



GAN ENG SENG SCHOOL
End-of-Year Examination 2016



CANDIDATE
NAME

CLASS

INDEX
NUMBER

BIOLOGY (Three Express)

Paper 1

5158/01

13 October 2016

Paper 1 : 1 hour

Candidates answer on the Optical Answer Sheet (OTAS).
Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and index number on the OTAS. Shade your index number on the OTAS.

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 OTAS.

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

Read the instructions on the OTAS very carefully.

Any rough working should be done in this booklet.

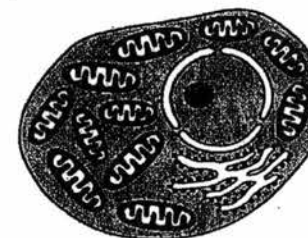
Total Marks
40

- 1 The cells of an ant and an elephant are, on average, the same small size, so an elephant just has more cells instead of having larger cells.

What is the main advantage of cells having a smaller size?

- A A smaller cell has larger cell membrane surface area than a larger cell
- B A smaller cell is less likely to burst than a larger cell
- C A smaller cell requires less energy than a larger cell
- D A smaller cell can carry out exchange of substances more efficiently than a larger cell

- 2 The diagram below shows an extracted animal cell under an electron microscope.



The cell is likely to

- A be a cheek epithelial cell
- B be a mature red blood cell
- C require high levels of oxygen
- D produce large amounts of glucose

- 3 Which sequence shows the correct involvement of organelle and substance in the production and secretion of an enzyme?

- A Golgi apparatus → ribosome → rough endoplasmic reticulum → vesicle
- B nucleus → smooth endoplasmic reticulum → Golgi apparatus → vesicle
- C rough endoplasmic reticulum → vesicle → Golgi apparatus
- D smooth endoplasmic reticulum → vesicle → ribosome

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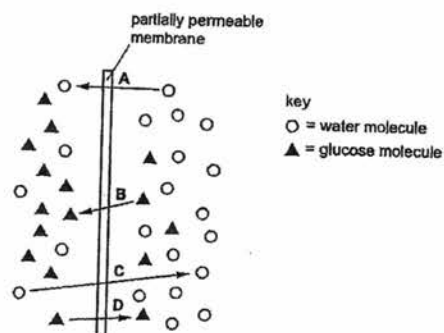


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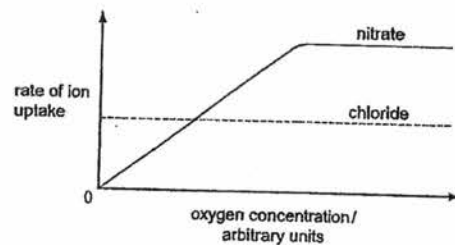
3

- 4 The diagram represents the passage of water molecules and glucose molecules across a partially permeable cell surface membrane.

Which arrow indicates osmosis?



- 5 The roots of a plant are placed in a dilute solution containing chloride and nitrate ions. The graph shows how the rate of uptake of chloride and nitrate ions by the roots of the plant varies with oxygen concentration.



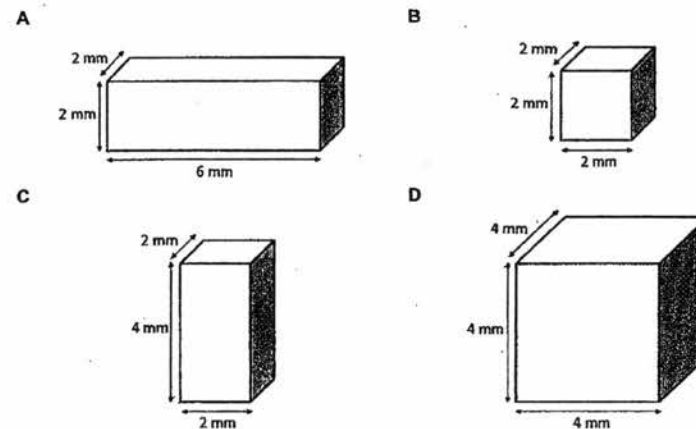
What can be concluded about how chloride and nitrate ions enter the roots?

	chloride	nitrate
A	active transport	active transport
B	active transport	diffusion
C	diffusion	active transport
D	diffusion	diffusion

4

- 6 The diagrams show agar blocks, each completely immersed in a beaker of a solution of coloured stain.

Which block would be stained most rapidly?



- 7 Three examples of monosaccharides are

- A glucose, cellulose, maltose
B glucose, fructose, galactose
C lactose, maltose, sucrose
D ribose, glycogen, galactose

- 8 The following fluids were extracted from a healthy man:

- 1 Plasma
2 Saliva
3 Sweat
4 Urine

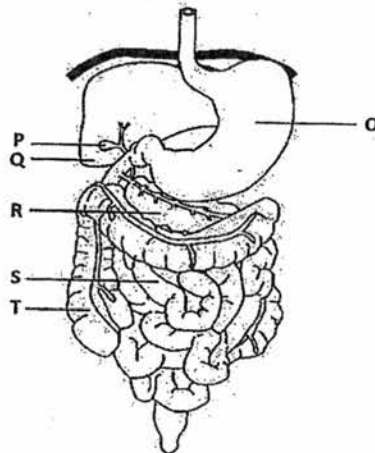
Which of the fluids would produce a positive result with Biuret test?

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

- 9 Which of the following is most likely to form an enzyme-substrate complex?

A amino acids and protease
 B cellulose and cellulase
 C disaccharides and lipase
 D starch and sucrase

- 10 The diagram below shows the human digestive system.

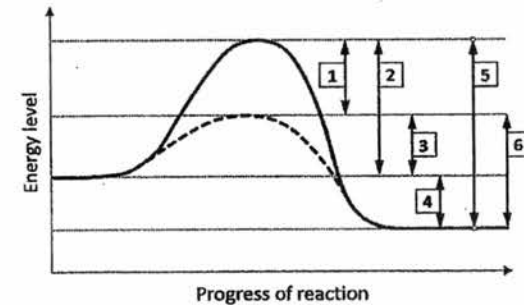


A student ate a meal consisting of skinless chicken breast and egg white omelette only.

From which parts must secretions be obtained from for the complete digestion of the meal?

A O and R only
 B O and S only
 C O, R and S only
 D O, Q and R only

- 11 The graph shows changing energy levels during a reaction.



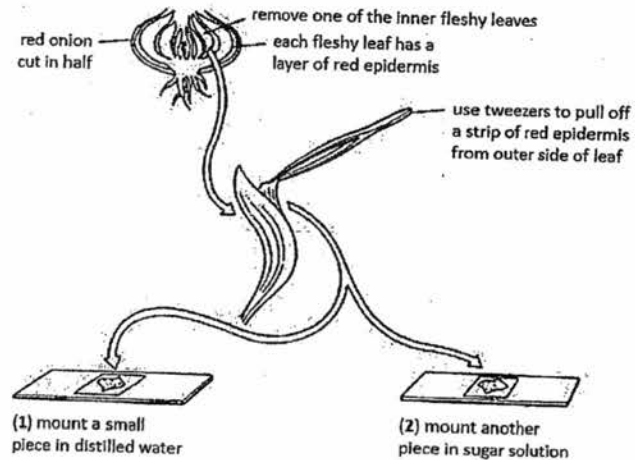
What is the activation energy of the reaction with and without the enzyme?

	Activation energy of the reaction	
	with enzyme	without enzyme
A	2	6
B	3	2
C	4	5
D	1	3

- 12 The products of digested food are present in the ileum. Which substances are transported in the blood capillaries and lacteal in a villus?

	Blood capillary	Lacteal
A	fatty acids and glycerol	amino acids and glucose
B	amino acids and glucose	fatty acids and glycerol
C	fat droplets	amino acids and glucose
D	amino acids and glucose	fat droplets

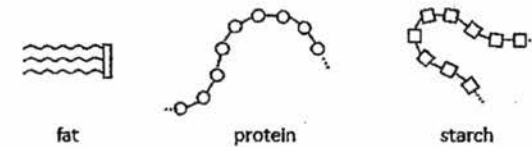
- 13 The diagram shows the procedure to prepare slides containing onion epidermis soaked in different liquids for 10 minutes before being observed under the microscope.



Which option most accurately describes the cells on slides 1 and 2?

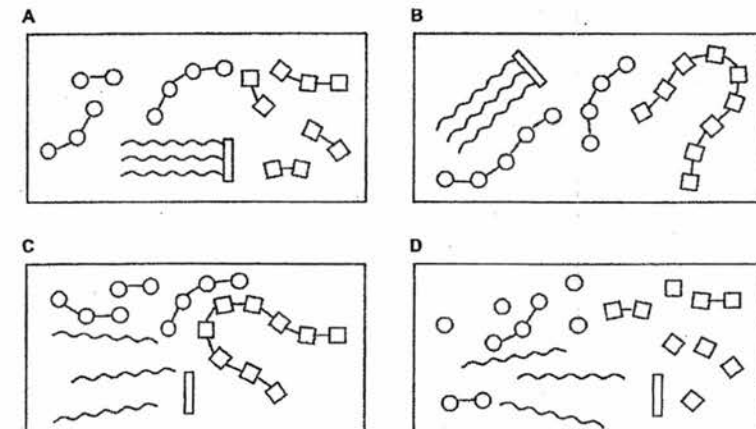
	Slide 1	Slide 2
A	Turgid	Plasmolysed
B	Plasmolysed	Not visible
C	Turgid	Crenated
D	Crenated	Not visible

- 14 The diagrams represent molecules of fat, protein and starch at the beginning of the human alimentary canal.



