Respiration

Question Paper 2

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Energy and respiration
Sub Topic	Respiration
Booklet	Theory
Paper Type	Question Paper 2

Time Allowed : **72 minutes**

Score : **/ 60**

Percentage : **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 Adipose tissue is specialised connective tissue that functions as the major storage site for fat in the form of triglycerides.
The human body contains two types of adipose tissue:
white adipose tissue (WAT) and brown adipose tissue (BAT).

- WAT is more common and is found under the skin and around some internal organs.
- BAT is found in infants around the back and shoulders.
- BAT is also found in adults but in relatively smaller quantities.
- BAT cells contains more mitochondria than WAT cells.
- BAT is involved in the maintenance of a constant blood temperature when the external environment is cold.

(a) (i) Blood temperature in humans is maintained by a process called homeostasis.

With reference to blood temperature, outline the main principles of homeostasis.

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(ii) Suggest why infants have relatively more BAT than adults.

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(b) Mitochondria in BAT cells function differently from those in other cells during periods of cold environmental conditions.

Fig. 8.1 shows part of a mitochondrion in a BAT cell.

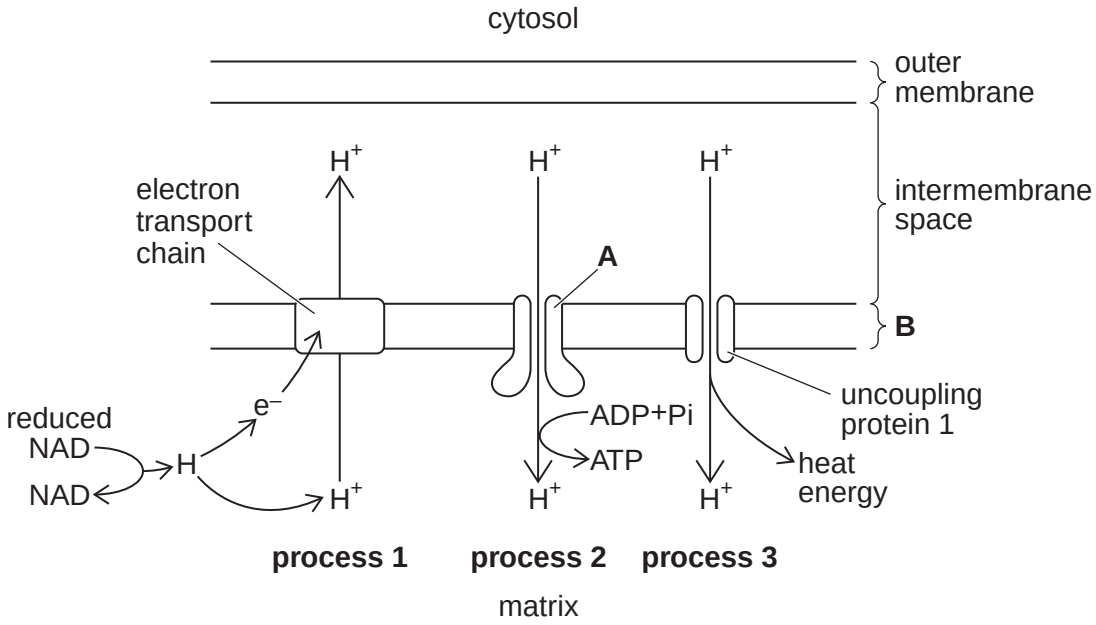

Fig. 8.1

(i) Name structures **A** and **B**.

A .....

B ..... [2]

(ii) Draw an arrow on Fig. 8.1 to indicate the direction of the proton gradient that exists between the matrix and the intermembrane space. [1]

(iii) State the **two** processes, shown in Fig. 8.1, that will be more active during periods of cold external environmental conditions.

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(iv) State the by-product that is obtained as a result of processes **1** and **2**.

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(v) Suggest the main respiratory substrate for BAT cells.

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[Total: 12]

2 **(a)** An experiment was carried out to investigate the effect of temperature on the rate of oxygen consumption of the lizard, *Sauromalus hispidus*. The body temperature of a lizard varies with environmental temperature.

Several lizards were fitted with small, airtight masks that covered their heads. Air was supplied inside the mask through one tube, and collected through another. The differences between oxygen concentrations in the air supplied for inhalation and the exhaled air enabled the researchers to measure the rate of oxygen consumption of the lizards.

The rate of oxygen consumption of each lizard was measured when it was at rest and when it was running. Measurements were made at different temperatures ranging from 15 °C to 40 °C.

Fig. 4.1 shows the results.

