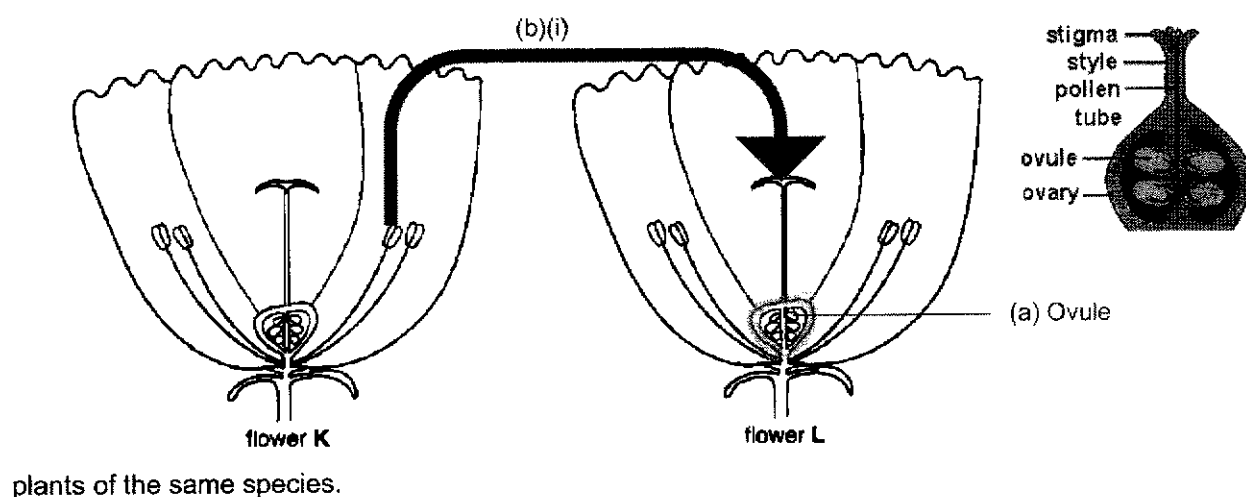
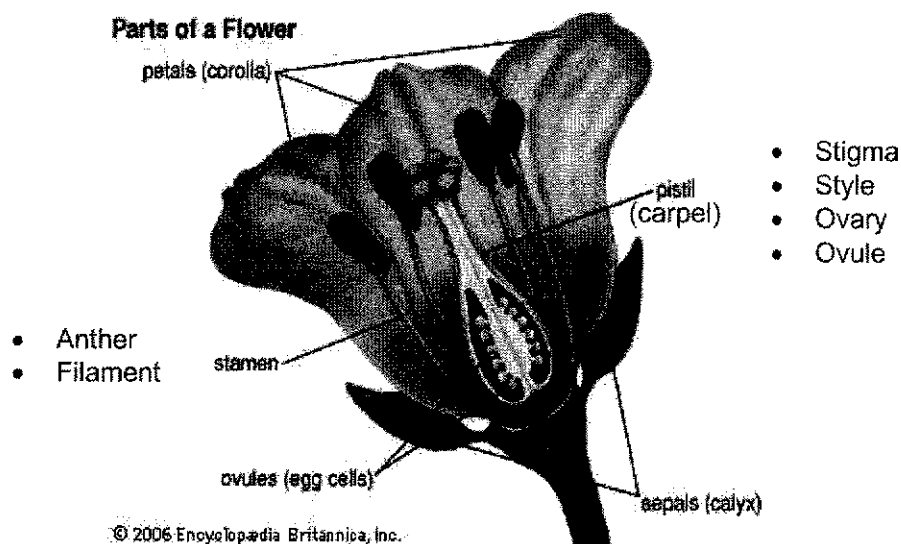


Fig. 4.1

plants of the same species.

- (a) On flower L, name and label the part of the flower that produces the female gamete, ovum. [2]
 Label correctly, any one of the ovules [1]
 Name - ovule [1]
- (b) (i) On Fig. 7.1, draw an arrow to represent the transfer of pollen from flower K to flower L during cross-pollination. [1]
 line from the anther of K to stigma of L ;

[Turn over



(ii) State an advantage of cross-pollination.

