Answer **all** the questions.

1 **(a)** Fig. 1.1 represents a sensory neurone connected to its associated receptor cells.

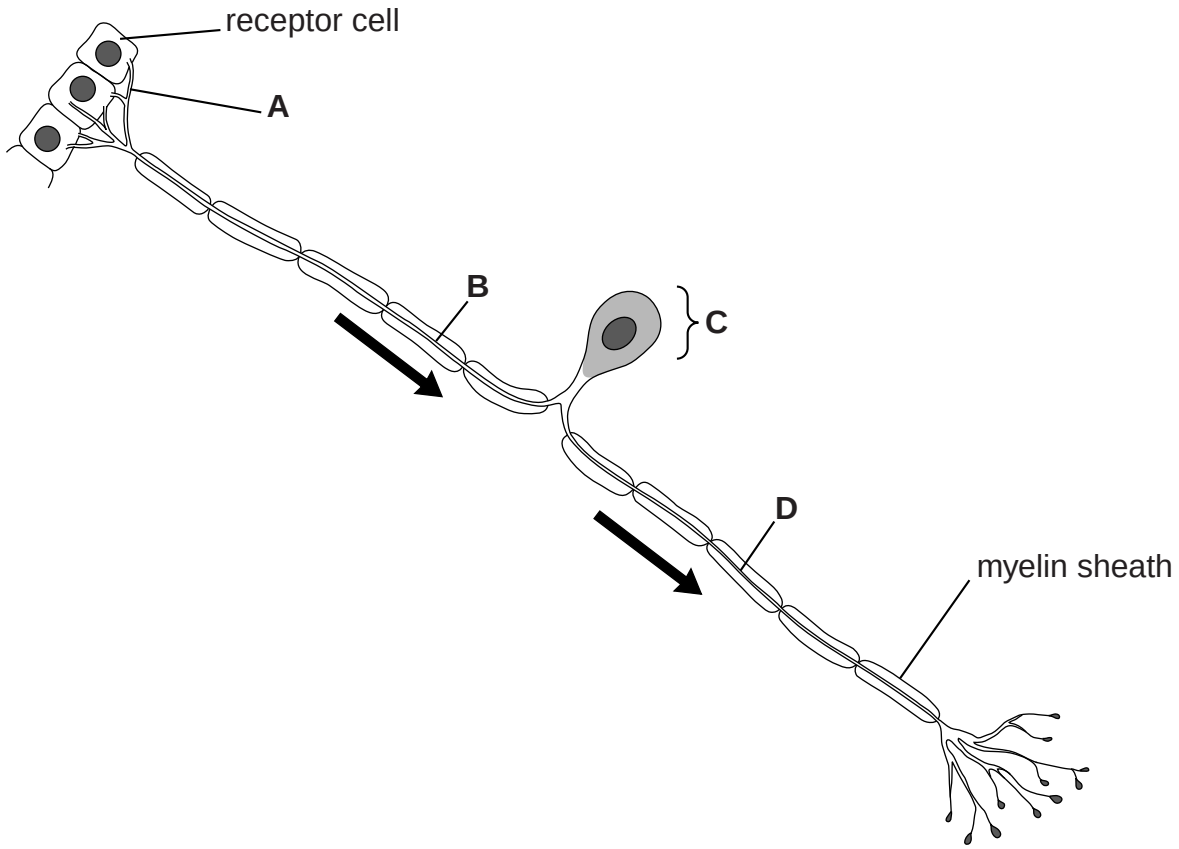

Fig. 1.1

(i) Identify the parts of the neurone labelled **A** to **D**.

A .....

B .....

C .....

D .....

[4]

(ii) What is represented by the arrows on Fig. 1.1?

.....

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

(b) Describe and explain how the **resting potential** is established **and** how it is maintained in a sensory neurone.

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

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

(c) Fig. 1.2 shows the changes in the membrane potential of a sensory neurone when the receptor cells are stimulated.

Fig. 1.3 indicates the strength of the stimuli that results in the corresponding changes in membrane potential.

