



**SECTION A (40 MARKS)**

*Answer all the questions in this section the spaces provided*

1. (a) The skin, respiratory surfaces, and alimentary canal are possible sites through which micro-organisms may gain entry to the human body. For each of these sites, describe the mechanisms that prevent the entry of micro-organisms.

(a) The skin. (3 marks)

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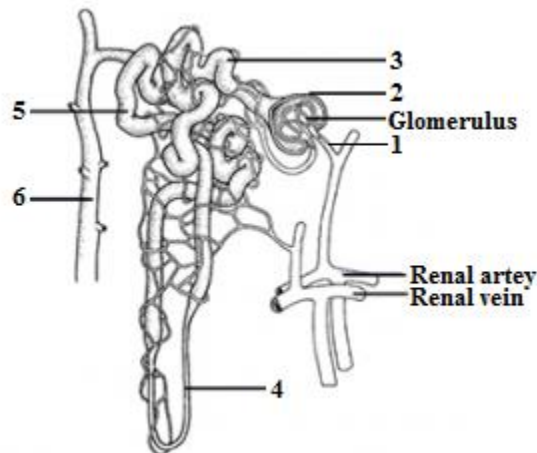
(b) The respiratory system. (3 marks)

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(c) The alimentary canal. (2 marks)

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2. In an experiment to investigate the functioning of the mammalian kidney, samples were taken by micropipette from different regions. The diagram below shows the sample sites, labeled 1 to 6.



Each sample was analyzed to determine the concentration of glucose, protein, urea and sodium ions. The flow rate was also measured at each of the sample sites. The results are shown in the table below.

Samples sites within the kidney	Concentration (g dm <sup>-3</sup> )				Flow rate (cm <sup>3</sup> min <sup>-1</sup> )
	Protein	Glucose	Sodium ions	Urea	
1. Plasma in afferent arteriole	80	1.5	34	0.3	600.0
2. Filtrate in Bowman's capsule	0	1.2	34	0.3	125.0
3. End of proximal convoluted tubule	0	0	34	1.6	25.0
4. Bottom of loop of Henle	0	0	70	1.8	1.5
5. Beginning of distal convoluted tubule	0	0	30	1.8	1.5
6. Beginning of collecting duct	0	0	2.2	2.2	1.3

Use the information in this table and your own understanding to answer the following questions.

(a) Explain the changes in the composition of proteins and glucose between the plasma in the afferent arteriole (sample site **1**) and the end of the proximal convoluted tubule (sample site **3**).

(2 marks)

● Protein

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● Glucose

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(b) Comment on the changes in sodium ion concentration in the different sample regions.

(2 marks)

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(c) Explain the changes in urea concentration as it moves along the nephron. (2 marks)

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(d) Suggest an explanation for the fall in the flow rate as fluid moves from the plasma into and then along the nephron. (1mark)

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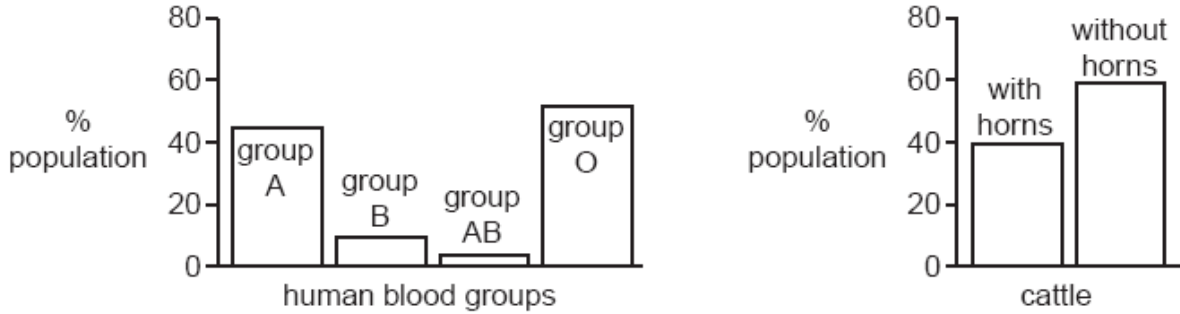
(e) The experiment was carried out at 37 °C. When the experiment was repeated at 30 °C, the glucose concentration at the end of the proximal convoluted tubule was 0.15 g dm<sup>-3</sup>. Suggest an explanation for this result. (1mark)

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3. (a) The bar charts show the percentages of a human population with each type of blood group and the percentages of a cattle population with and without horns.