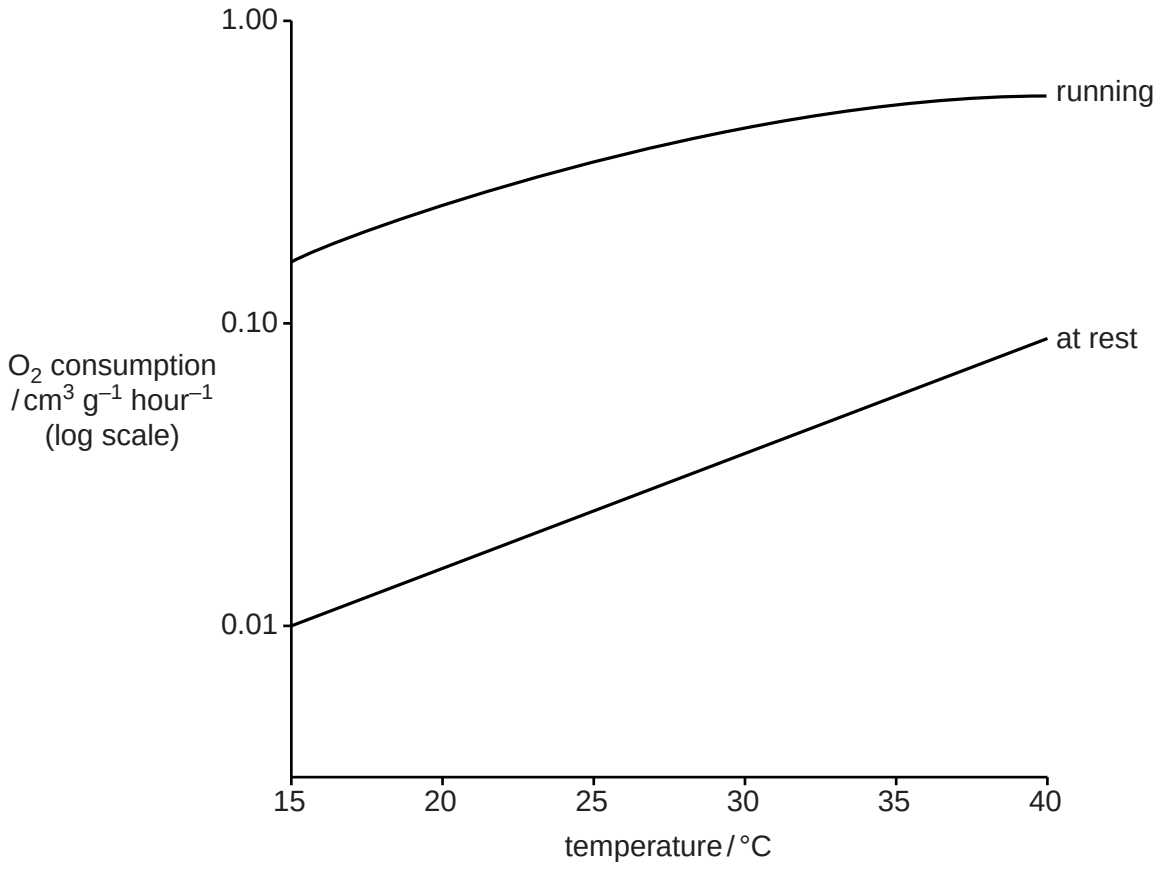

Fig. 4.1

(i) Running requires rapid use of ATP by muscle cells in the legs and heart of a lizard.

With reference to the events occurring inside a mitochondrion, explain why a faster use of ATP requires a greater rate of oxygen consumption.

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(ii) Explain the effect of temperature on the rate of oxygen consumption in *Sauromalus* when at rest.

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(b) The researchers also measured the oxygen debt that was built up when a lizard was running.

They measured this for two species of lizard, *Sauromalus hispidus* and *Varanus gouldi*, at six different temperatures.

The results are shown in Table 4.1.

Table 4.1

temperature / °C	**15**	**20**	**25**	**30**	**35**	**40**
***Sauromalus* oxygen debt / $cm^3 O_2 kg^{-1}$**	70.3	81.3	93.0	102.0	118.0	154.0
***Varanus* oxygen debt / $cm^3 O_2 kg^{-1}$**	62.0	72.2	78.5	87.9	96.7	102.0

(i) The oxygen debts were found by using the masks described in **(a)**.

Suggest what measurements were taken, and how these measurements were used to calculate the oxygen debt.

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(ii) Compare the oxygen debt built up by a running *Varanus* with that of a running *Sauromalus*.

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(iii) *Varanus* is a fast-moving carnivore. *Sauromalus* is a slow-moving herbivore.

Explain how the results in Table 4.1 indicate that *Varanus* is well-adapted for its mode of life.

