Name: _____( ) Class:_____

CHIJ KATONG CONVENT
END-OF-YEAR EXAMINATIONS 2016
Secondary Three Express

BIOLOGY (WITH SPA) **5158**

Duration: 2 hour 15 minutes

Class:

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, registration number and class on all the work you hand in.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid/ tape.
The use of an approved scientific calculator is expected, where appropriate.

Section A
Answer **all** questions.
Indicate your answers on the Optical Answer Sheet provided.

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

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

At the end of the examination, hand in:
(a) Optical Answer Sheet;
(b) Section A question paper;
(c) Answers to Sections B and C **separately**.

INFORMATION FOR CANDIDATES

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

FOR EXAMINER'S USE	
Section A	/ 20
Section B	/ 50
Section C	/ 30
TOTAL	/ 100

This question paper consists of **26** printed pages.

Name:_____( ) Class: _____

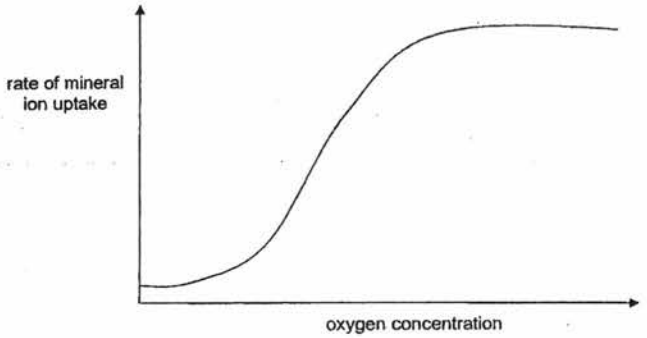
Section A [20 marks]
Answer **all** the questions in this section.
Indicate your answers on the Optical Answer Sheet provided.

1 Which cell type has the most number of ribosomes?

A muscle cell
B red blood cell
C sieve tube element
D xylem

Use the following graph to answer Questions 2 and 3.

The graph shows the effect of oxygen on the rate of mineral ion uptake by root hair cells.



2 Which cell organelle in root hair cells is necessary for mineral ion uptake?

A cell surface membrane
B mitochondria
C nucleus
D ribosomes

3 Which process(es) is/ are involved in mineral ion uptake by root hair cells?

A active transport only
B diffusion only
C osmosis only
D active transport and diffusion only

4 A plant cell is immersed in distilled water.

Which statement explains why water moves into the cell?

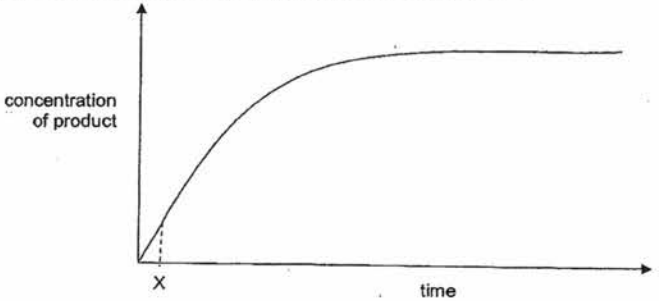
A The cell surface membrane is fully permeable.
B The cellulose cell wall is partially permeable.
C Water enters the cell by active transport.
D Water moves down a water potential gradient.

5 An unknown substance causes cut surfaces of apples to turn brown.

Which statement describes a test to determine if the substance is an enzyme?

A Boil the apple and see if it turns brown when exposed to air.
B Drop a few drops of iodine on apple and see if it turns blue-black.
C Place the apple in an environment that does not contain oxygen and see if it turns brown.
D Test whether the apple turns brown in an atmosphere of pure carbon dioxide gas.

6 The graph shows the profile of an enzyme-catalysed reaction at 30 °C.

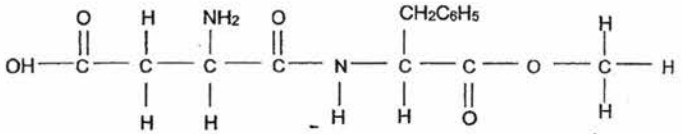


Which statement is true at time X?

A Most enzyme molecules will have free active sites.
B The number of available substrate molecules is low.
C The number of enzyme-substrate complexes is the highest.
D The rate remains the same if more enzyme is added.

7 Aspartame is an artificial sweetener found in low-calorie soft drinks.

The structure of aspartame is found below.