- More varieties of offspring are produced which leads to greater genetic variation. [1] (increased chance of survival / to adapt to changing environmental conditions)
 - Offspring can inherit beneficial qualities from both parents. [1]
 - Seeds produced (compared to asexual reproduction, a clone/ daughter plant) are capable of surviving longer before germination. [1]
-[1]

(c) Describe two features **visible in Fig. 7.1** that suggest the flowers are insect-pollinated.

- Large petals [1]
- stamens / anthers / filaments, inside flower or short, stamens / filaments or small anthers [1]
- stigma inside flower / short style [1]
- stigma broad / wide / **not feathery** [1]

Rejected answers about:

- Scented (not visible)
- Colourful (can't tell from black and white diagram)
- Nectar (can't be seen) – Usually only **nectar guide** (lines on petals)

OK: Nectar guide (not exactly but reasonable)

.....[2]

[Total: 6 marks]

[Turn over

10

- 5 Apple scab is a disease that infects apple trees.
Fig. 5.1 shows apples from uninfected and infected apple trees.

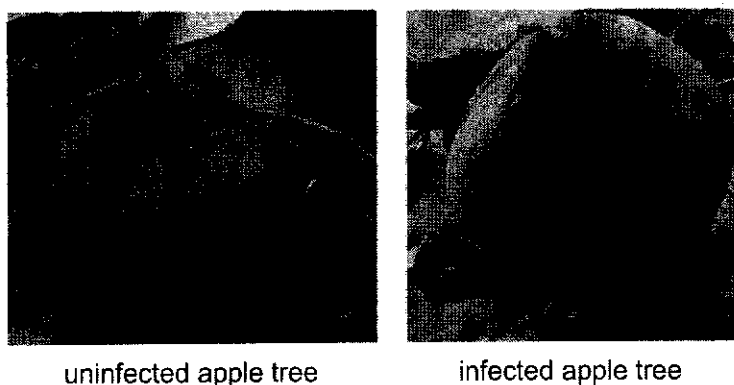


Fig. 5.1

There is a gene that determines whether or not apple trees are resistant to apple scab disease.
There are two alleles for this gene:

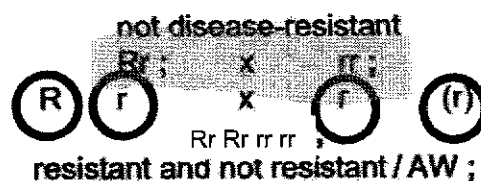
- disease-resistant, **R**
- not disease-resistant, **r**

Note: Many students did not seem to get the idea that the disease-resistant allele is dominant to the not disease-resistant allele, which was represented by the conventional small letter.

- (a) A farmer did a test cross to **uninfected apple tree** of a **uninfected apple tree**. He got **similar number** of apples that were disease-resistant and not disease-resistant.

Draw a genetic diagram to explain the results of his test-cross.

parental phenotypes
parental genotypes
gametes
offspring genotype
offspring phenotype



[3]

Marking scheme:

- Parental genotypes correct [1]
- Offspring genotypes correct; accept ECF [1]
- Phenotypes of offspring stated + Ratio / All elements of a genetic diagram seen above present [1]

[Turn over]

- (b) (i) The farmer wanted to breed disease-resistant apple trees. State the parental genotypes of apples he should use to ensure that **all generations** of his plants would be disease-resistant.

.....RR..... andRR..... [1]

- (ii) Explain your answer to (i).

Marking Scheme:

- **F1 generation / Offspring will be ALL resistant** in phenotype.
 - Note: RR / Rr genotypes will give resistant phenotypes as recessive allele is masked in the presence of a dominant allele
 - Mark for ECF from (b)(i) is awarded here, i.e. if the answers to (b)(i) were **Rr and RR / RR and Rr**.
- 1 for mention of when F1 (RR and RR) is crossed, **the subsequent F2 generation will all** be resistant (phenotype) too (**and F3, F4, F5, F6 to infinity**)
 - Need to get (b)(i) correct to get this mark
- 1 for mention of why **other combinations of parents** will not work / relevant terms:
 - recessive allele is masked in the presence of a dominant allele
 - there is a chance of 2 recessive alleles coming together if both resistant in phenotype parents are carriers/ heterozygous / not homozygous dominant / not pure-breeding

Using **both homozygous dominant /RR** parental plants / **parental plants that are pure-breeding/ have 2 copies of the dominant allele** will ensure that all the F1 offspring are disease resistant / **RR/ pure-breeding** [1] and subsequent generations when the F1 offspring is crossed [1].

