



ZHONGHUA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2023

SECONDARY 4 EXPRESS

Candidate Name	Class	Register Number
	4E5	

BIOLOGY

6093 /02

14 September 2023
1 hour 45 minutes

Additional Materials: Nil

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces at the top of this page.

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.

Write your answers in the spaces provided on the question paper.

Section B

Answer all **three** questions, the last question is in the form Either/Or.

Write your answers in the spaces provided.

You are advised to spend no longer than one hour on **Section A** and no longer than 45 minutes on **Section B**.

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

All essential working must be shown clearly.

For Examiner's Use	
Section A	50
B7	10
B8	10
B9 E / O	10
Total	80

Section A

Answer **all** questions.

Write your answers in the spaces provided.

- 1** A contractile vacuole is found in some unicellular organisms. It is a structure that periodically expands, filling with water, and then contracts, expelling its contents out of the cell. In an experiment, a marine unicellular organism was placed in several dilutions of seawater. The output rate of its contractile vacuole and changes in its body volume were measured and recorded.

Fig. 1.1 shows the data collected during the experiment.

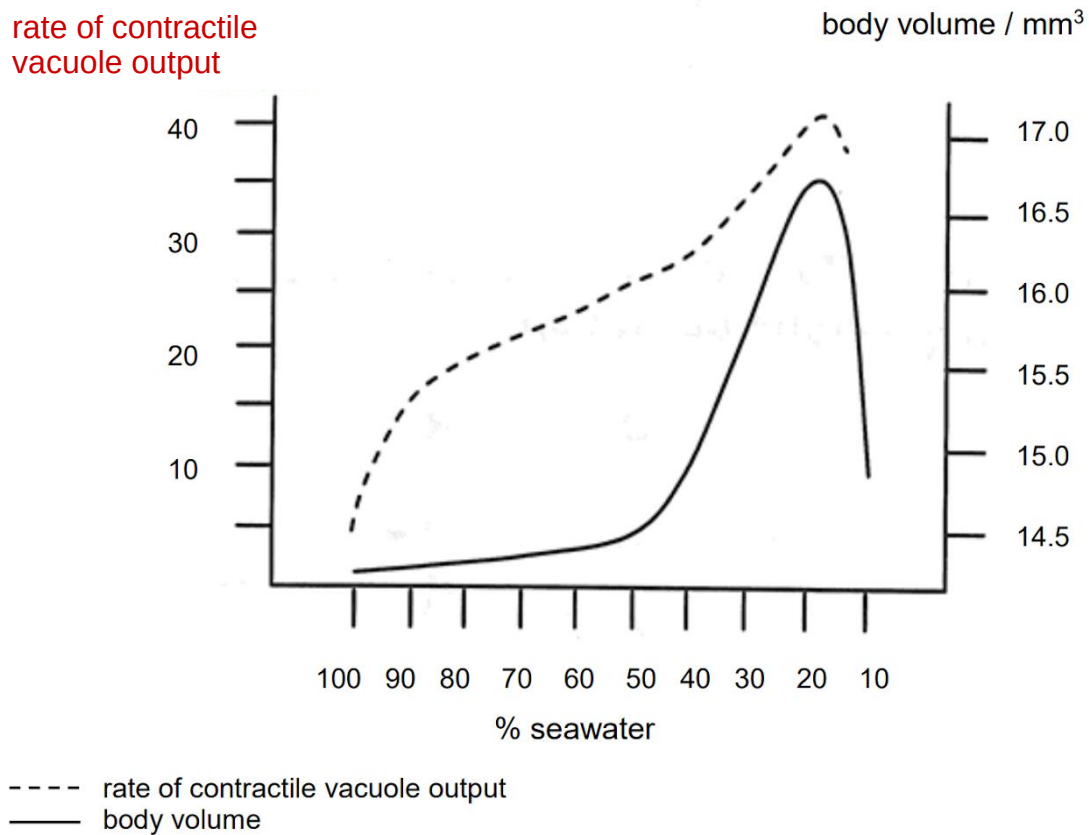


Fig. 1.1

- (a)** Besides water, name another substance that can also enter the contractile vacuole.