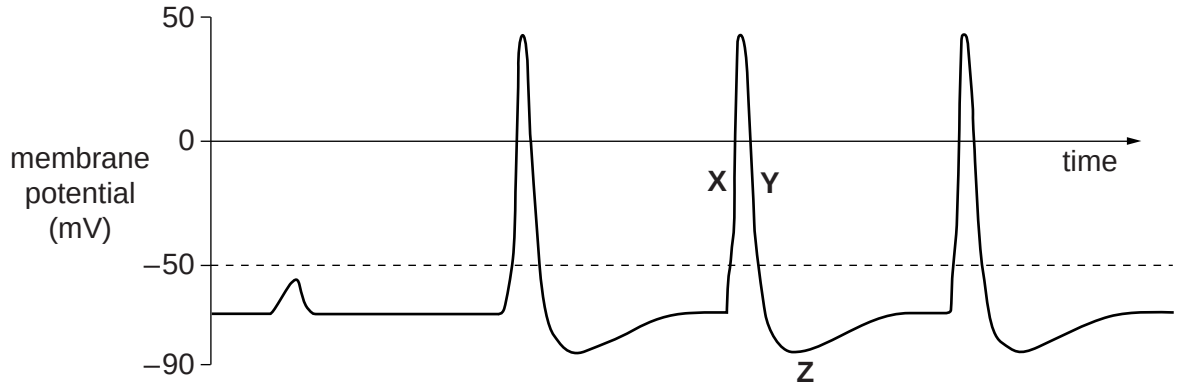

Fig. 1.2

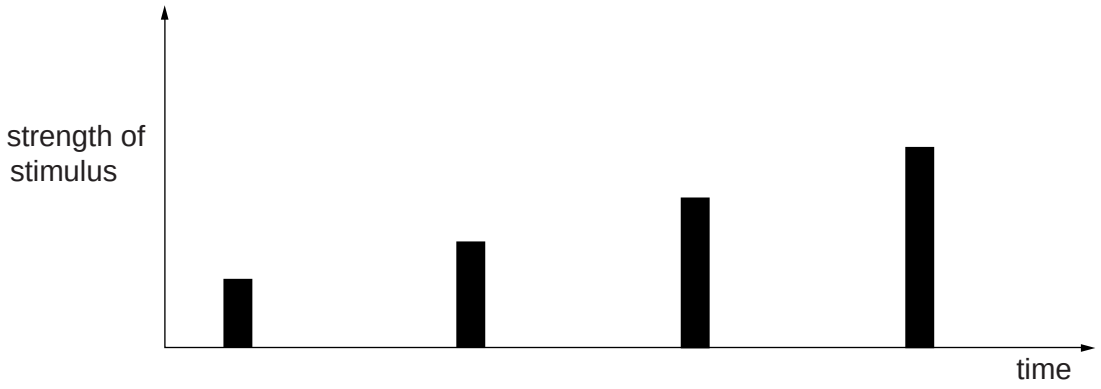

Fig. 1.3

(i) State the term used to describe what is happening at each of the points **X**, **Y** and **Z** on Fig. 1.2.

X .....

Y .....

Z .....

[3]

(ii) What term is used to refer to the value of −50 mV on Fig. 1.2?

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

(iii) Comment on the relationship between the strength of a stimulus, as shown in Fig. 1.3, and the resulting action potential, as shown in Fig 1.2.

.....

.....

.....

.....

.....

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

[Total: 15]

Turn over

2 The liver is an organ that is metabolically very active, carrying out over 500 different functions. Some of its important functions include converting chemicals including toxins, into other compounds.

Fig. 2.1 outlines some of the reaction pathways that take place in the liver cells.

The ***underlined words*** represent toxic compounds.