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(iv) Most lizards, including *Sauromalus*, have very simple lungs with no alveoli. *Varanus*, however, has lungs that are more like those of mammals, containing large numbers of air sacs similar to the alveoli of human lungs.

Suggest how this difference could account for the differences in the oxygen debts of *Sauromalus* and *Varanus* shown in Table 4.1.

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[Total: 17]

3 **(a)** The production of ATP by oxidative phosphorylation takes place in the electron transport chain in a mitochondrion.

(i) State the part of the mitochondrion in which the electron transport chain is found.

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(ii) Describe briefly where the electrons that are passed along the electron transport chain come from.

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(iii) Describe the role of oxygen in the process of oxidative phosphorylation.

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(b) The brain depends on a constant supply of oxygen for aerobic respiration. Anaerobic respiration is not sufficient to keep neurones in the brain alive. This is because neurones require especially large amounts of ATP. Up to 80% of the ATP is used to provide energy for the Na^+/K^+ pump.

When a person suffers a stroke, blood flow to part of the brain is stopped, so some neurones receive no oxygen. ATP production by oxidative phosphorylation stops. Fig. 4.1 shows some of the ways in which the lack of ATP affects a neurone in the brain.

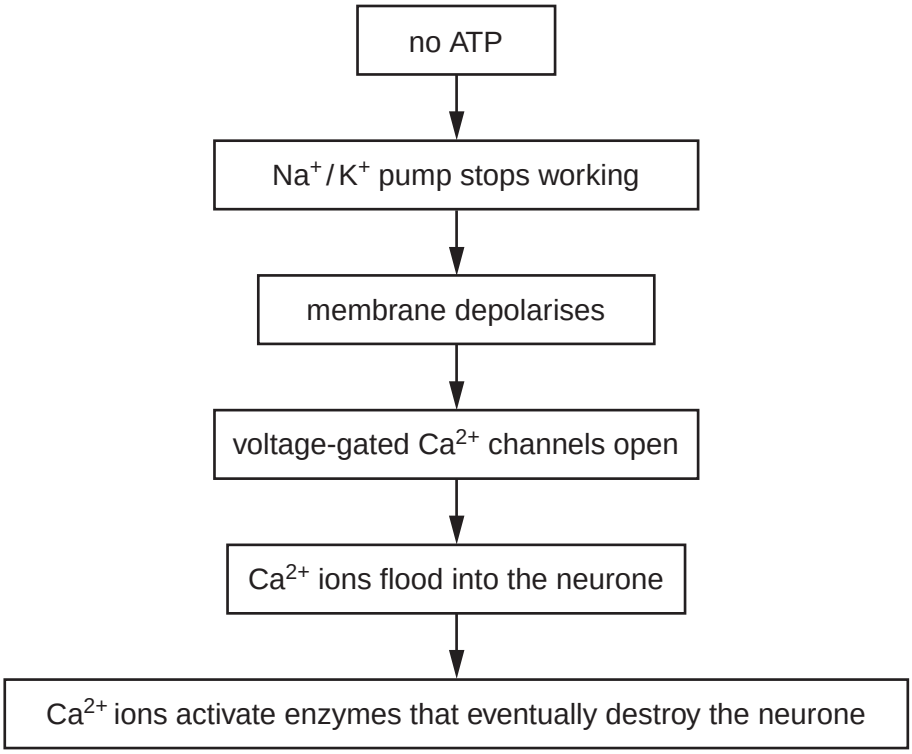

Fig. 4.1

(i) Explain why the membrane of the neurone depolarises when the Na^+/K^+ pump stops working.

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(ii) Suggest why calcium ions flood into the neurone when the Na^+/K^+ pump stops working.

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(c) The freshwater turtle, *Trachemys scripta*, is able to survive for long periods in conditions of very low oxygen concentration. As in humans, the rate of activity of the Na^+/K^+ pump in the neurones in its brain falls sharply. However, in turtles this does not result in damage to these cells.

A better understanding of how the neurones in the turtle's brain survive in these conditions could lead to new treatments for people who have suffered a stroke.

Experiments show that, in turtle brain neurones, in conditions of low oxygen availability:

- most ion channels in the cell surface membranes immediately close
- after about four hours, the quantity of mRNA involved in the synthesis of proteins used to build ion channels, falls to less than one fifth of normal concentrations.

(i) Suggest how the closure of ion channels in the neurones of the turtle in very low oxygen concentrations could allow the cells to survive.

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(ii) Suggest what causes the quantity of mRNA for protein channels to fall.

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[Total: 16]

4 **(a)** Describe how ATP is synthesised by oxidative phosphorylation. [8]

(b) Using examples, outline the need for energy in living organisms. [7]

[Total: 15]

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