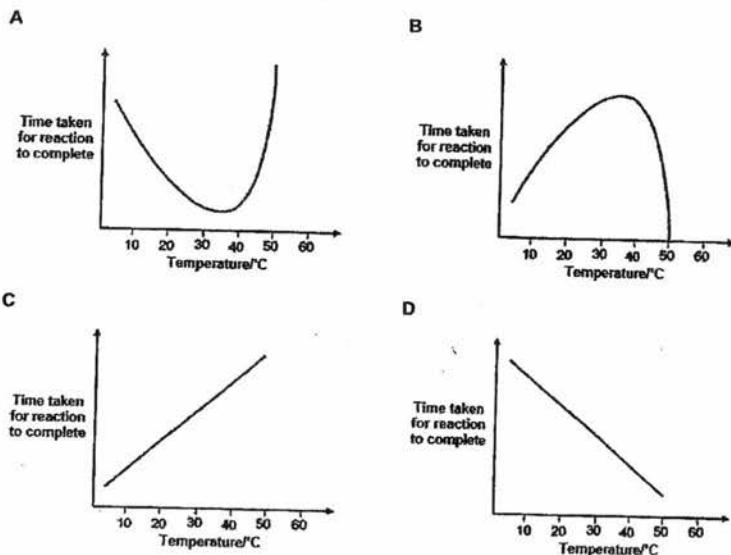
A sample of food that has been in a person's stomach for 3 hours was removed and mixed with bile. The mixture was left to stand for an hour.

Which diagram correctly represents the final products of this procedure?



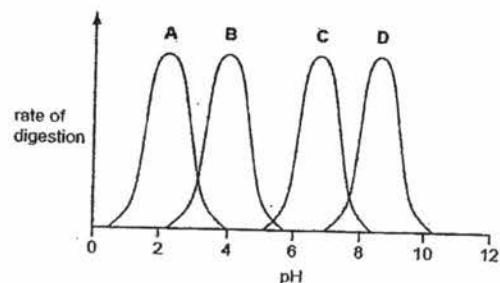
- 15 An enzyme is completely denatured at 50°C. A fixed concentration of this enzyme is added to a fixed concentration of its substrate. The time taken for completion of the reaction is measured at different temperatures.

Which graph shows the results?



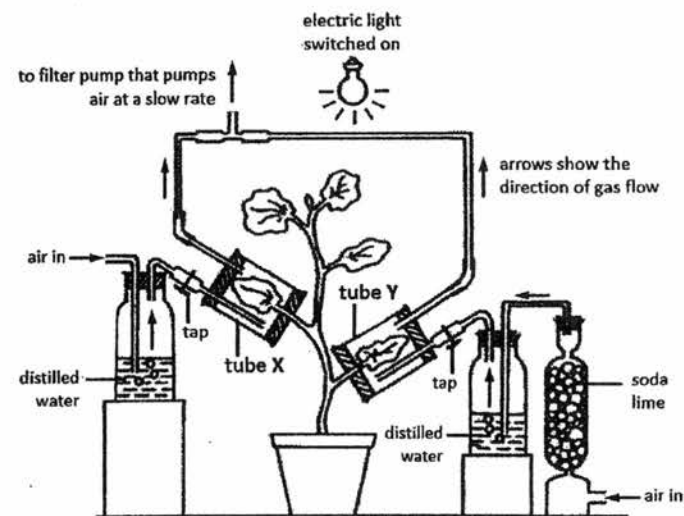
- 16 The diagram shows four graphs of the rate of reaction of enzymes over a range of pH.

Which graph represents the rate of reaction for lipase in the human digestive system?



Refer to the information and diagram below for Questions 17 and 18.

An experiment is set up as shown in the diagram below to investigate factors essential for photosynthesis.



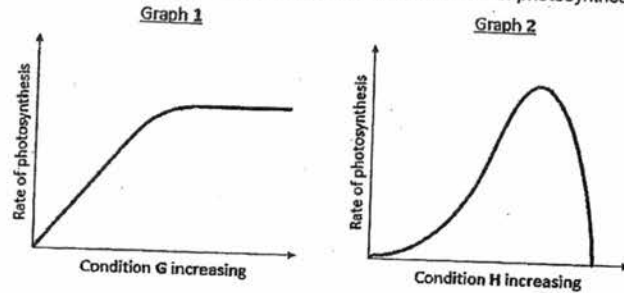
- 17 Which factor essential for photosynthesis is being investigated in this experiment?

- A light only
- B carbon dioxide only
- C carbon dioxide and light
- D carbon dioxide and water

- 18 What modifications would you make to the experimental set up to investigate the effect of light on the process of photosynthesis?

- A black out tube X
- B black out tube X and Y
- C remove soda lime tower and black out tube X or tube Y
- D remove soda lime tower and black out both tube X and tube Y

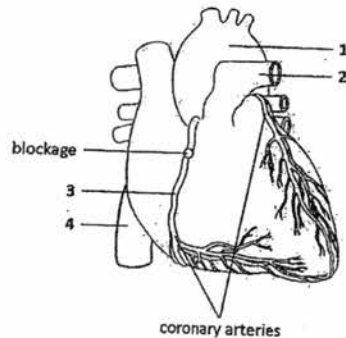
- 19 The graphs show how two different conditions affect the rate of photosynthesis.



Which conditions are being altered in graphs 1 and 2?

	Condition G	Condition H
A	carbon dioxide concentration	light intensity
B	carbon dioxide concentration	temperature
C	temperature	carbon dioxide concentration
D	temperature	light intensity

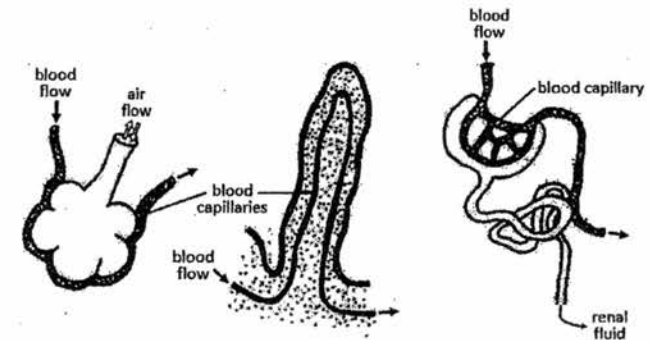
- 20 The diagram below shows a human heart that has a blockage in its coronary artery.



The coronary artery blockage can be treated by attaching a blood vessel to bypass the blockage. Which two vessels should be joined?

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

- 21 The diagrams below show three mammalian structures, and the blood supply to each by capillaries.



Some features describing the blood supply are listed:

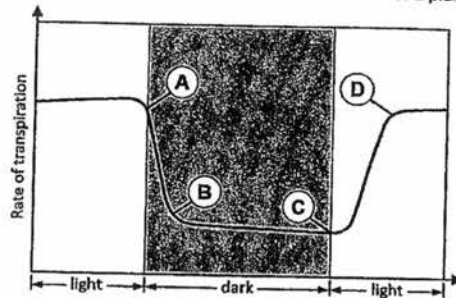
- 1 All are highly branched and thin to supply to a larger surface area.
- 2 All are very near the exchange surface to enhance the exchange of substances.
- 3 All rely on active transport to carry out exchange of substances.
- 4 All have thin walls to enhance the exchange of substances.

Which of these are adaptive features that are commonly possessed by all the structures shown, to allow them to perform their functions efficiently?

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

Refer to the information and diagram below for Questions 22 and 23.

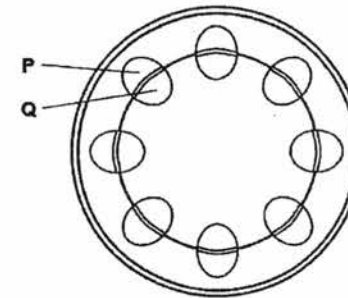
The following graph shows the rate of transpiration from the leaves of a plant.



- 22 At which point (A, B, C, or D) did the stomata begin to open?
- 23 What is a characteristic of the guard cells that cause stomata to open only when needed?
- A able to carry out active transport
 - B thickened inner walls
 - C covered with waxy, waterproof layer
 - D presence of chloroplasts
- 24 Which is an important process that directly causes a change in the shape of guard cells to open the stomata?
- A destarching
 - B osmosis
 - C diffusion
 - D active transport

Refer to the information and diagram below for Questions 25 and 26.

A herbaceous plant is placed in a well-lit experimental chamber through which humid air is being passed slowly. The diagram shows a section through a part of the plant, where the speeds of movement of fluids in tissues P and Q are measured.



- 25 Which of these correctly identifies tissues P and Q in the plant?

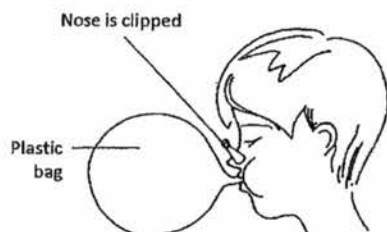
	Tissue P	Tissue Q
A	phloem	xylem
B	xylem	phloem
C	xylem	cambium
D	phloem	pith

- 26 The humid air is then replaced by dry air and the speed of the air passing through the chamber were increased.

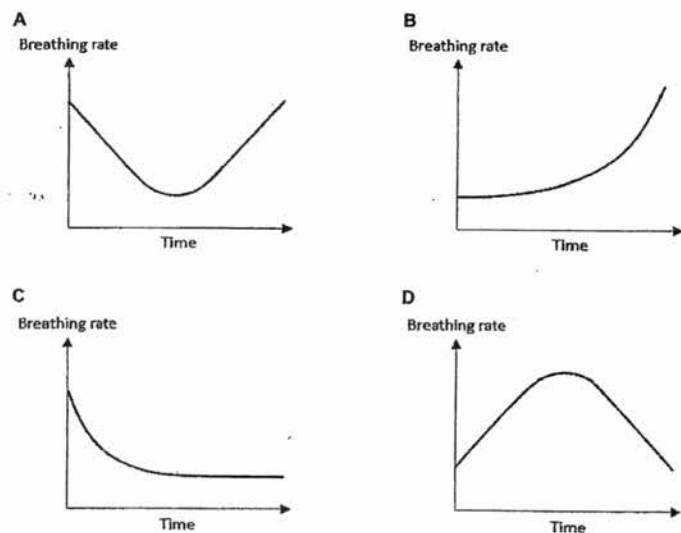
What changes were detected in the speeds of movement of the fluids in P and Q?

	Tissue P	Tissue Q
A	greatly increased upward movement	greatly increased downward movement
B	greatly increased downward movement	little change
C	change in direction from upward to downward	greatly increased upward movement
D	little change	greatly increased upward movement

- 31 In an experiment, a boy was asked to breathe into and out of a plastic bag for 5 minutes.



Which of the following graphs shows the pattern of change in breathing rate?



- 27 Translocation occurs in phloem tubes. Aphids feed on the contents of phloem tubes.