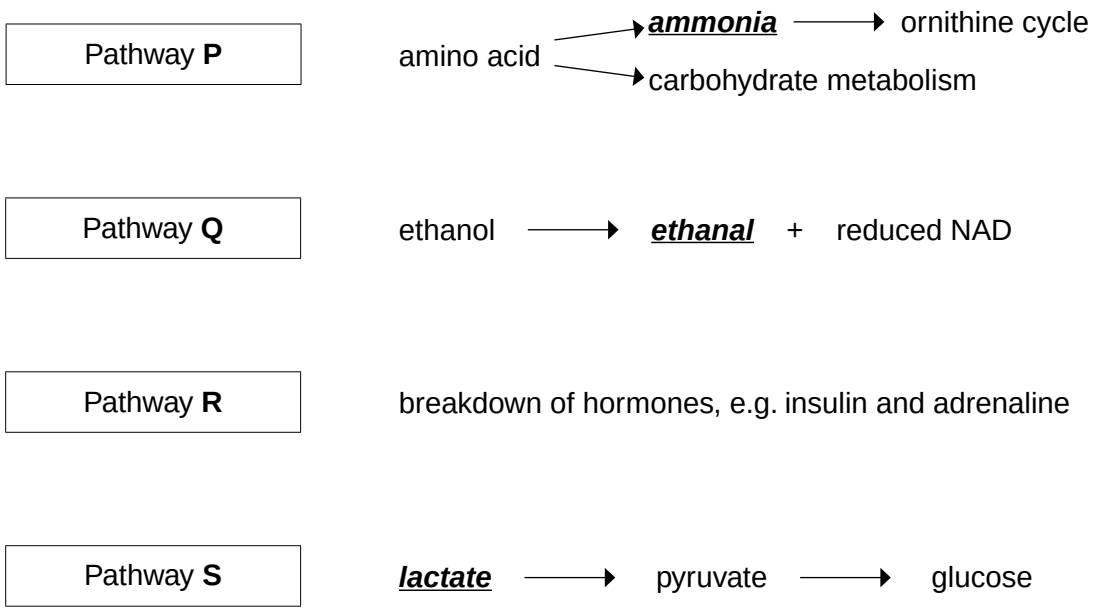

Fig. 2.1

(a) (i) State the product of the ornithine cycle in Pathway **P** and the organ to which this product is transported for removal from the body.

product .....

organ the product is transported to .....
[2]

(ii) The lactate that enters pathway **S** is produced by cells, such as muscle cells, undergoing anaerobic respiration.

Suggest why this lactate is converted into pyruvate by the hepatocytes (liver cells) rather than by the respiring cells in which it is produced.

.....

.....

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

(b) Insulin only remains in the bloodstream for a relatively short time. Pathway **R** breaks down insulin in the liver.

Explain what might happen to a person if the liver did not break down insulin.

.....

.....

.....

.....

.....

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

(c) Alcohol (ethanol) is oxidised in the liver by Pathway **Q**. If a person has a high alcohol intake, it will result in the production of excess reduced NAD.

(i) Excess reduced NAD in the liver cells will influence some metabolic pathways by:

- inhibiting the conversion of lactate to pyruvate
- inhibiting fatty acid oxidation
- promoting fatty acid synthesis.

Using this information **and** the information in Fig. 2.1, suggest the consequences for **liver metabolism** if a person has a regular high alcohol intake.

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

(ii) State **precisely** where in the liver cell the excess reduced NAD can be re-oxidised.

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

[Total: 8]

3 **(a)** Explain what is meant by the terms *autotroph* and *heterotroph*.

autotroph .....

.....

.....

heterotroph .....

.....

.....

[2]

(b) Fig. 3.1 is a transmission electron micrograph showing part of a chloroplast, including some of the internal membranes.