[1]

- (b) Describe and explain the effect on the rate of contractile vacuole output as the percentage of seawater increases from 20% to 100%.

[3]

- (c) Describe one other relationship observed in Fig. 1.1 as the percentage of seawater increases from 20% to 100%.

[1]

- (d) Suggest and explain what has happened to the marine unicellular organism at 10% seawater.

[2]

[Total: 7]

- 2 Fig. 2.1 shows the oxygen uptake before, during and after strenuous exercise.

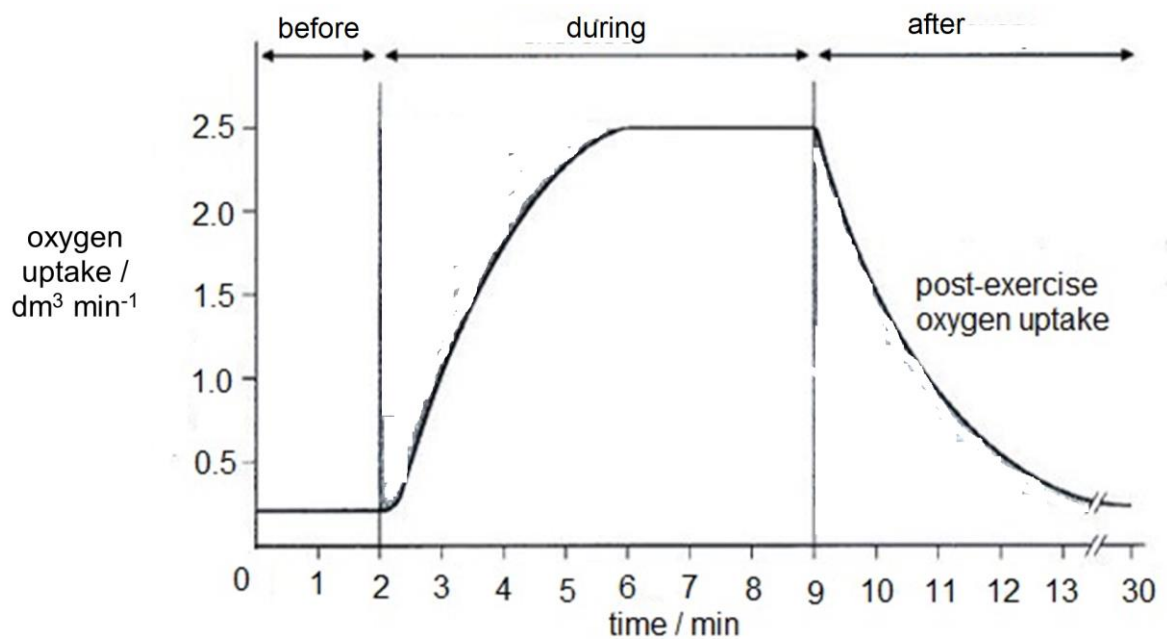


Fig. 2.1

Fig. 2.2 shows the lactic acid concentration in blood samples taken at different time intervals during and after exercise.



Fig. 2.2

- (a) (i) On Fig. 2.1, mark with the letter **D**, the area that shows oxygen deficit.

[1]

(ii) State a reason for this oxygen deficit.

.....

..... [1]

(b) With reference to Fig. 2.1 and Fig. 2.2, explain the rise in concentration of lactic acid in the blood.

.....

.....

.....

.....

.....

.....

..... [3]

(c) (i) On Fig. 2.2, draw a line to show the change in muscle glycogen concentration during the period of exercise. [1]

(ii) Explain the graph drawn in (c)(i).

.....

.....

.....

..... [2]

(d) Suggest how the curve in Fig. 2.2 might be different if the person suffers from emphysema.

.....

..... [1]

[Total: 9]

- 3** The kidney is an organ with the second highest mitochondrial content and oxygen consumption after the heart.

Fig. 3.1 is an electron micrograph section of the proximal convoluted tubule. Microvilli form the brush border on the surface facing the lumen. Mitochondria are present closer to the plasma membrane of the cells.