Which type of nutrient would be lacking in their diet?

- A amino acids
B fat
C sucrose
D water

- 28 Some characteristics of the human gas exchange system are listed.

- 1 a difference in temperature between the air in the alveoli and the blood
- 2 a large surface area of the alveoli and the blood capillaries
- 3 a short diffusion distance between the air and the blood
- 4 elastic fibres in the walls of the alveoli

Which factors affect the rate of oxygen uptake into the blood?

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

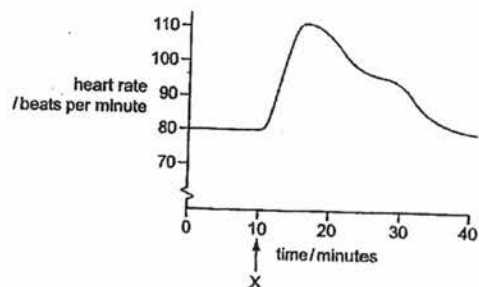
- 29 When breathing out forcefully, which muscles are contracting?

	Diaphragm	External intercostal muscles	Internal intercostal muscles
A	✓	x	✓
B	✓	x	x
C	x	✓	x
D	x	x	✓

- 30 Which reaction is catalysed by carbonic anhydrase when red blood cells pass through the lungs?

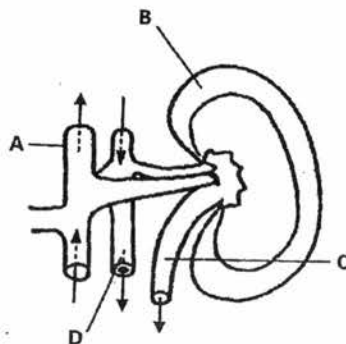
- A $\text{H}_2\text{CO}_3 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
B $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$
C $\text{HCO}_3^- + \text{H}^+ \rightarrow \text{H}_2\text{CO}_3$
D $\text{H}_2\text{CO}_3 \rightarrow \text{H}^+ + \text{HCO}_3^-$

- 32 A person begins to smoke a cigarette at time X. The graph shows how their heart rate changes.

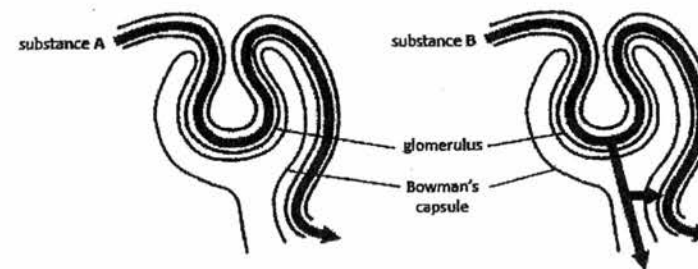


Which substance in cigarette smoke is the main cause of the change in heart rate between 10 and 18 minutes?

- A carbon dioxide
 - B nicotine
 - C smoke particles
 - D tar
- 33 The figure below shows a kidney and associated structures.
- Which part contains the lowest concentration of urea?



- 34 The diagram below represents the movement of substances A and B through a normal, healthy human kidney tubule, at the region of a Malpighian corpuscle.



Which of the following statements are correct?

- 1 Substance A is reabsorbed.
- 2 Substance A could be protein.
- 3 Substance A could not be present in urine.
- 4 Substance B is filtered but not reabsorbed.
- 5 Substance B could be mineral salts.

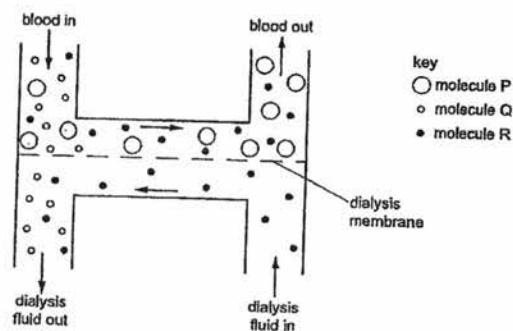
- A 1 and 2
- B 2, 3 and 4
- C 2, 3 and 5
- D 2 and 5

- 35 Mannitol is a type of sugar that decreases the permeability of kidney tubules to water.

How is the urine composition affected when a person consumes mannitol solution?

- A Large volume of dilute urine.
- B Large volume of concentrated urine.
- C Small volume of dilute urine.
- D Small volume of concentrated urine.

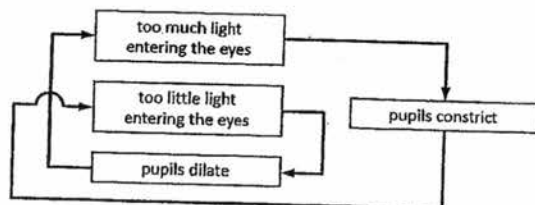
- 36 The diagram shows what happens to molecules of glucose, protein and urea as blood passes through a kidney dialysis machine.



What are molecules P, Q and R?

	molecule P	molecule Q	molecule R
A	glucose	protein	urea
B	glucose	urea	protein
C	protein	glucose	urea
D	protein	urea	glucose

- 37 The diagram refers to the control of pupil size in the eyes in response to the amount of light entering the eyes.



Why is this a negative feedback system?

- A It decreases the amount of light entering the eyes.
 B It increases any change in the amount of light entering the eyes.
 C It increases the amount of light entering the eyes.
 D It reverses any change in the amount of light entering the eyes.

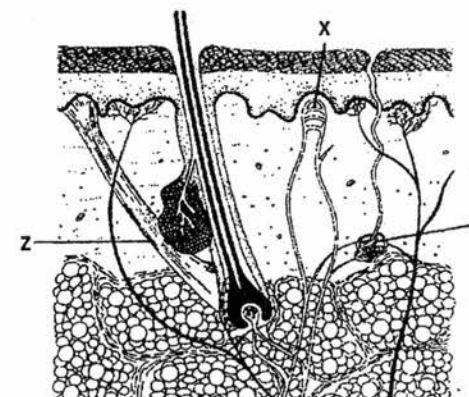
- 38 Which of these factors are controlled by homeostasis?

	Glucose concentration in blood	Water content in ileum	Temperature in stomach	Glucose concentration in duodenum lumen
A	yes	yes	no	yes
B	yes	no	yes	yes
C	yes	no	yes	no
D	no	yes	yes	no

- 39 Which homeostatic function of the liver is controlled and monitored by the pancreas?

- A Deamination of amino acids
 B Release of glucose
 C Release of iron
 D Removal of toxins

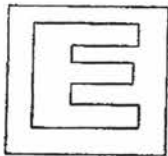
- 40 The diagram shows the vertical section through human skin.



What happens to parts X, Y and Z in very hot conditions?

	X	Y	Z
A	dilates	inactive	relaxes
B	constricts	active	contracts
C	constricts	inactive	contracts
D	dilates	active	relaxes

END OF PAPER



GAN ENG SENG SCHOOL
End-of-Year Examination 2016



CANDIDATE
NAME

CLASS

INDEX
NUMBER

BIOLOGY (Three Express)

Paper 2

5158/02

11 October 2016
1 hour 45 minutes

Candidates are to answer on the Question Paper.
Calculators are allowed in the examination.

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on the cover page.
Write in dark blue or black pen on both sides of the paper.
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

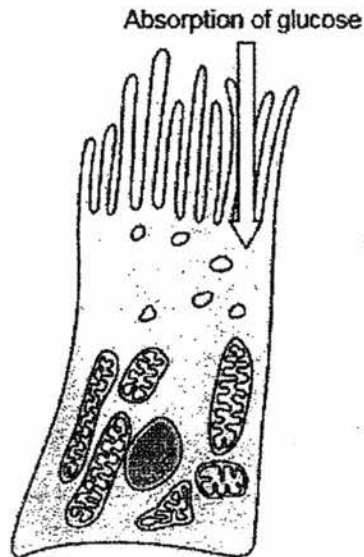
Answer **three** questions. Question 10 is in the form of Either/Or question. Only one part should be answered.

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

For Examiner's Use	
Section A	
Section B	
8	
9	
10 Either/Or	
Total	80

SECTION A (50 Marks)Answer all the questions in this section

- 1 Fig. 1.1 shows a cell M found in the kidney, which can absorb glucose rapidly.

**Fig. 1.1**

- (a) Name the region in the kidney where cell M may be found, and the function of this region. [2]

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- (b) Name and explain how two structural adaptations shown in the cell allow it to rapidly absorb glucose. Label these structures in Fig. 1.1. [3]

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- (c) Name one other specialised cell that shows similar adaptations, and explain how they help the cell function. [3]

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Total: 8 marks

- 2 Gelatin is hardened protein obtained from the partial hydrolysis of collagen, the most abundant type of protein found in mammals. Extracts of some fresh fruits have been used in cooking to make meat tender, as they contain enzymes that prevent the hardening of gelatin.

In an investigation, a toothpick was vertically inserted into hardened gelatin in each of the three set-ups at the start of the experiment. A buffer solution and fruit extract was then added into the gelatin. After twenty minutes, the results are shown in Fig 2.1.

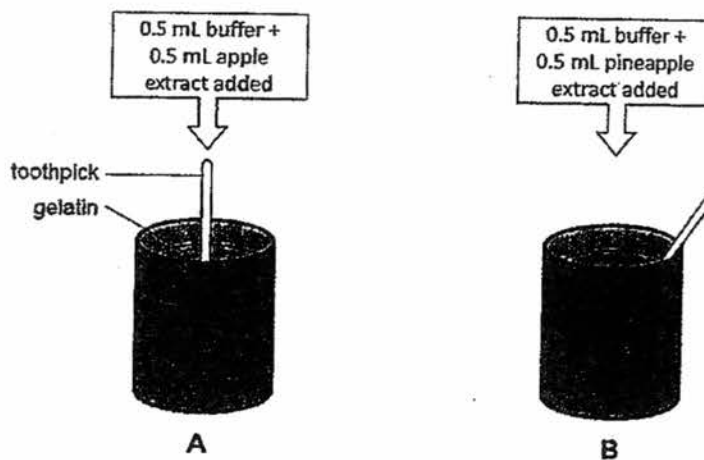


Fig. 2.1

- (a) Define the term *enzyme*. [1]

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- (b) State the type of enzyme being investigated here and deduce the action of the enzyme on gelatin. [1]

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- (c) Suggest a reason for the observation of the gelatin with the apple extract in Fig. 2.1(a). [1]

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- (d) Jun Heng, a Biology student, suggested using the Biuret test to detect if a chemical reaction has taken place in this experiment, by testing for the end-products. Explain to Jun Heng if his suggestion is an effective method for determining the completion of the process. [2]

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Total: 5 marks

- 3 Fig. 3.1 shows a water plant growing in a shallow pond, with leaves floating on the water surface. Fig. 3.2 shows a section through one of its leaves.

