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.

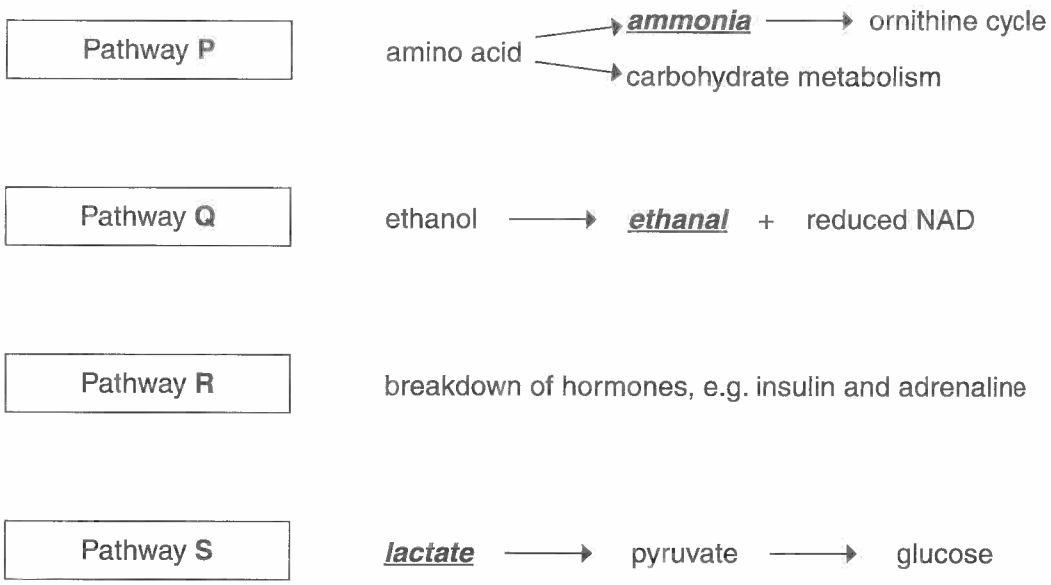

Fig. 2.1

(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.

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..... **[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.

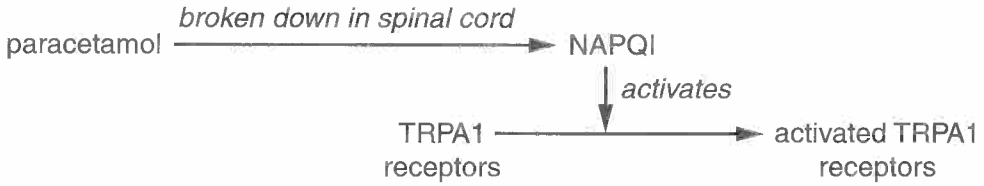
..... **[1]**

[Total: 8]

4 (a) Paracetamol is a drug that is commonly used as a painkiller. For many years, scientists have been uncertain about the way in which paracetamol works.

A recent study has shown that:

- paracetamol is broken down in the spinal cord into a compound called NAPQI
- NAPQI activates a receptor protein called TRPA1
- TRPA1 is found on the plasma (cell surface) membranes of neurones
- the activated receptor protein, TRPA1, interferes with the transmission of the nerve impulses from one neurone to the next.



(i) Name **one** chemical that transfers a nerve impulse from one neurone to another.

..... [1]

(ii) Suggest the part of the neurone where the plasma membrane has TRPA1 receptors.

Explain your answer.

part of neurone .....

explanation .....

.....

.....

.....

[2]

(b) One role of the liver is detoxification. Detoxification includes the breakdown of drugs such as paracetamol.

(i) Fig. 4.1 is a diagram that represents the structure of part of a liver lobule.