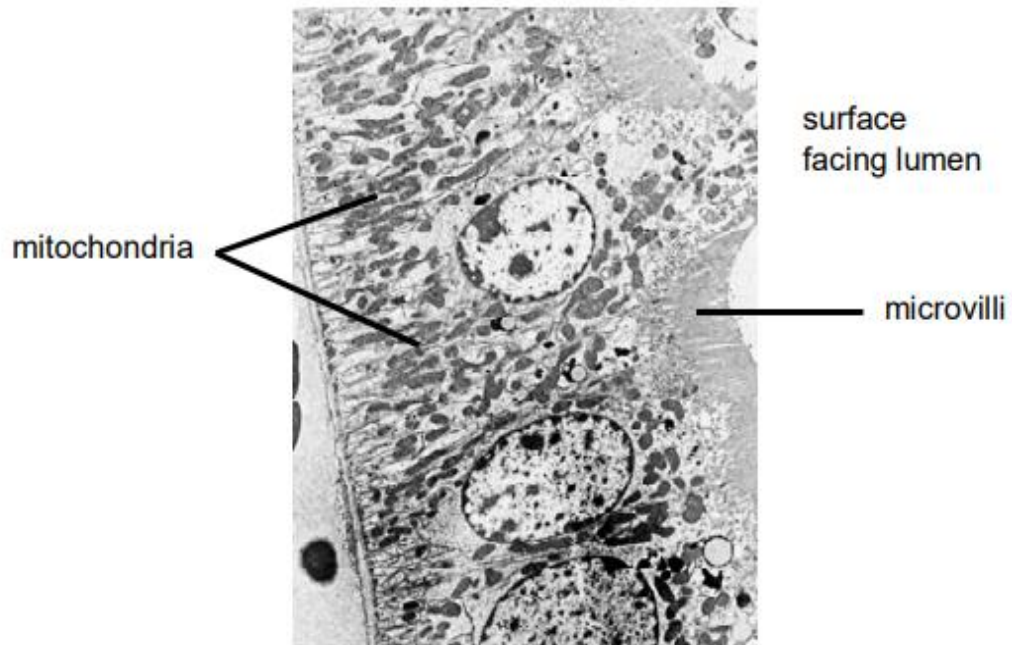


Fig. 3.1

- (a)** Suggest why proximal tubular cells have many mitochondria.

[2]

- (b)** Suggest a purpose for microvilli in the proximal tubular cells.

[2]

Fig. 3.2 shows the process of kidney dialysis.