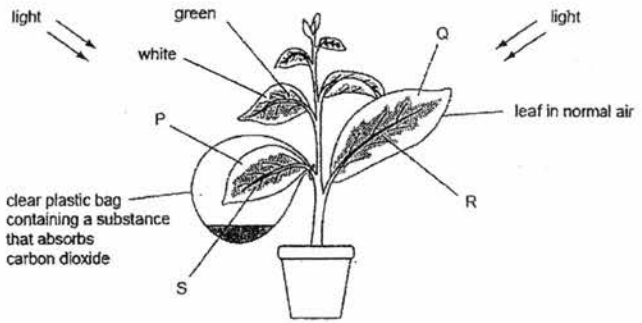
Which type of biological molecule does aspartame belong to?

A carbohydrate
B fat
C protein
D vitamin

8 Which property of water makes it suitable as a blood transport medium?

A Water acts as a solvent
B Water has high specific heat capacity.
C Water is transparent.
D Water molecules are held by cohesive forces.

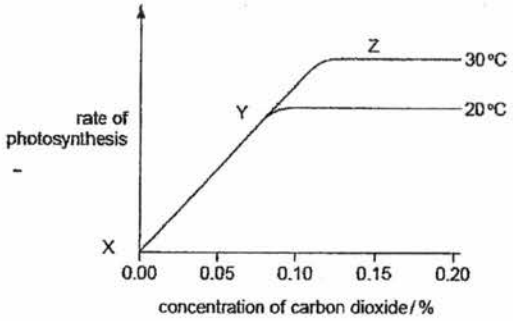
9 The diagram shows an investigation on photosynthesis. The plant has leaves that are green in the middle and white around the edges.



Which option shows areas of the leaves that lack only one factor needed for photosynthesis?

A P and Q only
B P and R only
C Q and S only
D R and S only

10 The graph shows the effect of temperature and carbon dioxide concentration on the rate of photosynthesis.



Which statement correctly describes the results of the investigation?

A Between X and Z, carbon dioxide concentration is a limiting factor.
B Between X and Y, carbon dioxide concentration is a limiting factor.
C Between X and Z, temperature is a limiting factor.
D Between X and Y, temperature is a limiting factor.

11 Equal quantities of a protease were added to 5 cm^3 of protein solutions of different pH. Each test-tube was kept at 37 °C.

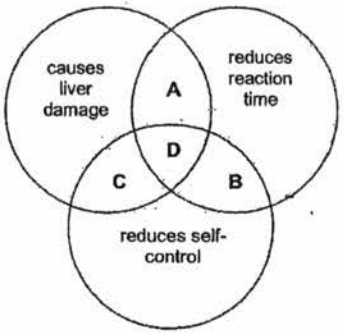
The amount of amino acid in each test-tube was measured after 3 minutes. The results are shown in the table.

pH	amount of amino acid / arbitrary units
1	0
2	1
3	1
4	2
5	3
6	7
7	9
8	10

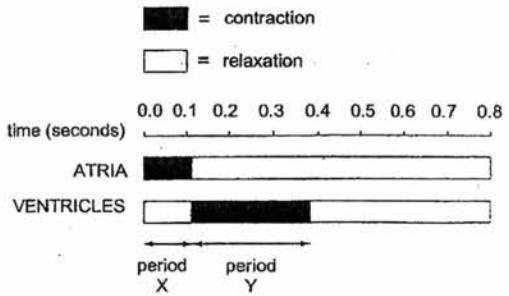
Which option shows the optimum pH and location of the protease in the human digestive system?

	optimum pH	location of the protease
A	1	duodenum
B	8	duodenum
C	1	stomach
D	8	stomach

12 Which section of the diagram represents the effects of excessive alcohol consumption on the body?



13 The diagram shows one cardiac cycle lasting 0.8 s.

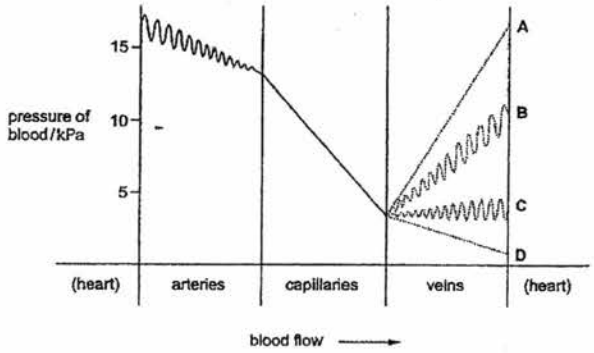


Which option shows the duration of the ventricular diastole?