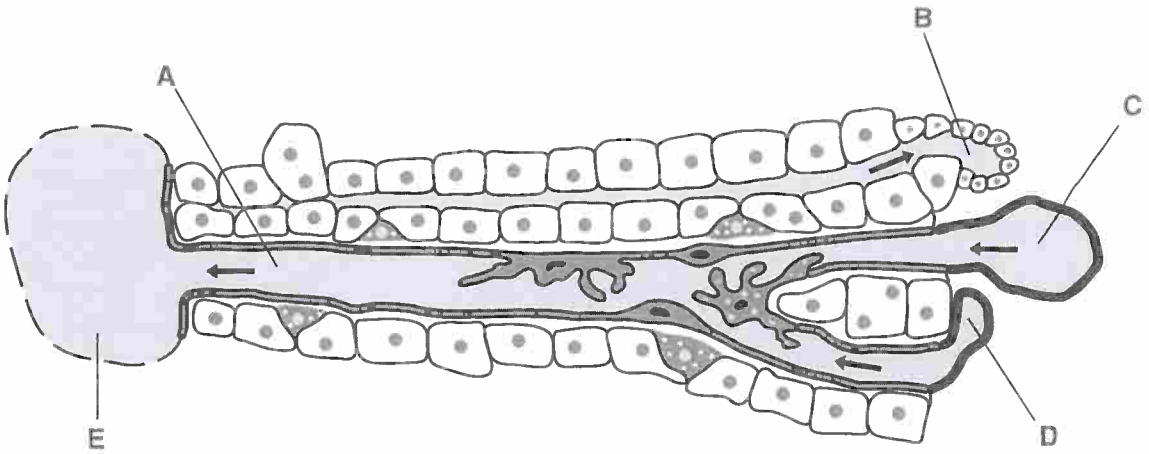


Fig. 4.1

Identify the parts labelled **A** to **E**.

A .....

B .....

C .....

D .....

E .....

[5]

(ii) During detoxification, paracetamol is metabolised in the liver cells as follows:

- approximately 90% is combined with two chemicals, sulfate and glucuronide, and excreted
- approximately 5% is oxidised by the P450 enzyme system, which produces NAPQI
- the NAPQI is then metabolised using another compound called glutathione.

Once the sulfate and glucuronide reserves in the liver are used up, the P450 system takes over completely. However, continued metabolism of paracetamol will result in high concentrations of NAPQI accumulating in the liver cells, causing cell death.

Suggest a reason for the accumulation of high concentrations of NAPQI in the liver cells.

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..... [1]

(iii) The liver has considerable powers of regeneration, even if a high proportion of its cells are damaged.

Name the liver cells that can lead to this regeneration **and** the type of cell division that they carry out.

name of liver cells .....

type of cell division ..... [1]

[Total: 10]

2 **(a)** Fig. 2.1 is a photomicrograph through the centre of a lobule of a mammalian liver.

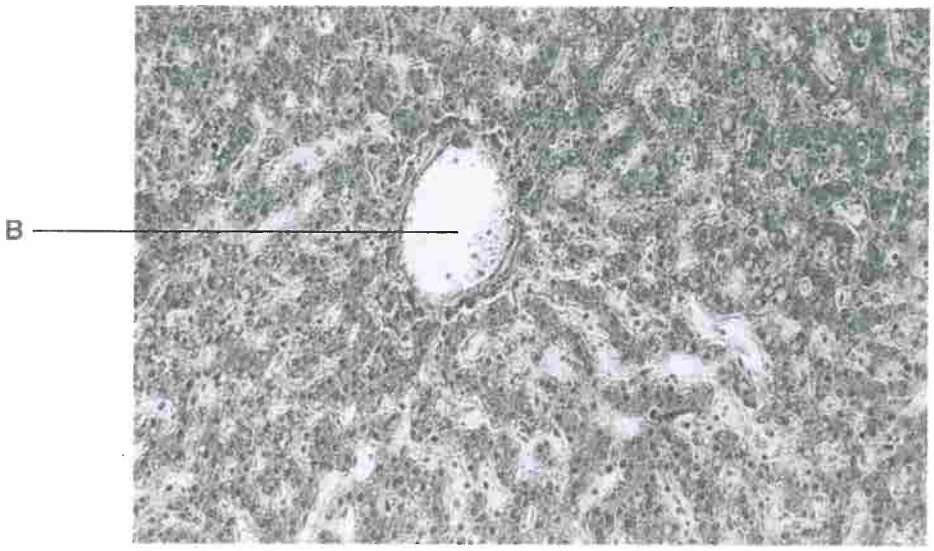

Fig. 2.1

(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.

