1 **(a)** Fig. 3.1 is a diagram representing a mitochondrion located in the cytoplasm of an animal cell.

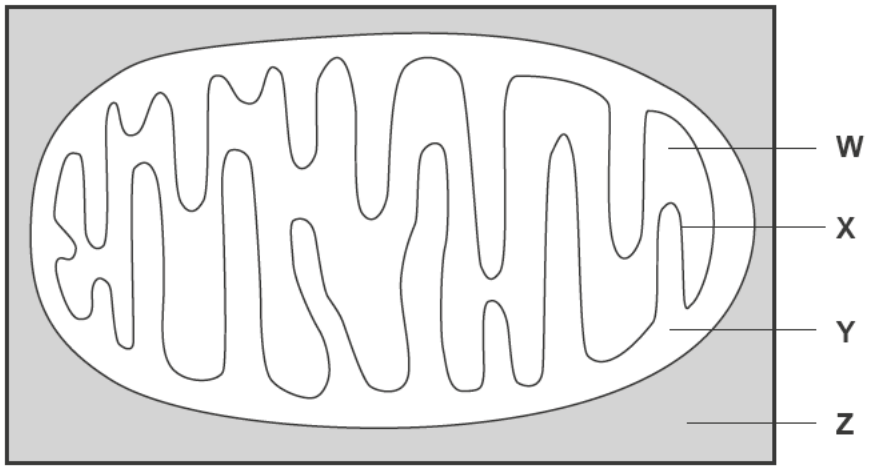


Fig. 3.1

(i) Use the letters **W** to **Z** to identify the region in Fig. 3.1 where each of the following occurs.

You may use each letter once, more than once or not at all.

link reaction .....

glycolysis .....

electron transport chain .....

Krebs cycle ..... **[4]**

(ii) Why does aerobic respiration yield fewer molecules of ATP than the theoretical maximum?

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

(b) Explain why the incomplete breakdown of glucose in **anaerobic** respiration produces less ATP than aerobic respiration.

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

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.... **[5]**

[Total : 11]

2 **(a)** Humans harvest a wide range of fruits and vegetables as food. Cellular respiration supplies energy and forms part of the natural ripening process in fruits and vegetables. This ripening process may continue after the fruits and vegetables are harvested, as the cells continue to respire.

The rate of cellular respiration after harvesting affects the shelf-life of fruits and vegetables as it can lead to changes in food quality. After harvesting, some fruits and vegetables enter a dormant (inactive) state while others remain active during storage.

Table 5.1 contains data that show the respiration rate of a selection of fruits and vegetables stored at different temperatures after harvesting. The respiration rate is measured by the rate of carbon dioxide produced.

Fruits and vegetables	**Respiration rate (mg CO_2 kg^{-1} h^{-1})**				
	at 0 °C	**at 5 °C**	**at 10 °C**	**at 15 °C**	**at 20 °C**
Apple	3	6	9	15	20
Asparagus	60	105	215	235	270
Blackberry	19	36	62	75	115
Cauliflower	17	21	34	44	69
Onion	3	5	7	7	8
Orange	4	6	8	18	28
Parsnip	12	13	22	37	n/a*
Potato	n/a*	12	16	17	22
Turnip	8	10	16	23	25

* no data were collected at these temperatures

Table 5.1

(i) Describe the pattern of respiration shown by cauliflower at increasing storage temperatures of 0 °C to 20 °C.

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

(ii) Discuss what the data in Table 5.1 indicate about the best conditions for storage of fruits and vegetables.

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

(iii) Identify, with reasons, which fruit or vegetable listed in Table 5.1 is **least** likely to spoil during storage.

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

(iv) Which fruit or vegetable listed in Table 5.1 is likely to be the most difficult to keep fresh during storage? Give a reason for your answer.

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

(b) Respiration can be aerobic or anaerobic.

(i) Certain parasites live in the blood of mammals.

Suggest why, even though blood carries oxygen, these parasites are adapted to respire anaerobically.

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

(ii) The anaerobic respiration pathway in animal cells can be reversed, but the anaerobic respiration pathway in yeast cells cannot be reversed.

Explain why, using your knowledge of the differences between the two pathways.



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

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

[Total: 14]

3 **(a)** Glycolysis is the initial stage of cellular respiration.

(i) State **precisely** where in the cell glycolysis occurs.

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

(ii) Outline the process of glycolysis.

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

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

(b) Yeast cells can carry out **anaerobic** respiration.

Fig. 5.1 outlines the process of anaerobic respiration in yeast.

