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**BIOLOGY** **0610/42**

Paper 4 Theory (Extended) **October/November 2022**

**1 hour 15 minutes**

You must answer on the question paper.

No additional materials are needed.

**INSTRUCTIONS**

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

**INFORMATION**

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

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**1** Phytoplankton consist of many species of single-celled and many-celled algae.

View solution

**(a)** Algae are classified in the Protoctist kingdom. All algae contain one or more chloroplasts.

State the name of another kingdom that contains organisms which have chloroplasts.

..... [1]

A student investigated the species composition of the phytoplankton in a lake.

Fig. 1.1 shows some of the phytoplankton collected by the student.

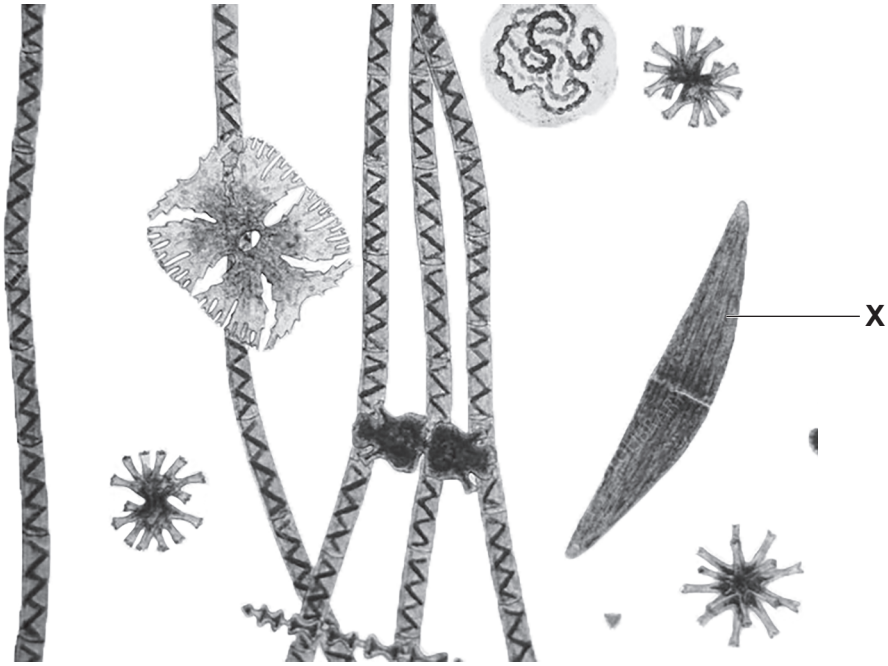


**Fig. 1.1**

View solution

**(b)** The actual length of alga **X** is 0.19 mm.

Convert the actual length of alga **X** to micrometres.

..... μm [1]

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**(c)** The student made careful drawings of seven types of alga found in the samples of lake water.

The drawings are shown in Fig. 1.2.

