1 **(a)** Fig. 1.1 represents a molecule of ATP.

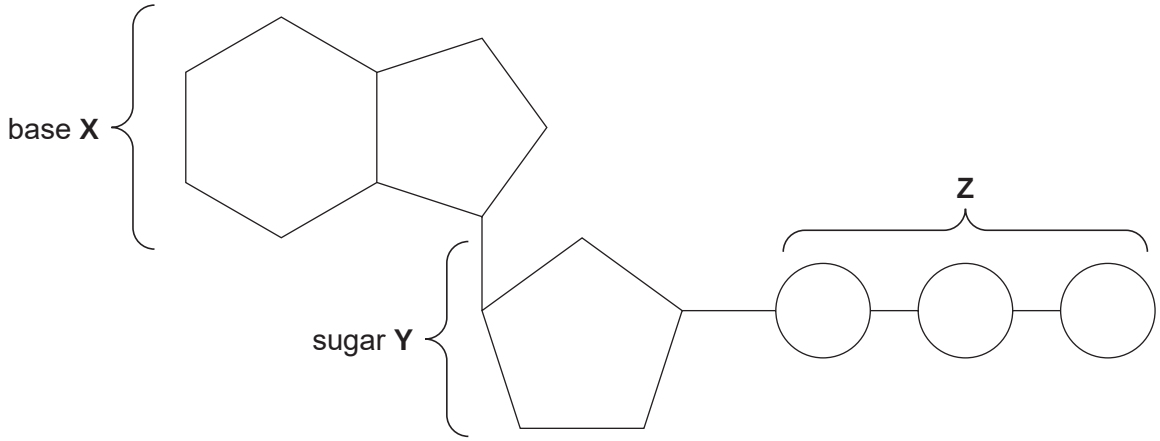

Fig. 1.1

(i) Name the parts of the ATP molecule labelled **X**, **Y** and **Z**.

X .....

Y .....

Z ..... **[3]**

(ii) With reference to Fig. 1.1, describe and explain the role of ATP in the cell.

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..... **[3]**

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(b) Fig. 1.2 is an electron micrograph of a mitochondrion from an animal cell.

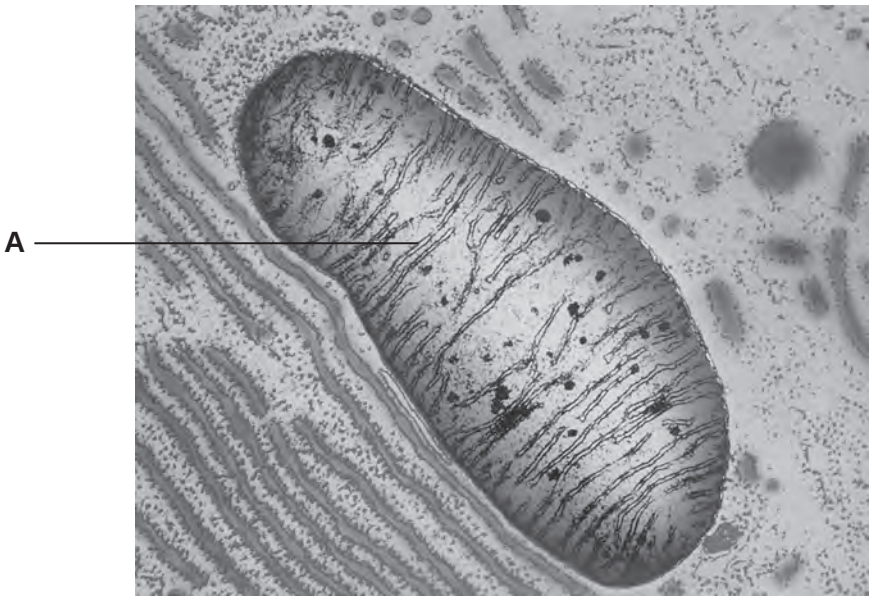

Fig. 1.2

(i) Name the structure labelled **A**.

..... **[1]**

(ii) Name the specific process that is carried out by structure **A** in the mitochondrion.