If he uses both heterozygous plants, there is a (25%) chance that the offspring would be non-resistant / rr [1].

If he uses one homozygous dominant (RR) parent plant and one heterozygous (Rr) plant, the offspring would all have a phenotype of being disease-resistant. However, as (50%) of them will have a **heterozygous genotype/ carry the recessive/ not-resistant / r, allele**, when the offspring is crossed/ self-bred, there is a chance of some offspring being not-resistant / rr / homozygous recessive.

Note: It's not necessary for the student to give the probability to be awarded the mark.
[3]

[Total: 7 marks]

[Turn over

- 6 In Canada, farmers are breeding fish in large nets because the wild stocks of fish are decreasing. **Fig. 6.1** is a diagram of a salmon fish farm in the ocean. **The salmon only eats the food provided by the worker.**

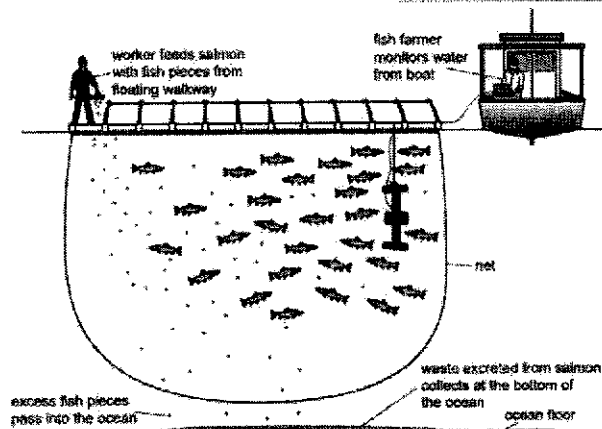


Fig. 6.1

- (a) (i) State the lowest possible trophic level in any of the food chains that the salmon in **Fig. 6.1** belongs to.
Secondary consumer / third trophic level [1]

Note: Food chains always begins with a producer!

1 st Trophic Level	2 nd Trophic Level	3 rd Trophic Level	4 th trophic level
Producer	Primary Consumer	Secondary Consumer	Tertiary consumer (usually also final level consumer as food chains are short)

- (ii) In the ocean, **phytoplankton [PRODUCER]** carry out photosynthesis. They **reproduce rapidly** and small numbers support large numbers of **zooplankton**. The **small fish** that are fed to the **salmon** feed on zooplankton.

Construct a fully labelled pyramid of biomass for the food chain described above. [3]

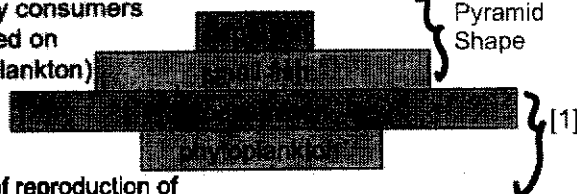
According to textbook,

Phytoplankton → zooplankton → small fish → large fish

(microscopic plant-like organisms that can photosynthesize)

(microscopic primary consumers that feed on phytoplankton)

Normal/ Usual Pyramid Shape



What happens is that the rate of reproduction of phytoplankton is fast enough to replace the organisms that were eaten by zooplankton

Marking scheme

- Exception in shape [1] – the zooplankton (PRIMARY CONSUMER) block must be longer than the phytoplankton (PRODUCER)

[Turn over

- 'Usual Shape' for others [1] - the size of the **small fish and salmon must follow a pyramid shape**, i.e. the small fish must be smaller than the zooplankton and the large fish block smaller than the small fish block*
- OR Proportion [1] – the blocks must be of equal vertical height, blocks are 'stacked' in the centre
- Correct trophic levels i.e. 4 trophic levels/ correct food chain [1] labelled

Biomass = mass of each individual x number of individuals at each level

The bacteria level in the ocean area with the salmon fish farm is found to be as high as the bacteria level in a waterbody contaminated with untreated sewage.

