

Section A

Answer **all** questions.

- 1 Fig. 1.1 shows a genus of single-celled green algae known as *Chlorella*. *Chlorella* is a type of phytoplankton; it is known for its high photosynthetic efficiency and its potential as a dietary supplement to support nutritional needs of the body.

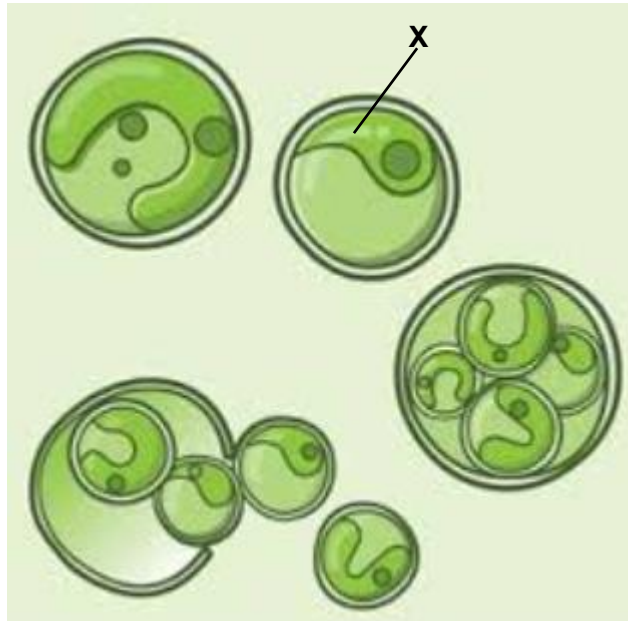


Fig. 1.1

- (a) Organelle **X** enables *Chlorella* to perform photosynthesis.
Identify organelle **X**.

..... [1]

(b) Fig. 1.2 shows the relationship between light intensity and the relative rate of photosynthesis in *Chlorella*.

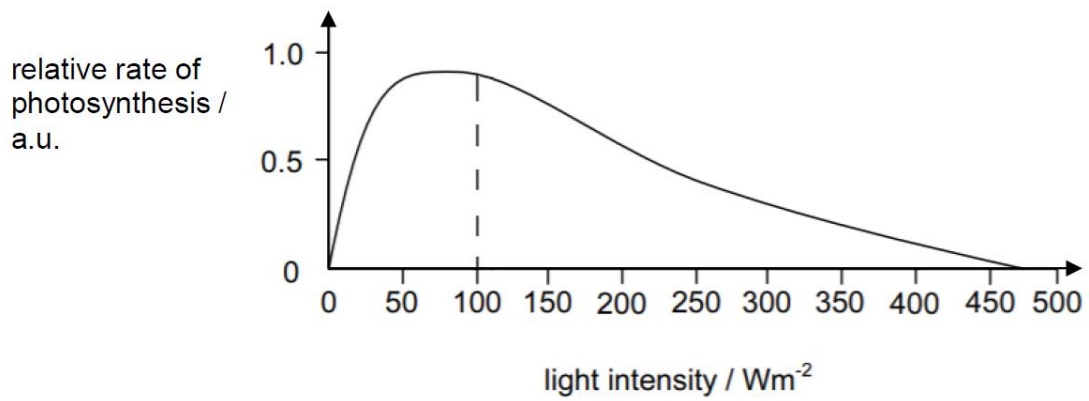


Fig. 1.2

Briefly describe the relationship between light intensity and the relative rate of photosynthesis in *Chlorella* shown in Fig. 1.2.

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- (c) Fig. 1.3 shows the relationship between depth, rate of photosynthesis and respiration of *Chlorella*.

