Candidate Name _____	Class	Register Number

PEIRCE SECONDARY SCHOOL

DEPARTMENT OF SCIENCE

Second Semestral Examination for Secondary Three Express

Biology **5158**

Friday **14 Oct 2016** **1130 - 1330**

Additional materials:
OTAS paper

Time: 2 hours

INSTRUCTIONS TO CANDIDATES

Write your name, class and register number in the spaces provided at the top of this page and on all separate answer paper used.

There are **TWO PARTS** in this paper. All the questions in both **PART 1** and **PART 2** are compulsory.

PART 1 - consists of 30 multiple choice questions. Shade your answers on the OTAS sheet provided with a soft pencil.

PART 2 - **Section A** consists of 6 compulsory structured questions. Write your answers in the space provided on the paper.

PART 2 – **Section B** consists of 3 compulsory essay questions. Write your answers on the lines provided.

PARENT'S SIGNATURE

This paper consists of **25** printed pages
Setter: Mdm Yeong

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[Turn over

PART 1
Multiple Choice Questions [30marks]
Shade your answers in the OTAS sheet provided

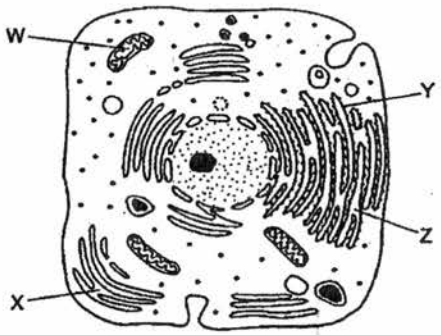
1 The table shows comparisons between a red blood cell and a root hair cell.

Feature number	Feature	Red blood cell	Root hair cell
1	Transports oxygen	Yes	Yes
2	Cytoplasm present	No	Yes
3	Large surface area to volume ratio	Yes	Yes
4	Nucleus present	No	Yes

Which comparisons are correct?

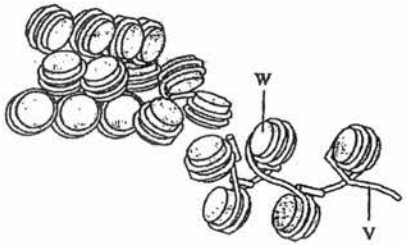
A 1, 2 and 3
B 1, 3 and 4
C 1 and 2 only
D 3 and 4 only

2 The diagram below shows a cell as seen under an electron microscope. What are the functions of the numbered parts in the cell?



	Aerobic respiration	Formation of polypeptides	Transport of proteins	Synthesis of fats
A	W	X	Y	Z
B	W	Y	Z	X
C	X	Z	W	Y
D	Z	W	Y	X

3 The diagram below shows part of a chromosome. The chromosomes comprise of two types of molecules, W and V.



What are the identities of these two molecules?

	W	V
A	DNA	protein
B	chromatin	protein
C	protein	DNA
D	protein	chromatin

4 A substance M found in apples causes them to turn brown when exposed to air. What would you do to determine if substance M is an enzyme?

A Boil the apples and see if they turn brown when exposed to air.
B Deprive the apples of oxygen and see if they turn brown.
C Soak the apples in an acidic or alkaline solution and see if they turn brown.
D Place apples in a container of pure carbon dioxide and see if they turn brown.

5 Which of the following shows the functions of water in the body?

key: √ = yes
× = no

	Regulation of body temperature	Helps to digest starch to maltose	Carry urea in the blood	Component of cytoplasm
A	✓	✓	✓	✓
B	✓	✓	×	×
C	✓	×	✓	✓
D	×	✓	✓	✓

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6 A student was asked to identify the two food substances in each of the three test tubes, X, Y and Z. The table below shows the results of the student's tests.

test-tube	reagent added to test-tube		
	Biuret solution	Benedict's solution	Iodine
X	violet	brick red precipitate	brown
Y	blue	Blue	blue-black
Z	violet	Blue	blue-black

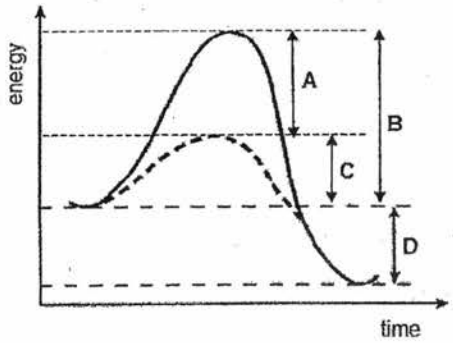
What conclusion is consistent with the results?

A Egg white and sucrose had been placed in tube X.
B Glucose and starch had been placed in tube X.
C Starch and sucrose had been placed in tube Y.
D. Maltose and starch had been placed in tube Z.

7 James has a damaged liver. Many functions of the body will be affected. However, there are some functions which will not be affected.
Which of the following function will **not** be affected?

A secretion of digestive enzymes
B production of bile
C formation of urea
D formation of glycogen

8 The graph shows changing energy levels during a reaction, with and without the presence of the enzyme specific to this reaction.
What is the activation energy of the reaction without the enzyme?