Which type of variation is shown in each population? (1mark)

Human:

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Cattle:

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(b) Albinism (lack of skin pigmentation) in humans is caused by two recessive alleles. A phenotypically normal (non-albino) couple have three children; the first two are non albino, the third is an albino. In your answer, use “A” for the dominant allele and “a” for the recessive allele.

(i) What are the genotypes of the parents? (1mark)

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(ii) Is there a possibility that their next child will be an albino? Explain your answer (2 marks)

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(iii) The albino child eventually marries a non-albino whose father was an albino.

What is the probability that their first child will be an albino? Show all working. (4marks)

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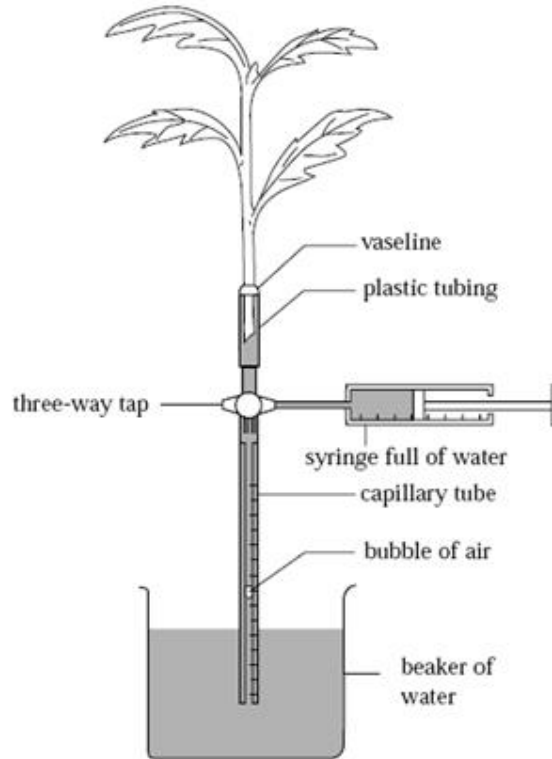
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4. A potometer is a device for investigating the rate of transpiration. Prior to setting up, the potometer and the stem of a leafy shoot are immersed in water. Under water, the bottom centimetre of the stem is cut off and the cut end inserted into the plastic tubing. The apparatus is removed from the water, a bubble of air allowed to enter the open end of the capillary tube and that end then inserted into a beaker of water. The completed set-up for a simple potometer is shown below.



- (a) What assumption is made when this apparatus is used to investigate the rate of transpiration? (1mark)

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- (b) Explain each of the following.

- (i) Why it is necessary to cut the leafy shoot and fit it into the potometer under water (1mark)

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- (ii) How the bubble of air is introduced into the capillary tube. (1mark)

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- (iii) Why a syringe is attached. (1mark)

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- (iv) Why the set-up is left for 15 minutes before taking readings. (1mark)

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(c) The table below shows some results recorded using the apparatus.

Time (minutes)	Distance travelled by bubble (mm)		
	“Normal” room conditions	Covered with clear plastic bag	Covered with black plastic bag
0	0	0	0
2	18	10	4
4	36	19	8
6	55	29	11
8	74	38	15
10	90	48	18

(i) Account for the results shown in the table. (2 marks)

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(ii) In ‘normal’ room conditions, the distance moved by the bubble was 90 mm during 10 minutes. The capillary tube has a cross sectional area of  $0.8\text{mm}^2$ . Calculate the rate of movement in  $\text{mm}^3 \text{minute}^{-1}$ . (Show your working in the space below.) (1mark)

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5. (a) Describe how each of the following structures adapt a bony fish to locomotion in water.  
 (i) Scales. (2 marks)

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(ii) Myotomes (2 marks)

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(b) State **two** adaptations of the synovial joints in man. (4 marks)