- (b) (i) Explain **how** the high bacteria levels result from the excess fish pieces and waste excreted from the salmon.

Bacteria decomposes [1 – Role of bacteria] the organic materials (e.g. untreated sewage/ fertilizers washed into the water bodies / uneaten food). / Bacteria obtain energy by breaking down dead organisms, faeces and excretory products.

In the presence of such a **large quantity of organic materials**, bacteria will **multiply rapidly** [1 – Why bacteria will multiply quickly when there's excess fertiliser and sewage].

.....[2]

- (ii) Describe the effects of high bacteria levels on other aquatic plants and animals.

[1 – ref to oxygen levels]

High bacteria levels **use up dissolved oxygen (during aerobic respiration) in the process of decomposition** in the water and **reduce oxygen levels** in the water.

[1- impact on other organisms]

Other aquatic plant and animals **die** from the lack of oxygen.

.....[2]

[Total: 8 marks]

Recall: Indicators of untreated sewage released into the water body:

1. Low Oxygen Level
2. High level of bacteria
3. Few other living organisms

[Turn over

Section B [20 marks]

Answer any **two** questions from this section.

Write your answers into the spaces provided.

- 7 *Rhabdostyla* lives in **freshwater** (is like distilled water usually higher water potential) habitats, such as ponds, lakes and rivers.

Rhabdostyla has a contractile vacuole that fills with water and empties at intervals as shown in Fig. 7.1. The contractile vacuole **removes excess water**.

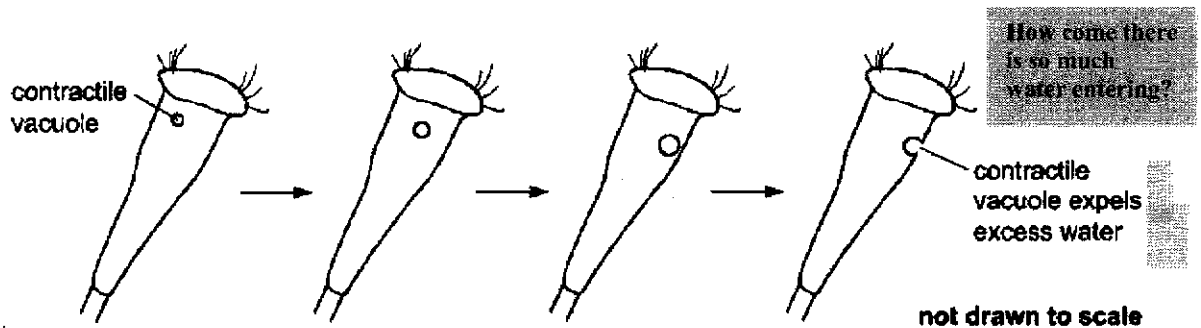


Fig. 7.1

- (a) Explain, using the term osmosis, why *Rhabdostyla* needs to remove excess water.

Marking scheme

- 1 for identification of higher water potential in where
- 1 for direction of **net movement of water molecules** (from high to low)
- Ref to Osmosis and description of osmosis process (max 2)
- Effect on cell – burst and why (max 2)

Lives in an environment with **higher water potential** than the cell [1]

Net movement of water molecules by osmosis [1] **into** [1 – direction] the cell (through a partially permeable membrane [1] – Max 2 for ref to definition of osmosis.

Cell would burst [1] if it does not pump out the excess water as it has no cell wall [1]

.....[4]

- (b) Predict if contractile vacuoles would be found in single-celled **organisms with cell walls**. Explain your answer.

No [1 for prediction].

This is as the cell wall supports the cell and **stops it from bursting** [1 for property of cell wall/ stops it from bursting] when there is a net movement of water molecules into the cell by osmosis.

OR: Cell walls are **inelastic** / do not stretch/rigid/ inflexible/ keep shape of cell [1 for characteristic of cell wall]. As such, when there is a continuous net movement of water molecules into the cell, **cells are turgid/ have high turgor pressure / resist any increase in, volume/ pressure /the cells will not burst**.