A 0.1 s
B 0.3 s
C 0.4 s
D 0.5 s

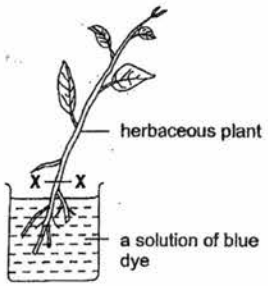
14 The diagram shows the blood pressure of a person at rest as the blood leaves the heart and passes through arteries and then capillaries.

Which graph shows the pressure of blood as it flows through the veins before returning to the heart?

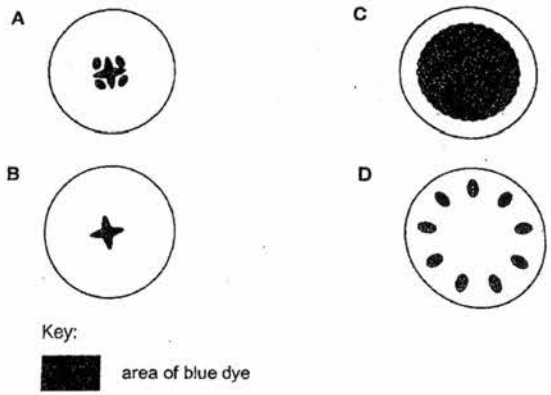


CHIJ Katong Convent End-of-Year Exams 2016 Biology 5158 (With SPA) Sec 3E

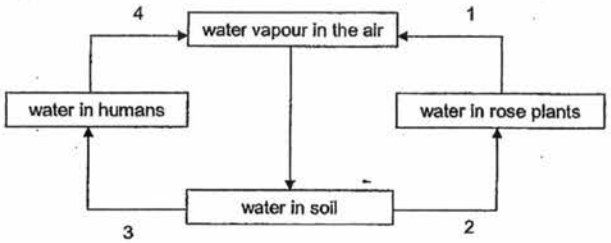
15 An experiment was set up to investigate the movement of blue dye up a herbaceous plant.



If a section is cut at X-X, which cross-section shows the distribution of the blue dye?



16 The diagram shows the movement of water between the environment and some living organisms.

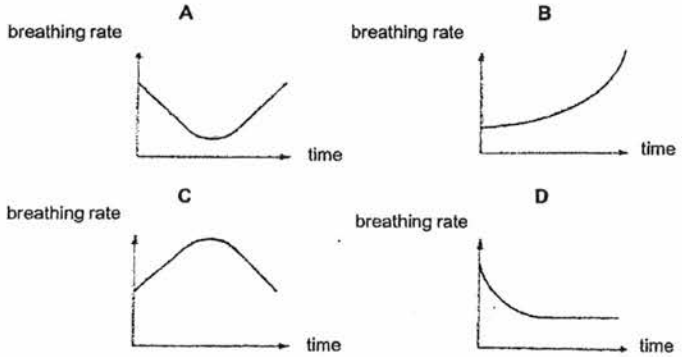


Which arrow(s) represent(s) transpiration?

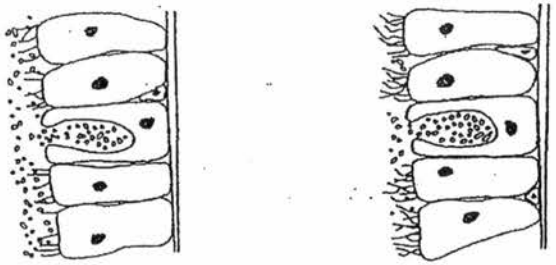
A 1 only
B 4 only
C 1 and 2
D 3 and 4

17 A man breathes into and out of a plastic bag containing atmospheric air for 15 minutes.

Which graph shows the breathing rate of the man over the 15-minute duration?



18 The diagrams show the epithelium lining a bronchiole of a smoker and of a non-smoker.



smoker non-smoker

Based on the diagrams, which statement explains why there is a higher tendency for mucus to drain into the smoker's lungs?

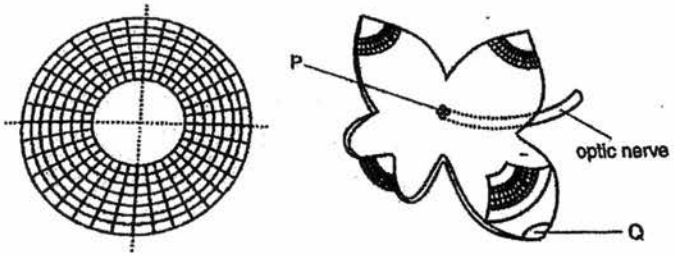
A A non-smoker has more active mucus secretion.
B A smoker has fewer cilia on the epithelial cells.
C Epithelial cells of a smoker divide more in a non-smoker.
D The cells burst in the bronchiole of a smoker.