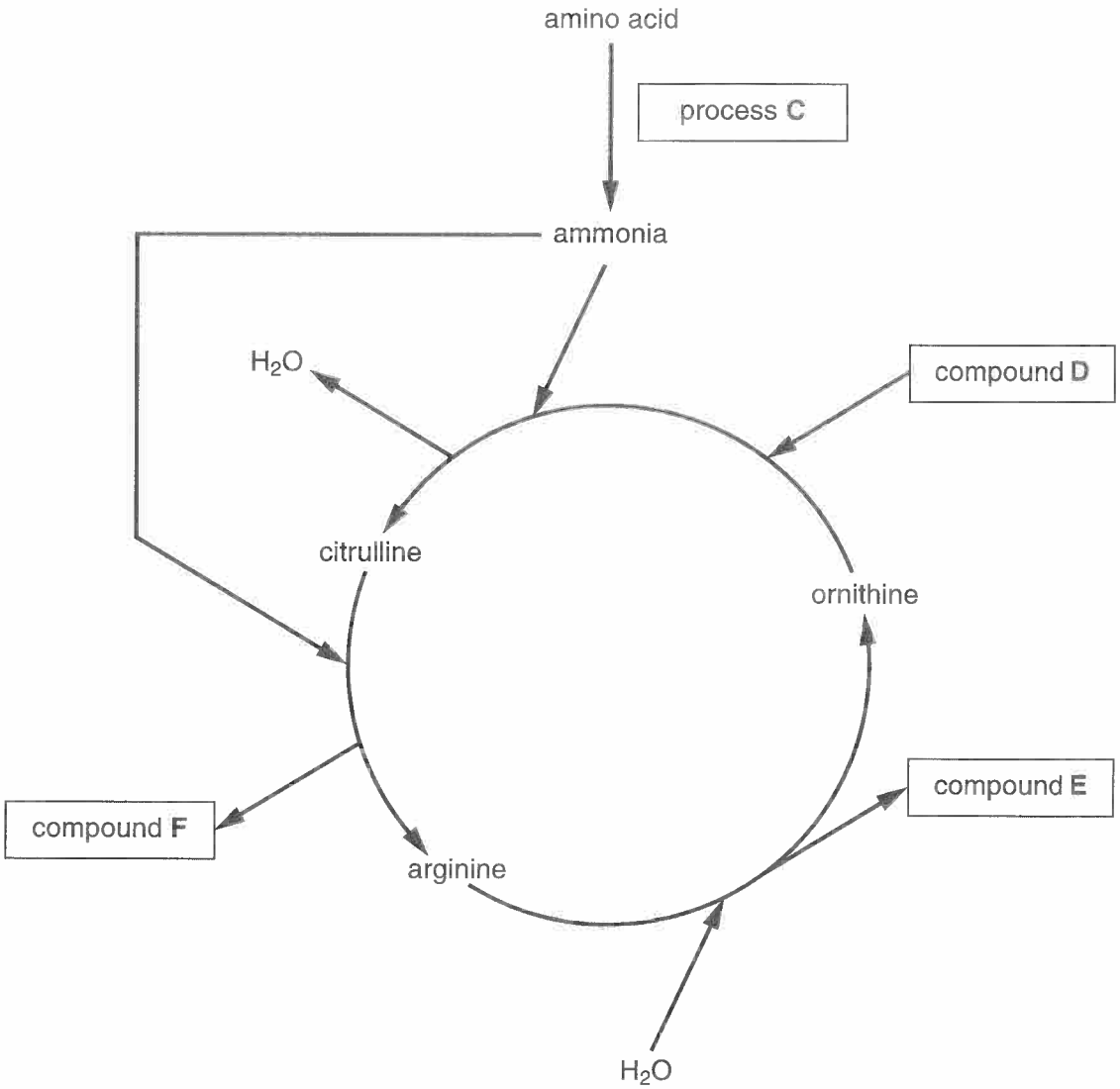

Fig. 2.2

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]