.....[2]

[Turn over

In an investigation, individual *Rhabdostyla* organisms were placed into different concentrations of sea water. The rate of water excreted by the contractile vacuole of each organism was determined. The results are shown in Fig. 7.2.

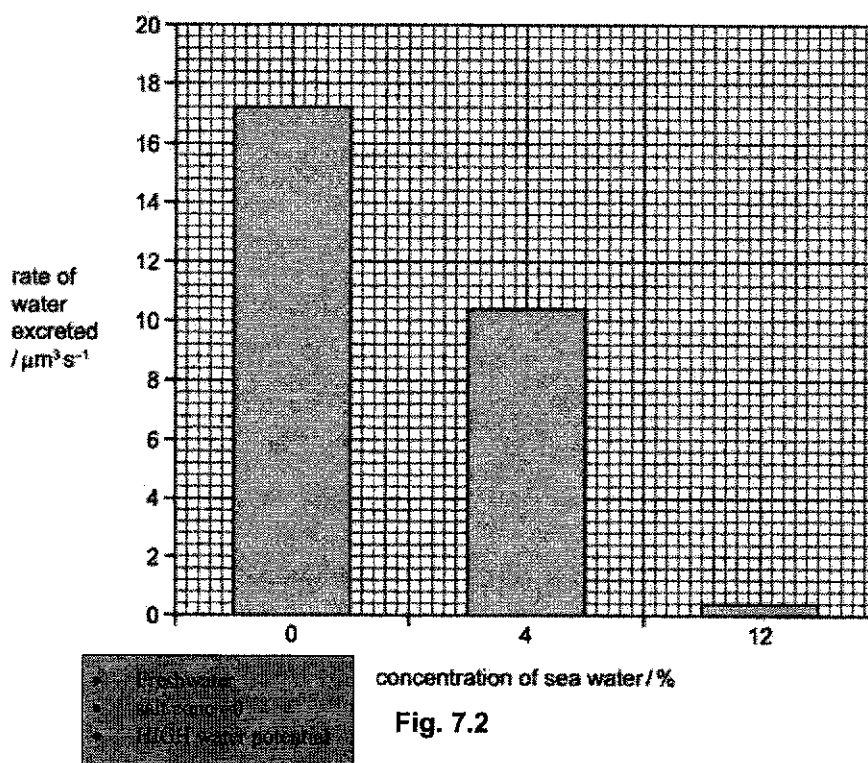


Fig. 7.2

(b) Describe and explain the results shown in Fig. 7.2.

As concentration of sea water increases from 0% to 12%, the removal of water decreases from $17.2 \mu\text{m}^3 \text{s}^{-1}$ to $0.4 \mu\text{m}^3 \text{s}^{-1}$ [1 for trend + 1 for QV i.e. quote values].

This is as the concentration of sea water increases, the water potential gradient / difference in water potential decreases. / A higher concentration of sea water means a higher concentration of solutes and lower water potential. [1]

Therefore, less water molecules enters the cell at higher concentrations of sea water and therefore less excess water to remove [1]

.....[4]

[Total: 10 marks]

[Turn over

- 8 Three enzymes, P, Q and R, were extracted from different regions of the alimentary canal of a mammal. The effect of pH on the activity of the enzymes was investigated at 40°C. The results are shown in Fig. 8.1.