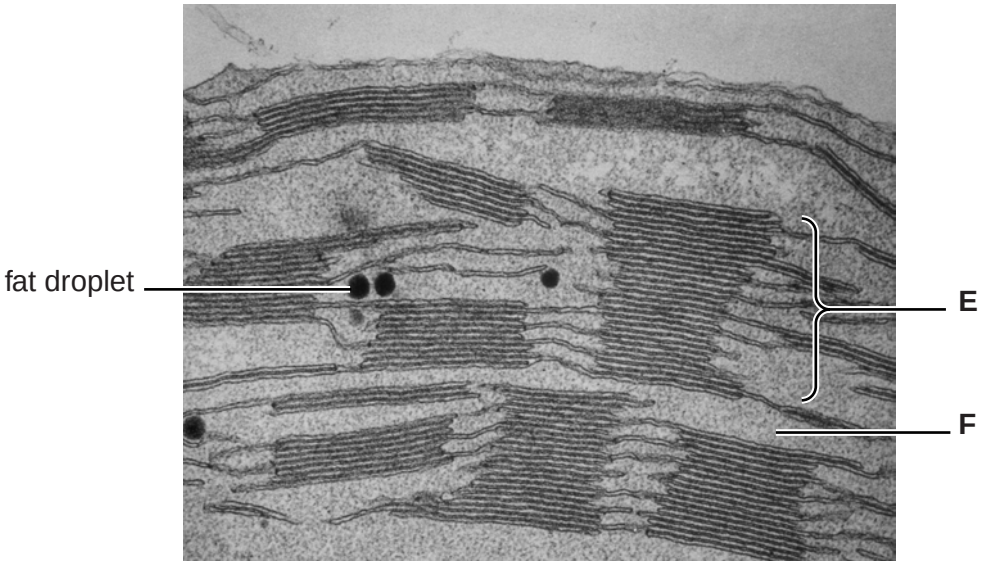

Fig. 3.1

(i) Identify **E** and **F** in Fig. 3.1.

E .....

F .....

[2]

(ii) The chloroplast contains fat droplets, as shown in Fig. 3.1. These act as a reserve of raw material **for the chloroplast**.

Suggest what this raw material might be used for in the chloroplast.

.....

.....

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

(c) Fig. 3.2 represents the light harvesting system found on the surface of the internal membranes of the chloroplast.

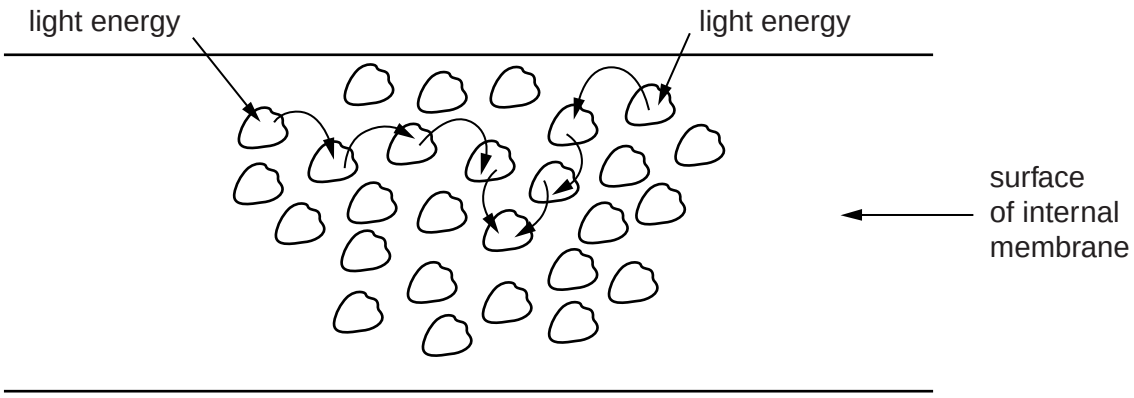

Fig. 3.2

Use the information in Fig. 3.2 to describe how light is harvested in the chloroplast membranes.

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

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

Turn over

(d) Many herbicides act by inhibiting photosynthesis in weeds. A series of research studies were carried out to evaluate the effectiveness of a triazine herbicide on the yield of a crop of corn, *Zea mays*. Some of the data obtained is shown in Table 3.1.

Study	Plots not treated with herbicide		Plots treated with herbicide		Yield difference with herbicide	
	Number of plots	Mean yield ($kg\,ha^{-1}$)	Number of plots	Mean yield ($kg\,ha^{-1}$)	($kg\,ha^{-1}$)	(%)
A	90	8321.4	51	8756.9	+435.5	+5.2
B	21	10344.8	3	11457.0	+1112.2	+10.8
C	30	10411.8	14	10954.5	+542.7	+5.2
D	20	13982.9	7	13607.7	−375.2	−2.7
E	2	6532.5	8	11041.6	+4509.1	+69.0
F	66	8750.2	63	8971.3	+221.1	+2.5
G	17	11671.4	7	10807.1		

Table 3.1

(i) Calculate the yield difference caused by the application of herbicide in study **G**.