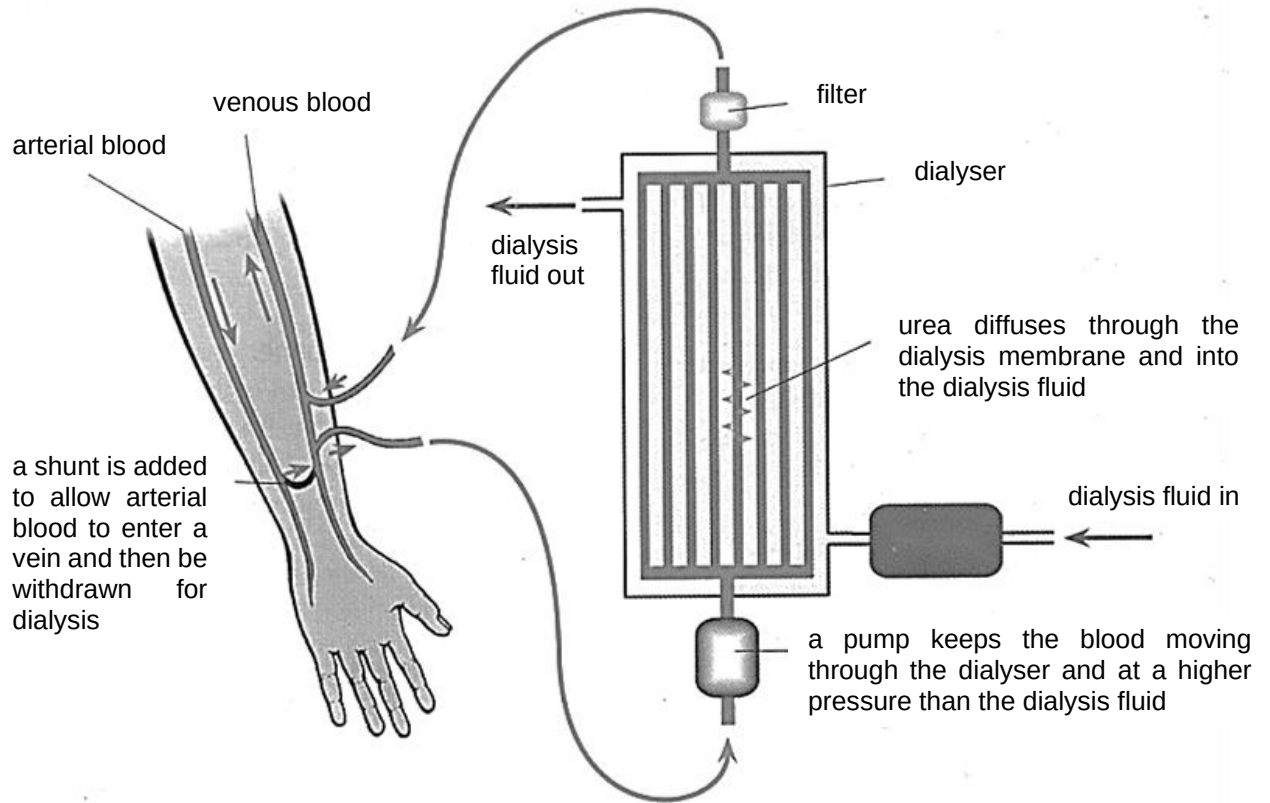


Fig. 3.2

- (c)** Compare and contrast the mechanism of kidney dialysis to the structure and function of the proximal tubular cells and its microvilli in the kidney.

[4]

[Total: 8]

[Turn over

4 Fig. 4.1 shows the cross-section of the human skin.

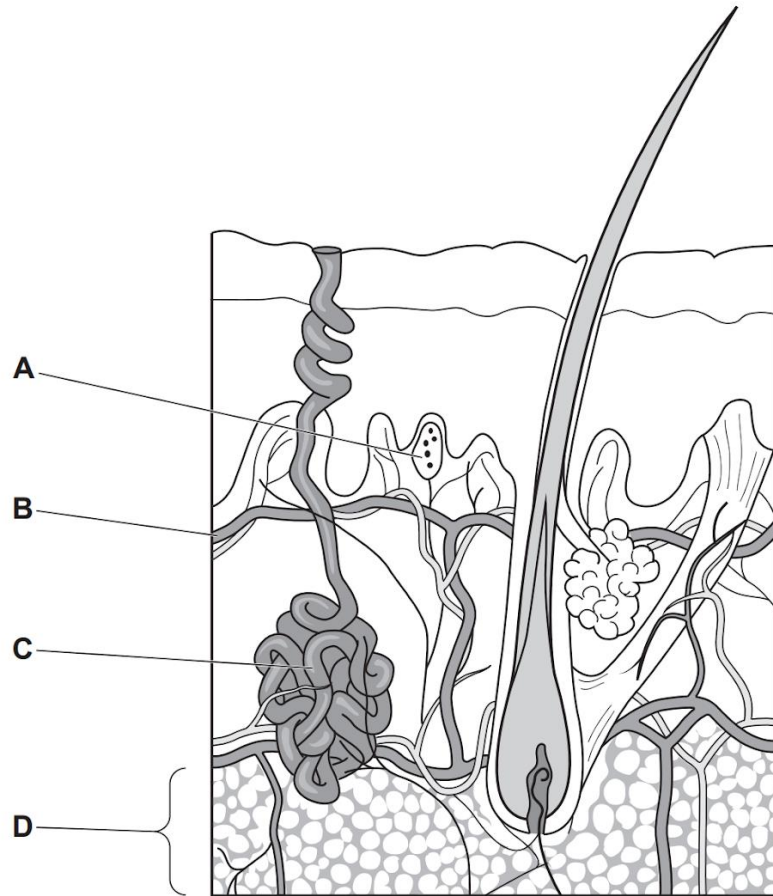


Fig. 4.1

(a) (i) Identify the structures labelled **C** and **D**.