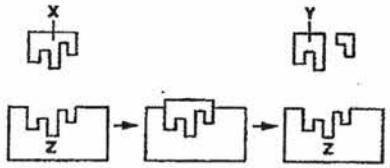


9 Which of the following correctly describes these terms: excretion, secretion and egestion?

1. Removal of urine in the kidney.
2. Getting rid of undigested wastes from the alimentary canal.
3. Movement of carbon dioxide from the blood capillaries to the alveoli.
4. Release of insulin from the pancreas.

	excretion	secretion	egestion
A	1	4	2
B	2	3	1
C	3	1	2
D	4	3	1

10 The diagram below represents a model of enzyme action.



Which of the following shows the correct identities of **X**, **Y** and **Z**?

	X	Y	Z
A	sucrase	glucose	sucrose
B	sucrase	sucrose	glucose
C	sucrose	glucose	sucrase
D	sucrose	sucrase	glucose

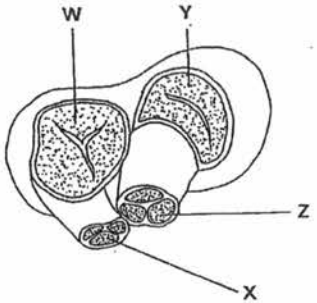
11 The following structures refer to the parts of a respiratory system of man

1) alveoli
2) larynx
3) bronchiole
4) trachea
5) bronchus

In which order would a molecule of carbon dioxide in the body leaves the body to enter the external environment?

A 1 – 3 – 5 – 2 – 4
B 4 – 2 – 5 – 3 – 1
C 1 – 3 – 5 – 4 – 2
D 2 – 4 – 5 – 3 – 1

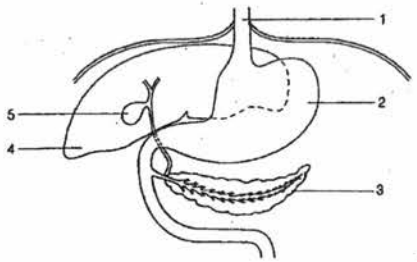
12 The diagram below shows a section through a mammalian heart showing the different valves.



Which of the following description about the position of the valves is correct?

	Valve Z	Valve X	Valve W	Valve Y
A	Between LA and LV	Between RA and RV	Between LV and pulmonary artery	Between RV and aorta
B	Between LV and aorta	Between RV and pulmonary artery	Between RA and RV	Between LA and LV
C	Between RA and RV	Between LA and LV	Between LV and aorta	Between RV and pulmonary artery
D	Between LV and pulmonary artery	Between RV and aorta	Between LA and LV	Between RA and RV

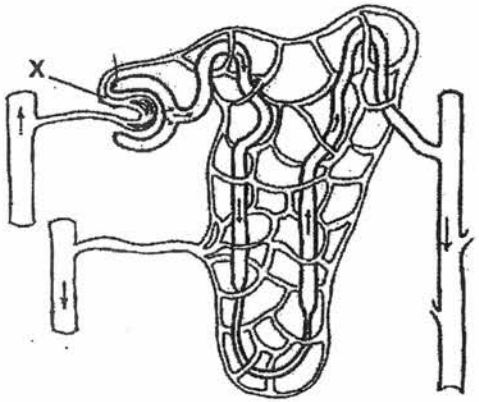
13 The diagram shows part of the human alimentary canal.



Which two structures produce substances involved in the digestion of proteins?

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

14 The diagram below of a mammalian nephron.



What happens if the diameter of the blood vessel is enlarged at X?

A More sodium will appear in the urine.
B Less glucose will appear in the urine.
C Water reabsorption will be decreased.
D Rate of urine production will be reduced.

15 Blood samples were taken from three veins in the body and the concentrations of carbon dioxide, oxygen and urea in each sample were measured. The results are shown in the table below.

Vein	Carbon dioxide concentration	Oxygen concentration	Urea concentration
1	43	34	0.8
2	48	35	6.8
3	33	90	5.2

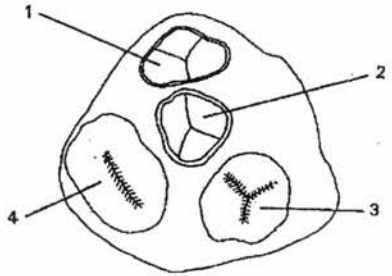
Which veins were sampled?

	Hepatic vein	Pulmonary vein	Renal vein
A	1	3	2
B	2	3	1
C	3	1	2
D	3	2	1

16 A drug has been found to inhibit the effects of antidiuretic hormone. What would the consequence of administering this drug to a healthy person be?

A A smaller volume of urine would be produced.
B More proteins would be present in the urine.
C The urine produced will be more concentrated.
D The person will become dehydrated.

17 The diagram below shows a transverse section of a mammalian heart.



What are the conditions of these valves during the diastole of the ventricles?

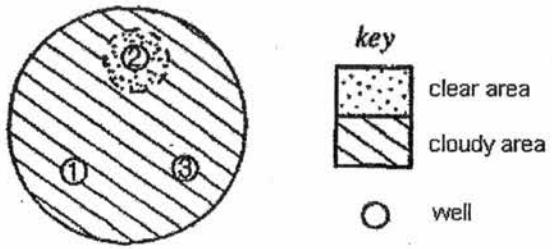
	Valve 1	Valve 2	Valve 3	Valve 4
A	Opened	Opened	Closed	Closed
B	Closed	Closed	Opened	Opened
C	Opened	Closed	Opened	Closed
D	Closed	Opened	Closed	Opened

18 A person with blood type A requires a blood transfusion. Which of the following blood types can he receive blood from?