View solution

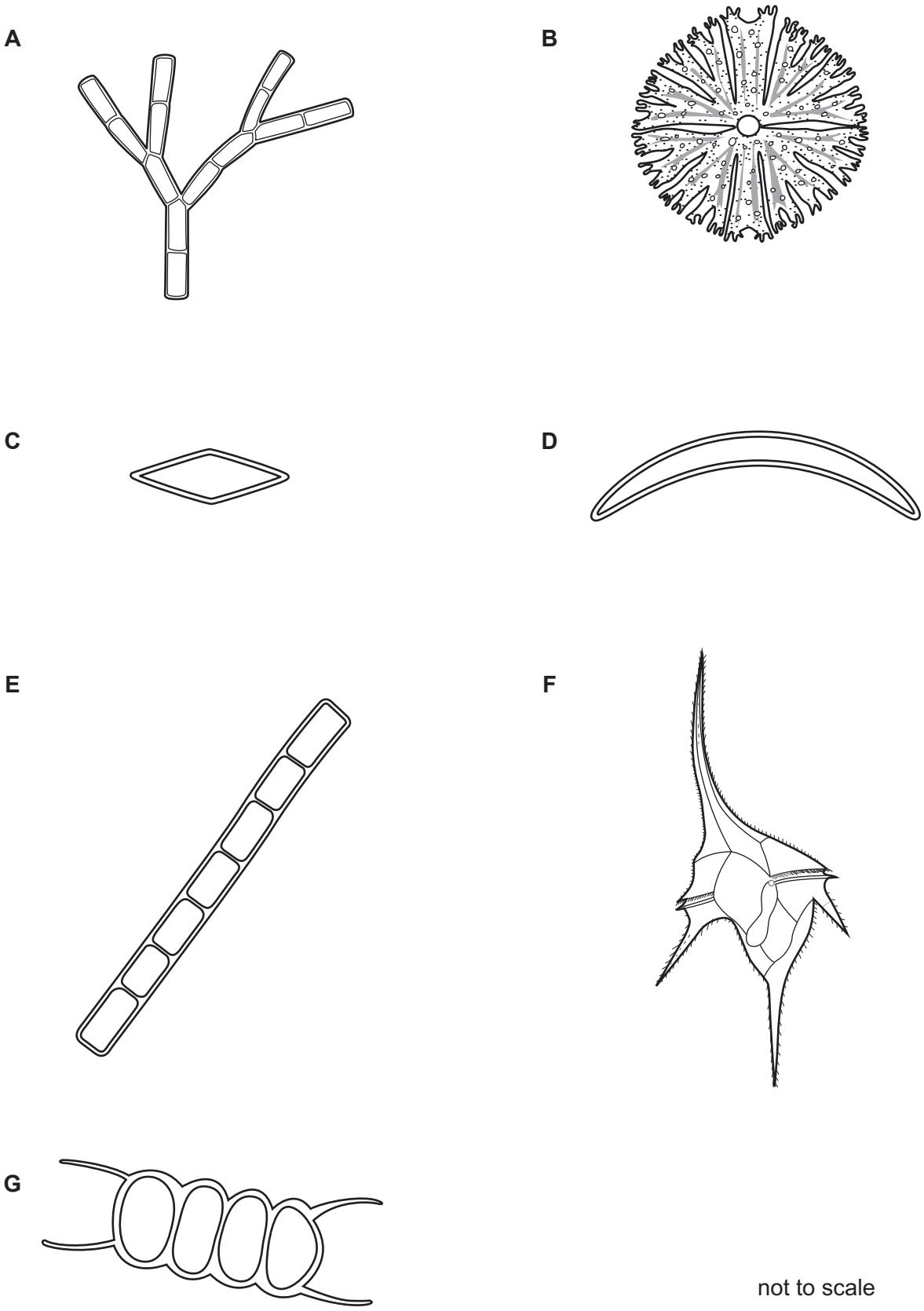


**Fig. 1.2**

Use the key to identify each of the species **A** to **G**. Write the letter of each species in the correct box beside the key.

| | | | |
|---|---|---|---|
| 1 | alga has four spine-like extensions | go to 2 | |
| | alga does not have four spine-like extensions | go to 3 | |
| 2 | alga has spine-like extensions that are all the same length | *Scenedesmus communis* | |
| | alga has spine-like extensions that are different lengths | *Ceratium hirundinella* | |
| 3 | alga has a round shape | *Micrasterias radiosa* | |
| | alga does not have a round shape | go to 4 | |
| 4 | alga narrows towards the ends | go to 5 | |
| | alga does not narrow towards the ends | go to 6 | |
| 5 | algal cell is semi-circular in shape | *Closterium dianae* | |
| | algal cell is not semi-circular in shape | *Navicula radiosa* | |
| 6 | alga is branched | *Chaetophora incrassata* | |
| | alga is not branched | *Zygnema* sp. | |

[5]

View solution

**(d)** Phytoplankton are photosynthetic organisms.

Describe the importance of phytoplankton in the food web of lake ecosystems.

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..... [3]

[Total: 10]

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**2** Fig. 2.1 is a diagram of the human alimentary canal and associated organs.

