Candidate Name: _____ Class | Index No.

FUHUA SECONDARY SCHOOL

Secondary Three Express

End of Year Examinations 2016

3E

BIOLOGY

5158

5 October 2016
0930 – 1145
2 hour 15 minutes

Additional Materials: OMR

INSTRUCTIONS TO CANDIDATES
Write your name, class and index number on the OMR sheet and question booklet.
Write in dark blue or black pen.
You may use a pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions. Shade your answers on the OMR sheet provided.

Section B and C
Answer **all** questions in the space provided in the Question Booklet.

You are advised to spend no longer than 30 minutes on Section A, no longer than 1 hour on Section B, and no longer than 45 minutes on Section C.

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

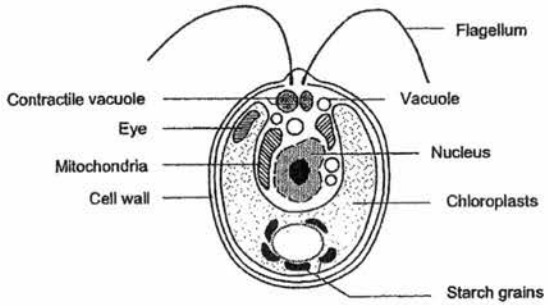
PARENT'S SIGNATURE	FOR EXAMINER'S USE			
	Section A	Section B	Section C	TOTAL
	30	40	30	100

Setter: Ms Veronica Tei **Vetter:** Mr Ng Wei Ping

This question paper consists of 31 printed pages including this page.

Section A: Multiple Choice Questions (30 marks)
Answer **all** questions.
Shade your answers on the OMR sheet provided

1 The diagram below shows a drawing of a unicellular organism, *Chlamydomonas*.

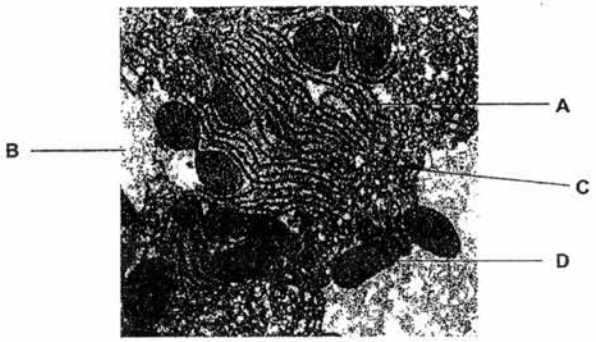


Based on the figure above, what can be concluded about *Chlamydomonas*?

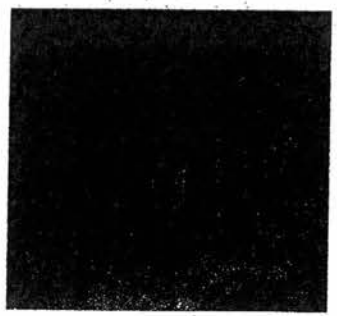
A *Chlamydomonas* uses its flagellum for movement.
B *Chlamydomonas* is an animal cell because it contains small vacuoles.
C *Chlamydomonas* is a plant cell because it has a cell wall and chloroplast.
D *Chlamydomonas* is an animal cell because it contains mitochondria and nucleus.

2 HMG-coA reductase is an enzyme which controls the production of cholesterol. This enzyme is found embedded within a membrane.

The diagram below shows an electron micrograph of a part of a liver cell.
Where in the cell could this enzyme be found?



3 The diagram below shows an electron micrograph of a stoma.



How wide was the stomatal opening?

A 0.42 μm
B 0.72 μm
C 1.89 μm
D 2.10 μm

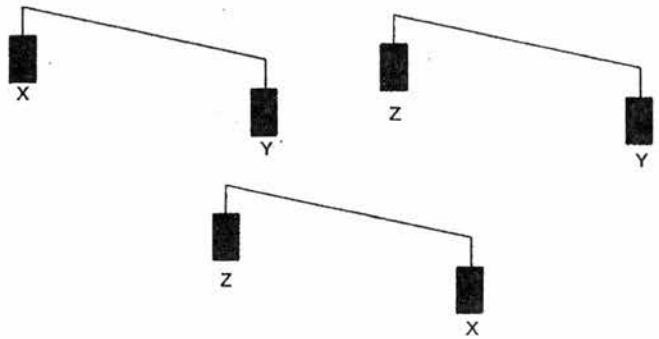
4 Which of the following is true about diffusion?

	requires energy	requires membrane
A	√	√
B	x	√
C	√	x
D	x	x

legend:
√ : yes
X : no

69

5 Three potato strips (X, Y and Z) with the same mass were placed into three different solutions. The mass of the three potato strips were then compared using a beam balance. The results are shown in the diagram below.

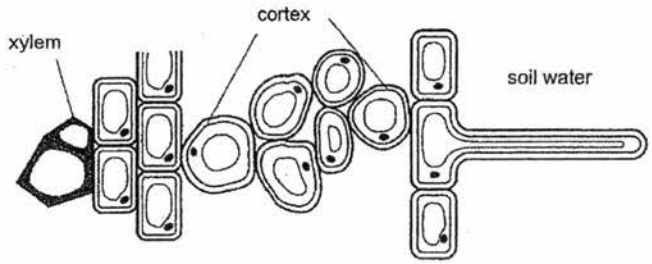


Which of the following solutions is the potato strips placed in?

	X	Y	Z
A	10% sucrose solution	25% sucrose solution	Pure water
B	10% sucrose solution	pure water	25% sucrose solution
C	25% sucrose solution	pure water	10% sucrose solution
D	25% sucrose solution	10% sucrose solution	Pure water

6 Land flooded by the sea is not suitable for growing plants long after the salty flood water has drained away.

The diagram represents a transverse section through a part of the root of a plant.



Which values of water potential (kPa) in the xylem and soil water help to explain why the land flooded with salty water is unsuitable for growth of plants?
**water potential of pure water is 0 kPa.*

	xylem	soil water
A	0 kPa	-700 kPa
B	-1800 kPa	-700 kPa
C	-700 kPa	-1800 kPa
D	-1800 kPa	0 kPa

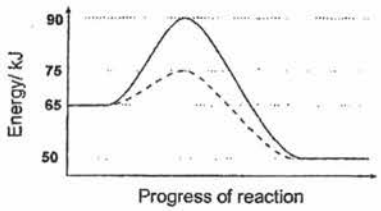
7 Lovastatin is a drug used in the treatment of high cholesterol. It functions by competitively binding to the active site of enzyme, HMG-CoA reductase, thus inhibiting the reaction which forms cholesterol.

The diagram below shows a drawing of lovastatin.

Which of the following may be the original substrate of HMG-CoA?

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

8 The graph shows changing energy levels during a reaction, with and without an enzyme that is specific for that reaction.

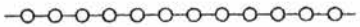


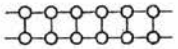
Which of the following shows the change in amount of activation energy required after the addition of the enzyme?

A - 10 kJ
B - 15 kJ
C - 25 kJ
D - 40 kJ

9 The diagram shows part of a starch molecule.

Which of the following diagrams represents the outcome of digestion of the above molecule by maltase?

A 

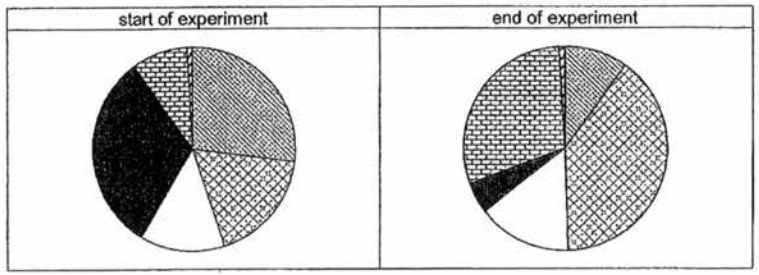
B 

C 

D 

10 Liquid X was extracted from a part of the digestive system and added to some food.

The diagram below shows the changes in the percentage of carbohydrates, proteins and fats after the addition of liquid X.



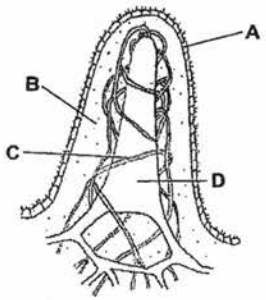
Legend:

polypeptides glucose starch
amino acids proteins maltose

Where is liquid X extracted from?