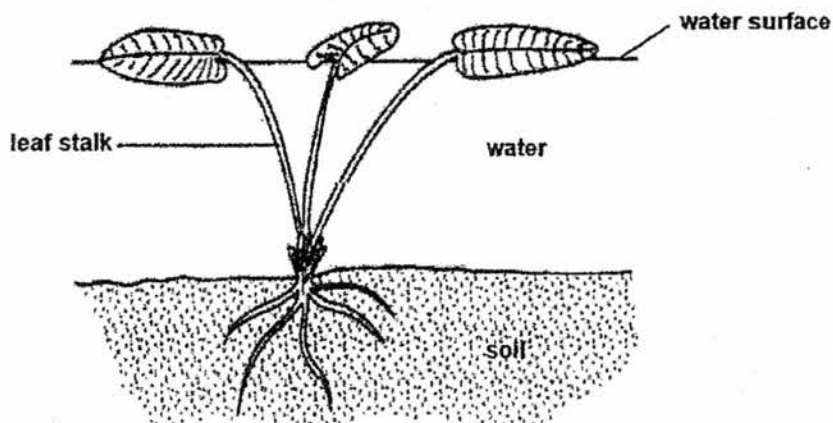
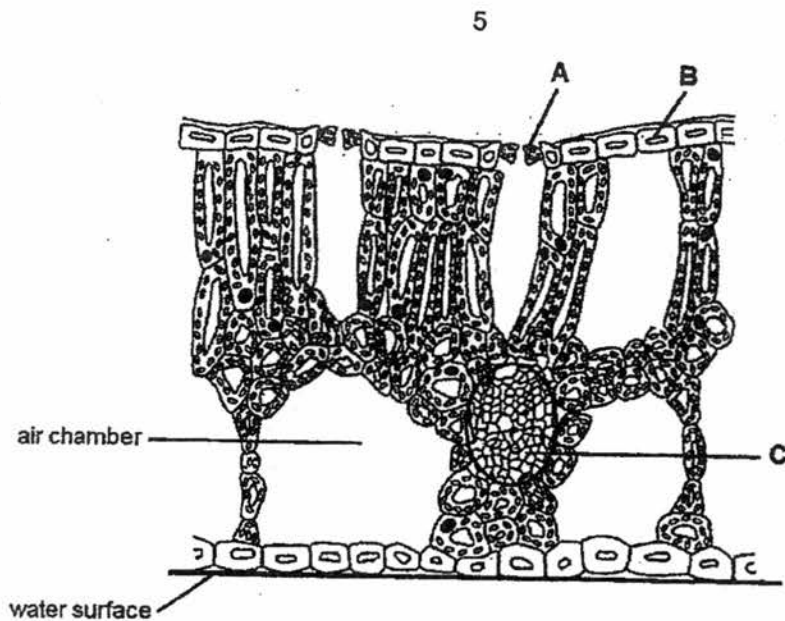


Fig. 3.1



- (a) Identify the types of cell or tissue found at A, B and C. [2]
- A :
- B :
- C :
- (b) Compare the leaf structure seen in Fig. 3.2 with a typical plant growing on land, and state two ways in which they differ. [2]
- 1 :
-
-
-
- 2 :
-
-
-
- (c) Suggest two different functions of the air chamber seen in Fig. 3.2. [2]
-
-
-
-

- 4 Fig. 4.1 shows a shoot of a destarched plant at the start of an experiment on the movement of substances within a plant. At two locations on the stem, Y and Z, tissue was removed as in the shaded sections shown in Fig. 4.2. Leaf E and leaf G are each wrapped inside a plastic bag.

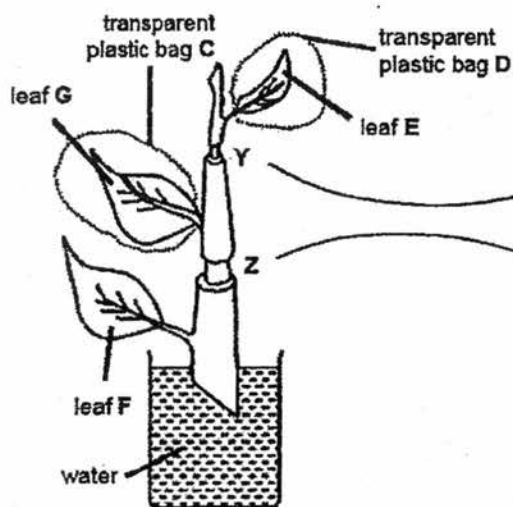


Fig. 4.1

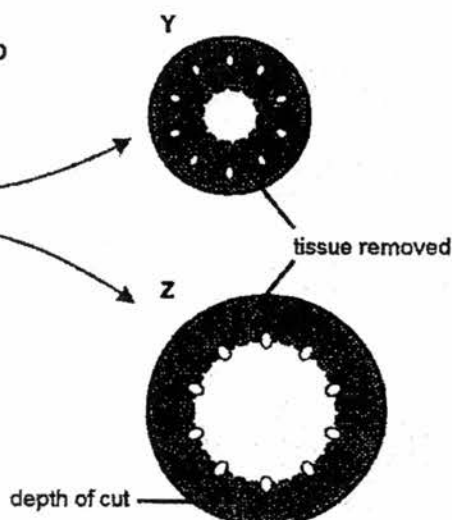


Fig. 4.2

After the plant was left in sunlight for six hours, more water was found inside bag C than inside bag D.

- (a) Name and define the process that caused water to be found inside the plastic bags. [1]

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- (b) Suggest how the appearance of leaf E might differ from that of leaf G. Explain your answer. [2]

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(c) After six hours, leaves **F** and **G** were tested for the presence of starch.

- (i) Name the test reagent that can be used to detect the presence of starch in the leaves. Describe the observations for both presence and absence of starch. [3]

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- (ii) Comparing leaf **F** and **G**, it was found that leaf **G** contained no starch, while leaf **F** contained starch. Taking into consideration the tissue removed, suggest reasons to explain why leaf **G** contained no starch. [4]

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Total: 10 marks

- 5 Fig. 5.1 shows the cross section of a leaf. The arrows in Fig. 5.1 show the pathway taken by water inside the leaf as it moves out of the leaf.



Fig. 5.1

- (a) Name the processes 1, 2, and 3 seen in Fig. 5.1.

[3]

Process 1 :

Process 2 :

Process 3 :

- (b) The leaf shown in Fig. 5.1 was found in bright sunlight during the day. Using appropriate labels showing the relative concentration of carbon dioxide, show the direction of movement of carbon dioxide between the interior and exterior of the leaf.

[2]

Total: 5 marks

- 6 Fig. 6.1 shows the body temperature of a person before, during and after a cold water bath. The temperature of the bath water was 22°C.

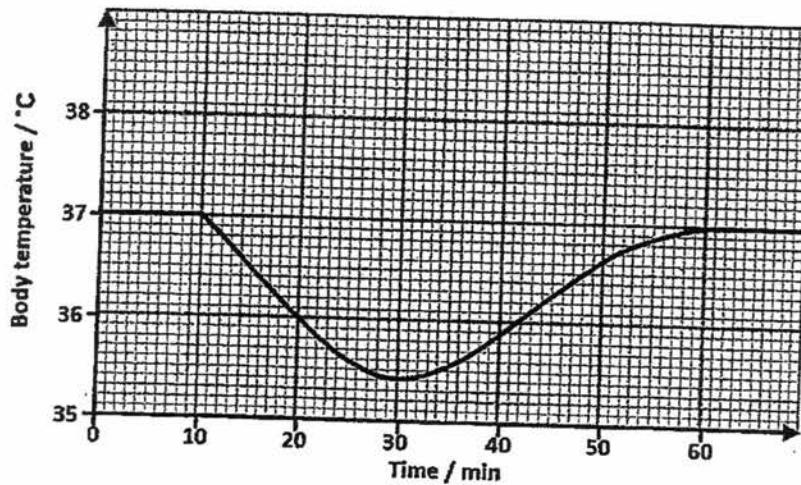


Fig. 6.1

- (a) Explain why there was a fall in the person's body temperature. [1]

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- (b) Estimate the duration that the person was in the bath. [1]

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- (c) Explain how the corrective mechanism in the person's body help to return his body temperature to normal. [4]

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- 7 Fig. 5.1 and Fig. 5.2 show photomicrographs of different blood smears on glass slides.

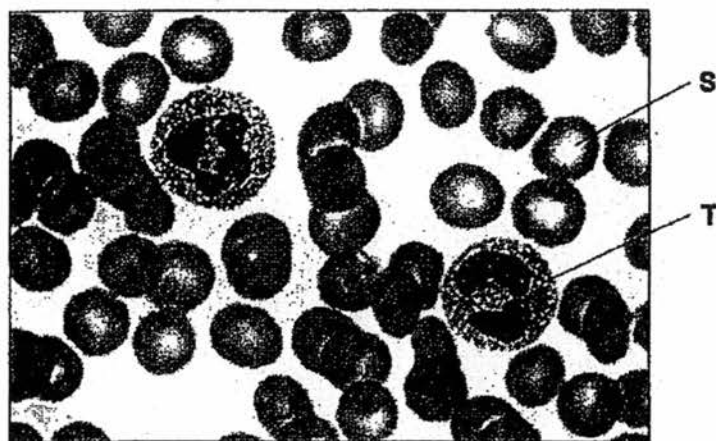


Fig. 5.1

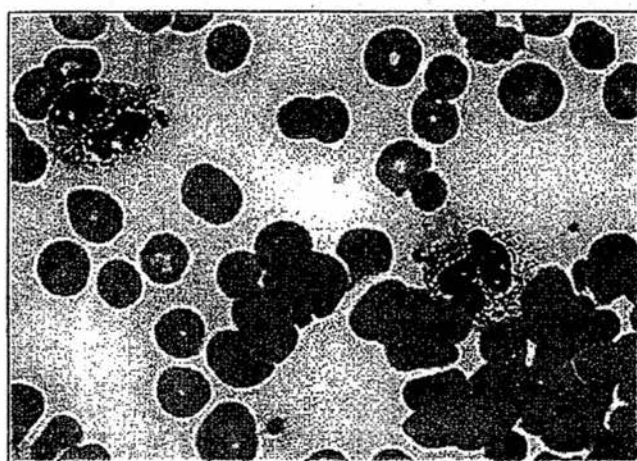


Fig. 5.2

- (a) State the function(s) of cell S and cell T in Fig. 5.1.