19 Mydriasis is a condition in which the pupil is excessively dilated.

Which is a possible consequence of mydriasis?

A Cones will not be able to function optimally.
B He will not be able to see anything temporarily if he moves from a brightly lit place to a dark place.
C The image formed on the retina will not be focussed.
D The radial muscles of his iris will be contracted for extended periods of time.

20 A human eye was cut along the dotted line from its front view. The diagram shows the front view before dissection and the view of the dissected eye.



front view before dissection dissected view

What are the labelled structures **P** and **Q**?

	P	Q
A	blind spot	cornea
B	blind spot	pupil
C	fovea	iris
D	iris	blind spot

Section B [50 marks]
Answer **all** the questions in this section.
Write your answers in the spaces provided.

21 Insulin is a polypeptide produced by pancreatic cells.

Fig. 21.1 is an electron micrograph of a pancreatic cell.

Fig. 21.1

(a) **(i)** Describe the structure of a polypeptide.

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..... [2]

(ii) Name and describe a food test used to identify the insulin polypeptide.

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.....

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..... [2]

21 **(b)** On Fig. 21.1, label and identify the organelle that

(i) contains genetic information for the formation of insulin polypeptide; [1]

(ii) releases energy for formation of insulin polypeptide. [1]

(c) Insulin is produced by pancreatic cell and released out of the cell, directly into the blood stream.

State the pathway of insulin from the site of production to outside the pancreatic cell.

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..... [2]

[Total: 8]

22 *Paramecium* is a fresh water organism that has contractile vacuoles that are filled with water from the surrounding and expels water when the vacuoles contract.

Fig. 22.1 shows the image of *Paramecium*.

Fig. 22.1

Paramecium is placed in different concentrations of salt solution and the number of contractions shown by *Paramecium* in one minute is counted. The experiment is conducted in triplicates and the average number of contractions counted in one minute is recorded in Table 22.1.

Table 22.1

concentration of salt solution / mol dm^{-3}	average number of contractions counted in one minute
0.00	105
0.20	98
0.50	62
0.70	45

(a) State and explain how water enters *Paramecium*.

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..... [3]

22 (b) Describe and explain the results shown in Table 22.1.

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..... [4]

[Total: 7]

23 In 1822, a man, Alexis Bidagan, suffered an injury from a gun fired at close range. The injury was a hole about 10 cm in diameter, penetrating both his chest and stomach walls, below his diaphragm. When the wound healed, the edge of the hole in his stomach sealed itself with the edge of the hole in his chest wall.

Fig. 23.1 shows the position of the opening that remained in Alexis's stomach until he died 58 years later.

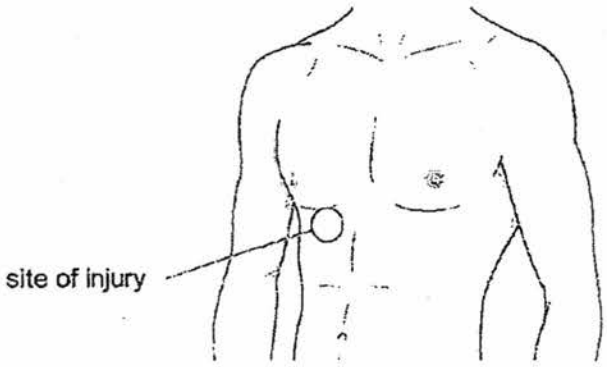

Fig. 23.1

(a) Name two organs, other than the stomach, that would have been exposed to infection through the hole before the wound healed.

..... [2]

23 **(b)** The insides of his stomach would have a lower risk of getting infected than other organs.

Suggest why this is so.

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..... [2]

(c) After Alexis has recovered, food can be retained in his stomach and digests normally in the alimentary canal.

Fig. 23.2 shows a section of the digestive system where food passes through.

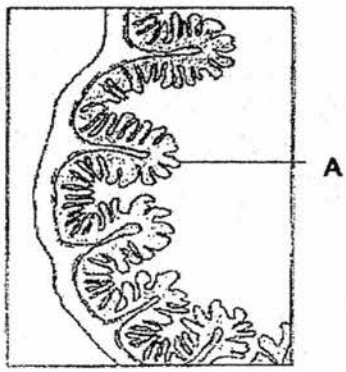

Fig. 23.2

(i) Identify structure **A**.