1 blood type A
2 blood type B
3 blood type AB
4 blood type O

A 1 only
B 1 and 3 only
C 1 and 4 only
D All of the above.

19 Three wells were cut in agar jelly, which contained milk protein. Different solutions were placed in each well. The diagram shows the final appearance of the jelly.



Which solutions could have given the results shown?

	well 1	well 2	well 3
A	amylase	intestinal juice	boiled gastric juice
B	gastric juice	intestinal juice	amylase
C	boiled intestinal juice	amylase	gastric juice
D	intestinal juice	boiled gastric juice	amylase

20 Which of the following is the correct description of the different parts of the respiratory system during inhalation?

	External Intercostal muscles	Position of the ribs	Diaphragm	Shape of Diaphragm
A	Contract	Raised	Contract	Flattened
B	Relax	Lowered	Relax	Dome Shape
C	Relax	Raised	Relax	Flattened
D	Contract	Original position	Contract	Dome Shape

21 What do the cilia do in the bronchi of the lungs?

	trap bacteria	*move mucus out of the lungs*	
A	√	√	Key
B	√	X	√ = function of the cilia
C	X	√	X = not a function of the cilia
D	X	X	

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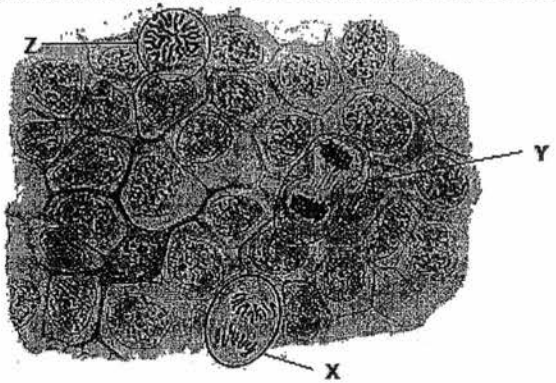
22 What produces identical cells as a result of mitosis?

A Half the chromosome number goes into each of the daughter cells.
B The cytoplasm is exactly halved to form the two daughter cells.
C The DNA is exactly copied into the two daughter cells.
D The organelles are equally divided between the two daughter cells.

23 The diagram below shows animal cells undergoing various stages of mitosis.



Identify the stages of mitosis occurring in the cells labelled X, Y and Z.

	X	Y	Z
A	anaphase	prophase	interphase
B	anaphase	telophase	prophase
C	prophase	metaphase	telophase
D	prophase	anaphase	telophase

24 In some dragonflies, the females have two X chromosomes while the males have one X chromosomes and no Y chromosomes. If the normal diploid number in a dragonfly is 16, what would be the number of autosomes in the body cells of the male and female flies?

	Male dragonflies	Female dragonflies
A	14	14
B	15	16
C	14	15
D	13	14

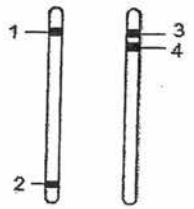
25 A man with blood group A and his wife with blood group O, had two sons, both of blood group A. The man concluded that he must be homozygous for the gene I^A, since he thought half his children would be of blood group O if he were heterozygous. His conclusion was not correct because of the reason below.

A His wife might have been heterozygous.
B Sons always have the same blood group as the father.
C Genetic ratios are unreliable for small numbers.
D The F1 ratio for a heterozygous father and group O mother is 3 Group A:1 Group O

26 In cockroaches, a chromosome may carry a recessive allele, which causes death if present in a homozygous animal. Two cockroaches carrying this allele were mated. Which proportion of their **living** offspring will carry this allele?

A 0%
B 25%
C 50%
D 67%

27 The diagram below represents a pair of homologous chromosomes showing four regions where genes are found. Which pairs are alleles?



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

28 Pure breeding pea plants with green pods are crossed with pure breeding pea plants with yellow pods. All the F1 generation have green pods. Plants from F1 generation are allowed to be interbred.
What colour are the pods of the F2 generation?

A 100% green
B 100% yellow
C 50% green : 50% yellow
D 75% green : 25% yellow

29 The following table shows the base ratios for DNA collected from four different animal species. Which species likely contains DNA with an adenine concentration of 21.1%

Species	Cytosine	Guanine	Thymine
A	31.6	32.4	18.0
B	29.6	29.2	20.8
C	24.8	24.9	25.4
D	32.1	31.9	17.6

30 The following are various steps in the process of gene expression.

1 The template strand is transcribed.
2 Peptide bonds are formed.
3 mRNA is transported through a nuclear pore into the cytoplasm.
4 The ribosome detaches from the mRNA.
5 tRNA anticodons undergo base pairing with mRNA codons.

What is the correct order of these steps?