..... **[1]**

(c) Some animals conserve energy by entering a state of torpor (a short period of dormancy), in which they allow their body temperature to fall below normal for a number of hours.

In an investigation into torpor in the Siberian hamster, *Phodopus sungorus*, the animal's respiratory quotient (RQ) was measured before and during the period of torpor.

The respiratory quotient is determined by the following equation:

$$RQ = \frac{\text{volume of carbon dioxide produced}}{\text{volume of oxygen consumed in the same time}}$$

RQ values for different respiratory substrates have been determined and are shown in Table 1.1.

Table 1.1

substrate	RQ
carbohydrate	1.0
lipid	0.7
protein	0.9

(i) Initially, the RQ value determined for the hamster was 0.95, but as the period of torpor progressed, its RQ value decreased to 0.75.

What do these values suggest about the substrates being respired by the hamster during the period of the investigation?

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..... **[3]**

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(ii) Describe the way in which an endothermic animal, such as a mammal, normally prevents its body temperature from decreasing when the external temperature decreases.

In your answer, you should use appropriate technical terms, spelt correctly.

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..... **[5]**

[Total: 16]

2 **(a)** Fig. 2.1 represents the first stage of respiration.

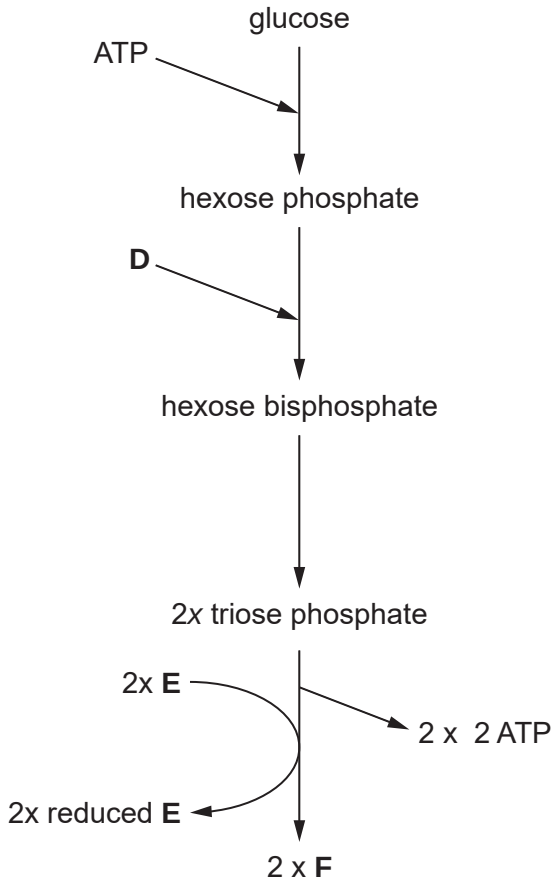

Fig. 2.1

(i) Name the stage represented by Fig. 2.1.

..... **[1]**

(ii) State precisely where in the cell this stage takes place.

..... **[1]**

(iii) Identify the compounds **D**, **E** and **F**.

D .....

E .....

F ..... **[3]**

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(b) In **anaerobic** conditions, compound **F** does not proceed to the link reaction.

Describe the fate of compound **F** during anaerobic respiration in an animal cell **and** explain the importance of this reaction.

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..... **[5]**

(c) Fig. 2.2 is a drawing of a common seal, *Phoca vitulina*, an aquatic mammal.

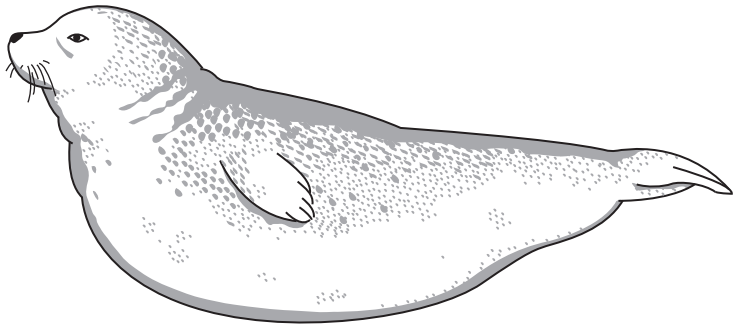

Fig. 2.2

The seal comes to the surface of the water to obtain air and it can then stay underwater for over 20 minutes.