..... [1]

(ii) Describe and explain how structure **A** is adapted for its function.

.....

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..... [3]

[Total: 8]

24 In 1883, a German scientist, Engelmann, used a green algae to study the effect of light on photosynthesis. This algae has long spiral-like or ribbon-like chloroplasts. He placed the algae on a slide with a suspension of aerobic bacteria and observed the distribution of bacteria under different light conditions.

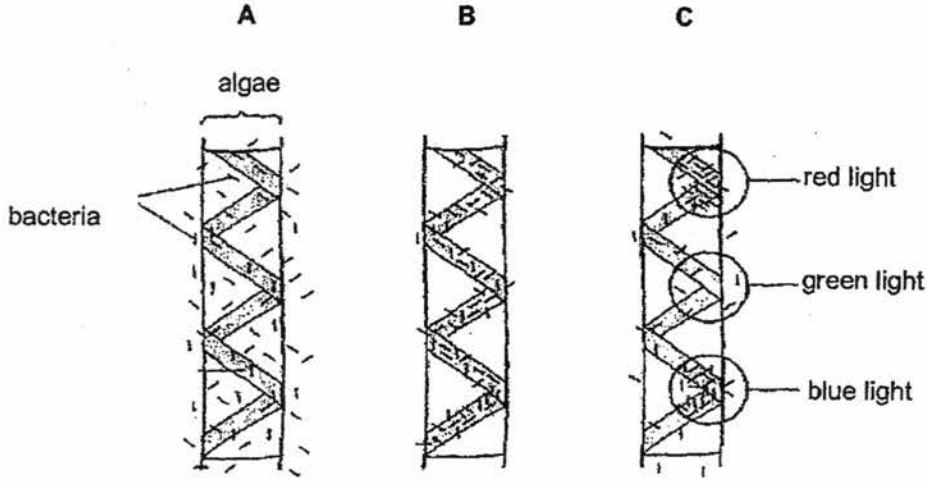

Fig. 24.1

key
algae **A**: in darkness
algae **B**: under white light
algae **C**: under light spots of different colours

(a) Describe the distribution of bacteria in experiments **A** and **B**.

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..... [2]

(b) Account for the bacteria distribution in experiment **B**.

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.....

..... [2]

(c) **(i)** Suggest what did Engelmann wish to find out from the experiment.

..... [1]

24 **(c)** **(ii)** State two conclusions that can be drawn from the results in experiment **C**.

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..... [2]

[Total: 7]

25 Fig. 25.1 shows the blood supply to liver cells.

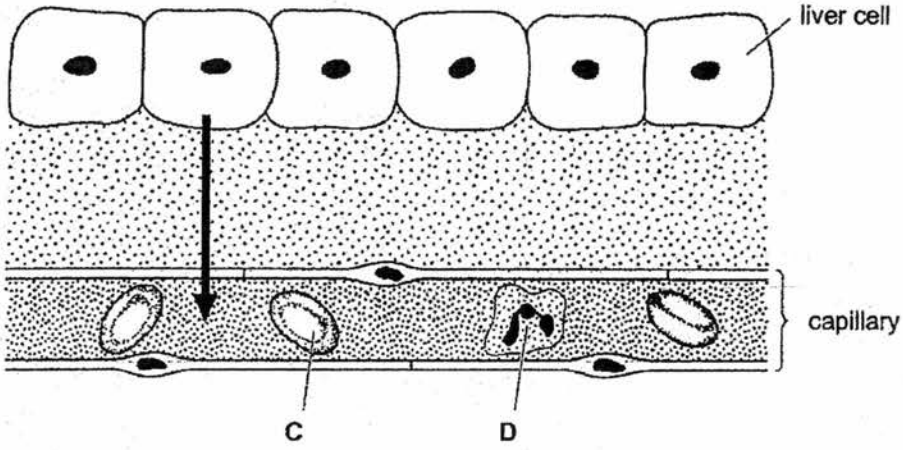

Fig. 25.1

(a) **(i)** Name the cells labelled **C** and **D**.

C .....

D ..... [2]

(ii) The arrow in Fig. 25.1 shows the movement of substances from the liver cells into the capillary.

Name two substances that move in the direction shown.

1. .....

2. ..... [2]

25 (b) Table 25.1 shows the response of three unknown blood types and serum containing antibodies a and b respectively.

Table 25.1

blood type	antibody a serum	antibody b serum
X	✓	✓
Y	✓	×
Z	×	✓

key
✓ agglutination occurs
× agglutination does not occur

(b) (i) State the identity of blood types **X**, **Y** and **Z**.