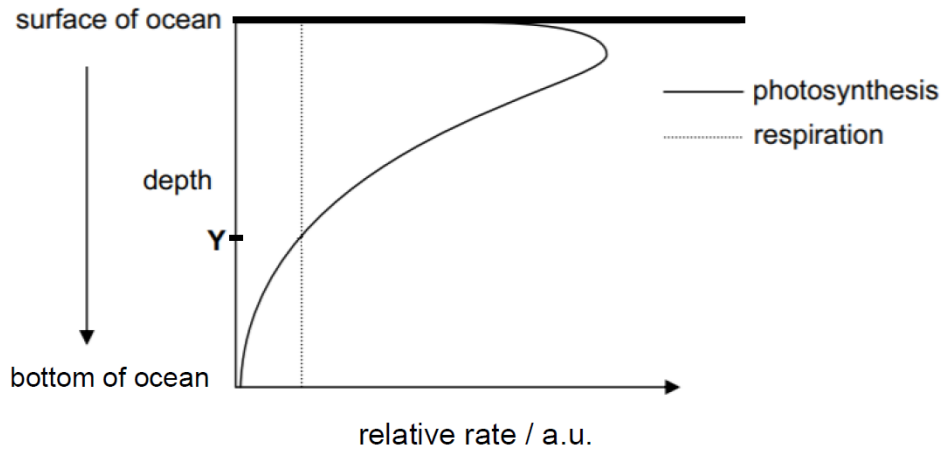


Fig. 1.3

- (i) With reference to Fig. 1.2 and 1.3, explain the shape of the curve showing the rate of photosynthesis in Fig. 1.3.

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- (ii) Explain why *Chlorella* cannot live permanently at a depth below point Y as shown in Fig. 1.3.

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[Total: 10]

2 Fig. 2.1 shows an apparatus used to investigate the movement of substances.

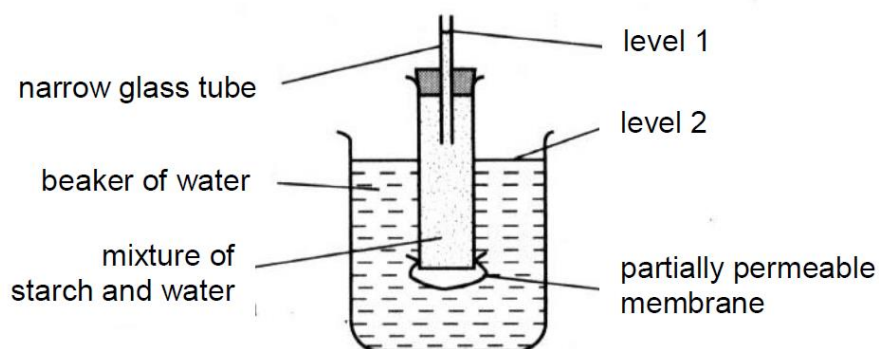


Fig. 2.1

(a) (i) Describe the change (if any) in level 1 and 2 after 4 hours.

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..... [1]

(ii) Explain your answer in (a)(i).

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..... [1]

(b) Prior to the start of the investigation, before the apparatus containing the starch mixture was immersed into the beaker of water, it was found that some of the mixture had already risen up the narrow glass tube. Identify and describe what causes this.

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..... [2]

(c) The starch mixture was replaced using a solution of unknown solute A. Solute A is soluble in water. State another property of solute A that will cause level 1 to rise.

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..... [1]

[Total: 5]

- 3** Raw pineapple juice contains an enzyme called Bromelain. Bromelain has been used as a key ingredient to make meat softer and more tender.

(a) (i) Suggest the type of enzyme found in pineapple juice.

..... [1]

(ii) Explain how Bromelain tenderises the meat.

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..... [1]

The chef has an idea to marinate meat with alkaline spring water after learning about the health benefits of drinking alkaline water.

(b) The chef discovered that meat marinated with fresh pineapple juice and alkaline water was tough and hard to chew during food tasting. Explain this phenomenon.

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..... [2]

A dessert chef wanted to make pineapple jelly. The jelly powder used, primarily contains gelatin, which is a protein made from collagen. He experimented with both fresh and canned pineapple for his jelly dessert. It is known that high heat is used during the production of canned food.

(c) The chef noticed that only jelly using canned pineapple can solidify whereas the jelly using fresh pineapple is unable to solidify. Explain this phenomenon.

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..... [2]

[Total: 6]

- 4 A patient has a disease which damages his pancreas and he is required to take one capsule of medicine shown in Fig. 4.1 daily to supplement his need for the presence of all pancreatic enzymes.

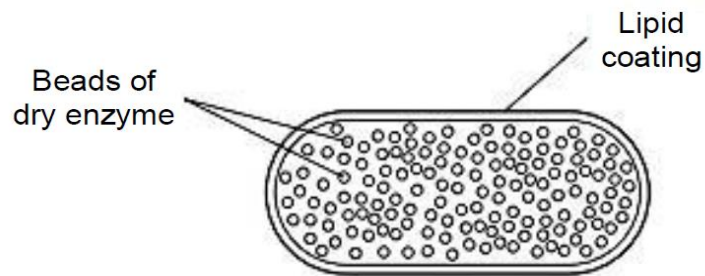


Fig. 4.1

- (a) Name two enzymes that can be produced in the pancreas of a healthy person.