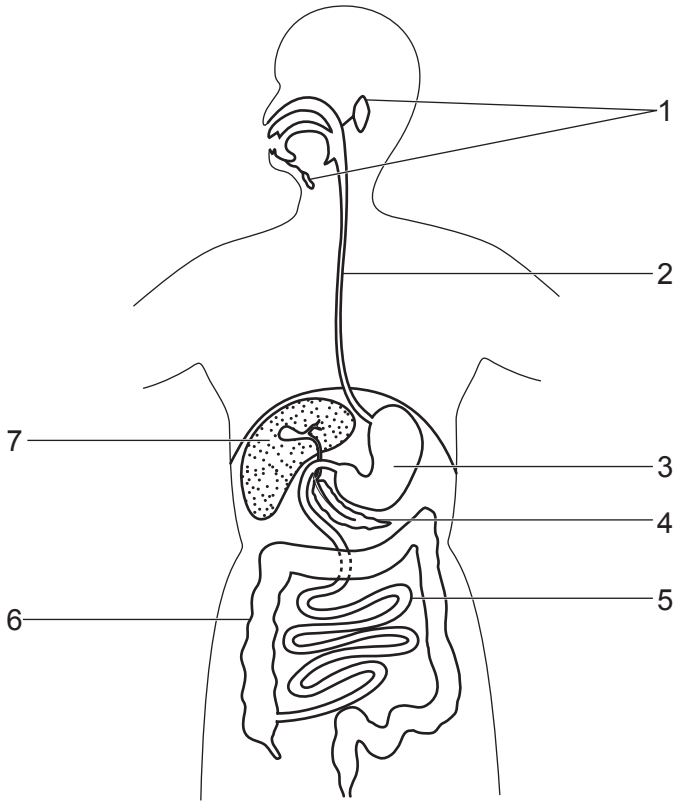


**Fig. 2.1**

**(a)** Table 2.1 shows enzymes, the organs that secrete these enzymes, their substrates and products.

Complete Table 2.1.

View solution

**Table 2.1**

| enzyme | organ that secretes the enzyme | number identifying the organ on Fig. 2.1 | substrate | product or products |
|---|---|---|---|---|
| amylase | | 1 | | |
| | | 3 | protein | |
| lipase | | 4 | | |
| maltase | | | | |

[4]

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**(b)** Explain the role of hydrochloric acid in the alimentary canal.

View solution

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..... [3]

**(c)** State a function of the region of the alimentary canal labelled 6 in Fig. 2.1.

View solution

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..... [1]

**(d)** Describe how food eaten by humans is reduced to smaller pieces **and** explain how this makes chemical digestion more efficient.

You may refer to Fig. 2.1 in your answer.

View solution

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..... [6]

[Total: 14]

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**3** Aphids are insects that feed on phloem sap by inserting their mouthparts into phloem tissue.

Fig. 3.1 shows an aphid feeding on phloem tissue in a leaf.




**Fig. 3.1**

**(a) (i)** State **two** features **visible in Fig. 3.1** that identify this animal as an insect.

View solution

1 .....

2 .....

[2]

**(ii)** Aphids can transmit viral pathogens when they feed on a plant.

View solution

Suggest how a severe infestation of aphids on crop plants can be avoided.

.....

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..... [2]

**(iii)** The aphid shown in Fig. 3.1 is feeding on phloem tissue in a leaf.

State the names of **two** tissues in the leaf that the mouthparts of the aphid pass through to reach the phloem.

1 .....

2 .....

[2]

View solution

**(b)** Aphids have been used to investigate the translocation of sucrose in phloem tissue. While they are feeding on phloem sap aphids excrete a sucrose-rich fluid known as honeydew.

In an investigation, two groups of four aphids were placed at intervals along the stem of a young willow plant, as shown in Fig. 3.2.