C

D

[2]

(ii) The thickness of layer **D** may undergo changes over several months.

Suggest and explain one reason for a decrease in the thickness.

.....

.....

.....

.....

[2]

- (b) Structure **A** can be unevenly distributed in human skin.

Name structure **A** and suggest a reason for this uneven distribution in the human skin.

[3]

- (c) Describe how **B** is involved in thermoregulation when there is a decrease in the external temperature.

[3]

[Total: 10]

- 5 Guinea pigs are small mammals that are produced for food or bred as pets in different parts of the world.

(a) Guinea pigs can have either straight hair or curly hair. The allele for straight hair, **T**, is dominant to the allele for curly hair, **t**.

(i) Distinguish between a gene and an allele.

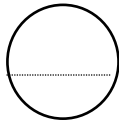
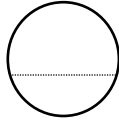
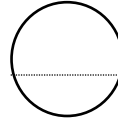
.....

.....

..... [2]

(ii) A breeder mated a pair of male and female straight-haired guinea pigs and was surprised when this pair produced an offspring with curly hair.

Complete the genetic diagram to explain the observation.

genotype of parents		x	
gametes			
offspring genotypes			
offspring phenotypes			

[4]

- (b)** The gestation period for guinea pigs usually lasts between 58 and 73 days. The mother usually gives birth to between two and four offspring.

Fig. 5.1 shows the uterus and developing offspring.

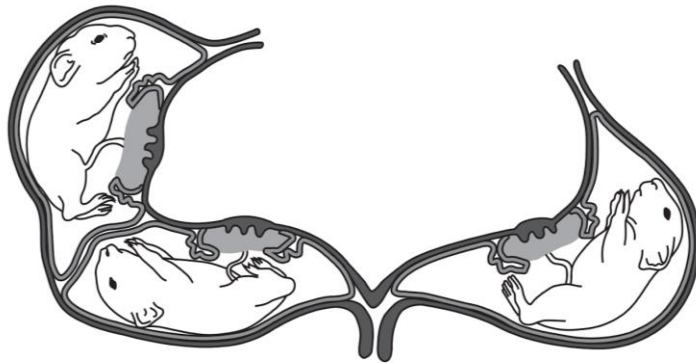


Fig. 5.1

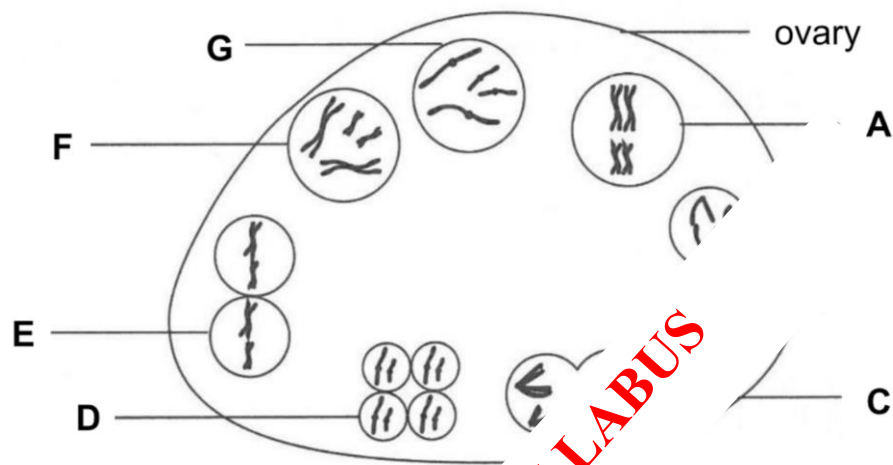
The offsprings of both humans and guinea pigs develop in a uterus.

With reference to the information provided and your knowledge of human development, discuss the similarities and differences in the development of human and guinea pig offsprings.

[illegible]

[Total: 10]

- 6 Fig. 6.1 shows the different stages of cell division in the human ovary labelled **A** to **G**.