(i) (ii) [2]

- (b) Explain how the lipid coating ensures that the enzymes are only released in the small intestine when the capsule is taken by oral consumption.

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..... [2]

- (c) Suggest why the lipid coating is not digested by the enzyme beads in the capsule.

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..... [1]

- (d) (i) State another medical condition, related to carbohydrate metabolism, which this patient may have.

..... [1]

- (ii) Suggest two possible treatments for the medical condition stated in (d)(i).

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..... [2]

[Total:8]

5 Fig. 5.1 shows a view of the heart from the front.

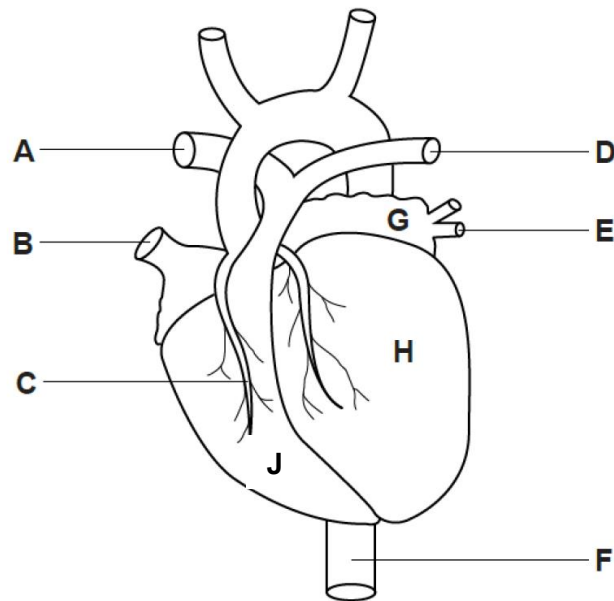


Fig. 5.1

- (a) Using only the letters **A** to **F**, list which of the blood vessels in Fig. 5.1 carries oxygenated blood.

..... [1]

- (b) (i) When a doctor takes your blood pressure, two readings are given. For example, 120 over 80 mmHg. Using the terms systole and diastole, suggest what the two figures represent in this example.

120 mmHg: 80mmHg: [1]

- (ii) Outline how blood moves from **G** to **H** during the cardiac cycle.

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..... [4]

- (c) The median septum separates chambers **J** and **H**. Suggest the consequences if a genetic defect results in a hole along this median septum.

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Fig. 5.2 shows the pressure changes to the left side of the heart.

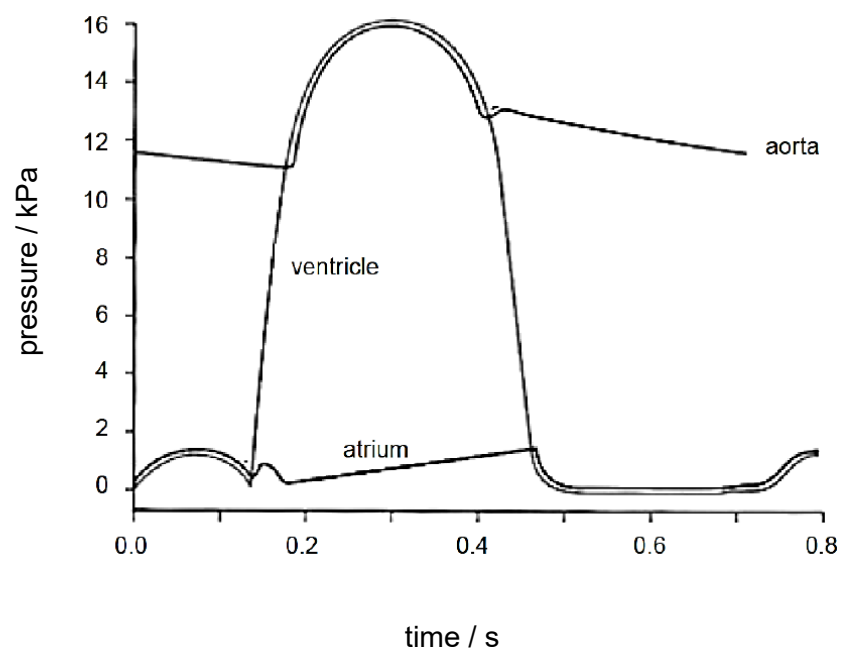


Fig. 5.2

- (d) Using arrows ($\longleftrightarrow$) and appropriate labels, indicate clearly on Fig. 5.2 the parts of the graph which corresponds to the following stages of the cardiac cycle.