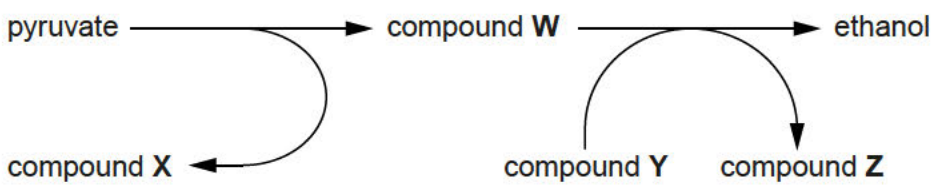


Fig. 5.1

Identify the compounds **W** to **Z**.

W .....

X .....

Y .....

Z .....

[4]

(c) In South-East Asia the main source of commercial sugar is the palm, *Borassus flabellifer*. Sap of this species has a high sugar content. Yeasts and bacteria, however, can contaminate the sap as it is collected and ferment the sugar, producing ethanol. This contamination makes it less suitable as a source of sugar.

A study was carried out to investigate the effect of three treatments traditionally used to reduce fermentation during the collection of the sap. The sap is treated in one of the following ways:

- with a weak alkaline solution (treatment **A**)
- with bark from the tree *Vateria copallifera* (treatment **V**)
- with bark from the tree *Careya arborea* (treatment **C**)

The sap was collected from the palm trees over a 60-hour period. Samples of the collected sap were taken at 15 hour intervals. In each sample, the concentration of alcohol and the number of bacteria were recorded.

The results are shown in Table 5.1.

Treatment	Sample time (hours)	Alcohol concentration (%)	Number of bacteria (10^6 cm^{-3})
Control (no treatment)	15	0.2	19
	30	3.5	800
	45	5.2	2200
	60	2.6	3400
A	15	0.0	3
	30	0.1	4
	45	0.2	5
	60	0.3	7
V	15	0.2	110
	30	1.1	2900
	45	1.2	2400
	60	1.8	2000
C	15	0.4	230
	30	1.1	160
	45	1.3	3
	60	3.6	40

Table 5.1

(i) With reference to Table 5.1, describe the effect of the different treatments on the alcohol concentration of the treated samples compared with the control samples.

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

(ii) Suggest a reason for the difference in alcohol concentration **at 60 hours** between the two bark treatments **V** and **C**.

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

(iii) To be used as a source of commercial sugar, the sap needs to be as uncontaminated as possible.

Suggest, with a reason, which of the treatments shown in Table 5.1 would be the best for use with sap so that it is suitable as a source of commercial sugar.

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

[Total: 14]

4 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.

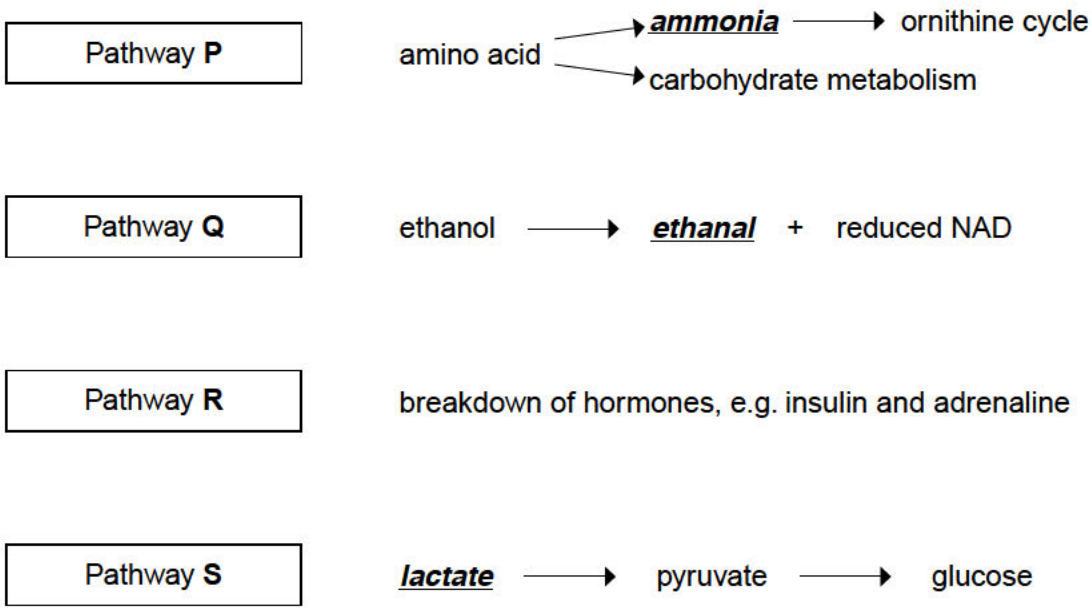


Fig. 2.1

(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.

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..... **[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]