- (a) Using the letters in Fig. 6.1 _____ stages of cell division in their correct sequence. [1]

- (b) (i) Name the _____ division illustrated in Fig. 6.1. [1]

- (ii) With reference to Fig. 6.1 only, give two reasons to support your answer in (b)(i).

1 _____

2 _____

[2]

- (c) Name the biological term used to describe the state of the cells in stages **D** and **G** with respect to the number of chromosomes found in their nucleus.

D _____

G _____

[1]

(d) Account for the difference in appearance between *Ascaris* in stages **G** and **F**.

.....

.....

.....

.....

[1]

[Total: 6]

OUT OF SYLLABUS

Section B

Answer three questions.

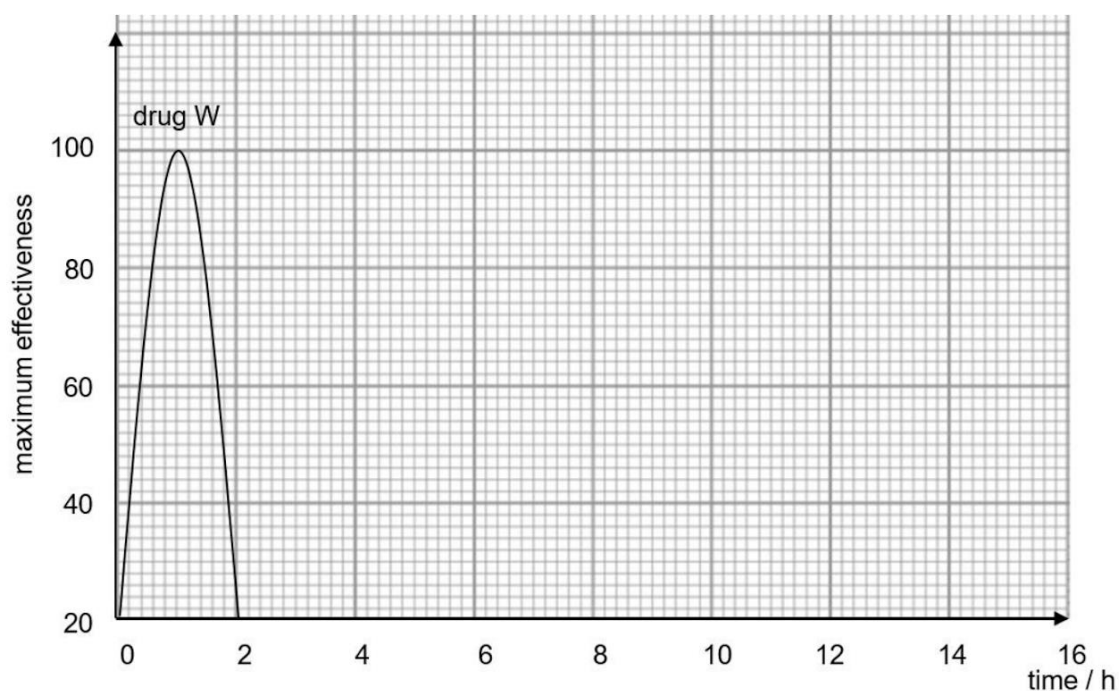
Question 9 is in the form of an Either/Or question. Only one part should be answered.

- 7 Four types of insulin were studied for their effectiveness in treating diabetes mellitus. The results of the study were recorded in Table 7.1. All the times recorded were from the point of ingestion of the drugs.

Table 7.1

drug	W	X	Y	Z
time taken for drug to start working / h	0	1	1.5	1.5
time taken for drug to reach maximum effectiveness / h	1	2	3	8
time taken for effect to wear off / h	2	4	12	16
maximum effectiveness / arbitrary units	100	80	60	40

- (a) Plot the data in Table 7.1 on the grid below. The graph for drug **W** has been done for you.



- (b)** Explain how insulin helps to regulate blood glucose concentration after a meal.

[3]

- (c)** Suggest one advantage and one disadvantage of using drug **Y** to treat diabetes mellitus.

[2]

- (d)** A person with diabetes mellitus plans to eat his lunch at 12 pm.

Suggest and explain what time the person should consume drug **W**.