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

End of Part 1

Class	Register Number

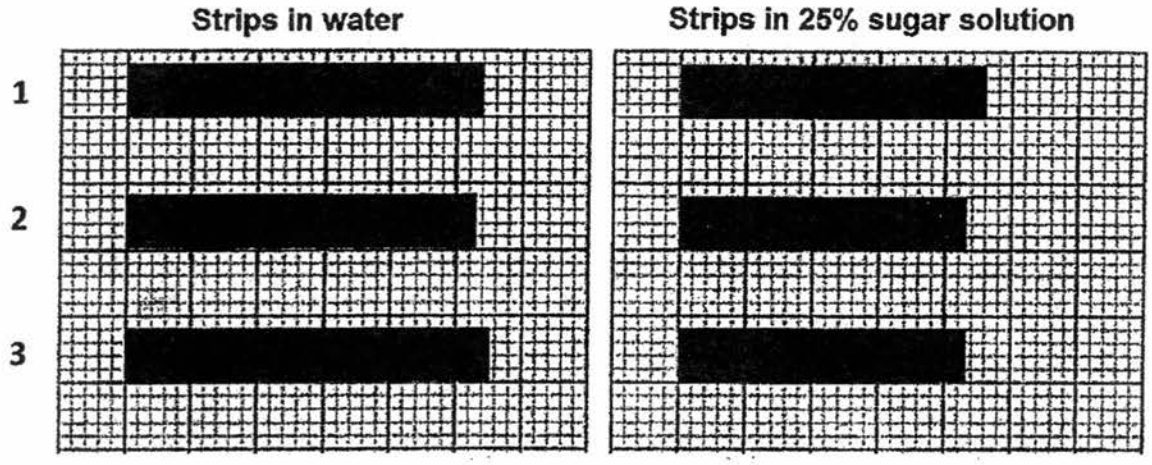
Candidate Name _____

Second Semestral Examination for Secondary Three Express

BIOLOGY 5158 PART 2
Section A [40marks]
Answer **all** questions. Write your answers in the spaces provided.

1 Six strips of potato tissue, each 5.0 cm long, were obtained from a potato. Three strips were placed in water and another three were placed in 25% sugar solution.

After 1 hour, the cylinders were removed from the solutions, blotted dry and outlined onto graph paper as shown below.



(a) Record the new lengths of the strips (in 25% sugar solution) in the table below, then calculate the average length of the strips. [2]

Cylinder	Length of strip in water / cm	Length of strip in 25% sugar solution / cm
1	5.4	
2	5.3	
3	5.5	
Average length	5.4	

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(b) Explain why the strips change in length in

(i) water. [2]

_____

_____

_____

_____

_____

(ii) 25% sugar solution [2]

_____

_____

_____

_____

_____

(c) Which other measurements could have been taken to show that the strips had changed during the experiment? [1]

_____

[Total : 7m]

2 Two students, Andrew and Matt, ran a 1000 metres race. Before the race, when they were both resting, Andrew's pulse rate was 83 beats per min while Matt's pulse rate was 70 beats per min. Andrew and Matt completed the race using the same duration of time.

Immediately after the race, their teacher measured and recorded their pulse rates at an interval of 2 minutes. **Fig. 2** shows the results.

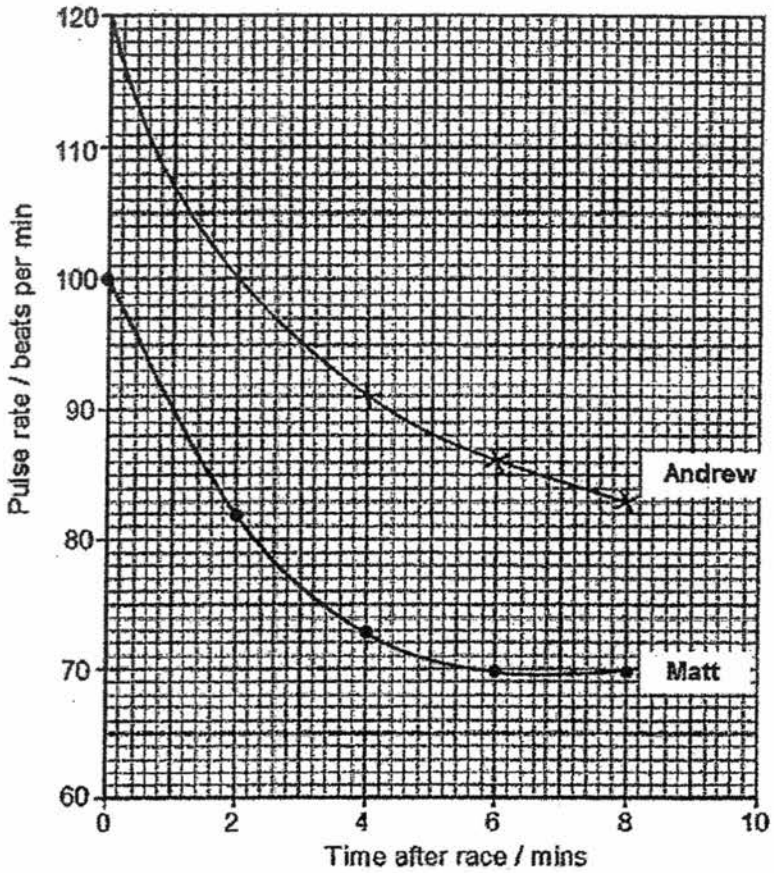


Fig. 2

(a) Time taken for pulse rate to return to the resting rate is one of the indicators of the fitness level of an individual.