[2]

S :

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T :

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- (b) Blood cells from donors with known blood types were mixed with recipient blood from patients **U**, **V**, **W** and **X**, to find compatible donor-recipient matches. **Table 5** shows the results obtained. Some of the mixtures showed a visible reaction, as seen in **Fig. 5.2**.

Table 5

		donor blood type		
		A	B	AB
recipient	U	-	+	+
	V	-	-	-
	W	+	+	+
	X	+	-	+

Key

‘+’: Visible reaction

‘-’: No visible reaction

- (i) State what has happened to the **S**-type cells in **Fig. 5.2**. Explain what caused them to do so, and the possible ill effects to patients when this reaction takes place.

[3]

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- (ii) Based on the results show above, suggest the possible blood type of each recipient.

[2]

U : **V** :

W : **X** :

- (iii) Give reasons to support your answer for person **V**.

[3]

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Section B (30 Marks)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 nephrons found in the kidneys of three different species of mammals. Table 8.1 shows more information about these different species.

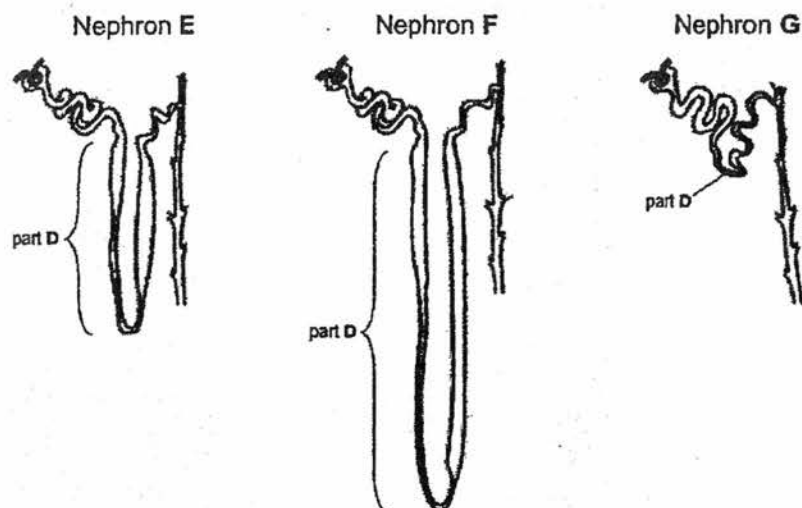


Fig. 8.1

Table 8.1

Species of mammal	Manatee	Human	Desert rat
Habitat	Lives in aquatic freshwater habitats like rivers and lakes	Lives mainly on land	Lives on very dry desert land
Water potential of urine produced	Very high	High	Very low
Relative amount of water loss from body			
Legend	Evaporation Faeces Urine		

- (a) Define the term *excretion*.

[1]

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- (b) Describe how excess amino acids are converted into urea.

[2]

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- (c) Identify part D in Fig. 8.1, and state its function.

[1]

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- (d) Using the information provided in Fig. 8.1 and Table 8.1,

- (i) deduce which nephron can be found in each species

[2]

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- (ii) explain why the length of part D in each species is different.

[4]

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Total: 10 marks

- 9 Pneumothorax (Fig. 9.1), often called collapsed lung, is a condition where there is an abnormal accumulation of air in the space between the lung and the chest cavity wall, causing the lung to be separated from the chest wall. One possible cause of the accumulated air may be a puncture in the thoracic cavity wall.

People who suffer from pneumothorax often experience chest pain and breathlessness. In serious cases the condition can be life threatening.

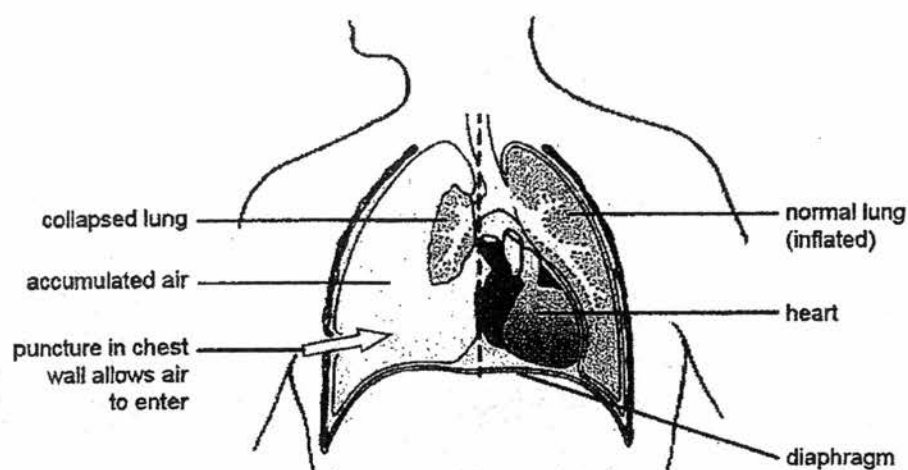


Fig. 9.1

- (a) Describe the events during inhalation of air, beginning with expansion of the chest cavity, which leads to air being drawn into the lungs. Explain how pneumothorax can cause breathlessness.

[4]

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- (b) Explain what effect(s) pneumothorax can have on the gaseous exchange occurring at the alveoli, and how this affects the breathing rate. [4]

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- (c) Sketch on the graph in Fig. 9.2 (of lung volume changes of lung during a few breathing cycles) the expected breathing pattern for a person with pneumothorax. [2]

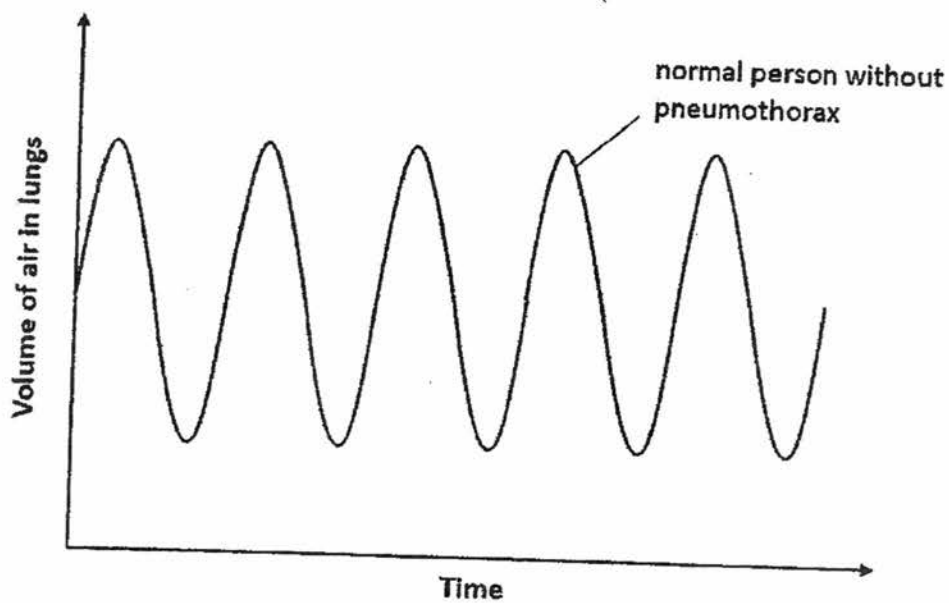


Fig. 9.2

Total: 10 marks

10 EITHER

Fig 7.1 below shows an experimental set up to investigate the effect of pH on rate of reaction of Enzyme **K** on pieces of 10 cm lean meat strips. Enzyme **K** is found inside the mammalian digestive system.