View solution

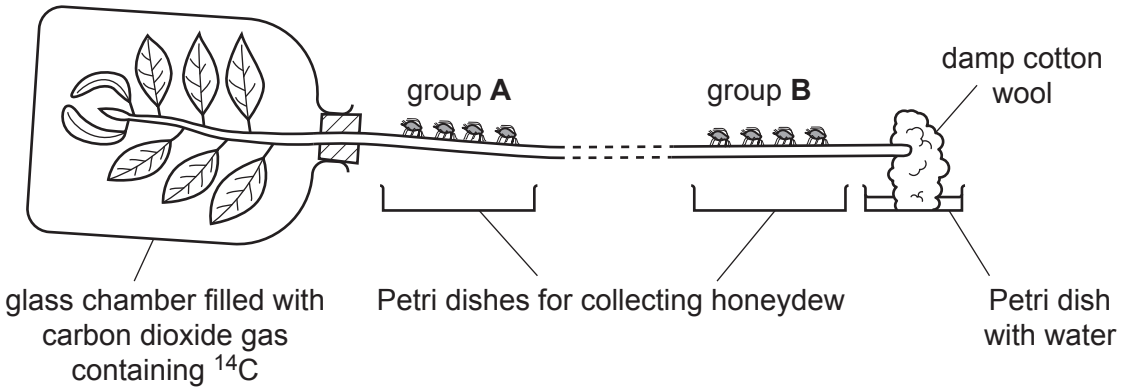


**Fig. 3.2**

The leaves were enclosed in an airtight glass chamber. A special form of carbon dioxide gas that contained radioactive carbon-14 ($^{14}C$) was supplied to the leaves for a short period of time.

Samples of honeydew were collected at intervals from the groups of aphids. The time taken for sucrose containing $^{14}C$ to travel the distance between group **A** and group **B** was recorded.

The investigation was repeated twice using a fresh stem and different groups of aphids for each trial. The results are shown in Table 3.1.

**(i)** Complete Table 3.1 by calculating the rate of movement of $^{14}C$ in trial 3.

**Table 3.1**

| trial | distance between group **A** and group **B** on the stem / mm | time taken for $^{14}C$ to travel between group **A** and group **B** / minutes | rate of movement of $^{14}C$ / mm per hour |
|---|---|---|---|
| 1 | 650 | 120 | 325 |
| 2 | 340 | 75 | 272 |
| 3 | 630 | 150 | |

[1]

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**(ii)** Outline how $^{14}C$ in carbon dioxide gas becomes incorporated into the sucrose molecules that are translocated in the phloem.

.....

.....

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.....

..... [3]

**(c)** Sucrose travels from the stem to other parts of the plant known as sinks, where it is used.

View solution

**(i)** State **two** parts of a plant that are sinks for sucrose.

1 .....

2 .....

[2]

**(ii)** Sucrose is used in the cells of the sinks in a plant.

View solution

Describe the uses of sucrose by sinks.

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..... [3]

[Total: 15]