(i) Compare the graphs of Andrew's and Matt's result. Suggest who the fitter student is. [1]

_____

(ii) Explain your answer to **(a)(i)**. [3]

_____

_____

_____

_____

_____

_____

(b) After the race both students were panting. Give an explanation to their panting. [2]

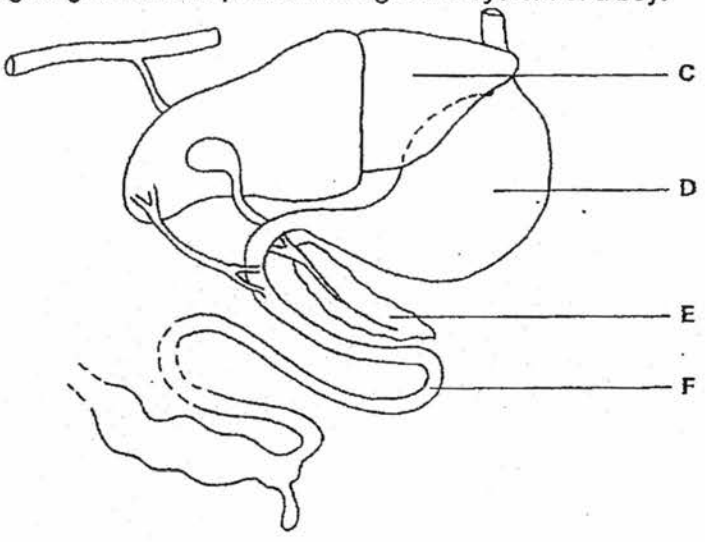
_____

_____

_____

[Total : 6m]

3 The following diagram shows part of the digestive system of a boy.



(a) During recess, the boy ate white rice and steamed fish with tomato sauce.

(i) Which food is digested in **D**? [1]

_____

(ii) Name the digested product of the food named in **(i)**. [1]

_____

(b) If there is an excess of the digested products named in **(a)(ii)**, describe in details how the body will deal with them. [3]

_____

_____

_____

_____

_____

(c) Besides its involvement in digestion, structure **F** also perform another important process.

(i) Name the process. _____ [1]

(ii) How is structure **F** adapted for the process named in **(c)(i)**. [3]

_____

_____

_____

_____

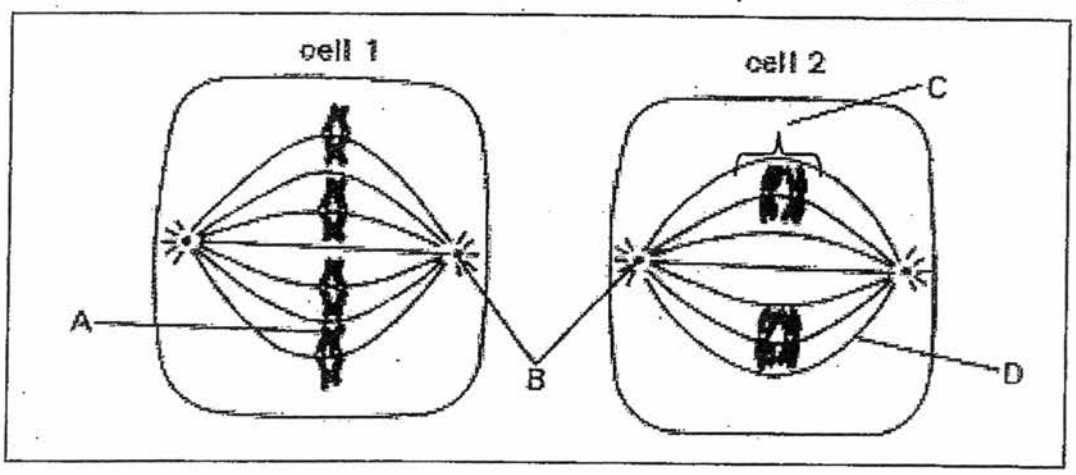
_____

_____

_____

[Total : 9m]

4 The figure below shows two cells from the same animal in the process of division.



(a) Name the structures labelled **A** to **D**. [4]

A : _____

B : _____

C : _____

D : _____

(b) (i) What type of cell division is shown in cell 1? [1]

_____

(ii) What phase of division is shown in cell 1 [1]

_____

(c) What is the main role of the type of cell division shown in cell 2? [1]

_____

_____

[Total : 7m]

5 Human blood contains four components, namely, red blood cells, white blood cells, plasma and platelets.

(a) State and explain two ways in which red blood cells are adapted to their function. [2]

1. _____

_____

2. _____

_____

(b) The blood in the pulmonary vein contains 20 cm^3 of oxygen in each 100 cm^3 of blood. 98.7% of the oxygen is carried in the red blood cells. The remaining percentage is carried in solution in the blood plasma.

