Answer **all** the questions.

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

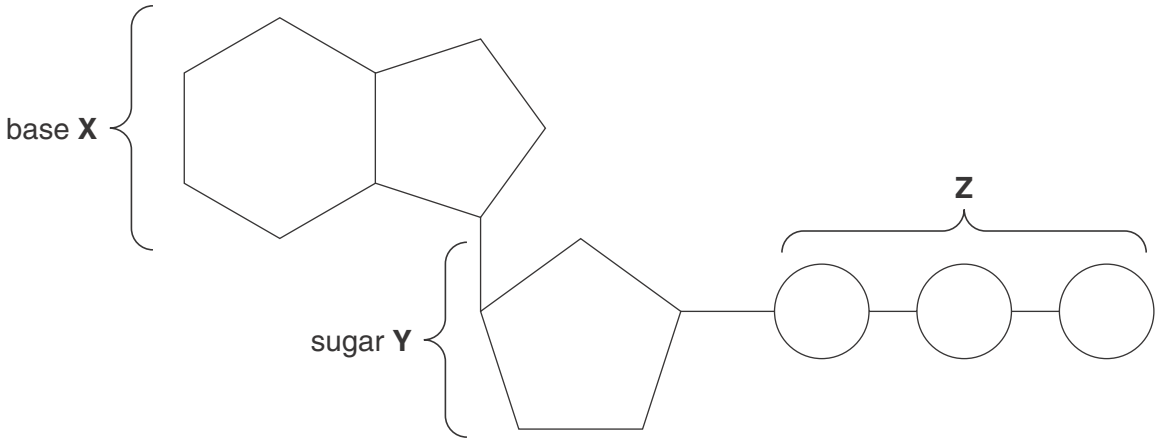

Fig. 1.1

(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]**

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

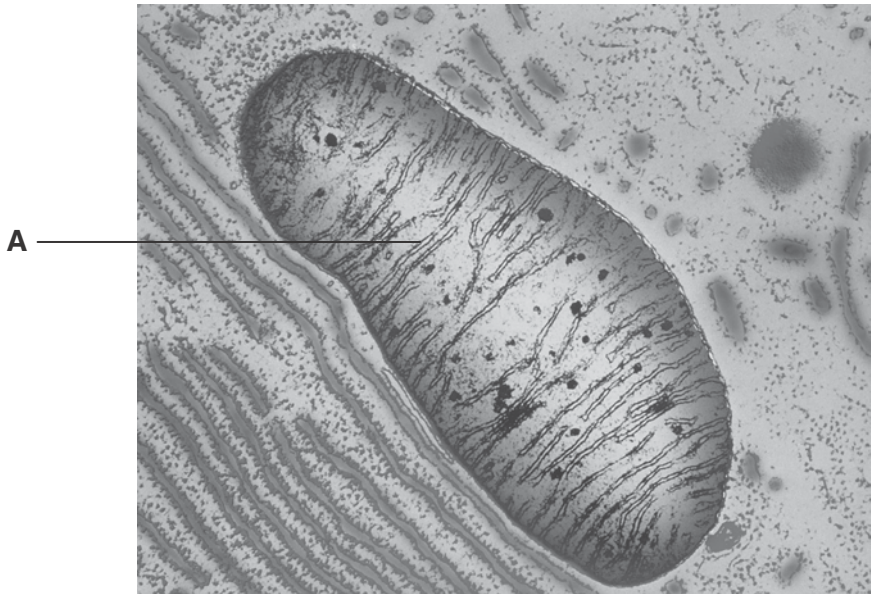

Fig. 1.2

(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]**

(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 is a photomicrograph through the centre of a lobule of a mammalian liver.