**4** **(a)** Fig. 4.1 is a flow chart showing some of the processes that occur in a biofuels power plant.

View solution

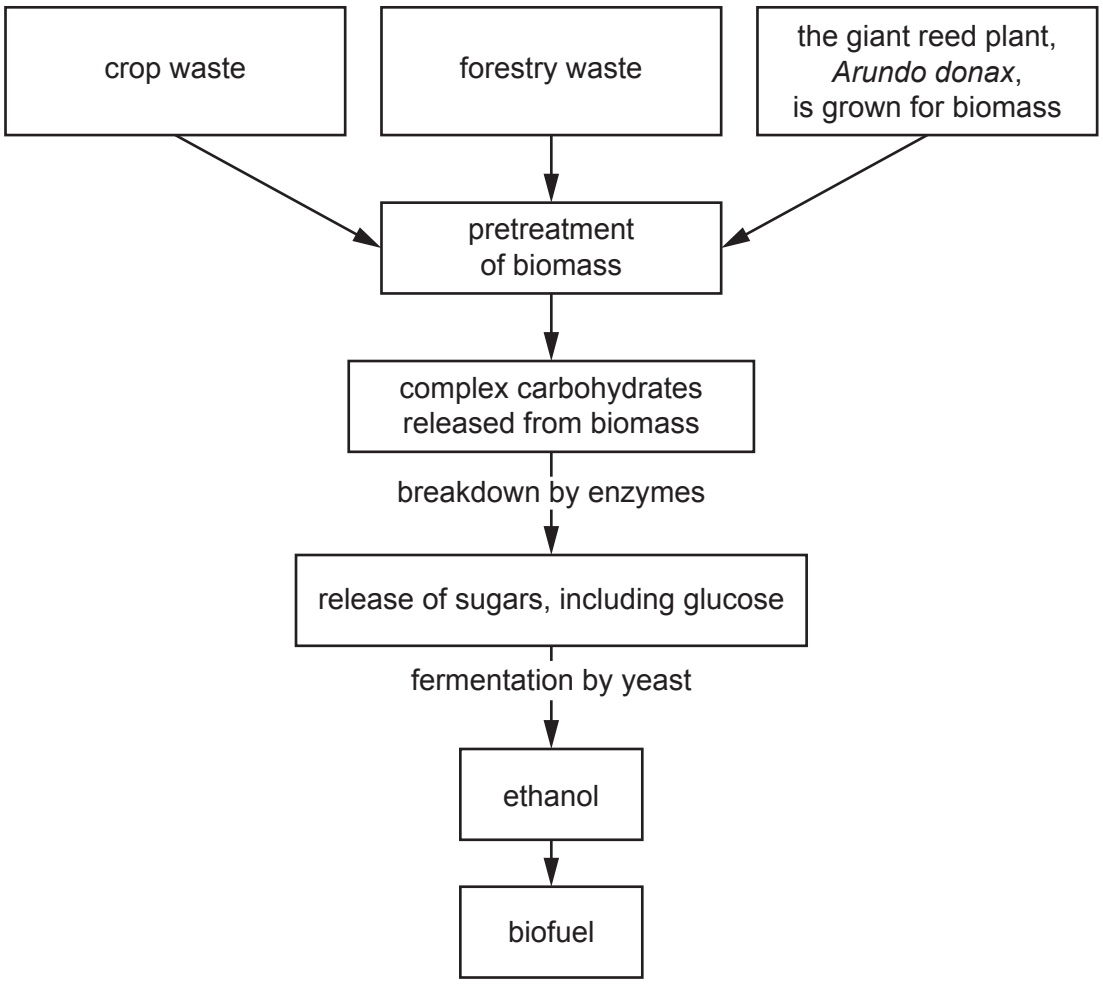


**Fig. 4.1**

**(i)** The fermentation stage shown in Fig. 4.1 requires yeast.

Complete the balanced chemical equation to show how ethanol is produced by yeast respiration.

..... ⟶ ..... + .....

[2]

**(ii)** Using the information in Fig. 4.1, suggest the environmental advantages of using ethanol as a fuel.

.....

.....

.....

.....

.....

.....

..... [3]

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**(iii)** Farmers grow giant reed plants as monocultures.

Describe the disadvantages of growing giant reed plants to provide biomass for the production of biofuels.

.....

.....

.....

.....

..... [2]

**(b)** One problem with using biomass in the process shown in Fig. 4.1 is that the breakdown stage produces a sugar called xylose and ethanoic acid. Yeast cannot use xylose, and ethanoic acid is toxic to yeast.

Scientists genetically engineered a type of yeast that can use xylose and ethanoic acid.

Fig. 4.2 shows the results of one of the trial experiments done by the scientists using their new genetically engineered yeast.