Calculate how much of the oxygen in each 100 cm^3 of blood is carried in solution in the blood plasma in the pulmonary vein. Show your working clearly. [2]

Answer _____

(c) The blood in the pulmonary artery has more carbon dioxide than oxygen. Briefly explain how is carbon dioxide released by the cells is transported in the blood. [2]

_____

_____

_____

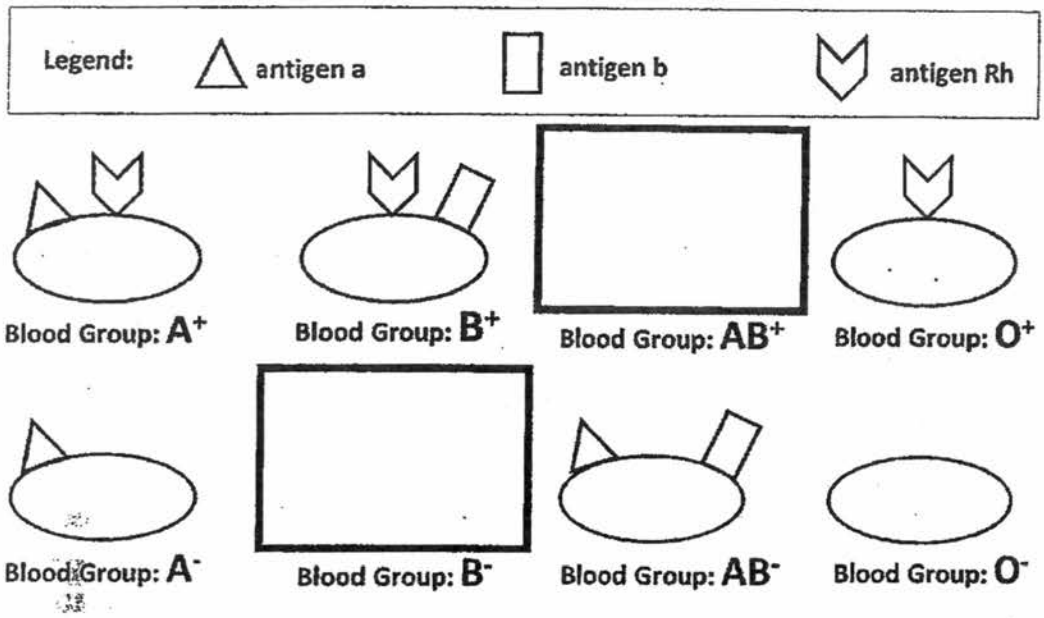
_____

_____

[Total : 6m]

6 Rhesus (Rh) blood group system, other than the ABO system, plays an important factor in blood transfusion compatibility. People with Rh+ group have an Rh antigen on the surface of the red blood cells and do not produce Rh antibodies.
People with Rh- group do not have an Rh antigen on the surface of the red blood cells but produces antibody Rh. As such, a person with red blood cell that has antigen A and Rh is known to be of A^+ blood group.

(a) Complete the diagram below for blood group AB^+ and B^- in the boxes provided. [1]



(b) A patient at the hospital with blood group A^- needs blood for transfusion. State the blood group(s) which the patient can receive. Explain your answer. [4]

[Total : 5m]

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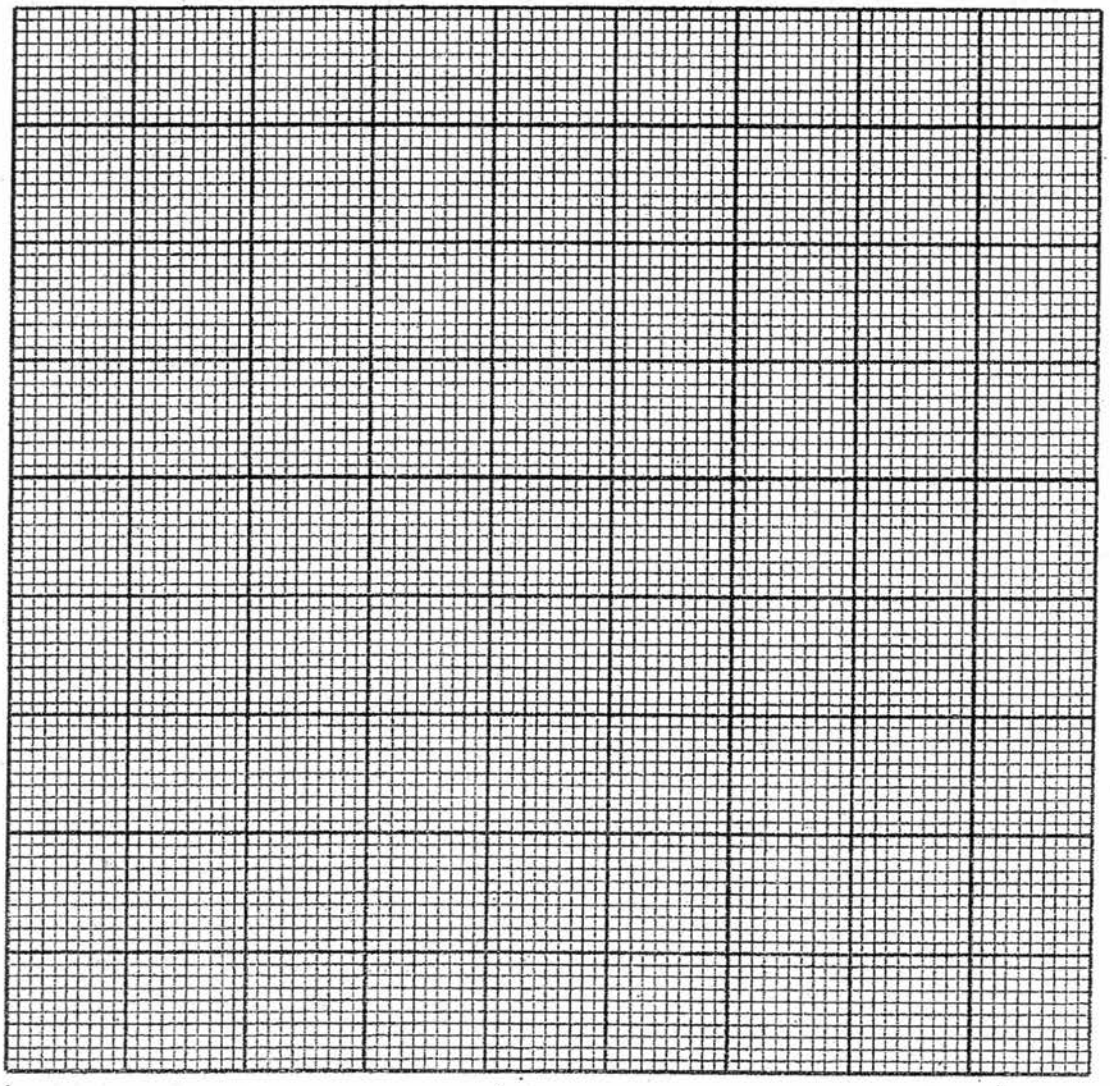
PART 2
Section B [30marks]
Answer **all** questions. Write your answers on the lined provided.