X .....

Y .....

Z ..... [3]

(ii) Explain your answer to **(b)(i)**.

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..... [3]

[Total: 10]

26 Fig. 26.1 shows the horizontal section of the human eye.

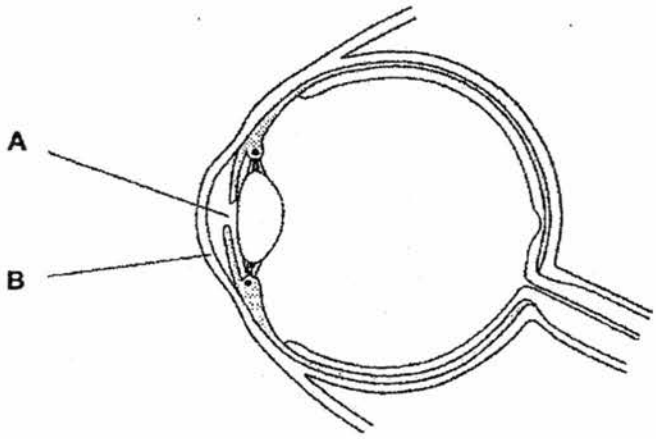

Fig. 26.1

(a) **(i)** Identify structures **A** and **B**.

A .....

B ..... [2]

(ii) Describe what happens to structure **A** when a person moves from a bright field into a dark room.

.....

..... [1]

(iii) Place a letter **Z** on Fig. 26.1 where a response occurs as a result of a reflex action. [1]

(b) In some individuals, the retina becomes completely detached from the tissues beneath.

Explain how this will affect their ability to see.

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..... [3]

26 **(c)** As people get older, cloudy (opaque) patches sometimes form in the lens of the eye. These are called cataracts.

Suggest how cataracts might affect the ability of the lens to carry out its function.

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.....

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.....

..... [3]

[Total: 10]

Section C [30 marks]
Answer **all** the questions in this section.
Write your answers in the spaces provided.

27 There are three unidentified leafy shoots **A**, **B** and **C** grown in

- an aquatic environment,
- a water-sufficient environment,
- a water scarce environment.

The three leafy shoots are placed in a potometer and under the same environmental conditions. Fig. 29.1 shows the set-up of the potometer.