A mouth
B stomach
C duodenum
D pancreatic duct

11 The diagram below shows a villus.



Where does the recombination of fats takes place?

12 Due to a viral infection, a person had part of his liver surgically removed.

Which of the following are the expected consequences of the removal of part of the liver?

I absence of fats digestion
II decrease insulin production
III increase urea production
IV decrease levels of iron in the body

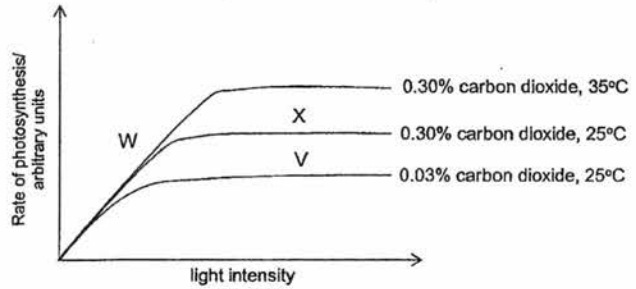
A I only
B IV only
C I and II
D III and IV

13 Radioactive carbon dioxide, $^{14}CO_2$, was introduced to the atmosphere surrounding a fully illuminated leaf. The movement of ^{14}C in the leaf was traced.

Which of the following statements is incorrect?

A ^{14}C is moving out of the leaf to other parts as glucose.
B ^{14}C is moving out of the leaf to other parts in the phloem.
C Photosynthesis is responsible for incorporation of ^{14}C into a carbohydrate.
D The rate of movement of ^{14}C from the leaf to other parts would be dependent on the rate of translocation.

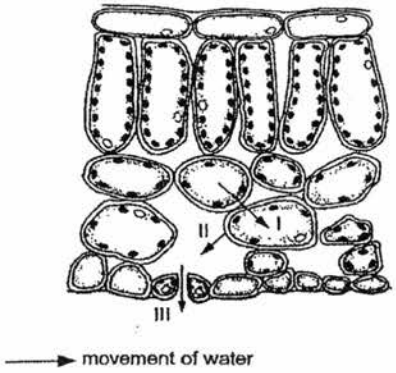
14 The graph shows the rate of photosynthesis at two different carbon dioxide concentrations and at varying light intensities at two different temperatures.



Which factors are limiting at points V, W and X?

	light intensity	carbon dioxide	temperature
A	V	X	W
B	V	W	X
C	W	V	X
D	X	W	V

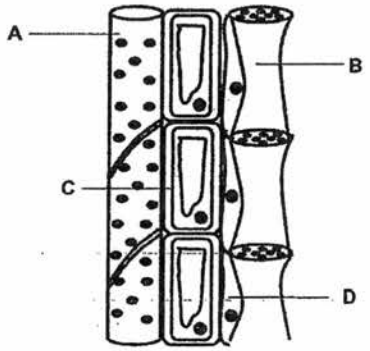
15 The diagram below shows the cross section of a dicotyledonous leaf. The numbered arrows indicate the movement of water across the cells and out of the leaf.



Which of the above arrow(s) will be affected by water potential?

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

16 A plant was exposed to a poison that inhibits respiration.
Which was the cell affected by the poison that led to the termination of movement of solutes in the phloem?



17 Transpiration is vital to the movement of water from the roots to the leaves. Below is a student's explanation of how transpiration affects movement of water.

I. Continuous entry of water into the roots creates root pressure which pushes water up the leaves.
II. Cohesion between water molecules allow water to be pulled up the xylem vessel.
III. Water vapour diffuse out of the mesophyll cells into the surrounding atmosphere.
IV. Water evaporates from the thin film of moisture surrounding the mesophyll cells.

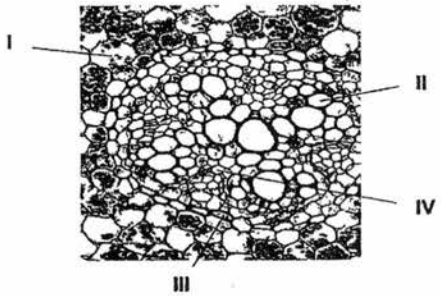
Which of the above statements are correct?

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

18 Some fluid was extracted from a part of a plant. Each tissue is tested for starch, proteins and reducing sugar. The results are shown in the table below.

test	iodine test	biuret's test	Benedict's test
observations	yellowish brown	blue	blue

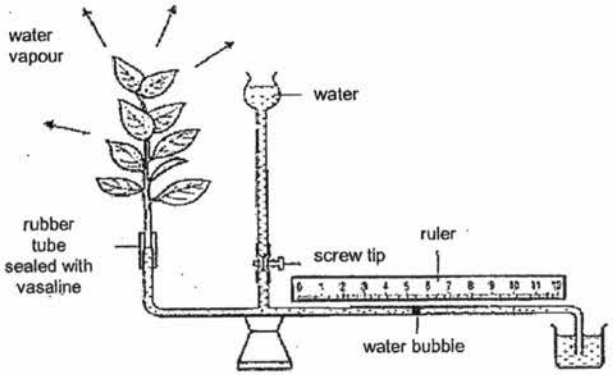
The photomicrograph shows part of a section of the plant.



Which part of the plant is the fluid possibly extracted from?

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

19 A classic experiment was used to study the effect of ammonium nitrate on transpiration rate as shown below.



The results of the experiment were documented in the table below.

concentration of ammonium nitrate/ mM	marking of water bubble on the ruler/ cm	
	start of the experiment	end of the experiment
0	6	5.20
1	4	3.10
10	5	4.07
100	7	5.94

Which of the following conclusions can be made from this experiment?

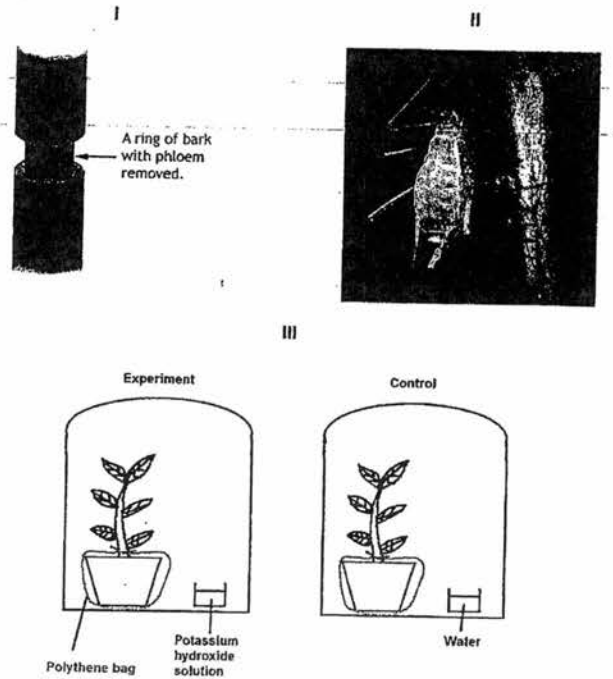
A At 100mM, the plant experienced a 6.25% decrease in the rate of transpiration.

B Increasing wind speed would cause the water bubble to move towards the left.

C The higher the concentration of ammonium nitrate, the higher the rate of transpiration.

D The higher the concentration of ammonium nitrate, the lower the rate of transpiration.

20 The diagrams below shows some examples of experiments used to demonstrate the different processes that occur in plant.



What process does each of the experimental set-up demonstrates?

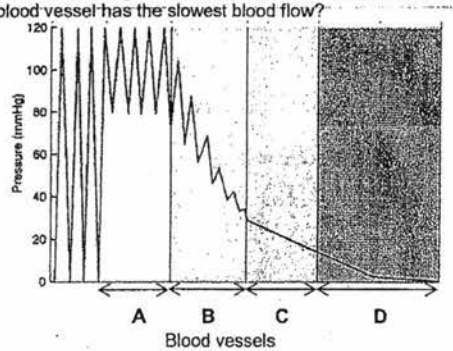
	I	II	III
A	photosynthesis	respiration	photosynthesis
B	translocation	respiration	transpiration
C	translocation	transpiration	photosynthesis
D	translocation	translocation	photosynthesis

21 Based on the information given below, deduce the blood type of Alfred.

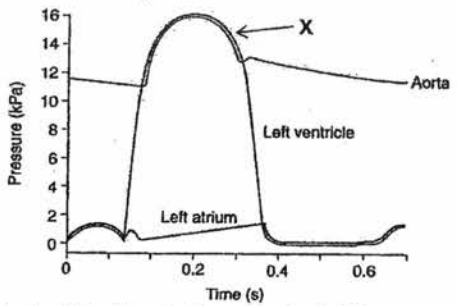
donor's blood type	what Alfred received from donor	results
O	blood plasma	agglutination of Alfred's red blood cells
B	red blood cells	agglutination of donor's red blood cell

A A
B B
C AB
D O

22 The graph below tracks the changes in blood pressure in different vessels of the systemic circulation. Which blood vessel has the slowest blood flow?