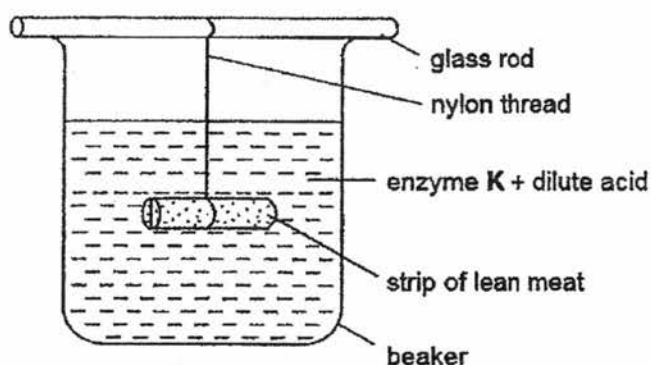


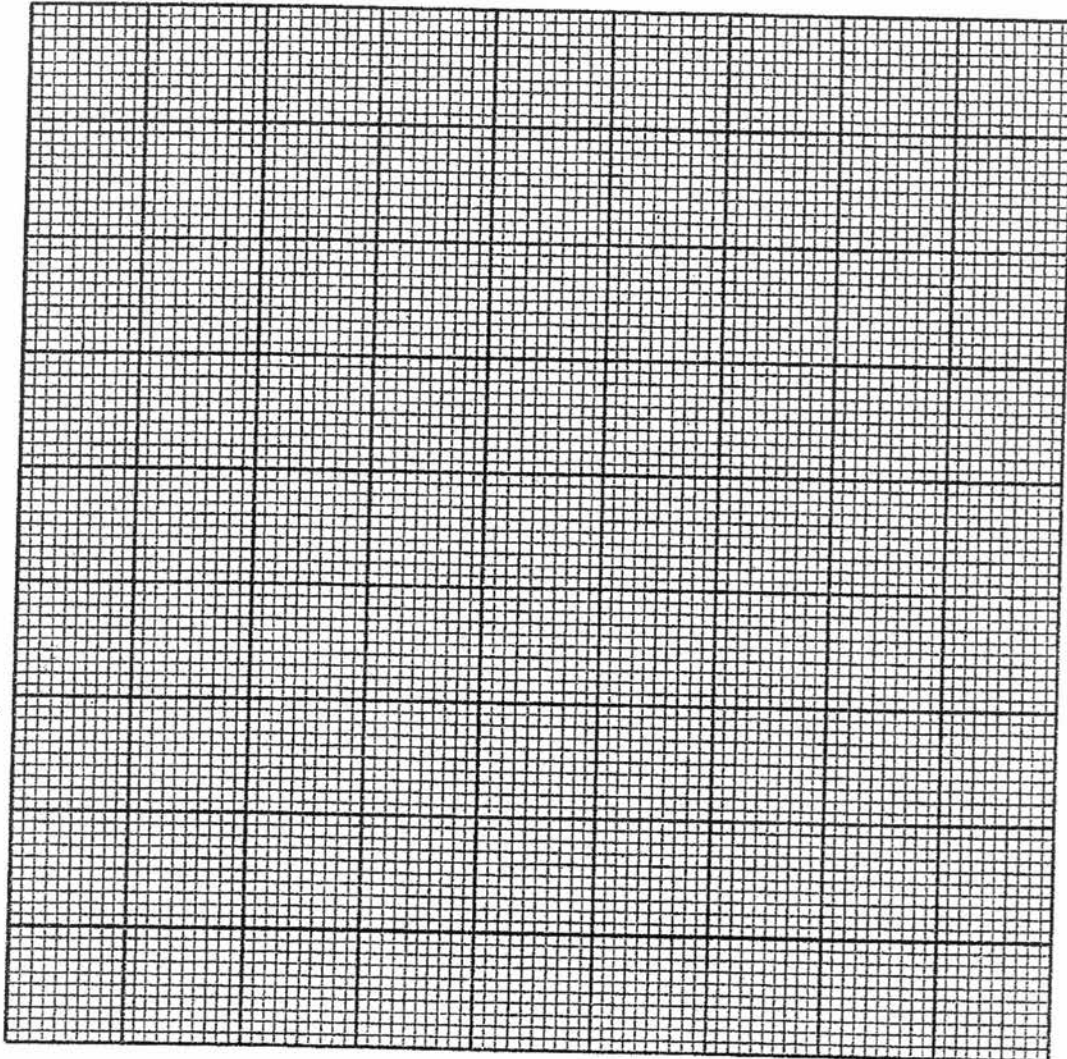
Fig. 10.1

After 24 hours, the final lengths of the lean meat strip in each solution were measured and recorded in **Table 10.1**.

Table 10.1

pH of solution	Final length of meat strip (cm)	Change in length of meat strip (cm)
1	5.0	5.0
2	1.0	9.0
3	4.0	6.0
4	7.0	3.0
5	9.0	1.0
6	10.0	0.0

- (a) Plot a graph of **change** in length of the lean meat strip against pH of solution. [4]



- (b) Describe how the length of the lean meat strip changes with the pH of the surrounding solution. [2]

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- (c) Identify Enzyme **K** and state where it is found in the digestive system. Explain your answer.

[4]

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Total: 10 marks

10 OR

Figure 10.2 shows a section through the human heart, seen from the front.

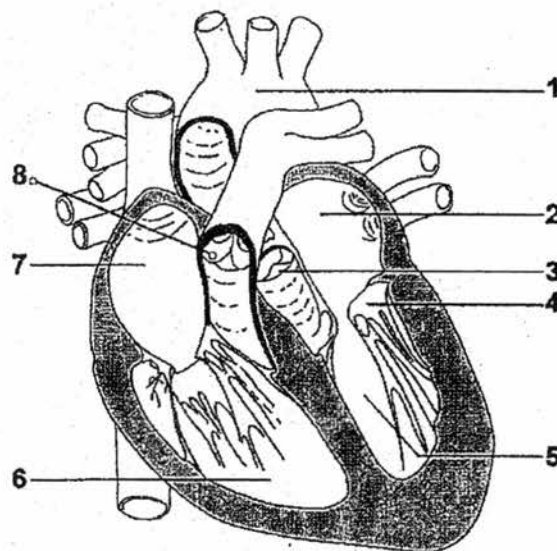


Fig. 10.2

- (a) Name part 4 in Fig. 10.2, and state its function.

[2]

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Figure 10.3 shows one type of artificial heart valve. In patients suffering from loss of function of part 4 shown in **Fig. 10.2**, this type of artificial valve could be used to replace part 4.

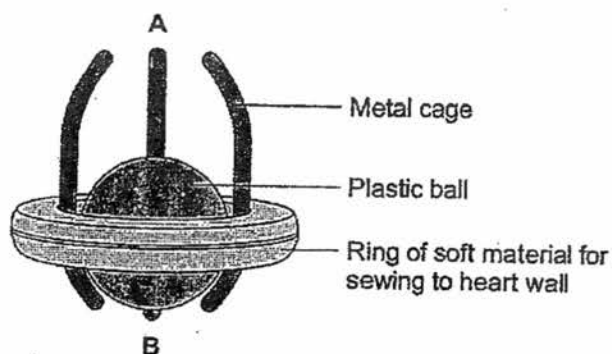


Fig. 10.3

In **Fig. 10.3**, the plastic ball is in the closed position, at region **B**. The artificial valve opens to let blood through when the ball is moved towards **A**.

- (b) Describe how the valve should be positioned in the heart to replace the function of part 4. [1]

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- (c) State which other part(s) shown in **Fig. 10.2** may be replaced by the artificial valve, should these other part(s) fail to function properly. [1]

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Fig. 10.4 shows the blood pressure changes in three different regions in a normal heart, during one complete cardiac cycle.

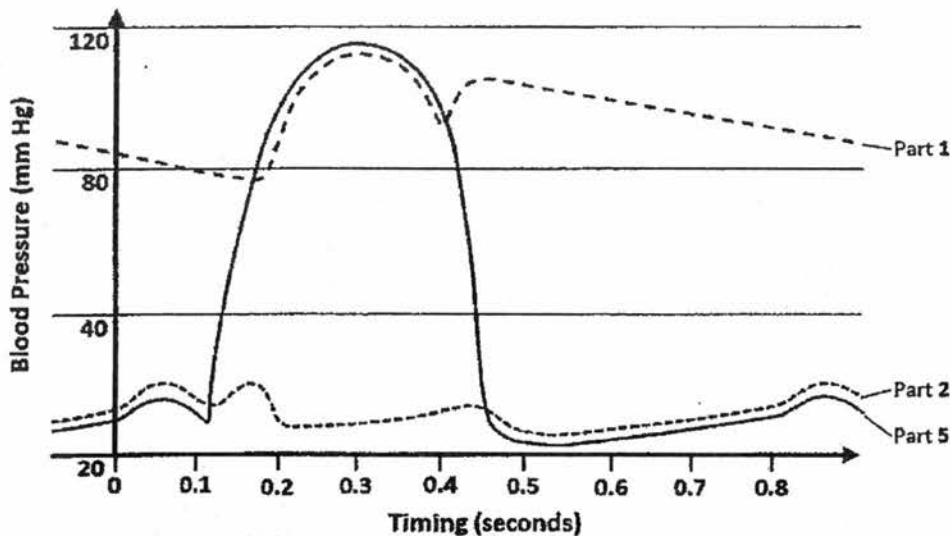


Fig. 10.4

- (d) Show in Fig. 10.4, by adding appropriate labels, when the
- ventricular systole occurs. [1]
 - replacement artificial valve opens and closes [1]
- (e) With reference to Fig. 10.3, suggest the maximum pressure that the artificial valve needs to be able to withstand. Explain your answer. [2]
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-
- (f) If part 4 fails to function properly, evaluate one benefit and one risk of going through an operation to replace it with an artificial valve. [2]
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-

Total: 10 marks

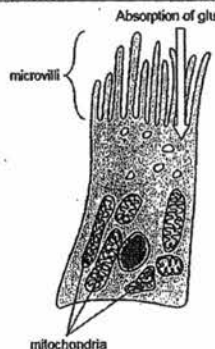
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Answers for Secondary 3 Express Biology EOY P1 2016

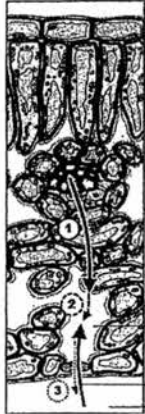
1.	D	11.	B	21.	C	31.	B
2.	C	12.	D	22.	C	32.	B
3.	C	13.	A	23.	D	33.	A
4.	A	14.	A	24.	B	34.	C
5.	C	15.	A	25.	A	35.	A
6.	B	16.	D	26.	D	36.	D
7.	B	17.	B	27.	B	37.	D
8.	A	18.	C	28.	C	38.	C
9.	B	19.	B	29.	D	39.	B
10.	C	20.	B	30.	A	40.	D

Answers for Secondary 3 Express Biology EOY P2 2016

Qn	Answer	Marks	Remarks
1. (a)	- Proximal convoluted tubule in cortex of kidney - Selective reabsorption of all glucose, amino acids, and part of the mineral salts and water from the filtrate/ultrafiltrate from Bowman's capsule.	[1] [1]	Common mistakes: - Did not know PCT is in the cortex - Misidentifying region: - Glomerulus - Bowman's capsule - Capillaries - medulla - Could not fully explain the function of PCT - Used "absorb" instead of "reabsorb" - Did not specify "reabsorb...into blood stream" - These are NOT the function of kidneys: - Deamination - Formation of urea - Formation of bile salts
(b)	- Microvilli greatly increase surface area for diffusion and active transport to take place more rapidly - Many mitochondria release/supply (R: produce) energy for active transport to take place - Labelling: Both labels correct (accept: mitochondrion)	[1] [1] [1]	Common mistakes: - Not sensitive to plural/singular forms of mitochondria/mitochondrion "produce energy" not accepted "microvilli", not "villi" - No labelling done on diagram - Increased surface area (or surface area to surface ratio) <u>does not</u> imply greater concentration gradient. These are different factors that affect movement of substances - Faster rate of absorption does not mean more absorption - Extension is not the same as protrusion "Having mitochondria" is what we see in almost all cells. "numerous mitochondria" should be used