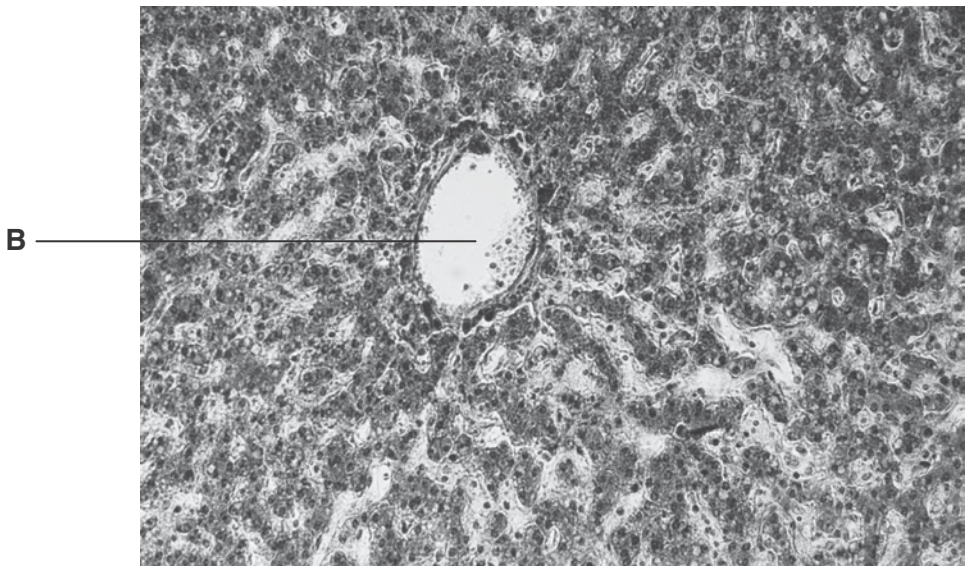

Fig. 2.1

(i) Name the type of vessel labelled **B**.

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

(ii) Name the cells that make up the lobule.

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

(b) Fig. 2.2 outlines the formation of urea in the liver.

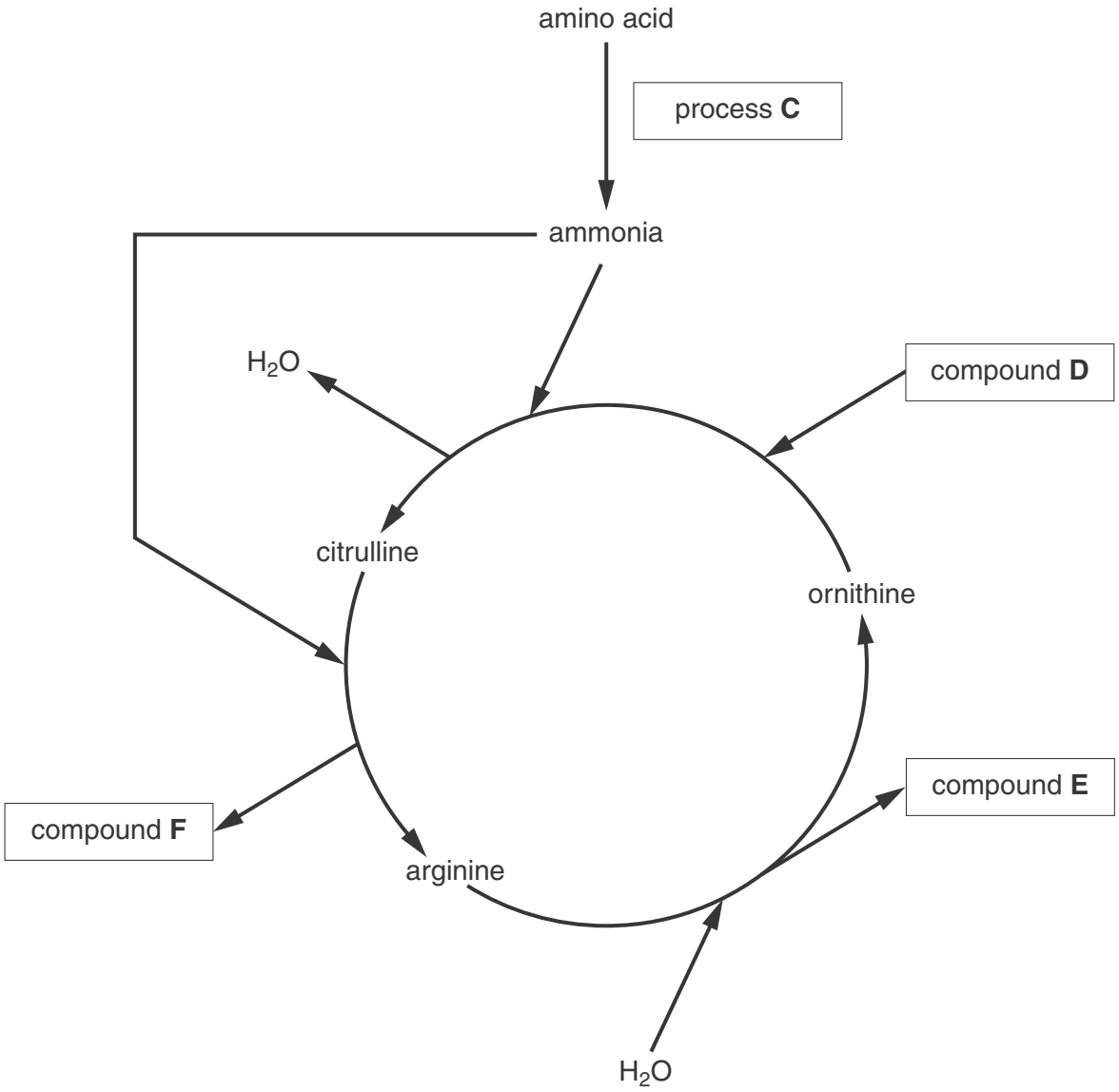

Fig. 2.2

Using Fig. 2.2, identify:

process **C** .....

compound **D** .....

compound **E** .....

compound **F** ..... **[4]**

(c) The urea formed in the ornithine cycle will be excreted from the body in urine. Urine also contains other chemicals.