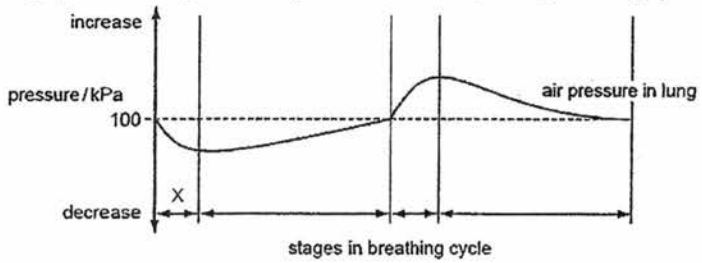
23 The following shows the pressure changes in the left side of the heart during one cardiac cycle.



Which of the following best describes what happens at point X?

	bicuspid valve	semi-lunar valve
A	close	close
B	close	open
C	open	close
D	open	open

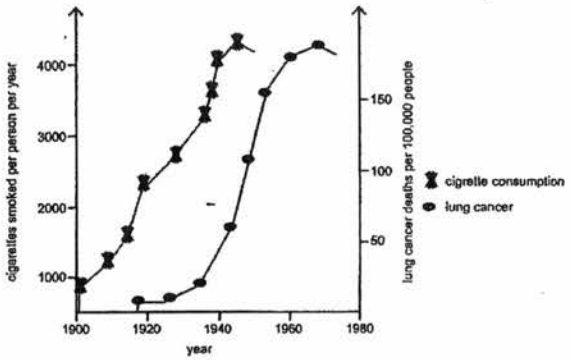
24 The graph shows changes in the air pressure within the lungs during a breathing cycle.



What happens to the diaphragm and internal intercostal muscles at stage X?

	diaphragm muscles	internal intercostal muscles
A	contract	contract
B	contract	relax
C	relax	contract
D	relax	relax

25 The graph below shows the relationship between cigarette consumption by men and lung cancer incidence in men.



What conclusions on the effects of smoking can you draw from this graph?

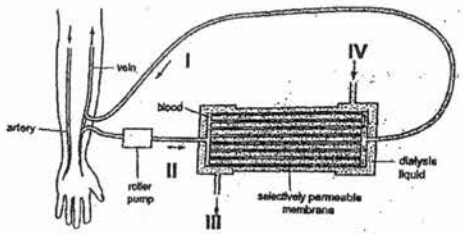
A Lung cancer does not develop immediately from smoking.

B Presence of tar in cigarettes causes uncontrolled cell division which increases risk developing lung cancer.

C The higher the number of cigarettes smoked per year, the more likely one will die from lung cancer.

D The number of cigarettes smoked per person per year has increased drastically from 1900 to 1980.

26 The diagram shows the flow of blood and dialysis fluid though a kidney machine.

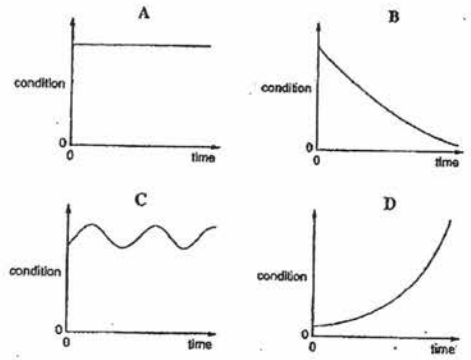


Four samples of liquids (**I – IV**) were drawn from different parts of dialysis machine.

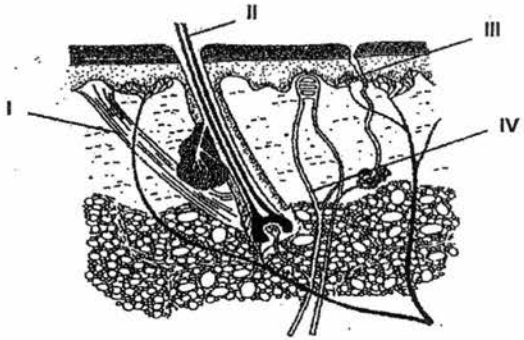
Which liquids contain the least and highest concentration of urea?

	least	most
A	I	II
B	I	III
C	IV	II
D	IV	III

27 The graphs show how four different conditions in the body may change with time. Which of the graphs depicts homeostasis which occurs in our body?



28 The diagram below shows a section through the skin.



A woman went out in the sun for a while and her face became flushed.

Which of the above structure(s) played a role in her face becoming flushed?

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

29 Which of the following corrective mechanism would restore the body's original condition?

	stimulus	arterioles	shunt vessels	sweat glands
A	temperature above norm	constricts	constricts	less active
B	temperature above norm	dilate	constricts	more active
C	temperature below norm	constricts	dilate	more active
D	temperature below norm	dilate	dilate	less active

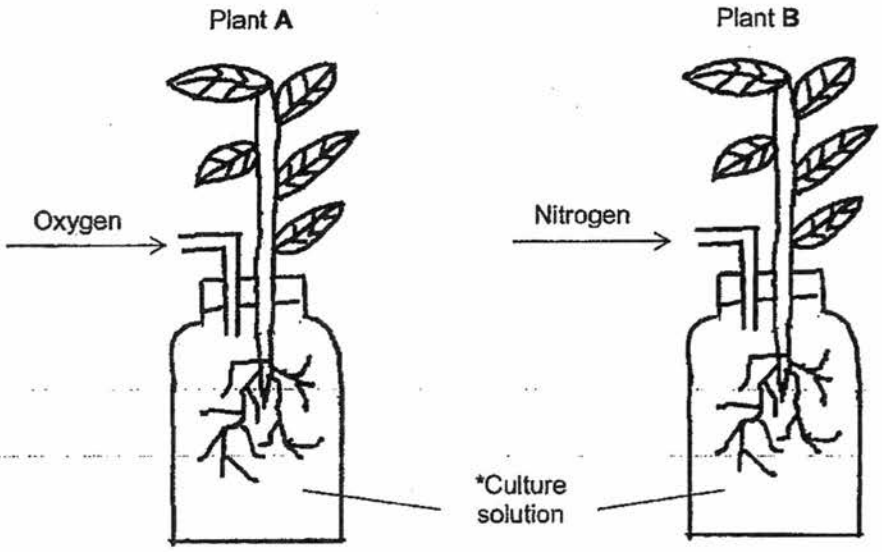
30 Which of the following processes is **not** directly controlled by negative feedback?

A absorption of glucose through the villi
B absorption of water through the walls of collecting duct
C maintenance of constant body temperature
D regulation of blood glucose concentration

FUHUA SECONDARY SCHOOL SECONDARY THREE BIOLOGY 5158	END-OF-YEAR EXAMINATION 2016	
	Class	Index Number
Candidate Name _____		

Section B: Structured Questions (40 marks)
Answer **all** questions in the spaces provided.

1 In an experiment, two identical plants were grown in a sunny environment and given the same culture solution. Oxygen was supplied to one plant while nitrogen was supplied to the other as shown in Fig. 1.1.



*culture solution contains all the ions necessary for plant growth dissolved in boiled water.
Fig. 1.1

Using the radioactive form of an ion, the rates at which it is absorbed from the culture solution by both plants were measured and recorded in Fig. 1.2.