7 When a tadpole undergoes metamorphosis to a frog, there are quite obvious structural changes. The changes of function are less obvious. For example, the tadpole excretes its nitrogenous waste as ammonia whereas the frog excretes urea.

(a) Plot a graph of the following data collected by a biologist: [3]

Age of tadpole or frog (days)	*Ammonia as percentage of total excretory material*
50	92
55	88
65	84
75	83
90	68
95	20
100	13
110	12



(b) The change from excreting mainly ammonia to excreting mainly urea occurs when the frog starts to live on dry land. Between which days do you think the animal leaves the water? [1]

(c) Ammonia is very soluble and toxic. Give reasons why it is possible for tadpole to excrete it safely whereas it is necessary for the frog to change to excreting the less toxic compound, urea. [3]

(d) The human body removes the toxic compound urea in the form of urine. Briefly describe how urine is produced from blood entering the kidneys. [3]

[Total :10m]

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8(a) Jamie is a two year old toddler whose father is a heavy cigarette smoker. When Jamie started to cough very badly, the doctor diagnosed that he was having bronchitis. In a blood screening test, traces of nicotine and carbon monoxides were found in Jamie's blood stream.

(i) Describe the conditions in Jamie's body which lead to his coughing.

(ii) Describe and explain in detail how the two chemicals from cigarette smoke could have entered Jamie's blood stream. [6]

8(b) What are some harmful effects of cigarette smoke on the respiratory system of a cigarette smoker? [4]

[Total : 10m]

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9(a) Enzymes are organic catalysts which show ***specificity in their actions*** and which are ***sensitive to changes in pH.***
With particular reference to a **named** enzyme, clearly explain the meaning of the terms that are in bold italics in the sentence above. [6]

9(b) Explain how enzymes work with respect to :

(i) the ES complex formation,

(ii) the lock-key hypothesis [4]

[Total : 10m]

End of Paper

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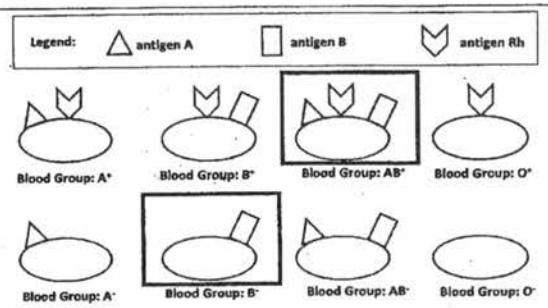
Answer Scheme for 2016 Sec 3E Biology SA2