(i) Atrial systole [1]

(ii) Ventricular diastole [1]

[Total: 11]

6 Fig. 6.1 shows the human male reproductive organs and associated structures.

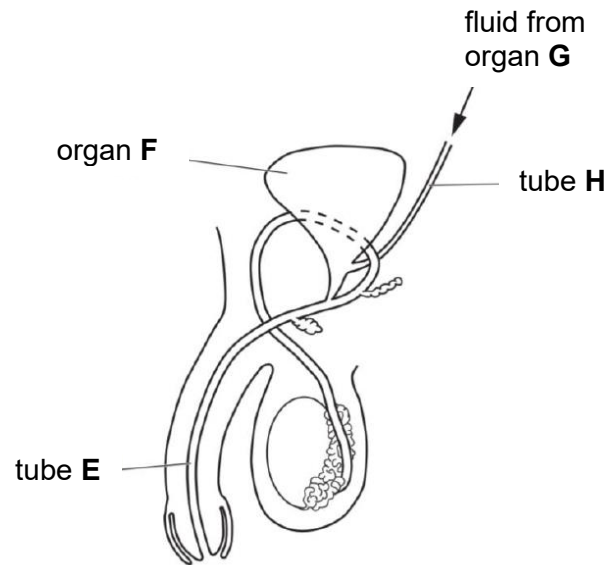


Fig. 6.1

(a) (i) Identify each of the following:

tube **E**

organ **F**

organ **G**

tube **H**

[2]

(ii) State one difference between the fluids carried by tube **E** and tube **H**.

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..... [1]

(b) State one way in which the fluid from organ **G** may be different in a person with diabetes compared to a person without diabetes.

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..... [1]

- (c) The flowers of a species of plant are either purple or white. This trait is controlled by a pair of alleles. A purple flower plant is self pollinated and 200 seeds were produced. These seeds grew into plants and the colour of the flowers produced were recorded in Table 6.2.

Table 6.2

colour of flowers	purple	white	red
number of plants	151	48	1

- (i) State the colour of the flower expressed by the dominant allele.

..... [1]

- (ii) Using a genetic diagram, show how self-pollination of the purple flower plant can produce white flower plants.

[4]

- (iii) Suggest a possible reason for the presence of the single red flower plant.

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 [1]

[Total: 10]

- 7 Hamsters are mammals, similar to humans. Fig. 7.1 shows the experimental setup used by a student to find out if body size affects the rate of respiration in hamsters. The hydrogen carbonate indicator turns yellow when it is acidic.

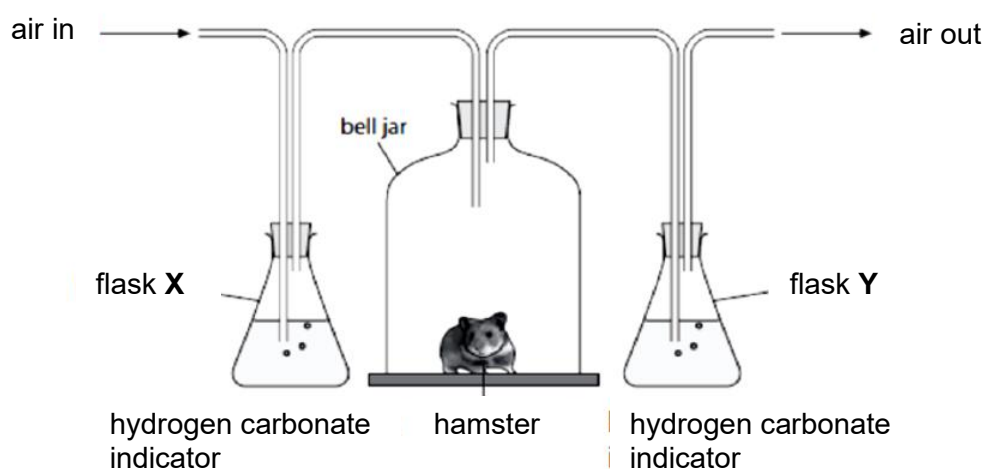


Fig. 7.1

She placed a small hamster into a bell jar and measured the time taken for the hydrogen carbonate indicator to turn yellow in flask Y. She repeated the experiment with a bigger hamster under the same conditions. Table 7.2 shows the results obtained.