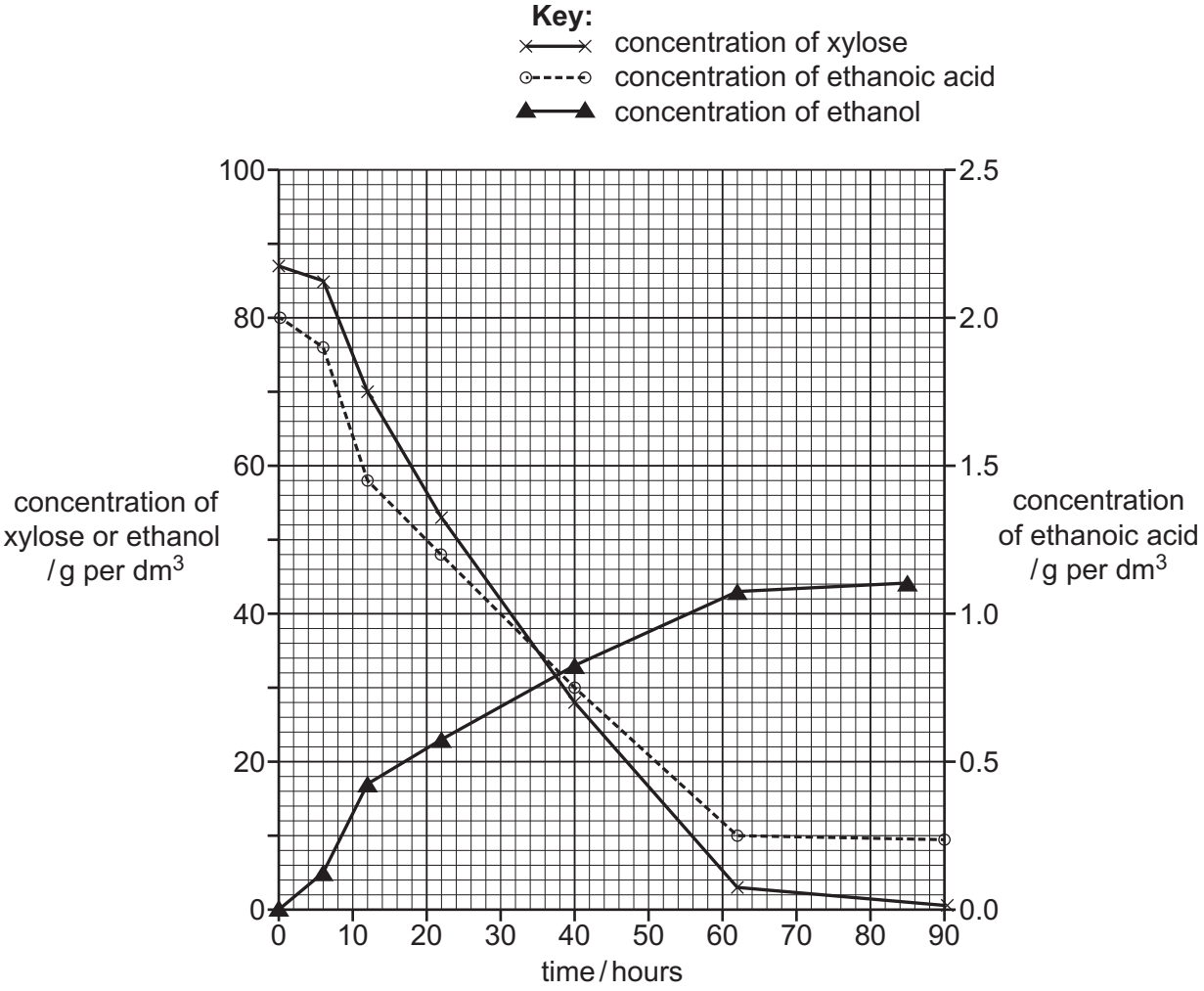


**Fig. 4.2**

**(i)** Describe the results shown in Fig. 4.2.

View solution

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..... [3]

**(ii)** The experiment was done at 30 °C.

View solution

The scientists repeated the experiment at 20 °C.

Predict the results that you would expect for the concentration of ethanol.

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..... [1]

[Total: 11]

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**5** Fig. 5.1 shows Mackinlay's cuckoo-dove, *Macropygia mackinlayi*, which is found on most of the islands in the south-west of the Pacific Ocean.



**Fig. 5.1**

**(a)** Karkar Island is one island where Mackinlay's cuckoo-dove is found. This species is part of many communities that are adapted to the different habitats on the island.

View solution

**(i)** Define the term community.

.....

.....

..... [1]

**(ii)** Complete the passage with the most appropriate word or phrase.

View solution

Adaptation is sometimes defined as the process resulting from .....

....., by which populations become more suited to their

..... over many generations.

[2]

**(b)** The highest point on Karkar Island is 1800 m above sea level.

In 1969, a researcher surveyed the bird species on Karkar Island. He recorded the vertical distribution of the birds between sea level and 1600 m.

View solution

In 2013, other researchers repeated the survey.

Fig. 5.2 shows the ranges of four species, as recorded in the two surveys. The vertical lines represent the range of heights where the birds were seen on the island.