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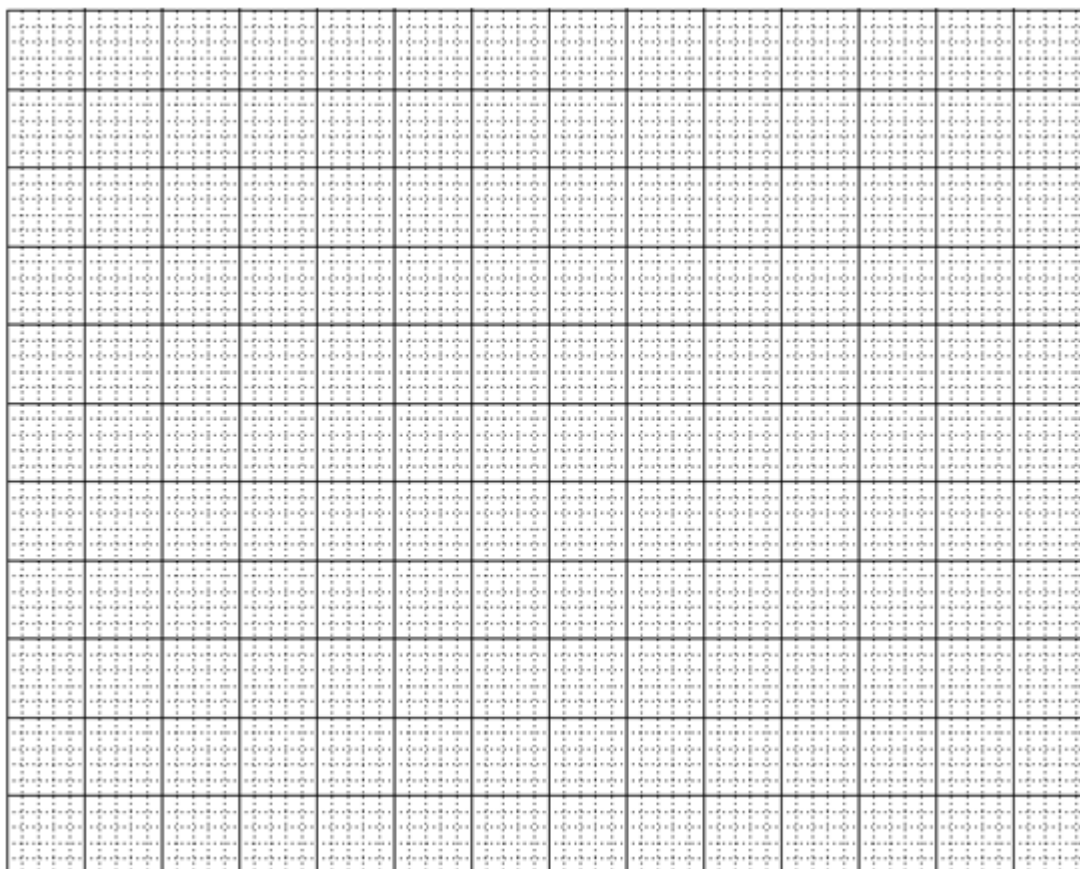
**SECTION B (40 MARKS)**

Answer question 6 (compulsory) and either question 7 or 8 in the spaces provided after question 8.

6. It was suspected that a pollution incident involving slurry had occurred in a local river. Oxygen content of the water in the river was measured, both upstream and downstream from the suspected slurry (raw sewage) leak. Samples were taken at seven points along the river and the results are shown in the graph below.

Distance along the stream (m)	0	20	40	60	80	100	120
Oxygen concentration (arbitrary units)	7.0	7.0	1.6	2.0	3.4	5.0	7.0

- (a) Plot a graph of this data. (7 marks)



- (b) From the graph determine:

- (i) the distance along the stream where the slurry leak occurred. (1 mark)

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- (ii) the least oxygen concentration and the distance when it occurred. (2 marks)

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(c) Account for the shape of the graph between:

(i) 20m – 40m along the stream.

(3 marks)

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(ii) 60m – 120m along the stream.

(3 marks)

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(d) Waterways can also be polluted by fertilizer run- off.

The effects of fertilizer run-off and pollution by slurry are different in some ways.

State and explain **two** of these differences.

(3 marks)

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7. (a) Describe the adaptations of the essential parts of entomophilous flowers to pollination.