Table 7.2

size of hamster	time taken for indicator to turn yellow / minutes
small	8
big	14

- (a) Describe and explain the difference in the results obtained.

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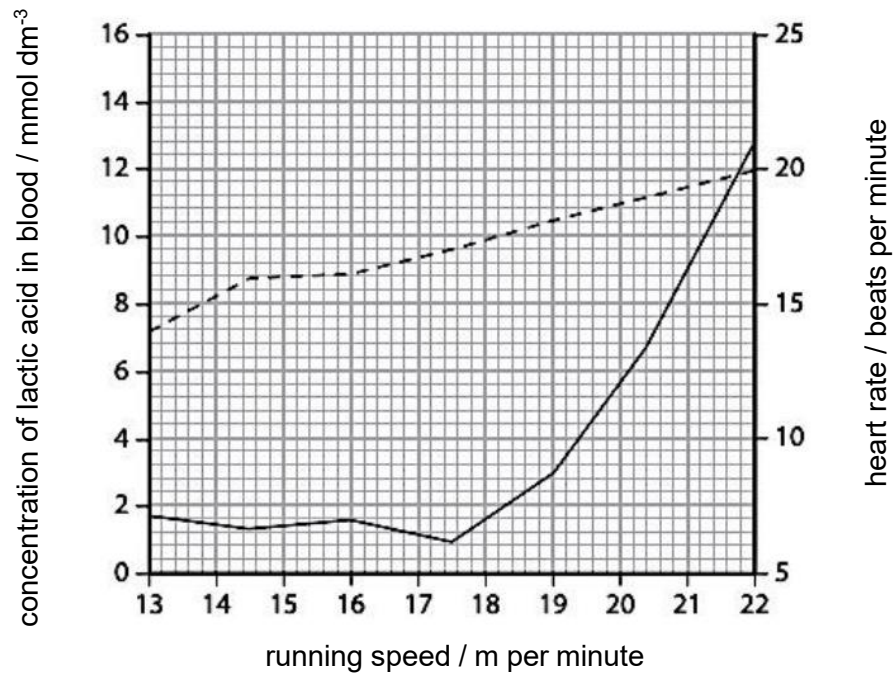
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[4]

- (b) In a separate investigation, the hamster was made to run on a hamster wheel at different speeds. Fig. 7.3 shows the concentration of lactic acid in the blood and the heart rate of the hamster while running.



Legend:

- concentration of lactic acid in the blood
 - - - - - heart rate of hamster while running

Fig. 7.3

- (i) Explain why the concentration of lactic acid changes at running speeds greater than 18 m per minute.

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- (ii) After running, the hamster was allowed to rest. Explain why the heart rate does not return to normal immediately.

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[Total: 10]

8 (a) Define what is a *vaccine*.

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..... [1]

(b) The mRNA vaccine for COVID-19 involves injecting an mRNA coding for a viral protein found on the surface of the virus. When exposed to the actual virus, the immune system will be ready to protect the body against the virus.

With reference to the protective function of named blood components, explain how vaccinating a pregnant woman can help to protect both the pregnant mother and her foetus against COVID-19 virus.

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..... [4]

- (c) Influenza (flu) is an infectious disease caused by a virus. People who are considered 'at risk' are offered a vaccination against flu each year. The bar chart in Fig. 8.1 shows the number of people in a population and the percentage of those who were vaccinated against flu.