			
(c)	- Root hair cell - Root hair <u>increases surface area</u> for <u>faster</u> absorption of <u>water and mineral salts</u> <u>Many mitochondria releases/supply energy</u> for <u>active transport</u> of mineral ions <u>when their concentration in the surrounding soil is too low for diffusion to take place efficiently</u> OR - Intestinal epithelial cell - Microvilli <u>increases surface area</u> for <u>faster</u> absorption of <u>nutrients</u> (OR glucose/monosaccharides, amino acids, mineral salts) <u>Many mitochondria releases/supply energy</u> for <u>active transport</u> of glucose and amino acids (OR nutrients) <u>when their concentration in the intestinal lumen is too low for diffusion to take place efficiently</u>	[1] [1] [1] [Max 3 marks]	Common mistakes: - Did not name cell - Villus/villi (structures in organ) - Root hair (structure in cell) - Cilia (structure in cell) - Capillaries - Did not specify what substance are absorbed "Exchange" is not the same as "absorb" "root hair" is long and narrow, "root hair cell" is not - Root hair cell does not actively transport water, only mineral salts - Incorrect: "Mitochondria produces energy..."
2. (a)	An enzyme is a <u>biological catalyst</u> that made of <u>protein</u> that <u>increases the rate of a chemical reaction</u> <u>without itself being chemically changed</u> at the end of the reaction.	[1]	Common mistakes: - Narrowing function on digestion/synthesis/breakdown - Talking about lowering activation energy "biological catalyst that catalyses reactions"
(b)	<u>Protease</u>; breaks down / digests proteins into <u>polypeptides</u>.	[1]	Common mistakes: Pepsin/trypsin named as the enzyme
(c)	(Accept any 1) - No protease is found in apple extract - Active site of enzyme in apple extract not specific to gelatin protein - Enzyme in apple requires a different temperature / pH to function - Enzyme in apple has been denatured, so could not function normally	[Max 1 mark]	Common mistakes: - Talk about "acidic enzyme" referring to pepsin - Just saying "apple extract has no effect on gelatin" without explaining why - Stating that apple is alkaline!
(d)	- Not an effective method - The fruit enzymes added, as well as gelatin (substrate) and peptides (products), are also protein in nature, so the Biuret test will always give a positive	[1] [1]	Many could not identify the core idea in the correct answer. Some could not even correctly recall the correct nutrient test

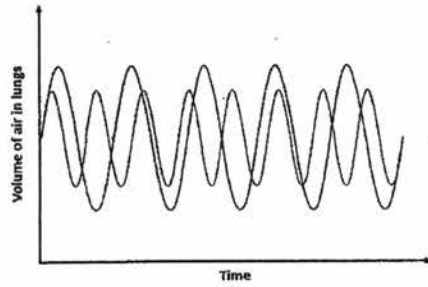
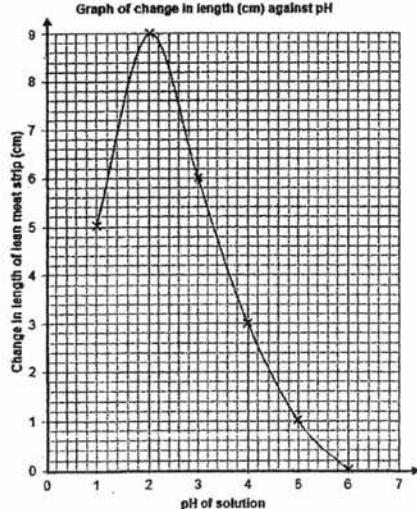
	result, regardless of the reaction taking place or not		
3. (a)	A : guard cell (R: stoma) B : epidermal cell C : vascular bundle	1 m for 2 correct answers. 2 marks for 3 correct answers. [Max 2 marks]	Common mistakes: - Not naming cells or tissues - Stoma is an opening/pore - Vacuole is an organelle - Mistaking "epithellum" for "epidermis" - Only naming xylem or phloem (or even cambium) when the entire vascular bundle was circled - Thinking that the entire leaf was upside down, and calling the upper epidermis the lower epidermis
(b)	- Stomata/guard cells found on upper epidermis (OR no stomata/guard cells found on lower epidermis) in this leaf, but stomata are usually found on lower epidermis for typical plant leaf; - Air spaces found in entire mesophyll tissue/layer (OR found in between palisade mesophyll tissue/layer) in this leaf, but usually found only in the spongy mesophyll layer for typical plant leaf;	[1] [1]	Common mistakes: - Did not compare with typical leaf - Even when the contrasting characteristics are mentioned, did not specify which belonged to water plant and typical land plant - Use of adjectives like "huge" and "tiny", instead of "large(r)" and "small(er)"
(c)	- Air spaces help the leaf float / buoyant / prevents leaf from sinking - Allows carbon dioxide to accumulate (OR be stored/trapped) and diffuse rapidly into mesophyll cells for photosynthesis to take place.	[1] [1]	
4. (a)	Transpiration, which is the <u>loss of water vapour</u> from the <u>stomata</u> of <u>aerial parts</u> of a plant.	[1]	Common mistakes: - Missed out key ideas like "water vapour", "stomata", - Defined "transpiration pull" or "osmosis" instead
(b)	- Appearance: Leaf E would appear <u>wilted</u> but Leaf G would appear normal/turgid (like leaf F). - Explanation: At Y, <u>xylem vessel was removed</u>, so <u>water could not be transported to Leaf E to replace the water lost</u> through transpiration	[1] [1]	Common mistakes: - Did not compare leaf E with G - Could not fully explain the reason - Did not specify where xylem and phloem are removed - Missed out the idea that wilting is due to water loss from transpiration being faster than rate of water uptake (or only discussing loss/uptake while ignoring the other) - Focused (due to the sunlight) on inability of leaf E to photosynthesise, and used this to explain wilting.
(c)(i)	- Iodine <u>solution</u> (R: Iodine) - Absence of starch – solution remains <u>yellow-brown</u> in colour - Presence of starch – solution turns <u>blue-black</u> in colour	[1] [1] [1]	Common mistakes: "Iodine" (which is a solid) instead of "iodine solution" (iodine dissolved in water to form aqueous solution) - Describing the steps for iodine test in leaf, which is not necessary

(c)(ii)	<u>Sunlight could reach leaf G</u> through the transparent plastic bag C - Only phloem tissue was removed at location Z, <u>xylem tissue was still intact/not removed</u>, and could <u>transport water to leaf G</u> - However, bag C <u>prevented carbon dioxide in the atmosphere from entering leaf G</u> (OR no more carbon dioxide could enter leaf G after the carbon dioxide in bag C was used up) - Thus, leaf G did not have all the conditions necessary for photosynthesis to take place (OR could only carry out photosynthesis at the beginning), to produce excess glucose to be converted to starch - Moreover, no sucrose from leaf F could be translocated to leaf G, since phloem was removed at Z.	[1] [1] [1] [1] [1] Max 4 marks	Common mistakes: - Misidentified tissue removed at Z as xylem - Most did not comment on sunlight as an essential condition that is not limiting - Many unaware that the plant was destarched, and had no roots, and still referred to these. E.g. "starch from the rest of the plant"
5. (a)	- Process 1 : osmosis - Process 2 : evaporation - Process 3 : diffusion	[1] [1] [1]	Many made mistakes for this question, even though it was from the notes
(b)	- Concentration correctly labelled - Direction of carbon dioxide movement correctly shown and labelled 	[1] [1]	Common mistakes: - Many did not label the diagram - Arrow did not start from outside leaf, though the stomata, to inside the leaf - No need to extend arrows all the way to the topmost cells
6. (a)	External temperature is lower than body temperature, so body loses heat to environment.	[1]	Common mistakes: - Did not state the difference in temperature, specifying where it is lower - Heat/Thermal energy always flows from region of higher to region of lower temperature, some did not explain this idea enough
(b)	20 minutes	[1]	
(c)	Liver increased metabolic rate increases heat	1 m for	Common mistakes: Including points that are not

	production. [1] - Muscles of the body shiver to produce heat. [1] - Arterioles in skin constrict and shunt vessels dilate, [1] to reduce blood flow to skin surface and decrease heat loss. [1] Rejected: - Sweat glands not active, to reduce heat loss from sweating (as person is wet) - Hair erector muscles contract and hair stands on end (Not effective in humans)	each point [Max 4 marks]	relevant to the question, like the receptors and hypothalamus, and what happens after the body temperature returns to normal - Many conceptual errors surface, e.g. - Shunt vessels and arterioles not discussed in together - Saying blood flow and heat loss is "prevented", even though it is just reduced. - Breathing rate (increase) applies only to increasing heat loss, not so much for reducing heat loss - Hair being raised is not effective in humans - Getting confused about effects of vasodilation and vasoconstriction, and not clear about which vessels are affected (shunt vessels and arterioles work in tandem). - Capillaries cannot constrict! It has not muscle layers
7.			
(a)	S (red blood cell) transports oxygen from the lungs to all parts of the body T (white blood cell) protects the body against invading pathogens OR (phagocyte) engulfs and ingests invading pathogens/foreign bodies	[1] [1]	Common mistakes: - transport oxygen from lungs to all parts of the body, not "around the body". The oxygen needs to be transported to be used somewhere, and not be aimlessly brought around the body - The wbc shown are phagocytes, not lymphocytes, so cannot specify their function as antibody production
(b)(i)	- agglutination/dumping together of red blood cells - antibodies in blood plasma of recipient bind with matching antigen on red blood cells (OR S-type cells) of donor - blocked small blood vessels and obstruct blood flow / OR may cause a stroke or organs not getting sufficient oxygen / OR reduced surface area to volume ratio of red blood cells, reducing rate of diffusion of oxygen / (accept reasonable answer)	[1] [1] [1]	Common mistakes: - spelt agglutination wrongly. "agglutination", "agglutination" "...antigen fit into antibody..." "bind with" should be used - Did not specify, or specified incorrectly that antigens are on rbc, and antibodies are in the blood plasma - Agglutination is NOT the same as clotting - Agglutination may be a special form of tissue rejection, but organ rejection is not relevant to the question, and wbc are not involved in this reaction "patient will die" is not accepted. Reason for death needs to be given, and even with reason given, "patient may die" is more appropriate "S-Type" refers to the cell type, and not a blood type
(b)(ii)	U : A V : AB W : O X : B	1 m for every 2 correct answers. [Max 2]	