Fig. 2.3 shows a seal at the surface of the water and Fig. 2.4 shows the same animal then submerging again.

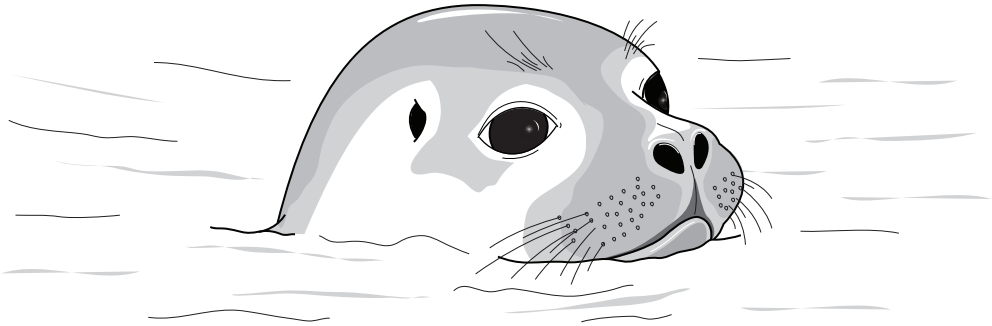

Fig. 2.3

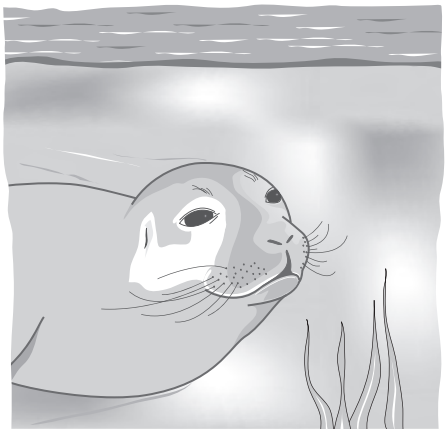

Fig. 2.4

Suggest how the seal is adapted to respire for such a long time underwater.

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..... **[3]**

[Total: 13]