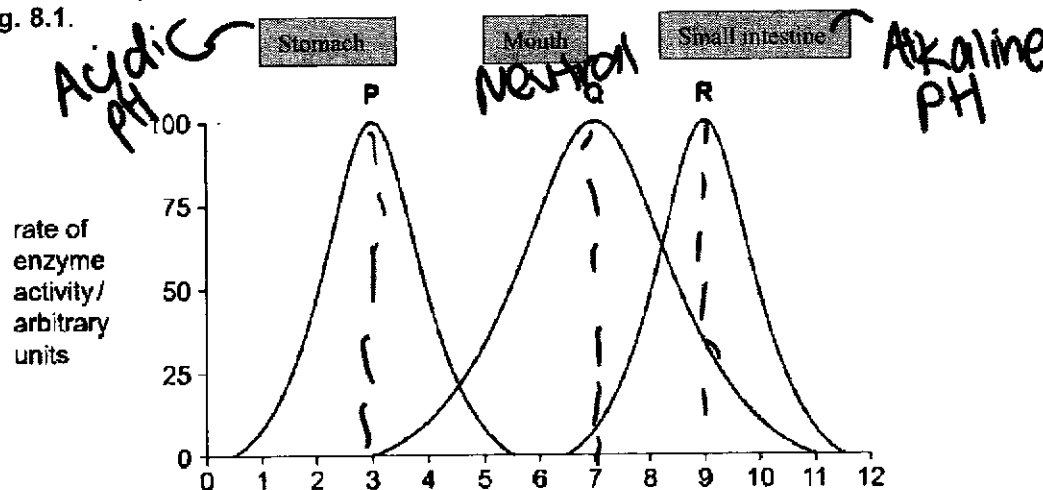


Fig. 9.1

- (a) (i) State in which part of the alimentary canal enzyme P is found in.

Stomach

.....[1]

- (ii) State a possible identity of enzyme R.

Pancreatic amylase / trypsin / peptidase/ lipase

Note:

Pepsin is a **protease** found in the stomach.

(So, protease is a vague answer. Have to name the protease in the small intestine – TRYPSIN)

.....[1]

- (iii) Using the lock and key hypothesis, describe and explain the effect of pH on the rate of enzyme activity of Q.

[Max 2 for describing]

pH 7 / neutral pH / (Accept range 6.8 to 7.2) is the optimum pH for enzyme Q [1 for identifying optimum pH] in which rate of enzyme activity is the highest at 100 AU.

Increasing / decreasing the pH past the optimum decreases the rate of enzyme activity [1]. At extreme pH of 3 and 11, the enzyme activity is 0 [1]

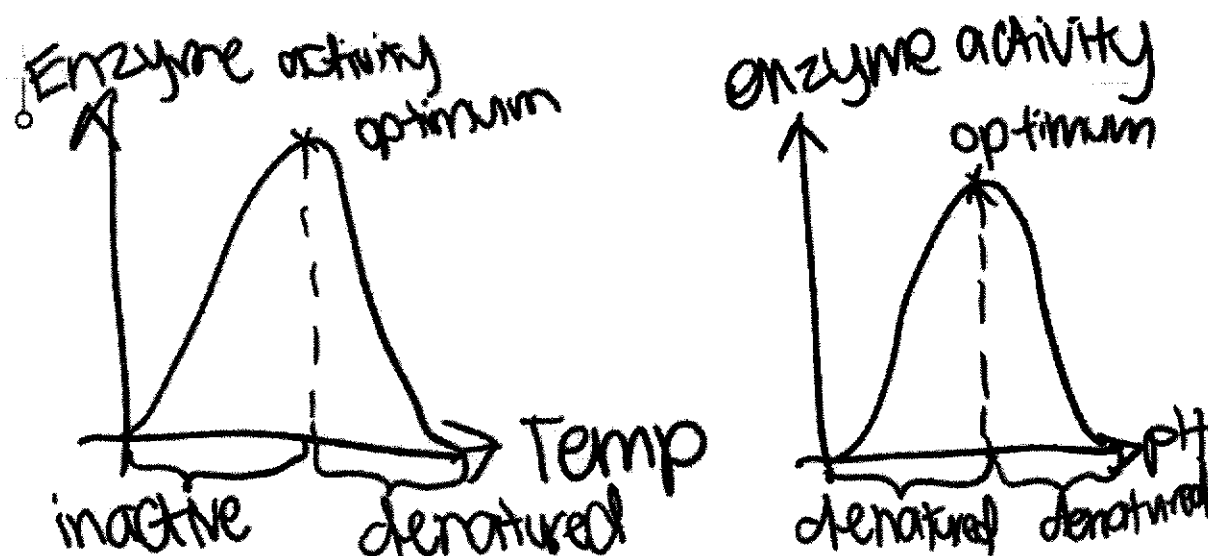
Explanation [Max 2]

Extreme pH denatures [1] the enzyme, causing the shape of the enzyme's active site [1] to be lost and hence a loss of function as the enzyme is no longer complementary [1] to the substrate.