(6 marks)

(b) Using a named example, describe the events from pollination to double fertilization.

(14 marks)

8. (a) Describe how the mammalian eye is adapted for accommodation.

(6 marks)

(b) Describe the mechanism of hearing in man.

(14 marks)

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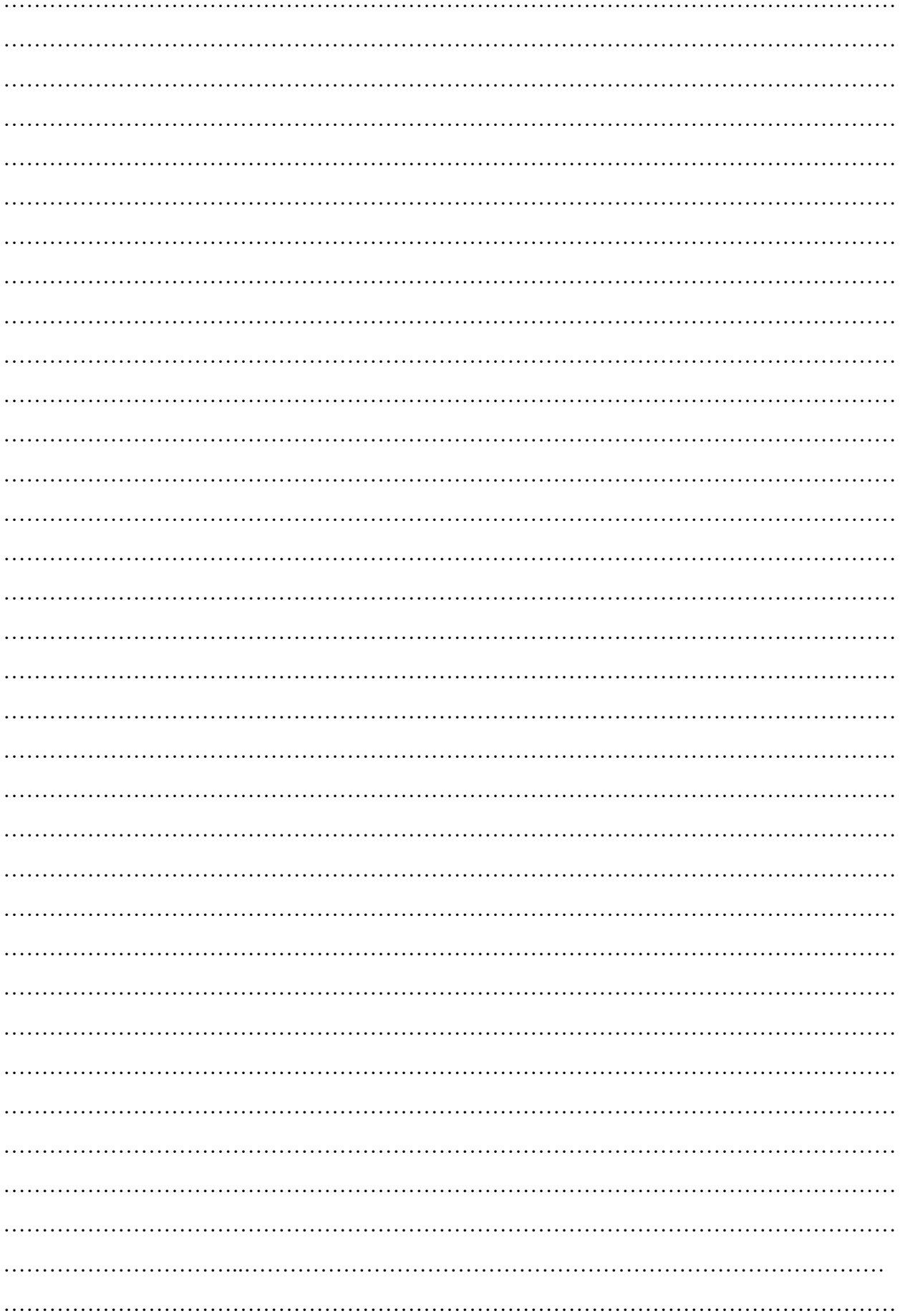
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