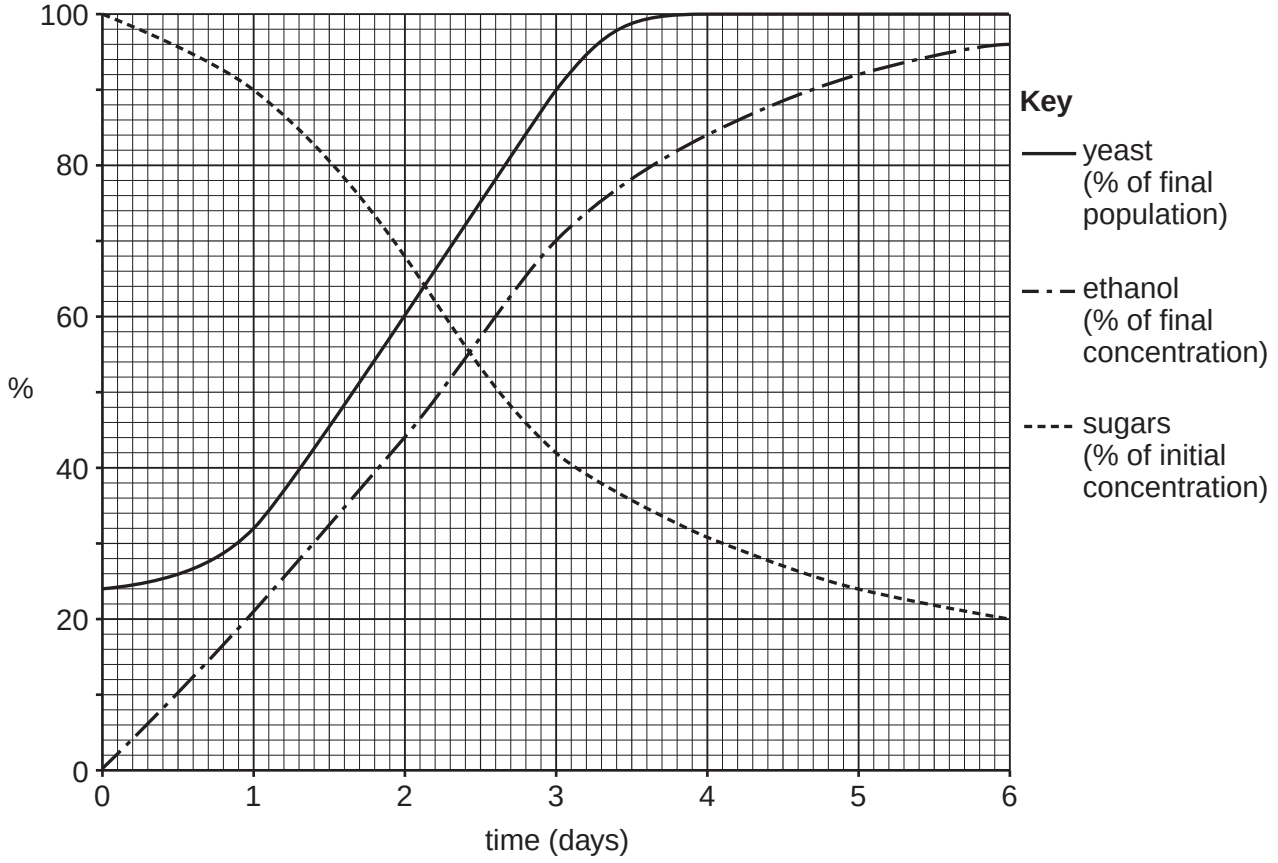
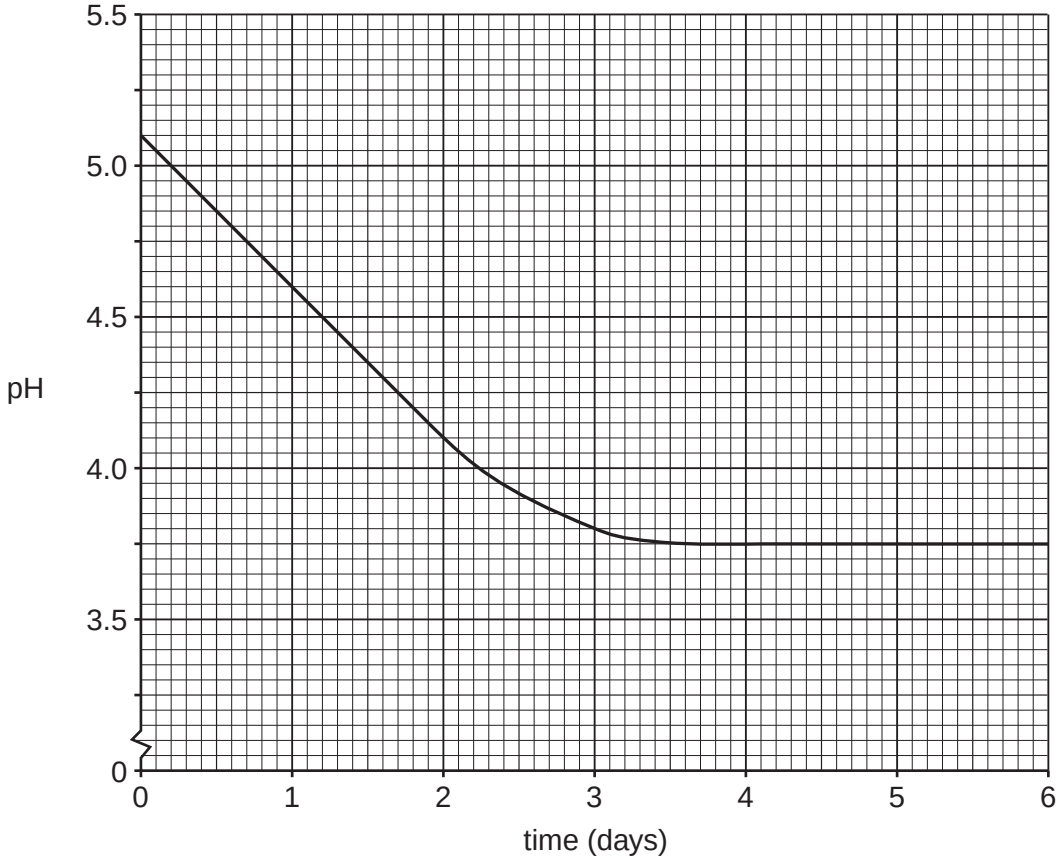