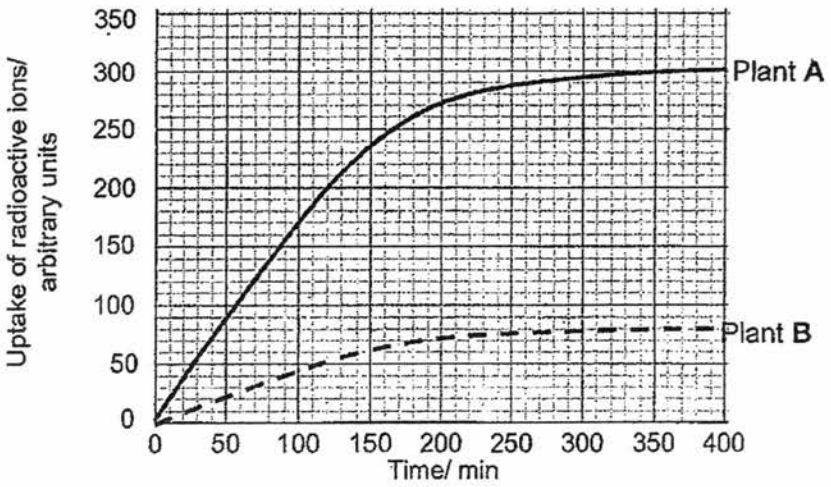


Fig. 1.2

(a) **(i)** Calculate the difference in uptake of radioactive ions between plants A and B after 6 hours.

..... [1]

(ii) Explain the difference in uptake between the two plants.

.....

.....

.....

.....

..... [2]

(b) Explain why it was necessary to use boiled water for the culture solution.

.....

..... [1]

(c) Describe how xylem is adapted for its function.

.....

..... [1]

[Total: 5]

2 Browning of the cut surface of some fruits and vegetables is due the presence of plant enzyme, polyphenol oxidase, which catalyses the reaction between colourless polyphenols and molecular oxygen to form brown complexes called melanins.

An experiment was carried out to investigate the effect of pH on the action of polyphenol oxidase. Details of the experiment are shown in Fig. 2.1.

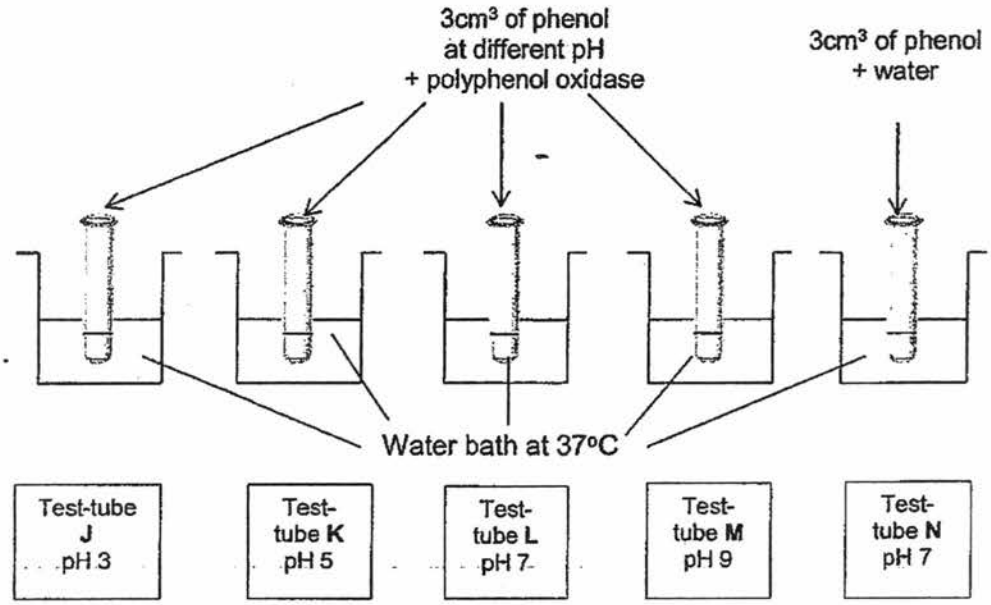


Fig. 2.1

(a) (i) Explain why the test-tubes were all placed in a water bath.

.....

..... [1]

(ii) State the purpose of test-tube **N**.

.....

..... [1]

(b) After 15 minute, a colorimeter is used to measure the absorbance of light by the solutions in test-tubes **J – N.** The higher the absorbance of light, the darker the solution is (i.e. solution is more brown). Table 2.1 shows the colorimeter reading for each of the solutions.

Table 2.1

test-tube	J	K	L	M	N
relative absorbance of light/ arbitrary units	0.01	0.34	0.98	0.30	0.01

Based on the results shown in Table 2.1, explain how the actions of phenol oxidase may be affected by pH.

.....

.....

.....

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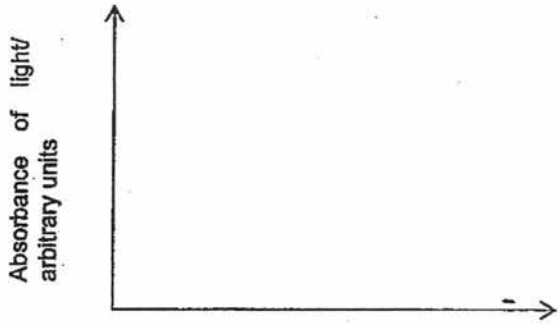
..... [4]

(c) **(i)** Suggest how the above experiment may be modified to investigate the effects of temperature on the action of phenol oxidase.

.....

..... [1]

(ii) On the graph below, draw the expected results of the experiment in (c)(i).



[1]

[Total: 8]

3 Fig. 3.1 shows the cross-section through a leaf of a plant

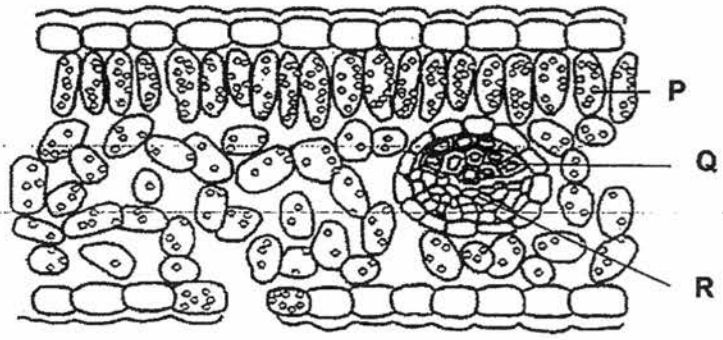


Fig. 3.1

(a) (i) State one difference between structures **P** and **Q**.

.....

..... [1]

(ii) Describe how structure **R** is adapted for its function.

.....

.....

.....

..... [2]

(b) The plant was exposed to carbon dioxide concentration of 0.03%. The size of stomata opening on the plant at different light intensity was measured at a constant temperature of 30°C. The results of this experiment were plotted on Fig. 3.2.

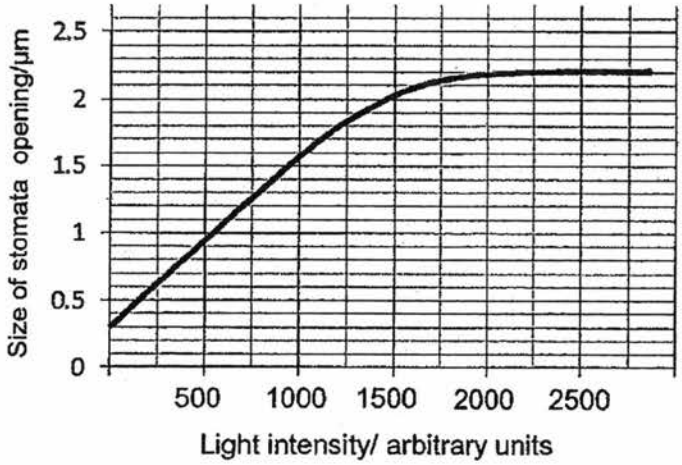


Fig. 3.2

(i) With reference to Fig. 3.2, describe the relationship between light intensity and stomatal aperture.

.....

.....

.....

..... [2]

(ii) Explain how light intensity affects size of stomata opening.

.....

.....

.....

.....

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.....

.....

..... [3]

(c) State and explain how the increase in atmospheric temperature may affect rate of transpiration and size of stomata opening.

.....

.....

.....

..... [2]

[Total: 10]

4 Fig. 4.1 shows the percentage of energy released by aerobic and anaerobic respiration during races run by athletes over different distances.