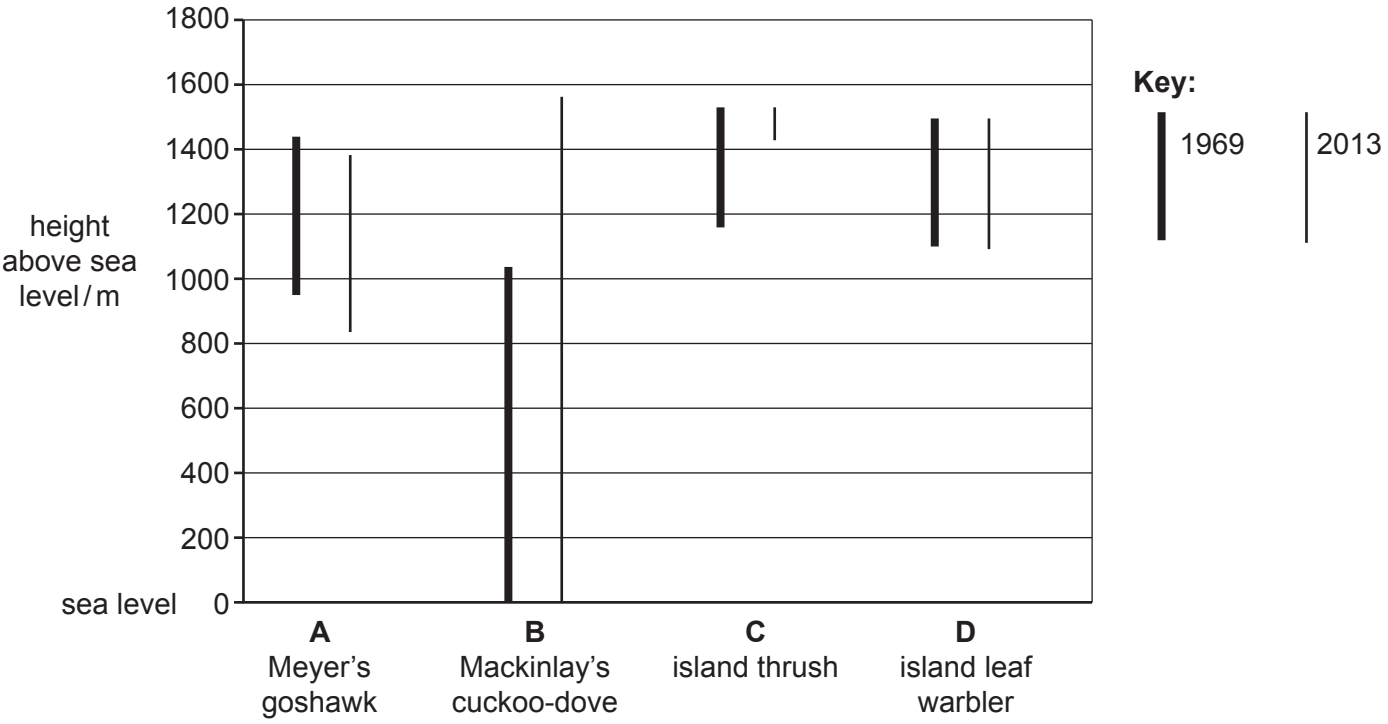


**Fig. 5.2**

**(i)** Compare the range in 1969 with the range in 2013 for each of the bird species shown in Fig. 5.2.

**A** .....

.....

**B** .....

.....

**C** .....

.....

**D** .....

.....

[4]

**(ii)** Using the information in Fig. 5.2, suggest reasons for the change in the range of the island thrush (**C**) on Karkar Island.

.....

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.....

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..... [3]

**(c)** Small oceanic islands are often inhabited by species of birds that are found nowhere else. Many of these species have decreasing populations and are often endangered.

View solution

Explain the risks to these species of birds that have decreasing populations.

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..... [3]

[Total: 13]

**6** **(a)** Fig. 6.1 shows diagrams of the circulatory systems of a fish and a mammal.

The arrows show the direction of blood flow through the circulatory systems.