100
80
60
%
40
20
0
0
1
2
3
4
5
6
time (days)
Key
yeast (% of final population)
ethanol (% of final concentration)
sugars (% of initial concentration)

Fig. 5.1(a)


5.5
5.0
4.5
pH
4.0
3.5
0
0
1
2
3
4
5
6
time (days)

3 A batch fermenter is used during the production of beer.

Fig. 5.1(a) and Fig. 5.1(b), **on page 3 of the insert**, show some changes that take place in the fermenter over the first 6 days.

(a) **(i)** Describe the pattern of growth of the yeast population in this fermenter.

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..... **[4]**

(ii) Fig. 5.1(a) shows that as the sugar concentration decreases the ethanol concentration increases.

Explain this relationship.

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..... **[3]**

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(iii) Using the information from Fig. 5.1(a), explain why ethanol is considered to be a primary metabolite of yeast.

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..... **[1]**

(iv) Using only the information from Fig. 5.1(a) and Fig. 5.1(b), outline how **two** factors may limit the maximum size of the yeast population.

1 .....

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2 .....

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[2]

(b) A mixture of three sugars is added to the batch fermenter at the beginning of the process:

- the monosaccharide glucose, which the yeast uses up first, during days 0 to 2
- the disaccharide maltose, which is used during days 1 to 5
- the trisaccharide maltotriose, which is used during days 4 to 6.

Suggest why the yeast uses the sugars in this order.

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..... **[3]**

(c) Ethanol is an important chemical that is manufactured on a large scale.

One large-scale process to produce ethanol uses biotechnology, with yeast acting on sugar in a fermenter.

Another large-scale process uses a chemical method instead of microorganisms. This method needs:

- ethene (obtained from oil)
- a high temperature of 300 °C
- high pressure steam.

Discuss the advantages and disadvantages of **using yeast** to make ethanol rather than using the chemical method.

In your answer you should give a balanced account of both the advantages and disadvantages.

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..... **[6]**

[Total: 19]

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4 Fatigue is a symptom of some medical conditions. One feature of fatigue is extreme tiredness, due to a lack of energy.

Medical conditions that have fatigue as a characteristic symptom include Type 2 diabetes, certain heart conditions, chronic fatigue syndrome (CFS) and emphysema.

(a) Explain how emphysema could result in fatigue.

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..... **[2]**

(b) In Type 2 diabetes, the target cells do not respond correctly to the insulin produced when there is an increase in blood glucose concentration.

Suggest why fatigue may occur in a person with Type 2 diabetes who is **not** taking medication.

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..... **[2]**

(c) Certain heart conditions result in a weak and irregular heart beat.

Suggest how a weak and irregular heart beat could result in fatigue.

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..... **[2]**

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(d) Chronic fatigue syndrome (CFS) is a condition in which symptoms vary from individual to individual.

It is thought that a number of different malfunctioning processes can contribute to this condition in an individual.

CFS can affect every system in the body and is identified by symptoms that include fatigue, muscle weakness and aching muscles.

(i) It has been suggested that, in the cells of people with CFS, pyruvate may not be transferred into the mitochondria efficiently.

Outline the consequences of an inefficient transfer of pyruvate into mitochondria and link this to the symptoms of CFS stated above.

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..... **[3]**

(ii) Some people with CFS overproduce T lymphocytes and associated cytokines. Despite this, the specific immune response is poor in these people, resulting in an increased susceptibility to infection.

Suggest a reason for the poor specific immune response in people with CFS.

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..... **[1]**

[Total: 10]