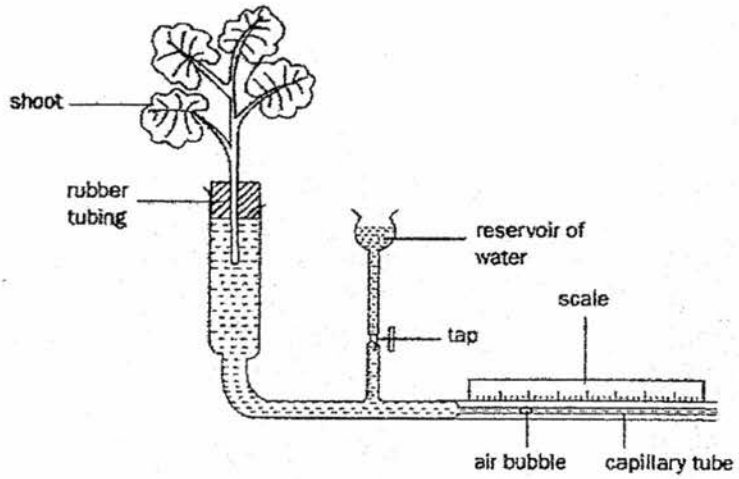


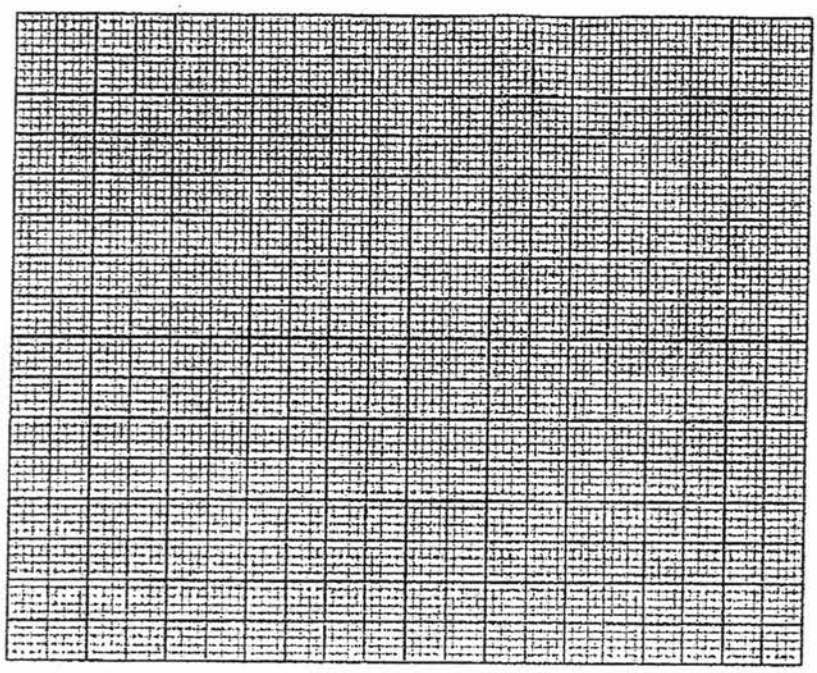
Fig. 29.1

The distance moved by the air bubble at every 30 minutes interval for each plant is recorded as shown in Table 29.1.

Table 29.1

time / mins	distance moved by air bubble / mm		
	Plant **A**	Plant **B**	Plant **C**
0	0	0	0
30	10	12	5
60	20	31	10
90	28	43	15
120	42	63	20
150	50	76	25

27 **(a)** Plot a best-fit graph of distance moved by air bubble against time for plant B.



[4]

(b) Using the graph, calculate the average rate of transpiration for plant **B**.

average rate of transpiration = ... [2]

27 (c) Identify the habitat of plants **A**, **B** and **C**. Explain your answer.

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..... [6]

[Total: 12]

28 (a) Using key features of the 'lock and key' hypothesis of enzymes, describe the main properties of enzymes.

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..... [4]

28 (b) Biological washing powders (detergents) contain one or more enzymes.

Using characteristics of enzymes, suggest the advantages of using biological washing powders compared to those without enzymes.

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..... [4]

[Total: 8]

29 Table 29.1 shows the oxygen consumption of a man moving at different speeds.

Table 29.1

speed / km h^{-1}	oxygen consumption / dm^3 min^{-1}
at rest	0.35
5	1.73
15	3.25

(a) The man exercises for one hour. Within the hour, he spent half the time walking at 5 km h^{-1} and the other half running at 15 km h^{-1}.

Calculate his total oxygen consumption during one hour and his average oxygen consumption per minute.

total oxygen consumption = ...

average oxygen consumption = ... [3]

29 **(b)** Using the information in Table 29.1, describe and explain the relationship between the speed of movement and oxygen consumption.

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..... [5]

(c) Explain the term *oxygen debt*.

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..... [2]

[Total: 10]

Sec 3E Biology EOY 2016 Answer Scheme

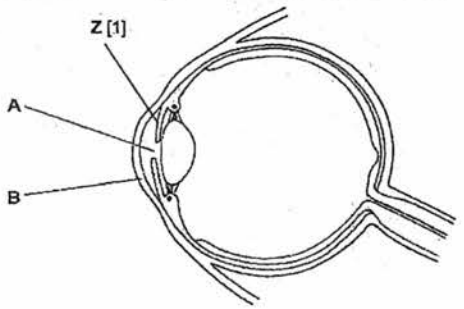
Section A

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
A	B	D	D	A	A	C	A	C	B

Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
B	C	D	D	B	A	B	B	D	A

Section B

21ai	Polypeptide is a linear sequence; Of amino acids joined by + peptide bonds;	1 1
21aii	Biuret test To 2 cm^3 of food sample, add 2 cm^3 of sodium hydroxide + copper(II) sulfate solution dropwise. If proteins are present, contents turned violet. If contents are absent, contents remained blue. Max = 2 marks	1 1 0.5
21bi	Label nucleus	1
21bii	Label mitochondrion	1
21c	Insulin produced by ribosomes; is sent to the rough endoplasmic reticulum; Insulin is packaged into vesicles; Vesicles containing insulin is sent to the cell surface membrane where they fuse To release insulin out of the cell.;	0.5 0.5 0.5 0.5
22a	Surrounding solution has a higher water potential than the cell cytoplasm; Water molecules enter the cell across a partially permeable membrane; By osmosis;	1 1 1
22bi	As the concentration of salt solution increases from 0.0 to 0.7 mol dm^{-3}, average number of contractions counted in one minute decreases from 105 to 45.;	1
22bii	As the concentration of salt solution increases, the water potential gradient between surrounding salt solution and cytoplasm decreases.; Less water enters the cytoplasm of Paramecium.; Fewer contractions occur to expel water out of Paramecium.;	1 1 1
23a	any 2 from: pancreas; liver; gall bladder; spleen; named blood vessel; Max 2 *credit (small intestine) once only. (b) Max 2 marks	1
23b	bacteria / virus / fungus / microoganism / pathogen; (stomach contents) acid(ic) / ref. HCl; (and/or) enzyme / protease; destroys / kills / ref. wrong pH for growth (of microorganism or colony implied); Max 2	1 1 1 1
23ci	Villus	1