Show your working.

Answer = ... $kg\,ha^{-1}$

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

(ii) Suggest why the researchers concluded that the data obtained from Study **E** was not useful in evaluating the effectiveness of the herbicide.

.....

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

(iii) Triazine herbicide acts on the weeds by binding to a specific protein associated with photosystem II, blocking the movement of electrons between electron carriers.

Explain the effect that the herbicide binding to this protein will have on photosynthesis.

.....

.....

.....

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

(iv) Plants treated with triazine herbicide can, when illuminated under experimental conditions, be seen to fluoresce (emit light) and give off small quantities of heat.

Suggest how this experimental finding could be explained.

.....

.....

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

[Total: 16]

4 Biological terms are often used incorrectly. This may be because they have similar spelling or refer to similar structures.

glucagon	***glycogenolysis***
gluconeogenesis	***glycolysis***
glycogen	***insulin***
glycogenesis	***negative feedback***

Select from the list above, the term(s) that refer to:

(a) a stage in respiration

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

(b) hormone(s)

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

(c) process(es) that produce glucose

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

(d) process(es) that have glucose as a starting point

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

[Total: 4]

5 **(a)** Adenosine tri-phosphate (ATP) is an important product of respiration. The ATP molecule is made up of five sub-units, as shown in Fig. 5.1.

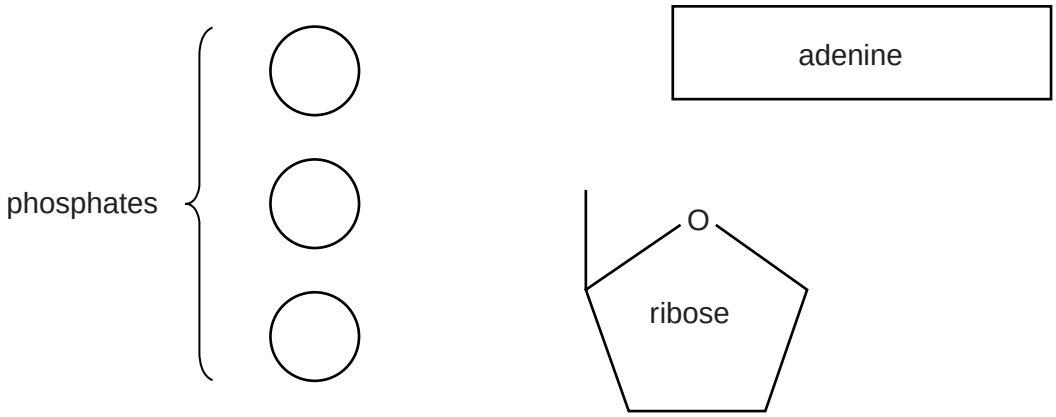

Fig. 5.1

(i) In the space below, indicate how these sub-units are joined in a molecule of ATP.

[2]

(ii) Suggest the type of reaction that removes a phosphate group from an ATP molecule.

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

(b) The formation of ATP is now widely accepted as being achieved by the process of **chemiosmosis**.

Various pieces of evidence have been documented to support this theory. Three of these are described below.

1 In isolated mitochondria that have had their outer membranes removed, electron transfer takes place but the mitochondria are unable to produce ATP.

2 The pH of the inter-membrane space is lower than the pH inside the rest of the mitochondrion.

3 The outer mitochondrial membrane is permeable to protons.
If isolated mitochondria are supplied with ADP and inorganic phosphate and placed in a solution of pH 8, no ATP is produced. If, however, these mitochondria are placed in an acidic solution, ATP is produced.

Identify the pieces of evidence above, **1**, **2** or **3**, that supports each of the following statements about the theory of chemiosmosis.

Write '**none**' if a statement is not supported by any of the pieces of evidence above.