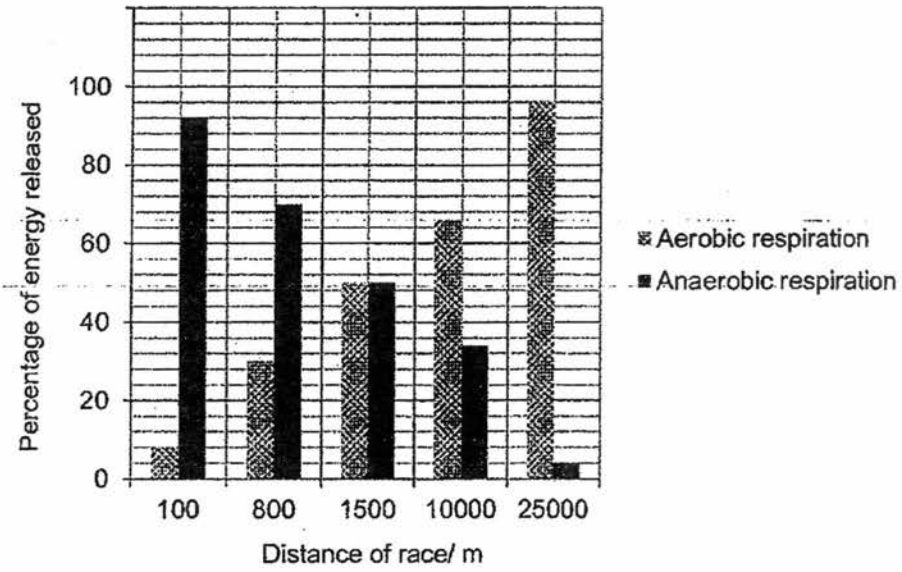

Fig. 4.1

(a) **(i)** With reference to Fig. 4.1, describe the difference in percentage of energy released by anaerobic respiration for 100m and 25000m race.

.....

..... [1]

(ii) Explain for the relationship between the percentage of energy released by anaerobic respiration and the distance of a race.

.....

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..... [3]

(b) Fig. 4.2 shows the changes in lung volume of an athlete before, during, and after his exercise.

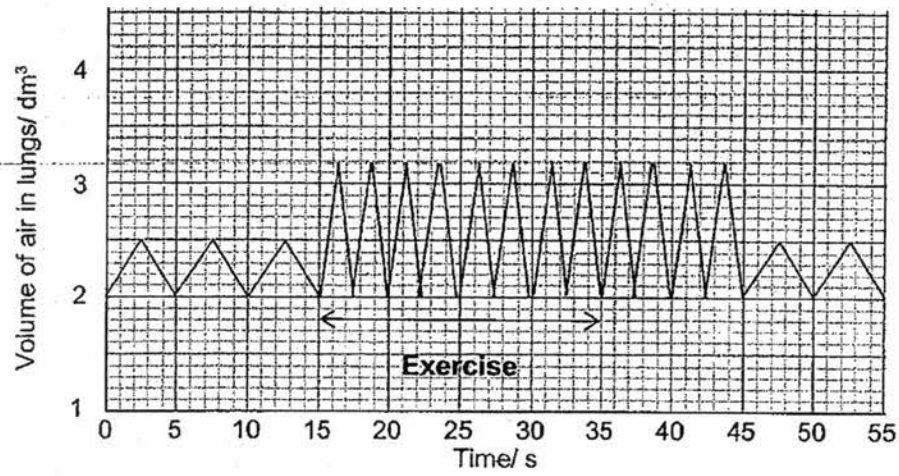

Fig. 4.2

(i) Calculate the number of breath per minute that the athlete took when at rest and while exercising. Show your working.

Number of breath taken at rest: .....

while exercising: ..... [1]

(ii) Explain for the difference in the number of breath taken at rest and while exercising.

.....

..... [1]

(c) Explain why the volume of air in the lungs remains high in the ten minutes following the end of the exercise.

.....

.....

.....

..... [2]

[Total: 8]

5 Some fluids (**X** and **Y**, **Z**) were extracted from three different parts of a nephron and tested for the presence of glucose and proteins. The results of the test are recorded in Table 5.1.

(a) Describe how Benedict's test is conducted.

.....

.....

.....

..... [2]

(b) Fig. 5.1 shows a nephron and the region where liquid X was extracted from.

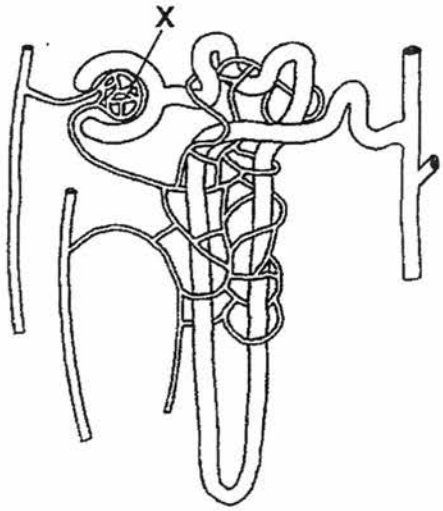

Fig. 5.1

(i) Based on the information obtained from Fig. 5.1, complete Table 5.1. [1]

Table 5.1

liquid	Benedict's test	biuret test
X		
Y	brick-red precipitate	blue solution
Z	blue solution	blue solution

(ii) On Fig. 5.1, label the regions where fluids **Y** and **Z** may be extracted from a healthy person. [1]

(c) With reference to Table 5.1, describe and explain for

(i) the biuret test result for liquid **Y**.

.....

.....

.....

..... [2]

(ii) the difference in Benedict's test results for liquids **Y** and **Z**.

.....

.....

.....

.....

.....

..... [3]

[Total: 9]

Section C: Free Response Questions (30 marks)
Answer **three** questions.
Question 8 is in the form of an **EITHER/ OR** question.
Only **ONE** part should be answered.

6 A two-day study was conducted to examine the effect of consuming a dilute alcohol solution (weak beer) on urine production in healthy individuals.

In the evening, two groups of ten volunteers emptied their bladders and completed an intermittent exercise protocol in hot and humid conditions to dehydrate. They were then fed the same meal and given equal volumes of water to drink for rehydration.

In the following morning, they were each given 1L of beer to drink. Group A was given beer that was alcohol-free, while Group B was given beer which contains 4% alcohol.

Their urine output was then measured hourly for the next 5 hours and recorded in Table 6.1.

Table 6.1

time after drink ingestion/ min	average urine output/ cm^3	
	group **A**	group **B**
60	600	650
120	330	420
180	200	270
240	150	180
300	80	90

(a) Plot the data from Table 6.1 in the graph below. [4]

(b) Alcohol affects the production of anti-diuretic hormones (ADH).

(i) With reference to Table 6.1, describe and explain the effects of alcohol consumption on urine production in healthy individuals.

.....

.....

.....

.....

.....

..... [3]

(ii) Describe other short-term effects of excessive alcohol consumption on the body.

.....

..... [2]

(c) Explain why

(i) groups of 10 volunteers rather than individuals were used in this investigation.

.....

..... [1]

(ii) the volunteers must first dehydrate themselves and be given the same volume of water to drink before the investigation.

.....

..... [1]

[Total: 11]

7 Afibrinogenemia is a congenital disorder that affects the production of plasma protein, fibrinogen. Patients with afibrinogenemia have fibrinogen levels that are below 0.2g/L. Healthy individuals have fibrinogen levels that are between 2 – 4g/L.

(a) Describe the synthesis and transport of fibrinogen from the liver cell into the blood plasma.

.....

.....

.....

.....

.....

..... [3]

(b) Using the information given above, explain how afibrinogenemia may affect a person when he/ she suffers a cut.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(c) Thrombophilia is a medical term that describes a state in which the blood has an increased tendency to clot.

Suggest how thrombophilia may affect a person's heart.

.....

.....

.....

..... [2]

[Total: 9]

8 EITHER

(a) With reference to **named** structures, describe how heart muscle cells obtain amino acids from a piece of meat.

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.....

..... [8]

(b) Describe the fates of amino acids in the body.

.....

.....

.....

..... [2]

[Total: 10]

8 OR

(a) Compare photosynthesis and respiration.

.....

.....

.....

..... [2]

(b) Describe how one directional flow of blood from legs to lungs is ensured.