23cii	Describe / explain One cell thick epithelium [0.5] / Short distance for nutrients to diffuse into blood capillaries. [1] Each villus is well-surrounded by blood capillaries. [0.5] / Maintains a steep concentration gradient for fast diffusion of nutrients into blood capillaries.[1]	
24a	In A, bacteria is uniformly distributed; while In B, bacteria is concentrated on the chloroplasts;	1 1
24b	Oxygen gas is produced by the chloroplasts during photosynthesis; Bacteria uses the oxygen gas released to carry out aerobic respiration on the chloroplasts;	1 1
24ci	To determine the effect of light on photosynthesis.;	1
24cii	Light is required for photosynthesis.; Red and blue light promote greater rate of photosynthesis than green light.;	1 1
25ai	C – red blood cell; D – phagocyte;	1 1
25aii	Urea; Carbon dioxide;	1 1
25bi	X – blood type AB; Y – blood type A; Z – blood type B;	1 1 1
25bii	X agglutinates with antibodies a and b respectively, suggesting it has antigens A and B → blood type AB.; Y agglutinates with antibody a, suggesting it has antigen A → blood type A; Z agglutinates with antibody b, suggesting it has antigen B → blood type B;	1 1 1
26ai	A – pupil; B – cornea;	1 1
26aii	A dilates when light becomes less intense.	1
26aiii		
26b	Reasonable reference to light receptors/sensitive cells/rods/cones; Not in contact with optic nerve; No impulses; To brain; No picture formed/blindness/unable to see	1 1 1 1 1

	(Reject: Blurred vision or reduced visionary power) Less/no nutrition for retina; Max 3	1
26c	Failure to focus (all) light (rays); Blurred image AW; Any reference to the passage of light rays being impaired (eg. Reflection/refraction/deflection/absorption/convergence); Ref. possible change in elasticity/ability to accommodate; Faded colour vision; Max 3	

Section C

27a	Correct scale; Correct axis; Correct plotting of points for plant B; Best fit line;	1 1 1 1
27b	Gradient for plant B Average rate of transpiration = working = correct answer	 1 1
27c	Plant A – water sufficient environment; Intermediate rate of water loss through transpiration; Plant B – aquatic environment; Abundant supply of water to replace water lost through transpiration → Greatest rate of water loss through transpiration; Plant C – water scarce environment; Adapted to dry conditions by reducing rate of water loss through transpiration;	1 1 1 1 1 1
28a	Enzyme is the lock, substrate is the key.; Each enzyme has a specific active site; To which the substrate which has a complementary shape binds to. Each enzyme acts on a specific substrate. Enzyme activity is dependent on temperature. At high temperature, active site of enzyme is denatured. Substrate cannot bind to active site of enzyme. Max 4	1 1 1 1 1 1
28b	Enzymes remain chemically unchanged at the end of the reaction; → Small amounts of enzymes are required for the reaction.; Digestive enzymes in washing powders Speed up digestion of oils and dirts in soiled clothes. Cleaning can occur faster. Max 4 marks	1 1 1 1 1
29a	Total oxygen consumption = (30 X 1.73) + (30 X 3.25) = 149.4 ~ 149dm^{3}h^{-1} (to 3sf)	1 1

	Average oxygen consumption per minute = 149.4 / 60 = 2.49 dm^3 min^{-1}	1
29b	As the speed of movement increases, oxygen consumption rises as well. Reference to data ie speed increases from at rest to 15 km/h, oxygen consumption increases from 0.35 to 3.25 dm^3 min^{-1} During exercise, energy demand of the muscles undergoing contractions increase. Muscles carry out **aerobic respiration** at a greater rate to meet this energy demand Thus, more oxygen and glucose is delivered to the muscles to be oxidized and yield energy.	1 1 1 1 1
29c	Oxygen debt occurs when there is insufficient oxygen to meet the demands of the vigorous muscular contractions and the lactic acid build up in the muscles causing fatigue and muscle pain.	1 1