Procedures have been developed to test for the presence of some of these chemicals, such as hormones.

(i) A pregnancy testing kit contains a testing 'stick' to detect a hormone in the urine.

Explain how the stick detects this pregnancy hormone.

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

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

(ii) The urine of some high profile athletes has been tested and found to contain abnormally high levels of banned steroids or their metabolites.

The pressure on elite athletes to succeed in their sport leads some of them to resort to the use of these performance-enhancing steroids.

Comment on whether the use of steroids should be permitted in sport.

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

[Total: 13]

3 **(a)** The Calvin cycle is the stage of photosynthesis during which carbon dioxide is fixed. The Calvin cycle uses the products of the light dependent stage.

(i) Name the products of the light dependent stage that are used in the Calvin cycle.

.....

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

(ii) Discuss the fate of triose phosphate (TP) in the Calvin cycle.

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

(b) A process known as **photorespiration** also takes place in photosynthetic cells. In this process, oxygen competes with carbon dioxide for the active site of the enzyme RuBP carboxylase (Rubisco).

Fig. 3.1 (a) and Fig. 3.1 (b) outline the processes of photosynthesis and photorespiration.

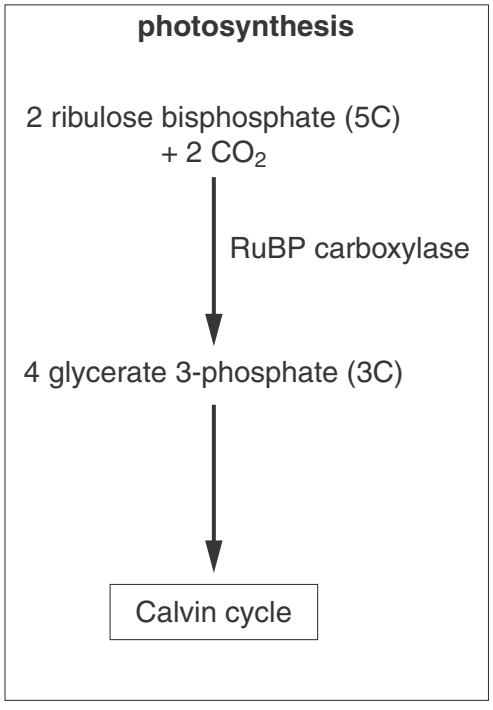

Fig. 3.1 (a)

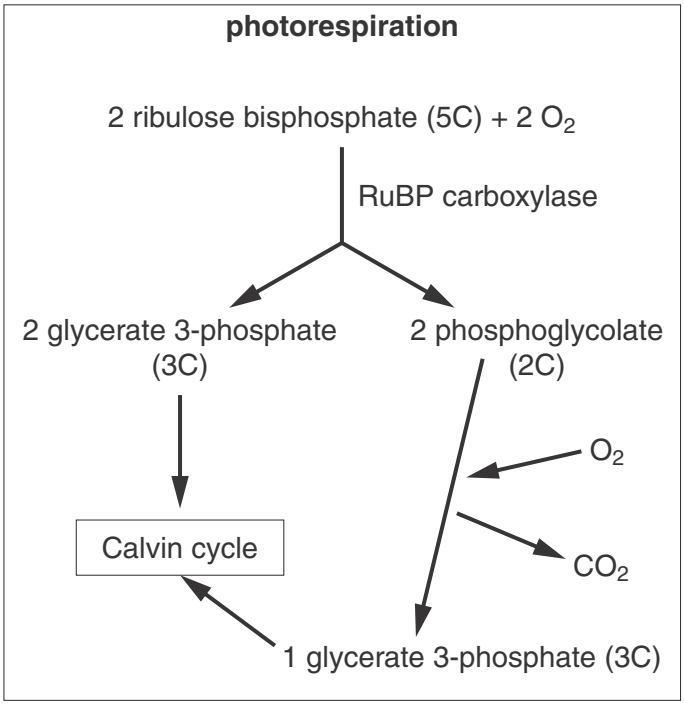

Fig. 3.1 (b)

(i) Suggest why the process outlined in Fig. 3.1 (b) is known as photorespiration.

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

(ii) Using Fig. 3.1 (a) and Fig. 3.1 (b), describe and explain the likely effect on photosynthesis of an increase in the oxygen concentration.

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

(iii) Some plants, known as C_4 plants, use an enzyme called PEP carboxylase, instead of Rubisco, to fix carbon dioxide.

Suggest why these plants do **not** show photorespiration.