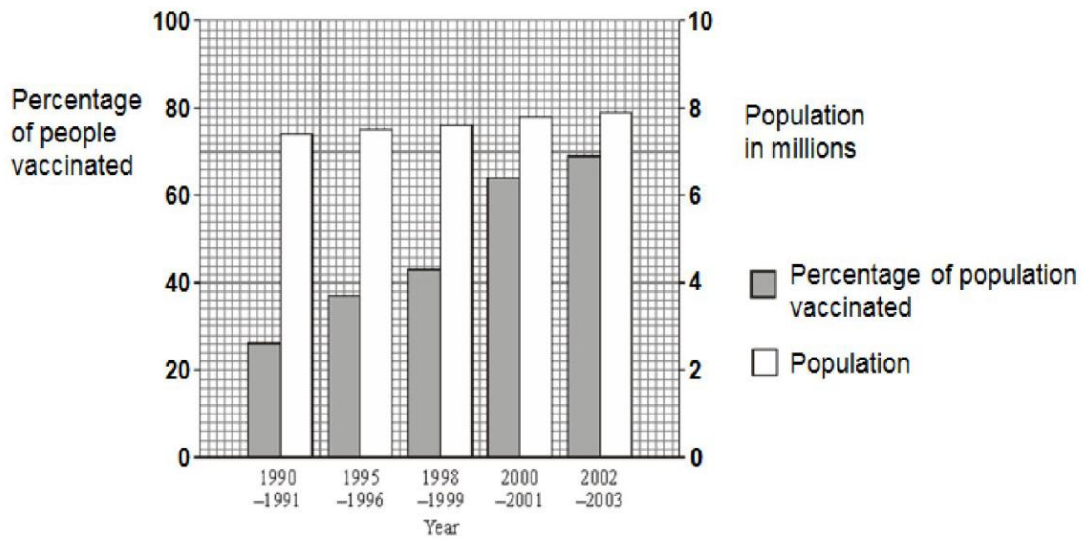


Fig. 8.1

- (i) Describe the change in the percentage of people vaccinated against flu from 1990 to 2003.

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 [2]

- (ii) Suggest possible cause(s) for the trend(s) described in c(i).

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 [2]

- (iii) Suggest why it is advisable for people to be vaccinated against influenza every year.

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 [1]

[Total: 10]

Section B

Answer **ONE** question from this section.

Either

9 An organism's expressed characteristics (traits) is determined by the protein synthesised.

(a) Outline the processes involved in the synthesis of protein from DNA.

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(b) Evolution by natural selection proposed by Charles Darwin is currently the accepted theory of evolution.

Outline natural selection as a mechanism of evolution for the formation of new species.

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..... [4]

(c) Fig. 9.2 shows the transfer to energy through a food chain.

Each number is the amount of energy, measured in kJ per m² per year, stored in the population of organisms.

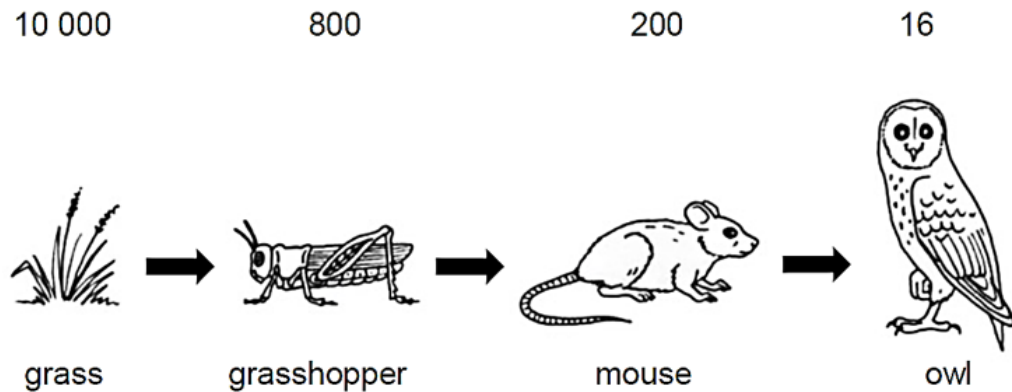


Fig. 9.2

- (i) State two reasons for the energy losses that occurs along the food chain shown in Fig. 9.2.

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..... [2]

- (ii) Calculate the overall percentage efficiency of the energy transfer from the grass to the owls. Show your working in the space below.

Answer: % [1]

- (iii) Based on the information in Fig. 9.2, suggest why owls are likely to be the final trophic level in this food chain.

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..... [1]

[Total: 10]

Or

- 9 Table 9.1 shows two experiments were carried out to investigate the effect of the removal of liver and kidneys from rats on blood urea concentration.

Table 9.1

experiment A	kidneys removed at start of experiment	liver removed eight hours later
experiment B	liver removed at start of experiment	kidneys removed eight hours later

The blood urea concentration of the rats was measured from 0 hour to 16 hours. The results are shown in Table 9.2.