		marks]	
(b)(iii)	- donor red blood cells containing antigen A (type A or type AB) or antigen B (type B or type AB) <u>did not cause agglutination</u> when mixed with plasma from V. - Therefore plasma from V does not contain antibody a or antibody b. - V has antigen A and antigen B on its red blood cells which means V has the AB blood type.	[1] [1] [1]	
8.			
(a)	<u>Removal of metabolic waste products and toxic substances</u> from the body of an organism	[1]	Most could answer this question, but many left out "toxic substances"
(b)	- Excess amino acid is transported to the <u>liver</u> for <u>deamination</u> / <u>removal of amino-group</u> - The amino group is <u>converted to urea</u> (while the remaining part of the amino acid is converted to glucose)	[1] [1]	Common mistakes: - Not accurate to say that urea is harmless. It is much less toxic than ammonia, but still is toxic if allowed to accumulate in higher concentrations, which is why it still needs to be excreted by the kidneys! - Some students did not include the word "excess" - Most had incomplete description
(c)	- Loop of Henle - Reabsorption of water	[1]	Common mistakes: - Some said function of LOH is to transport water, metabolic wastes to the DCT, but this is not the function of this special structure in the kidney - Reabsorption not the same as absorption
(d)(i)	- Manatee – nephron G - Human – nephron E - Desert rat – nephron F	1 m for 1 or 2 correct answers. 2 marks for 3 correct answers. [Max 2 marks]	Many swapped manatee and desert rat, even though they could - list function of LOH - see that nephron F had the longest LOH, so most water reabsorption occurs in nephron F (See part (d)(ii) comments about the possible reason)
(d)(ii)	Version 1: - Compared to humans, desert rat living in <u>very dry</u> desert habitat has a constant <u>shortage of water</u> intake and the <u>highest water loss</u> through evaporation, therefore have the <u>greatest need to conserve water</u> - The Loop of Henle is the <u>longest</u> to <u>maximize water reabsorption</u>, and <u>minimise water lost</u> in urine. Therefore its <u>urine</u> has the <u>lowest water potential</u> - Compared to humans, manatee living in <u>very wet</u> aquatic habitat has a constant <u>supply of water</u> and the <u>lowest water loss</u> through evaporation, therefore have the <u>least need to conserve water</u> - The Loop of Henle is the <u>shortest</u> to <u>minimize water reabsorption</u>, and <u>more water is lost</u> in urine. Therefore its <u>urine</u> has the <u>highest water potential</u> Version 2: - Desert rat living in <u>very dry habitat</u> has a constant	[1] [1] [1] [1] [1]	The causality needs to be clear and correct: - Water available in environment → - Amount of water intake → - Sufficient water retained in blood for survival → - Length of LOH to reabsorb water → - Amount of water left and lost in urine → Water potential of urine Common mistakes: - The explanation should begin with the water availability in the environment. A number of students also did not connect the reasons/explanation back to LOH length. - Referring to the loop of Henle

	shortage of water intake and the <u>highest water loss</u> through evaporation, therefore have the <u>greatest need to conserve water</u> - The Loop of Henle is the <u>longest to maximize water reabsorption</u>, and <u>minimise water lost</u> in urine - Therefore its <u>urine</u> has the <u>lowest water potential</u> (Explain the manatee in reversed conditions and needs, and human in moderate conditions and needs, giving rise to the observed LOH length and urine w.p.)	[1] [1] [1]	as nephron. LOH is only part of the nephron, and is the structure being discussed in this question - Water in the LOH is reabsorbed. Calling it water absorption reminds us of the alimentary canal where initial water absorption occurs - Main reason for length of LOH is <u>not</u> about time for reabsorption, but increasing reabsorption by creating a concentration gradient (Google "countercurrent exchanger") "need for water" not same as "need for conserving/reabsorbing water". All these mammals have similar need for water, which is why when the needs are not met, LOH needs to be longer to help reabsorb water. In fact, the <u>manatee needs to excrete more water</u>, or risk dying from water poisoning (Imagine blood cells bursting!), and this is done during ultrafiltration, when the water is forced through the glomerulus. - Size of animal is not an important factor here - Use of urine w.p. or concentration to explain length of LOH must be phrased correctly, or risk reversing the cause-effect relationship. E.g. "urine has low w.p., <u>therefore</u> LOH is longer to increase water reabsorption" (which implies the LOH works after the urine has been formed, which is incorrect) - Possibly because of the above point, many students got the animal-LOH length relationship reversed
9. (a)	- Expansion of chest cavity (OR thoracic cavity) lowers pressure in chest cavity - Lungs expand and pressure in lungs become lower than atmospheric pressure, causing air to rush into lungs - In pneumothorax, accumulated air in chest cavity increases pressure in chest cavity even after expansion - Lung does not expand enough and lung pressure is not lowered enough to draw enough air in from atmosphere, causing breathlessness.	[1] [1] [1] [1]	
(b)	- Less fresh air in alveoli lowers concentration of oxygen and increases concentration of carbon dioxide - Reduces concentration gradient of the gases between blood in capillaries and alveolar air - Slower rate of gaseous exchange. Less carbon dioxide removed from blood - Higher levels of carbon dioxide in blood detected by	[1] [1] [1] [1]	

	the brain increases breathing rate.		
(c)	- Smaller fluctuations in the tidal volume - Faster breathing rate 	[1] [1]	
10. E (a)	- Scale: Scale is appropriate, not too small, no odd scale - Line: Smooth and best fit. - Axes: Appropriately labelled. Positioned correctly - Points: Correctly plotted. 	[1] [1] [1] [1]	Common mistakes: Scale of graph: - Graph did not cover at least 2/3 of graph grids provided Line or curve: - Should be a curve (as learnt about effect of pH on enzyme activity) - Curve indicates that the variable of enzyme activity (or rate of action), as indicated by the change or reduction in length, is <u>continuously</u> affected by the other variable of pH. - Linking points with straight lines means that we are not sure about the correlation between the two factors (whether they are related at all to each other). - Do not extend line or curve beyond the plotted points, to the left of the first point or the right of the last point (cannot assume you can predict it with certainty) Axes and label: - Did not have title - Did not include unit - Incorrectly labelling y-axis as "length of meat strip (cm)" - Extra "x" and "y" labels on the x- and y-axis - Did not draw axis line and arrowhead - Flipped position of the axes! Independent variable is always the x-axis, and dependent variable is always the y-axis Points plotted: - Extra point being plotted at origin (0,0)
(b)	- As pH increases from 1-2, <u>change</u> in length of meat strip increases from 5 cm to 9 cm - As pH increases from 2-6, <u>change</u> in length of meat	[1]	Common mistakes: Not being specific and did not state the pH values given in the question

	- strip decreases from 9 cm to 0 cm - Greatest change in length of meat strip at optimum pH of 2	[1]	- Usually, describe from left (lower pH) to right (higher pH). But some managed to still be clear when starting from optimum pH and describing effects of decreasing and increasing pH from the optimum pH of 2. - If describing length instead of length change, will only get mark if the idea described is done in a way that still makes sense. However, many got the idea wrong when describing in terms of length
(c)	- Pepsin - A: pepsinogen, R: Protease/Trypsin (also found in pancreatic juice, with alkaline optimum pH) - Stomach - Explanation: - Like K, pepsin in gastric juice has optimum pH of about 2, as the hydrochloric acid provide acidic condition for optimum action - to digest protein in the lean meat into polypeptides, and reduce the length of the meat strip (Accepted: Both trypsin and pepsin are proteases found in digestive system, but K cannot be trypsin since trypsin has alkaline optimum pH, and K is denatured/inactive at alkaline pH)	[1] [1] [1]	Common mistakes: - Some identified K as lipase, not understanding that lean meat contains minimal amounts of fat - Protease is not specific enough, since trypsin is also a protease found in the digestive system - Not being specific and did not state optimum pH of 2 (or abt 2)
10. O (a)	- bicuspid/mitral/atrioventricular valve - Prevent backflow of blood from left ventricle into left atrium - OR Allow flow in only one direction / in the correct direction from left atrium to left ventricle - R: only stating that it prevents backflow (without at least mentioning back to atrium)	[1] [1]	
(b)	- Point A towards left ventricle (OR part 5), and B towards left atrium (OR part 2). - R: Between left ventricle and left atrium (without specifying orientation/direction)	[1]	
(c)	Part 3 and part 8	[1]	

(d)		[1]	Many answered this incorrectly, showing misunderstanding of the diagram
(e)	- Accepted range: 110-120 mm Hg - Valve must be able to withstand the maximum pressure during the cardiac cycle, exerted by the atrium and ventricle OR - Accepted range: 110-120 mm Hg <u>and higher</u> - Valve must be able to withstand not only the maximum pressure during the normal heartbeat, but also when the heart is generating higher pressure during vigorous exertion.	[1] [1] [Max 2 marks]	Common mistake: No unit (mm Hg) given The maximum ventricular pressure of about 115 mm Hg may be the maximum pressure in the graph, but is in fact the minimum pressure that the valve needs to tolerate. Since this graph shows the pressure changes in an average person under average conditions. When designing the valve, there needs to be a safety margin worked in to ensure patient safety.
(f)	Benefits: - Improved supply of oxygen/nutrients - Improved blood circulation - Heart does not have to work as hard / Heart works more efficiently - Improved cellular respiration - Able to carry out more strenuous activities / Not as easily tired. R: Prevent backflow of blood (This is the function of the valve, and is already explained in part 10 O (a)) Risks: - Danger of surgery / operation - Infection from surgery / operation - Artificial valve may not function properly/well in the heart (OR any reason given to suggest that the valve would not work. E.g. metal cage may corrode, soft material may fail, blood pressure may cause deformity of the materials, wear and tear limits lifespan of valve) - Immune reaction to materials used in valve	Any 1 benefit and 1 risk. [Max 2 marks]	