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

[Total: 11]

4 As part of a study to control Type 2 diabetes by modification of the diet, an investigation was carried out into the effects of different food compounds on the blood glucose and blood insulin concentrations of patients with this type of diabetes.

The food compounds, their components and their effect on blood glucose and blood insulin concentrations are summarised in Table 4.1.

Table 4.1

food compound	component(s)	effect on blood glucose concentration	effect on blood insulin concentration
sucrose	glucose and fructose	moderate increase	moderate increase
lactose	glucose and galactose	moderate increase	moderate increase
starch	glucose	substantial increase	substantial increase
cellulose	glucose	no effect	no effect
protein	amino acid	no effect	moderate increase
fat	fatty acid and glycerol	no effect	moderate increase

(a) Suggest an explanation for the differences observed in **blood glucose concentration**:

(i) between starch and sucrose,

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

(ii) between starch and cellulose.

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

(b) With reference to the food compounds in Table 4.1, explain how a person with Type 2 diabetes could control the condition by modifying their diet.

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

(c) Glycogen and glucagon are compounds that are involved in the control of blood glucose concentration.

Complete the table below to distinguish between these two compounds.

	glycogen	glucagon
type of compound		
role of compound		
site of production		

[3]

[Total: 10]

5 Fig. 5.1 is a trace that shows the changes that occur in the membrane potential of a neurone during the generation of an action potential.

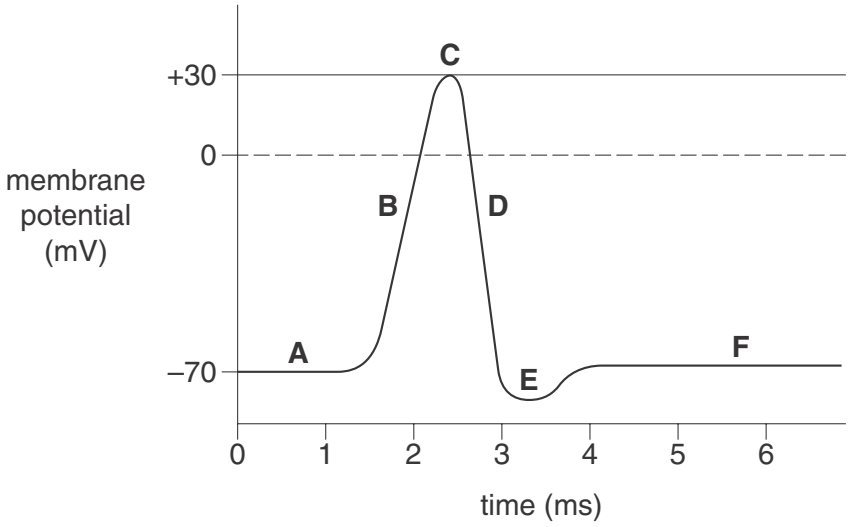

Fig. 5.1

(a) Using the letters **A** to **F**, indicate the point or points on the trace which correspond to the following:

(i) hyperpolarisation,

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

(ii) resting potential,

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

(iii) the membrane is most permeable to potassium ions,

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

(iv) depolarisation.

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

(b) Puffer fish, *Fugu spp.*, produce a powerful poison, tetradotoxin, and some species store it in high concentrations in their body tissues. Unless these fish are correctly prepared, eating them can be fatal.

Tetradotoxin is poisonous to humans because it blocks **gated** sodium channels in cell membranes, preventing action potentials. This does not happen in the fish themselves.

(i) With reference to Fig. 5.1, identify, using the appropriate letter, the part of the action potential trace that will be affected by tetradotoxin.

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

(ii) Suggest why tetradotoxin is **not** toxic to the puffer fish.

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

QUESTION 5(c) STARTS ON PAGE 16

(c) Multiple sclerosis (MS) is an auto-immune condition in which the nervous system is damaged. This damage leads to loss of sensation. One form of damage is shown in Fig. 5.2.

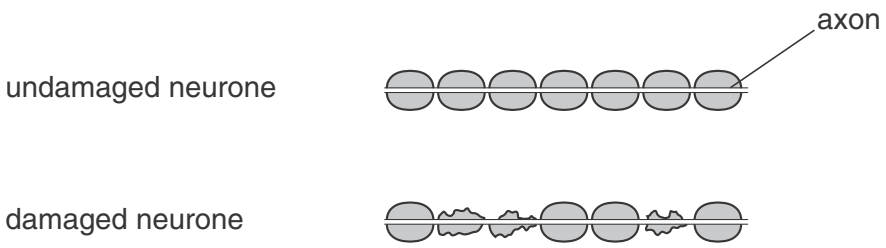

Fig. 5.2

(i) Suggest why MS is described as an auto-immune condition.

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

(ii) Explain why this damage leads to a loss of sensation.

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

[Total: 10]

END OF QUESTION PAPER