A number of students confused the pH graph with temp and stated that 'At low pH, the enzyme is inactive'. (X)

.....[4]

[Turn over



- (b) Some baby food is manufactured by pre-digesting food containing carbohydrates, fats and proteins with enzymes.

With reference to **named** digestive enzymes, suggest and explain why enzymes are added to manufacture baby food.

[1 for importance of digestion]

Enzymes help to catalyse the digestion of large, insoluble food molecules into small, soluble molecules that can pass through the partially permeable cell membranes of cell.

[1 for suggest/ link / connection suggesting that pre-digesting the baby food with enzymes helps with the digestion process]

As babies may not have a fully-developed digestive system yet, pre-digesting baby food with enzymes makes it easier for a baby's digestive system to cope with digestion.

Named enzymes [Max 3]:

Amylase breaks down starch into maltose [1]

Maltase breaks down maltose into glucose /simple sugar(s) [1]

Protease / pepsin / trypsin breaks down protein into polypeptides [1]

Peptidase breaks down polypeptides into amino acids [1]

Lipase, breaks down fats into fatty acids and glycerol [1]

.....[4]

[Total: 10 marks]

[Turn over

9 Cigarette smoke contains carbon monoxide and nicotine.

- (a) (i) Describe and explain how nicotine is harmful to smokers, especially for people with fatty substances deposited in the inner surface of the coronary arteries.

Nicotine **makes blood clot easily [1]** and thus **increases risk of blood clot being trapped** in coronary artery [1].

When this happens and the coronary arteries are blocked/ occluded completely [1], the supply of oxygen and nutrients to the heart muscle cells is cut off and heart muscle cells cannot carry out aerobic respiration [1] to contract to pump blood around the body [1].
Ok: Nicotine is an addictive substance so people find it hard to give up smoking/ compelled to smoke more [1]

Some students mixed up **how** CO and nicotine contributes to CHD. CO increases the rate at which fatty substances are deposited in the blood vessel.

.....[3]

- (ii) With reference to the properties of carbon monoxide, explain why it is recommended that pregnant women do not smoke.

- **[1 for property of haemoglobin]**

Carbon monoxide **binds to haemoglobin (permanently)** / Accept carboxyhaemoglobin / reduced oxygen (transport) / **decreases the ability of red blood cells to transport oxygen**

- **[1 for the link to how the above property is harmful]**

Accept without ref to mum or in the foetus as it can be for both/ ~~reduces oxygen available~~ to the foetus and hence limits the foetus' development

Note: Toxins in smoke can cross the placenta to reach the foetus too.

.....[2]

[Turn over

A study compared the percentages of men and women aged between 35 and 54 years who smoked cigarettes. The annual death rate caused by lung cancer was also recorded.

The results are shown in the two graphs in Fig. 9.1.