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..... [8]

[Total: 10]

End of Paper

Fuhua Secondary School
5158 Biology (SPA)
End of Year Examination
2016
Answer Scheme

Section A: Multiple Choice Questions (30 marks)

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

Section B: Structured Questions (40 marks)

1 a i (300 – 80 = 220 arbitrary units)
Plant A absorbed 220 arbitrary units of ions more than Plant B. [1]

Note:
- Deduct ½ mark if no units were given.

ii [2]
- mitochondria in the root hair cells of plant A is able to
- carry out aerobic respiration
- to release energy
- For active transport of the radioactive ions
- against the concentration gradient
- In contrary, root hair cells of plant B absorb the radioactive ions by diffusion
- while root hair cells of plant A absorb radioactive ions by both diffusion and active transport.

@ 0.5 marks each; max. 2 marks

Note:
- Reject: Plant B has less active transport as nitrogen is given which results in decrease oxygen concentration. This is not true. There is an absence of oxygen in the culture solution for plant B.
- Some candidates were confused about the question and explain how water is taken up by active transport.
- Phrasing error includes "Oxygen oxidises glucose".
- A significant number of candidates left this question unanswered.

b The water is boiled to remove dissolved gases (e.g. oxygen) [1]

Note:
- This question was generally badly performed. Most candidates assumed that the boiling of water was to denature enzymes or kill microorganisms that were present in the culture solution.

c [1]

Inner walls of xylem are thickened with lignin.	Provide mechanical support the plant and prevent collapse of vessel
Hollow lumen, without protoplasm/ cross wall OR made up of dead cells, does not have protoplasm/ cross wall	Absence of protoplasm and cross-walls reduces resistance to water flow in the xylem

- @ any adaptation with correct function – 1 mark; otherwise ½ mark for stating structural adaptation.
- accept any other possible answer

Note:
- This question was well-answered. Most students gave more than adaptation and function.

2 a i Ensure that the experiment occurs at an optimum temperature. [1]
OR
Ensure that temperature is kept constant across all the test tubes, throughout the experiment.

Note:
- Generally well-answered.

ii A control to show that the formation of brown complex is due to the reaction presence of polyphenol oxidase which catalyses the reaction between phenol and molecular oxygen. [1]

Note:
- Badly performed. Most candidates were unsure of the its function as a control. Common responses include:
  - "It acts as a control to show how enzyme is affected by pH"
  - "It acts as a control to show that the rate of reaction is increased by enzyme"
  - "It acts as a control to show that enzyme affects the reaction" without further elaboration of how the enzyme affects the reaction.
  - "It acts as a control to compare results with the other test tubes"
- A handful of candidates simply stated that test tube N served as a control, without further elaboration.

b [4]
- Polyphenol oxidase has an optimum pH of pH 7.
- Relative absorbance of light of 0.98 arbitrary units
- is the highest at pH 7. Hence, more brown complexes are formed.
- As the pH of the solution becomes more acidic or alkaline/ falls below or above 7,
- the rate of activity of polyphenol oxidase/ the relative absorbance of light decreases (or use specific date to explain this phenomenon)
- as pH falls away from optimum pH/ extreme pH changes, enzyme polyphenol oxidase begins denature
- 3D shape of active site is altered
- Shape of active site is no longer complementary to shape of substrate
- hence, substrate phenol is unable to bind to the active site.
- Decreased formation of enzyme-substrate complex.

@0.5 marks each

Note:
- Candidates commonly explain the relationship between pH and enzyme activity using the explanation of effects of temperature on enzyme activity. Hence, most candidates

			would erroneously state that increase in pH from 3 to 7 would lead to higher rate of enzyme action due to increase in kinetic energy and increase frequency of effective collision. • Most candidates recognise that beyond pH 7, the enzymes had denatured, but were unable to make such reference to the decrease in enzymatic activity for pH below 7. Candidates should avoid use of terms such as "after" pH 7. • A significant number of candidates failed to note the question prompt and went on the give lengthy description on the changes in enzymatic activity rather than the explaining for these changes. • Some candidates did not make any reference to the given data. • A significant number of candidates did not make reference to the change in SHAPE of ACTIVE SITE and may have simply state that the active site changed or the shape of the enzyme changed. • An expression error that was commonly made: "enzyme action increase/ decrease". However, it should be "RATE of enzyme action increase/ decrease."	
	c	i	• Test-tubes should have the solutions of the same pH of 7. • Test-tubes should be placed in water bath of different temperatures/ give example to show the idea of different temperature e.g. 0°C, 20°C, 40°C, 60°C @ 0.5 marks each Note: • Generally well-answered.	[1]
		ii	• Graph should be asymmetrical Note: • Some candidates had confused between the pH graph and temperature graph. • A significant proportion of students had drawn a symmetrical graph or failed to ensure a sharp drop in enzyme activity when temperature increases beyond the optimum temperature.	[1]
3	a	i	• Structure P contains (any named cellular structure e.g. nucleus, mitochondria, chloroplasts) than structure Q. • Structure Q is lined with lignin while structure P is not. • Structure P is a living cell while structure Q is made up of dead cells. @any one of the above, 1 mark; accept any other possible answers. Note: • Generally well-answered.	[1]
		ii	• Structure R has many mitochondria • in the companion cells for • active transport of • sucrose into the sieve tube elements to be transported. OR • Pores present in • sieve plates • allow rapid transport of sucrose and amino acids • through the sieve tubes OR	[2]

			• Absence of central vacuole, nucleus, and most organelles • In the sieve tubes elements • Reduces resistances (Reject: without resistance) • to transport of sucrose and amino acids • Sieve plates prevent the sieve tube elements from bursting. Note: • Generally well-answered. Most candidates gave more answering points than was required. • A number of students had incorrectly identified structure R to be the xylem. • Some candidates may have erroneously pointed out that there is active transport of glucose into the phloem (where it would be converted to sucrose). Note that sucrose is the transport carbohydrates in plants. • Some candidates did not identify the structures that made up R and assumed that R was solely the sieve tube elements. Thus, these candidates would have made an error by stating that companion cells are located next to R/ the phloem.	
	b	i	• As light intensity increases from 0-2000 arbitrary units, the size of stomata opening increases from 0.3-2.2μm. • When light intensity increases beyond 2000 arbitrary units, the size of stomata opening remains at 2.2μm @ 1 mark per point; no data given, max. 1 mark Note: • Quote data wrongly/ no units, deduct ½ mark • Data on light intensity and size of stomata opening must be given. Some candidates only made reference to one of these. • Some candidates failed to state the relationship between light intensity and size of stomata opening when light intensity increases beyond 2000 arbitrary units.	[2]
		ii	• As light intensity increases until 2000μm, rate of photosynthesis in guard cell increases and more chemical energy is available OR More sunlight is absorbed by guard cells and converted into chemical energy • More glucose is produced during photosynthesis OR More chemical energy is used to pump potassium ions (K +) • into the guard cells from neighbouring epidermal cells. • Water potential of guard cells is lowered. • Water from neighbouring epidermal cells moves into the guard cells by osmosis • When more water moves in to the guard cell, turgidity of guard cells increases and causes them to become more swollen. • The guard cells have a thicker cell wall on the side around the stomatal pore. This causes the swollen guard cells to become more curved and the stoma open wider. OR Uneven expansion of cellulose cell wall of guard cells causes stomata to open wider.	[3]

- When light intensity increases beyond 2000μm, light intensity is no longer the limiting factor/ Concentration of carbon dioxide or temperature may be the limiting factor affecting rate of photosynthesis.

@0.5 marks each; max. 3 marks.