(i) Electron transfer occurs on the inner membrane of the mitochondrion. ..... **[1]**

(ii) Protons are actively pumped across the inner mitochondrial membrane into the inter-membrane space. ..... **[1]**

(iii) Protons accumulate in the inter-membrane space. ..... **[1]**

[Total: 6]

6 The kidney is a vital organ in the body and is responsible for excretion. It also plays an important role in homeostasis.

(a) Complete the passage, using the **most suitable** term in each case.

The blood in the glomerulus has a high ..... pressure, which forces small molecules, such as glucose and ....., out of the glomerulus and into the lumen of the Bowman's capsule. This process is known as ..... .

In the proximal convoluted tubule, the glucose, most of the ..... and some of the salts are reabsorbed into blood ..... that surround the nephron at this point. **[5]**

(b) One aspect of the kidney's homeostatic role is the ability of anti-diuretic hormone (ADH) to increase the number of aquaporins in the plasma membranes of the cells lining the collecting duct. This increases the amount of water reabsorbed.

ADH is released in response to a decrease in the water potential of the blood plasma.

(i) State precisely where the cells that detect a decrease in the water potential of the blood plasma are found.

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

(ii) Name the cells that detect this decrease.

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

(c) Fig. 6.1 outlines some of the events that take place if the blood volume decreases, for example, due to a significant loss of blood.

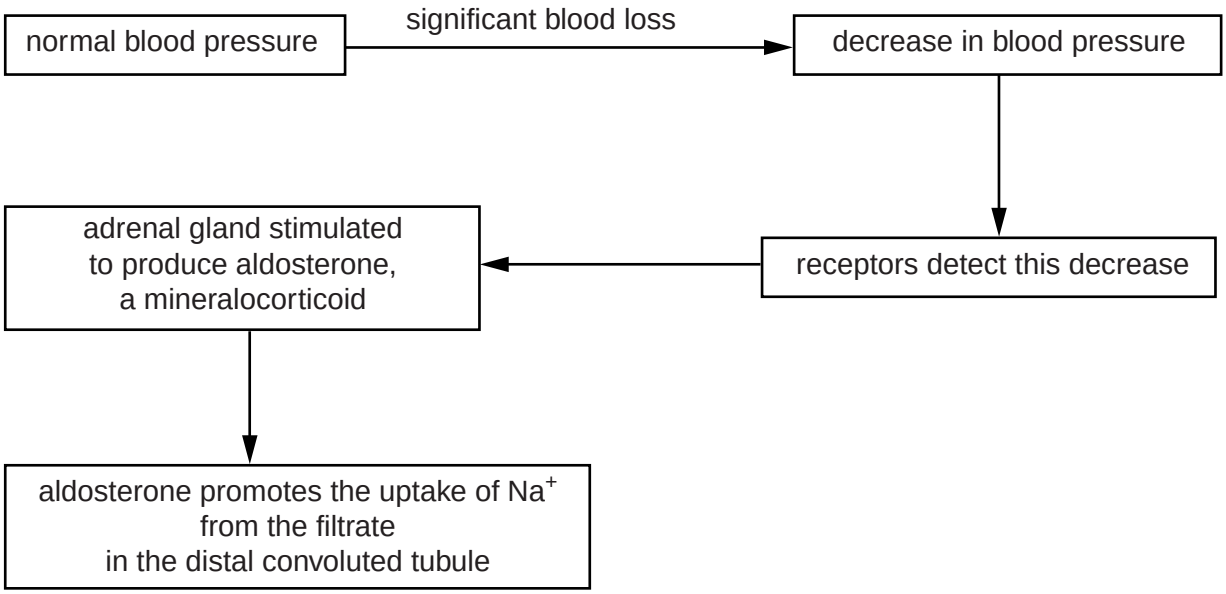

Fig. 6.1

(i) Name the part of the adrenal gland that releases aldosterone.

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

(ii) Suggest **and** explain what effect the action of aldosterone will have on the secretion of ADH.

.....

.....

.....

.....

.....

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

(iii) As the action of aldosterone takes effect, this is detected by receptors in the body and secretion of aldosterone decreases.

State the name of the mechanism that results in this decrease in aldosterone secretion.

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

[Total: 11]

END OF QUESTION PAPER