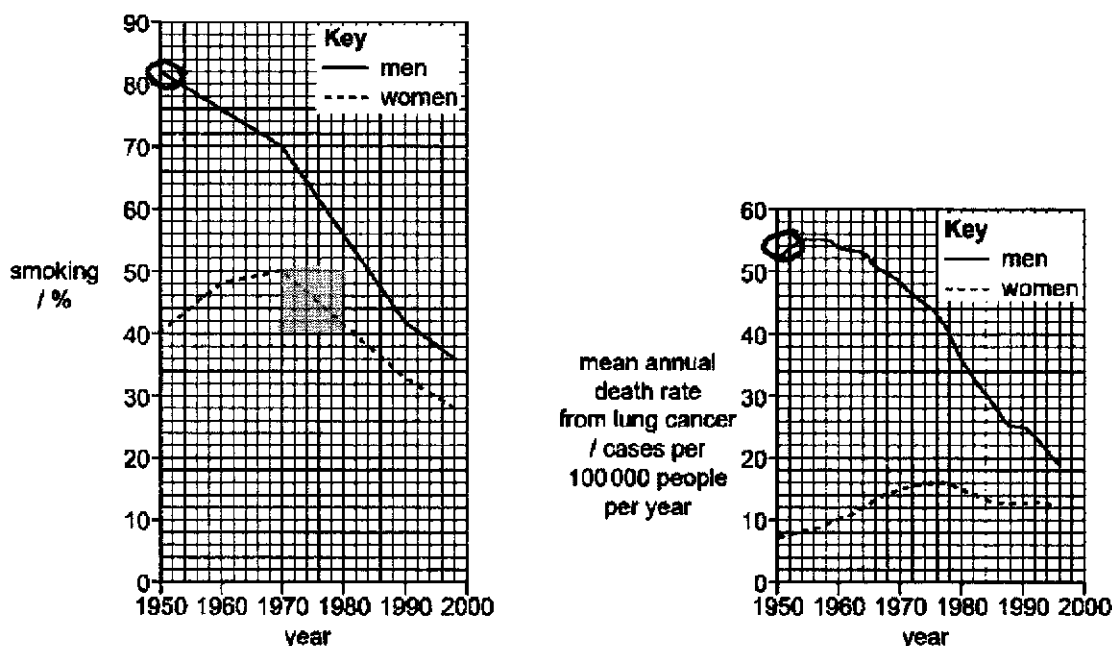


Fig. 9.1

- (b) Describe the trends with supporting data, shown in Fig. 9.1 and suggest reasons for these trends.

Use the information from both graphs in Fig. 9.1 to describe and explain the link between smoking and lung cancer.

Marking scheme

Trends [2] + Explanation [3] OR Trends [3] + Explanation [2]

Award 1m each for trends + QV with reference to X-axis or Y-axis (as long as it is clear which part of the graph students are referring to)

[1 for stating link/ correlation between both graphs] + [2 max for quoting individual data of graphs]

Overall, the graph of the mean annual death rate from lung cancer follows a similar shape to the % of smokers. [1/ As the % of male smokers decreased from 82% to 38% [1], the mean annual death rate from lung cancer also overall/ in general decreased from 55% in 1954 to 18% in 1996 [1] OR As the number of female smokers increased from 1950 to 1970, the mean annual death rate from lung cancer for females also increased in the same period.

[1 for explanation] Tar in cigarette smoke is carcinogenic / causes lung cancer.

Other marking points:

[1 for pointing out exceptions to trend / anomalies]

The mean annual death rate from lung cancer for females continued to increase till 1972 although the percentage of female smokers decreased from 1970 onwards. / Similarly, the mean annual death rate for males increased (and reached a plateau) from 1950 to 1958 although the percentage of smokers decreased then.

[Turn over

[1 for explanation]

This lag in the death rate trend (compared with % smokers) is as lung cancer develops over time.

[1 for description of other trends shown in the graph] + [1 for explanation]

More men smoked than women in general / overall [1] between 1950–1998 and hence the mean annual death rate from lung cancer is also higher in males than females. A possible reason why there are more male smokers than female smokers may be because more men are addicted to nicotine in tobacco smoke / more men lead a stressful lifestyle and smoke as way to release stress [1 for possible explanation showing understanding of relevant concepts]

The overall drop in % of male smokers is higher than in women / Maximum (implied) for women was 50% and 82% for men. This may be because

.....[5]

Note:

Tar also increases the risk of chronic bronchitis and/or emphysema / COPD.

Note: Chronic Obstructive Pulmonary Disorder (COPD) is a term that is used to describe two common diseases namely chronic bronchitis and emphysema.

Tar sticks to /blocks / damages/ paralyses cilia lining the air passages.

With the cilia lining is paralysed, mucus and dust particles cannot be removed. This also leads to persistent coughing. Emphysema arises due to violent coughing which causes the partition walls between the alveoli to break down. This reduces the surface area to volume ratio of alveoli, which reduces the rate of gaseous exchange and intake of oxygen. The lungs lose their elasticity and become inflated with air.

Tar also results in more mucus produced when the epithelium lining the airways is inflamed, making one prone to chronic bronchitis and/or emphysema.

[Total: 10 marks]

- End of Paper -

[Turn over