View solution

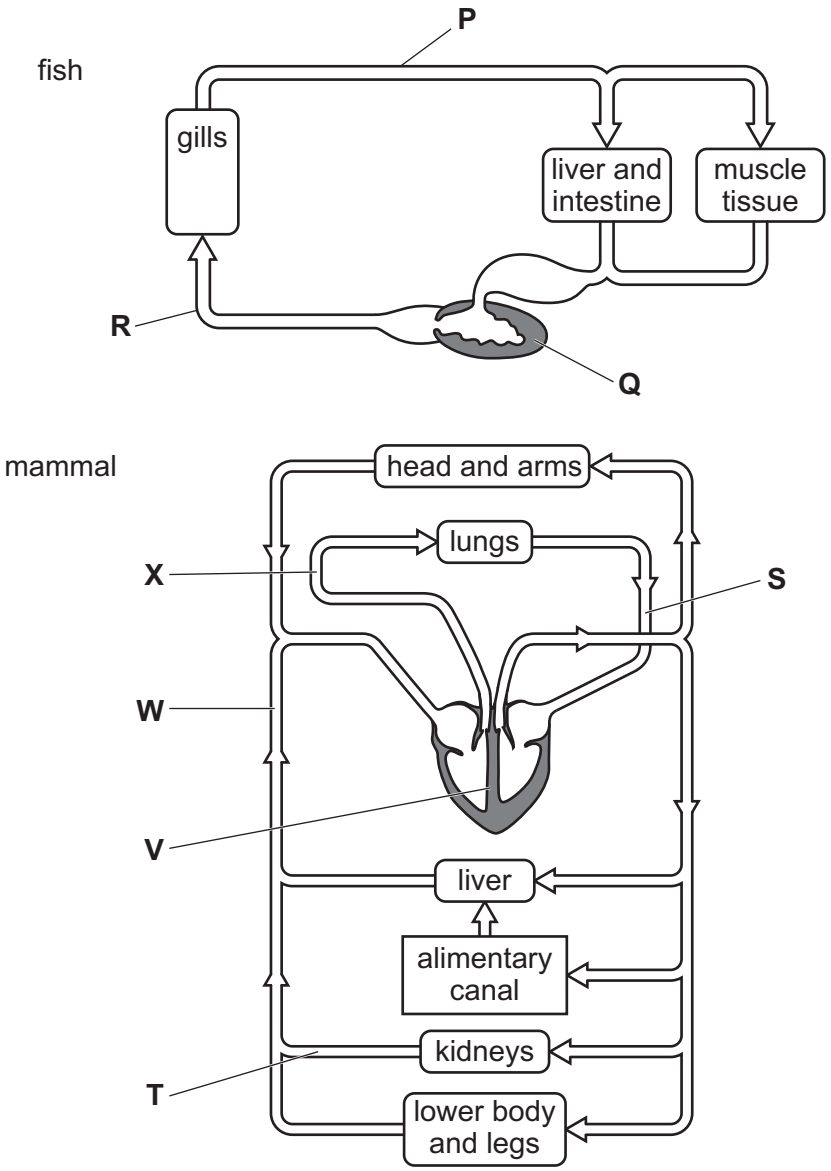


**Fig. 6.1**

**(i)** State the names of the structures labelled **Q**, **T**, **W** and **X**.

**Q** .....

**T** .....

**W** .....

**X** .....

[4]

**(ii)** State the name of structure **V** on Fig. 6.1 **and** describe its function.

View solution

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.....

..... [2]

**(iii)** Fig. 6.1 shows that fish and mammals have different types of circulation.

View solution

State why the fish circulation is called a single circulation.

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..... [1]

**(iv)** Explain the advantages of the double circulation of the mammal.

View solution

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..... [3]

**(b)** The blood vessels that supply the heart muscle can become blocked.

View solution

**(i)** State the name of the blood vessels that supply the heart muscle.

..... [1]

**(ii)** State **one** way in which blockages in these blood vessels can be treated.

..... [1]

View solution

**(c)** Substances move between blood and tissues at various sites in the circulatory system of mammals.

View solution

**(i)** Oxygen is absorbed into the blood as it passes through the lungs.

State the structures in the lungs where oxygen passes into the blood from the air.

..... [1]

**(ii)** State the site of filtration of blood in the kidneys.

..... [1]

**(iii)** State the name of the process in which products of digestion move into cells and are used to become part of the cells.

..... [1]

**(iv)** State the name of the process in which excess amino acids are broken down in liver cells to produce ammonia.

..... [1]

**(v)** State the name of the organ that releases oestrogen into the blood.

..... [1]

[Total: 17]

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