Note:
- Candidates showed a general lack of understanding on the causes affecting the size of stomata opening. A significant proportion of candidates explained that the increase in rate of photosynthesis led to an increase need for carbon dioxide/ oxygen production which led to the increase in size of stomata so as to allow increase diffusion of carbon dioxide into the leaf/ diffusion of oxygen out of the leaf. Others assume that increase in light intensity meant an increase in temperature and hence increase in evaporation of water and stomata opens to release the accumulated water vapour.
- Candidates commonly made this error in expression by stating that water enters the stomata and made it turgid. Stomata are just pores!
- A number of candidates went on to elaborate that the increase in glucose production led to increase rate of aerobic respiration for active transport. This is incorrect.

	c		• Increasing the atmospheric temperature would lead to increase in rate of transpiration. • Idea that more water is lost e.g. water is lost excessively from guard cells/ more water evaporates from mesophyll cells which causes water to be drawn from guard cells. • This causes guard cells to become flaccid and close • Stomatal aperture decreases as atmospheric temperature increase. Note: • A significant proportion of candidates were unable to answer to this question. These candidates had an impression that increase in rate of transpiration led to increase in size of stomata opening in order to allow the water vapour to diffuse out of the leaves. • Other candidates explained that size of stomata opening would decrease in order to prevent water loss without reference to its mechanism (i.e. increase water loss from guard cells → flaccid guard cell). Following from this, these candidates went on to explain that due to closure of stomata, rate of transpiration decreases (even though, in some cases, they may have explained that rate of evaporation of water from mesophyll cells would have increased. Thus, their answers were contradictory.) • Most students tend to over-elaborate, and described the loss of water in great details. • Some students failed to answer to the question and draw links to the size of the stomata opening, and instead stated simply that the stomata would close.	[2]
4	a	i	At 100m, the percentage of energy released by anaerobic respiration of 92% is higher than the percentage of energy released by anaerobic respiration for 25000m of 4%. @ 0.5 marks for data and 0.5 marks for highlighting the difference Note: • Candidates generally failed to describe the difference using comparative terms i.e. higher/ lower • Some candidates did not read the questions carefully and stated the difference between energy released by aerobic and anaerobic respiration instead. • Some candidates described the change in the percentage of energy released instead of the difference (e.g. percentage of energy released by anaerobic respiration decreased from 100m to 25000m race)	[1]
		ii	• For 100m race (short distance race), an athlete sprints and have to run very fast in a short period of time. • As a result, muscles need to contract more vigorously in short distance races • Increase energy demand over a short period of time • Increase demand for oxygen by muscle tissues • However, the breathing/ heart rate are not fast enough • insufficient supply of oxygen to muscle tissues for aerobic respiration • Muscles carries out anaerobic respiration at an increased rate (to supply the extra energy needed) • Any ref. to opposite activity • In contrast, in a long distance race (25000m race), an athlete has to run at a relatively slower pace than in a short distance race over a longer period of time. • To prevent accumulation of lactic acid in the muscles which may lead to muscle fatigue and cramps. • Decrease energy demand over a short period of time • Lower demand for oxygen by muscle tissues • Breathing rate/ heart rate of athlete is fast enough • sufficient oxygen supplied to muscle tissues needed for aerobic respiration • Muscles carries out anaerobic respiration at an decreased rate (to supply the extra energy needed) • Any ref. to opposite activity Either one of the above columns @0.5 marks each; max. 3 marks Reject: • Energy released by aerobic respiration is insufficient. • Oxygen intake is insufficient Note: • Question is poorly answered. • Most candidates were vague in their answers. Reference to supply of oxygen TO THE MUSCLES was commonly missed. Most candidates would have simply explained that oxygen intake is insufficient. • Candidates have the misconception that anaerobic occurs more in sprints as there is a lower energy demand as compared to running long distance. Hence, long distance run would require more aerobic respiration since it releases higher amount of energy than anaerobic respiration. • Candidates still persist in writing the "production of energy" instead of "release of energy"	[3]
	b	i	• Breathing rate at rest = 1 breath every 5 seconds = 60/5 = 12 breath per minute • Breathing rate while exercising = 1 breath every 2.5 seconds = 60/ 2.5 = 24 breath per minute Note: • Generally well done. • Deduct ½ mark if there is no working.	[1]
		ii	• During exercise, (skeletal) muscles requires more oxygen for aerobic respiration to • release more energy (for increase muscle contraction) @1 mark each Note:	[1]

- Generally well done.
- It is insufficient to state that exercise results in an increase in demand in energy. Candidates must link oxygen intake with the release of more energy through aerobic respiration.

c [2]

- During the sprint, the body incurred an oxygen debt
- and accumulation of lactic acid (which was produced during anaerobic respiration)
- Oxygen is needed to convert lactic acid back to glucose/
  OR
  To oxidize lactic acid (into carbon dioxide and water)
- In the liver.

Note:
- Generally well done.
- Candidates often failed to state where oxidation of lactic acid occurs.

5 a [2]

- Equal volume) of Benedict's solution and liquid X.
- Shake the mixture well
- Heat the mixture in a boiling water bath (Reject: warm water bath/ boiling water/ heat the mixture)
- For 3-5min (Reject: a few minutes)

@ 0.5 marks each, max. 2 marks

Note:
- Generally well done.
- Some candidates mixed up the procedures for Benedict's test and Biuret's test.

b i [1]

Liquid	Benedict's test	Biuret test
X	Brick-red precipitate	Violet solution (Reject: purple solution)

Note:
- Generally well done

ii [1]

Y – bowman capsule
Z – any point between proximal convoluted tubule to collecting duct

Note:
- Generally well done
- Some candidates were unsure of where the Bowman's capsule is and may have drawn the arrows for Y at the start of the proximal convoluted tubule. Other candidates genuinely assumed that Y is found in the proximal convoluted tubule as they had assumed that glucose had not been completely reabsorbed.

c i [2]

- Proteins molecules are too large to pass through
- the partially permeable basement membrane
- of capillary walls of glomerulus/ glomerular wall
- Hence, liquid Y does not contain proteins and solution remains blue.

Note:
- Generally well-answered except for occasional misinterpretation of test results (e.g. Biuret test is blue, hence glucose is present)
- Instead of stating the conclusion that could be made from the results (e.g. absence of protein molecules), some candidates would [illegible]

negative. Such answer is vague and meaningless.

ii [3]

- Idea that glucose molecules/ reducing sugars are driven out of the glomerulus into the Bowman capsule
- During ultrafiltration
- Hence, liquid Y contains glucose and brick-red precipitate is formed.
- Selective reabsorption
- Of ALL glucose
- by active transport takes place
- at the proximal convoluted tubule
- Hence, liquid Z does not contain glucose and solution remains blue.

@ 0.5 marks each; max. 3 marks

Note:
- Generally well done. Most candidates gave more than the required amount of points for the 3 marks.

Section C: Free Response Questions (30 marks)