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

Question		Answer	Marks
1	a	4.6+4.3+4.3 =13.2 / 3 = 4.4	2
	b	Water potential in water is higher than potato cell sap Endosmosis occurred, causing potato cells to swell and so increased in length Water potential in potato cell sap is higher than 25% sugar solution Exosmosis occurred, causing potato cells to shrink in size and so decreased in length	1 1 1 1
	c	Measure initial and final mass of strips	1
2	a	Matt Highest rate for Andrew is 120 bpm while Matt is 100 bpm Matt's heart does not need to work as hard to complete the race using same duration of time resulting in her having lower pulse rate. Matt's pulse rate returned to the resting rate of 70 bpm after 6 min but Andrew took 8 mins Shorter time taken for Matt's pulse rate to return to resting rate	1 1 1 1
	b	During race anaerobic respiration was switched on to produce enough energy for muscle contractions and lactic acids were produced After the race oxygen must be inhaled at a faster rate to break down the lactic acids.	1 1
3	a	Steamed fish Amino acids	1 1
	b	Excess amino acids will be deaminated in liver Amino acid is broken down into an amino group and a carbon residue Amino group is further converted to urea and removed in urine while carbon residue is converted to glucose	1 1 1
	c	Absorption of digested food Presence of villi and microvilli to increase surface area for absorption Lacteals in villi for absorbing digested fats and triglycerides Capillaries in villi for absorbing glucose and amino acids	1 1 1 1
4	a	A – chromosome / chromatid B – centrioles / asters C – homologous pair of chromosomes D – spindle fibre	4
	b	Cell 1 – mitosis , metaphase	2
	c	Meiosis is to produce haploid gametes for sexual reproduction	1
5	a	Biconcave disc shape to increase surface area for oxygen diffusion Absence of nucleus to accommodate more haemoglobin Presence of haemoglobin to bind reversibly with oxygen	2
	b	100% - 20 cm^3 1.3% - (20/100) x 1.3 = 0.26 cm^3	2
	c	CO_2 diffuses into RBC combines with water to form carbonic acids aided by enzyme acid anhydrase Carbonic acid dissociates into hydrogen ion and bicarbonate ion	1 2
		Bicarbonate ions diffuse out of RBC into plasma and is transported in plasma	
6	a		12
	b	1. A- & O- 2. The blood plasma of the patient has **antibody b** and **Rh**. 3. (Red blood cells from) donors of blood group **A- and O-** do not contain **antigen B**, which binds to **antibody b** in the blood plasma of the patient. Thus agglutination will not occur 4. Red blood cells from donors of blood group **A- and O- does not contain antigen Rh**, thus there is no agglutination in the presence of **antibody Rh** in the blood plasma of the patent.	1 1 1 1

Answers to Essay Questions

7(a) x-axis : age (days)
y-axis : ammonia as % of total excretory material
points neatly plotted
line of best fit

7(b) The animal must leave the water between days 75 and 100 when the amount of ammonia in the excretory products drops from 83% to 15%.

7(c) Tadpole lives in water.
The highly soluble ammonia can be removed rapidly by the large amounts of water entering the tadpole body across its skin, when it is submerged in water.
Frogs live on land no longer have the continuous intake of large amounts of water.
So urea will be a more suitable excretory product.

7(d) Blood enters kidney via renal artery which branches into afferent arteriole.
Afferent arteriole branches into capillaries called glomerulus which fit in a bowman capsule of a kidney nephron, capillaries rejoined to form efferent arteriole
Ultrafiltration of blood from glomerulus into kidney nephron due to increased blood pressure in glomerulus
All components in blood except plasma proteins and RBC are forced out of glomerulus into bowman capsule
As glomerular filtrate flows along nephron selective reabsorption of glucose and useful ions occurs and finally the remaining fluid that enters
the collecting duct is called urine.

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8a(i) -Cigarette smoke released by the father's cigarette diffuses into environment and inhaled by Jamie
-Irritants and tar in cigarette smoke
-cause swelling or inflammation of tracheal & bronchial wall leading to reduction in lumen
-excessive mucus released by goblet cells in wall
-resulting in paralysis of cilia lining tracheal & bronchial wall
-mucus and dust particles cannot be removed
-reducing airflow in the respiratory passageway making breathing difficult
-person coughs & wheezes persistently to clear air passages

8a(ii) -Nicotine & CO inhaled by Jamie enter respiratory passage way and reach the alveoli
-the 2 chemicals dissolve in water film lining the inner wall of the alveoli
-Chemicals then diffuse across the alveolar wall and tissue fluid
-Across the capillary wall and enter the blood stream

8b TAR
-Contains many cancer-causing substances that cause uncontrolled cell division and growth in lungs – blocking air sacs
-Causes paralysis of cilia lining of trachea & bronchi thus allowing dust particles to enter the lungs increasing risk of chronic bronchitis & emphysema

IRRITANTS
-Causes paralysis of cilia lining of trachea & bronchi thus allowing dust particles to enter the lungs increasing risk of chronic bronchitis
-Cause copious production of mucus leading to severe coughing resulting in emphysema.

9a Enzymes are substances produced in the living cells which can alter the rate of reactions in living cells.
Enzymes are specific in their action because of the rigid shape of their active sites.
Only substrate molecules that can fit into the active site can bring about reaction.
Proteins / starch can fit into active sites of pepsin / amylase in stomach / small intestine and be digested to polypeptides / maltose.
Other carbohydrates and lipids cannot fit into active sites of pepsin / amylase and hence no digestion of such carbohydrates and lipid in stomach

Enzymes require specific pH to work in for e.g. acidic, neutral or alkaline.
Example : pepsin needs pH 2.0 (acidic) to break down proteins to polypeptides/peptones
When food enters the duodenum which has an alkaline pH. The pepsin stops working.

9b Enzymes have rigid and fixed active sites which only the relevant substrates molecules can fit into.
Once the right substrate molecule with the correct shape and charge is fitted into the active site, an enzyme-substrate (ES) complex is formed.
The ES complex will then break down to give the products and releases the enzymes for recycling again.

Enzymes are liken to locks and
the active sites on enzymes are liken to the key holes on locks
Correct substrate molecules are liken to keys
When the right key is fitted into the key hole the lock can be opened.