[2]

[Total: 10]

- 8 Fig. 8.1 shows how the blood alcohol concentration changes after a person drinks an alcoholic beverage.

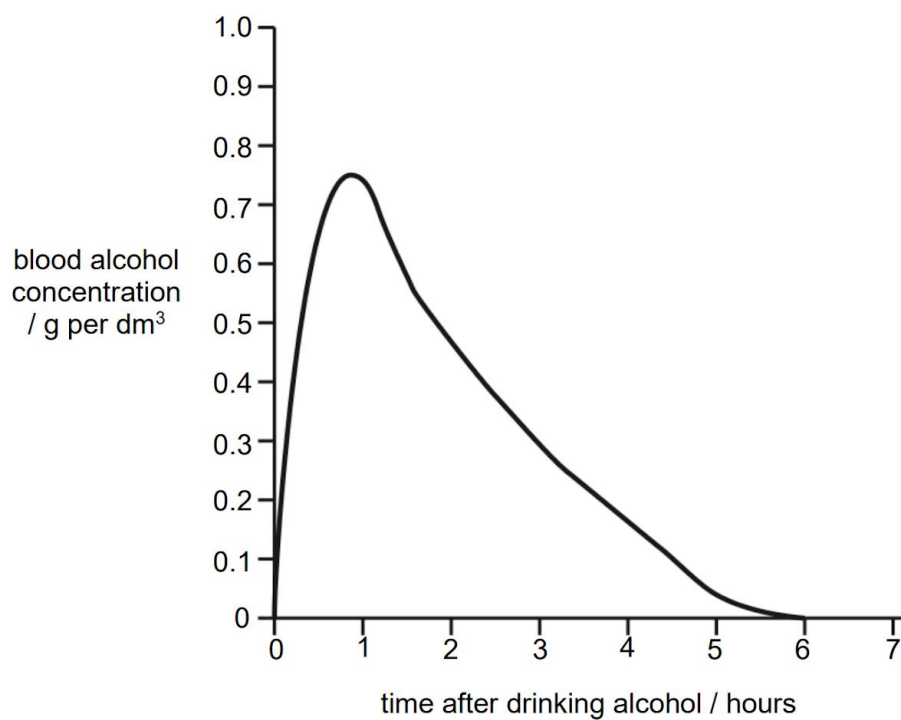


Fig. 8.1

- (a) Describe and explain the shape of the graph in Fig. 8.1.

- (b)** Suggest two reasons why the highest blood alcohol concentration may be different for two people despite drinking the same volume of an alcoholic beverage.

[2]

- (c)** Describe how the human body deals with excessive consumption of alcohol.

[3]

[Total: 10]

EITHER

- 9 (a)** With reference to the vascular tissues in roots, stems and leaves, describe the movement of essential materials within a plant.

[6]

- (b)** When the rate of water loss from a plant is greater than the rate of water uptake, the stomata close. Explain

- (i)** how the stomata close, and

[2]

- (ii)** how this closing is an advantage and disadvantage to the plant under these conditions.

advantage

disadvantage

[2]

[Total: 10]

OR

- 9 In India, the population of *Gyps bengalensis* (white-backed vultures) has fallen by 97% to an estimated 4000 vultures. This species is now considered to be “critically endangered”.

These are some explanations for the decline in the numbers of the species.

- Vultures feed on carcasses from farm animals which may have been treated with a particular painkiller drug. This drug is known to cause kidney failure in the vultures.
- Farmers continue to use up their stocks of the drug although its sale is being phased out by authorities.
- The drug is non-biodegradable and will remain in the environment.

- (a) Calculate the original population of the white-backed vulture.

Show your working clearly.

..... [1]

- (b) With reference to the above information, explain what is meant by the term *bioaccumulation* and *bioamplification*.

..... [3]

In an effort to save the vultures, a captive breeding programme has been set-up. Three centres have been built in India so far, each housing up to 40 vultures. These vultures have been collected from different areas of the Indian subcontinent.

- (c) Suggest why the decision was made to conserve the species in captivity rather than in the wild.

[3]

- (d) Outline three reasons why conservation of the white-backed vulture is important.

[3]

[Total: 10]

END OF PAPER