Table 9.2

time / hours	blood urea concentration / mg per 100 cm ³ blood	
	experiment A	experiment B
0	10.0	10.0
4	17.0	5.0
8	22.0	2.5
12	21.0	2.0
16	21.0	2.0

- (a) Plot graph of experiment **A** and **B** shown in Table 9.2 on the grid on the next page. [4]

- (b) Explain the change in blood urea concentration of the rats shown in Table 9.2.

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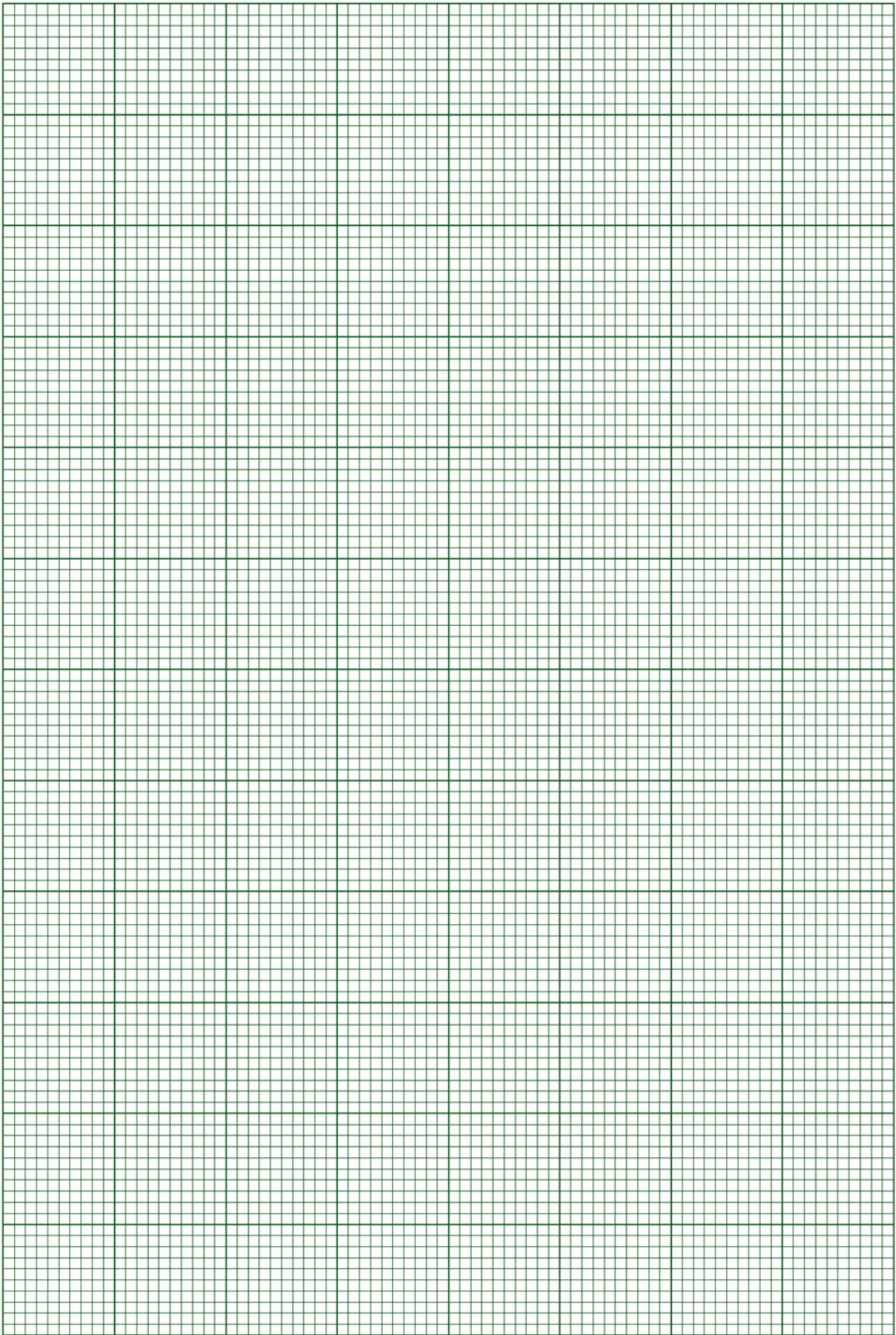
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- (c) Explain how kidneys maintain water potential within the body during a period of fasting without drinking water.

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[Total: 10]

End of Paper