6	a		• **P:** All points correctly plotted [-1/2 if cross is too big] • **A:** Both axes correctly labelled with correct units [x-axis should be time/ min (0.5); y-axis should be urine output/ cm^3 (0.5) • **L:** Best-fit line (0.5 for each graph) • **S:** Appropriate scale with graph covering more than half the graph paper (0.5 for each axis)	[4]
			Note: • -1/2 if both graphs are not labelled. • The cross "x" indicated on the graph should be small (within 1 small grid). • No short form for the axes labelling (e.g ave X average ✓) • Inappropriate scale was sometimes chosen. E.g for x-axis: those who chose 50, 100, 150, 200, etc, the graph will be <50% of the graph size given. Scale chosen must allow one to accurately plot every data given and not an estimation of the plot.	
	b	i	• Consumption of alcohol results in the decrease in production of ADH by the pituitary glands • Cells in the walls of the collecting ducts are less permeable to water. • Less water is reabsorbed • from the collecting duct into the capillaries/ into blood/plasma • Hence, consumption of alcohol results in a larger volume of urine is produced in healthy individuals [Reject: lower amount of urine] @0.5 mark each, max. 2 • Reference to data in the table At 60 min, the average urine output of group B (given alcohol) of 645cm^3 is higher than the average urine output of group A (no alcohol) of 600cm^3 / As seen from Table 7.1, at 60 min, the average urine output of group B (given alcohol) is 45cm^3 higher than the average urine output for group A (no alcohol) [1].	[3]
			Note: • Poor answering skills resulted in many failing to achieve full credit. • "With reference to ...," students are expected to quote values (with units) from the data presented to them. • Avoid using vague description such as ...it will affect.... Students are expected to specify the direction clearly (e.g increase/decrease/more/less). • Avoid using "amount" – specify exactly what is measured e.g mass? volume? • Some candidates have the misconception that the intake of alcohol lowers blood water potential and leads to reabsorption of more water and less volume of urine produced. However, they failed to make use of their data to deduce the effect of alcohol on ADH. It is already shown that more volume of urine is produced in the presence of alcohol intake.	
		ii	• Blurred vision • Aggression/decrease self-control • Dizziness • Poor judgement • Poor muscular co-ordination • Slurred speech • Reduced self-control • Increase reaction time/ his reaction becomes slower *accept any other possible answers. @ 1 mark each, max. 2 marks Note: (1) failure to read question properly. While a wide range of impact for alcohol abuse is taught, students have to apply them accordingly to the context asked. In this question, the focus is on body/health. Impacts related to social are rejected. More than 1 effect is required by the question. (2) Some wrote "Brain functions slower". Candidates are required to specify an aspect of the brain functions that are affected.	[2]
	c	i	To increase (statistical) reliability of results *Note:* *Having a larger sample size is not about getting the accuracy, rather to improve the reliability of the results collected.*	[1]
		ii	To ensure that any changes to urine production is due to effects of alcohol *Note:* *Poorly done. Most were unable to link the purpose to the measurement required. Many wrote about ensuring equal water potential in all volunteers.*	[1]
7	a		• Ribosomes attached to the rough endoplasmic reticulum synthesize proteins such as fibrinogen. • Fibrinogen synthesized in the RER is packaged into small vesicles and are pinched off from RER. • These fibrinogen-containing vesicles fuse with Golgi apparatus (GA) and release fibrinogen into the GA. • Fibrinogen is sorted/processed/modified/packaged in the GA • Secretory vesicles containing these modified fibrinogen are pinched off from GA and transported to the cell surface membrane • These secretory vesicles fuse with the cell surface membrane @ 0.5 marks each, max. 3 marks Note: • *Candidates need to be more precise in their answer. E.g Protein synthesis is due to **ribosomes** which are on rER.* • *Many misinterpreted the questions and focus their answer on diffusion of fibrinogen from the cell into bloodstream. This is probably due to poor question reading. The portion on "describe the synthesis of fibrinogen" was neglected.* • *The ribosomes are bound to rER and not what some candidates wrongly suggested that they detach from rER and move to GA.*	[3]
	b		• Conversion of fibrinogen to fibrin • ref to insoluble fibrin • Catalysed by thrombin • Insoluble fibrin form a mesh of threads on top of platelet plug • Which traps more blood cells • strengthen the platelet plug • Patients with afibrinogenemia produce a much lower amount of fibrinogen than healthy individual (0.2g/ L compared to 2-4g/ L) (idea that there is lesser fibrinogen) • Unable to effectively clot blood when there is a cut/longer time to clot/more susceptible to excessive blood loss/ bleeding/ bruising/ accept any other possible symptoms. @0.5 marks each Note: *Most candidates were able to describe the blood clotting process. However, candidates need to be selective in the answers given. The portion about thrombokinase is not relevant to the question.* *Common mistakes – wrong reaction (fibrin → fibrinogen) x ; wrong ref to the solubility for fibrinogen and fibrin! Since a mesh is formed, the product (fibrin) must be insoluble!* *Failure to link the blood clotting process to the disease result in partial credit. Majority wrote about what happens during clotting but did not state what will happen for a patient with afribrinogenemia.*	[4]
	c		• Coronary arteries may partially or completely clot, • which reduces blood flow to the heart muscles (cells/tissues). • Decreased amount of oxygen and glucose supplied to tissue cells for aerobic respiration. • Reduced aerobic respiration to release energy for activity of heart muscle cells[Reject: produce energy] • Heart muscle cells die/damaged • Results in heart attack/ angina/failure	[2]

OR

- Reference to blockage in artery
- resulting in heart muscle to work harder [Reject: faster]

@0.5 marks each; max. 2 marks

Note:
- *Poorly done. Reference to the heart was not made. Candidates often wrote about all other parts of the body except coronary artery. Some wrote about vein and capillaries but such answers were rejected as their impacts are significantly less severe than in arteries.*
- *It is wrong to say that heart pumps faster. When heart muscle does not receive sufficient oxygen and glucose, how is it possible for the heart to pump faster?*

8 EITHER

a [8]

- In the mouth
- meat is physically digested into smaller pieces
- by chewing/grinding
- Use of teeth
- In stomach
- pepsin digests proteins in meat into polypeptides (Reject: break down)
- In duodenum,
- trypsin breaks down the remaining proteins into polypeptides.
- erepsin breaks down polypeptides into amino acids
- In the ileum,
- amino acids are absorbed into blood capillaries in the villi
- by diffusion/ active transport
- amino acid is transported to the liver
- by the hepatic portal vein
- in the blood plasma/bloodstream
- Hepatic vein transports amino acids out of the liver to the heart
- Oxygenated blood and amino acids-rich blood returns to the heart from the lungs via pulmonary vein
- Oxygenated blood and glucose-rich blood is pumped out of the heart via the aorta
- and into coronary arteries which delivers glucose molecules to the heart muscle cells.

@0.5 marks each; max 8 marks

Note:
- *It is evident that candidates did not learn their mistakes during MYE. Do not use break down for chemical digestion! Those who used break down repeatedly in this exam were only penalised once.*
- *Once again, poor question reading skill results in partial credit awarded. Candidates failed to notice that a piece of meat was given and they are required to describe the entire process from ingesting the meat till absorption and eventually reaches the heart muscle cells.*
- *Some had the wrong concept that substances such as oxygen, glucose can diffuse from the chambers (atrium/ventricle) into the heart muscle. The heart muscle cells can only receive them via coronary arteries!*
- *Some missed out the liver in their description. The digested products have to pass through the liver before going to the heart.*

b [2]

- Amino acids may be used by tissue cells to build new protoplasm for growth/cell division [Reject: Repair cell]
- to make enzymes/hormones
- Excess amino acids are converted to urea
- in the liver
- By deamination
- Urea is transported to the kidney to be excreted

@0.5 marks each; max.2 marks

Note:
Damaged cells are not repaired but replaced! Hence, cell repair is rejected. Majority commented about the deamination process only.

8 OR

a [2]

Similarities (max 1)	
Both involves the exchange of gases	
Differences (max 1)	
Photosynthesis	**Respiration**
Occurs in the chloroplasts	Occurs in the mitochondria
Anabolic reaction	Catabolic reaction
converts light energy → chemical energy	chemical energy → heat energy
use CO_2 and water	uses glucose and oxygen (if aerobic)
Products: $O_2 + C_6H_{12}O_6$	Products of aerobic respiration: $CO_2 + H_2O$
Occurs only in plants and photosynthetic organisms e.g. photosynthetic bacteria	Occurs in all living organisms

*accept any other possible answers

@1 mark each; max. 1 mark for similarities, 1 mark for differences.

Students must compare point by point.

Note:
- *When asked for comparison, both similarity and difference are to be stated. The differences given must be matching.*
- *In subsequent exam, please avoid describing photosynthesis and respiration separately. Such answer will gain NO CREDIT!*
- *E.g Photosynthesis occurs in chloroplasts, converts light energy to chemical energy and converts carbon dioxide and water to glucose and oxygen. Respiration occurs in mitochondria, and uses glucose and oxygen to produce carbon dioxide and water.*

b [8]

- Presence of valves in veins in legs
- Prevents backflow of blood back to legs
- Skeletal muscles pump blood up the legs

- Blood from the legs enters the heart via vena cava
- Into right atrium
- **Muscles** in Right atrium contracts, pressure in right atrium higher than pressure in right ventricle
- Tricuspid valve forced/pushed open
- Blood flows from right atrium to right ventricle
- **Muscles** in right ventricle contracts, while right atrium relaxes
- Pressure in right ventricle greater than pressure in right atrium
- Tricuspid valve forced/pushed shut
- To prevent backflow of blood from right ventricle to right atrium
- **Muscles** in right ventricle contracts, pressure in right ventricle higher than pressure in pulmonary arteries
- Semilunar valves forced/pushed open
- Blood flows from right ventricles into pulmonary arteries and to the lungs
- When right ventricle relaxes, pressure in the right ventricle falls below pressure in pulmonary arteries
- Semilunar valves forced/pushed shut
- Preventing backflow of blood from pulmonary arteries to right ventricle.
- Reference to chordae tendineae and its function – prevent the valves from flipping inside out.

@0.5 marks each; max. 8 marks

Note:
- *State the action of the valve clearly – forced open/close. Avoid using blood flow through (named) valves.*
- *The sequence of events must be correct*

		• *Incomplete description* o *The event that causes the pressure change is also not written.* o *Pressure comparison was commonly missing in most scripts.* o *Specific function of the valves not written. E.g prevent backflow of blood from _____ to _____.* • *It was disappointing that some candidates are still having confusion with the heart structure. Some wrote the wrong valves, others wrote about the left side of the heart! Read the question. From legs to the lungs! Some quoted the wrong blood vessels involved. These are unacceptable mistakes.*	