Model Answers: Easy

1a

(a) The energy that this man expends in maintaining his breathing and heartbeat is calculated as follows...

- Correct data from question: 10 500 (kJ) **AND** 3.9 (%); [1 mark]
- (10 500 × 3.9) ÷ 100 **OR** 10 500 × 0.039 **OR** 409.5 (kJ); [1 mark]
- 410 (kJ); [1 mark]

[Total: 3 marks]

The person's typical total energy output is 10 500 kJ day^{-1}

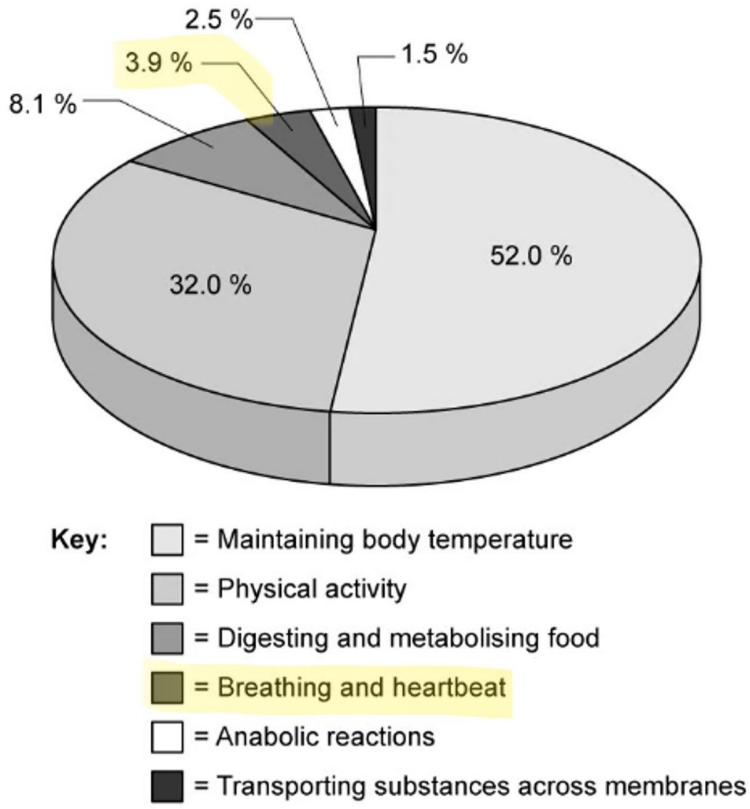

Fig. 1

Calculate the energy, in kJ, that this man expends in maintaining his **breathing and heartbeat**.

State your answer to the nearest whole number of kilojoules.

He spends 3.9% of his energy on breathing and heartbeat [1 mark]

(3.9% = 0.039)

10 500 × 0.039 = 409.5 kJ [1 mark]

Rounded to the nearest whole number = 410 kJ [1 mark]

[Total: 3 marks]

1b

(b) (i) A type of membrane transport that requires energy is...

Any **one** of the following:

- Active transport; [1 mark]
- Endocytosis / phagocytosis / pinocytosis; [1 mark]
- Exocytosis;
- Cotransport; [1 mark]

(b) (ii) Specific examples of processes that utilise energy for the transport of substances across membranes include...

Any **two** of the following:

- Sodium potassium pump in nerve cell membranes; [1 mark]
- Reuptake of neurotransmitters at a synapse; [1 mark]
- Exocytosis of digested bacteria from phagocytes/neutrophils/macrophages; [1 mark]
- Secretion/exocytosis of a named type of enzyme from a named cell type, e.g. of amylase from the cells of the salivary glands; [1 mark]
- Secretion/exocytosis of a named hormone from a named cell types, e.g. insulin from beta cells; [1 mark]
- Secretion/exocytosis of antibodies from plasma cells; [1 mark]
- Active uptake of calcium ions from muscle cells; [1 mark]
- Pumping protons across the inner mitochondrial membrane/cristae; [1 mark]
- Cotransport of sugar/glucose from the small intestine into the blood; [1 mark]
- Cotransport of sodium / glucose / amino acids from the kidney nephron into the blood; [1 mark]

Ignore non-human / plant-based examples

Accept other correct examples

[Total: 2 marks]

This is a synoptic question, meaning that it draws together your knowledge from several parts of the syllabus. The ability to draw together different ideas is an important exam skill in biology, so keep working at practice questions to build your confidence in this.

1c
(c) The energy characteristics of anabolic and catabolic reactions in cells, tissues and organs can be contrasted as follows...

- Anabolic reactions use/require energy; [1 mark]

- Catabolic reactions release energy; [1 mark]

[Total: 2 marks]

Remember that the laws of physics dictate that energy **can never be created or destroyed**. It is therefore always best to say that energy is either 'released' (catabolic) or 'used' (anabolic).

1d

(d) The parts of the ATP molecule labelled X, Y and Z in Fig. 2 are...

- X = phosphate; [1 mark]
- Y = adenine; [1 mark]
- Z = ribose sugar; [1 mark]

Allow Y and Z labelled together as adenosine; [2 marks]

[Total: 3 marks]

2a

(a) The order of ADP, AMP and ATP according to the number of phosphate groups is…

- AMP, ADP, ATP **OR** AMP < ADP < ATP **OR** 1= AMP; 2=ADP; 3=ATP; [1 mark]

[Total: 1 mark]

AMP is adenosine monophosphate

ADP is adenosine diphosphate

ATP is adenosine triphosphate

2b

(b) One advantage of releasing energy for cellular processes in small packets from many ATP molecules, rather than all at once from one molecule of glucose is…

Any **one** of the following:

- Very little wasted energy; [1 mark]
- Prevents cell temperature from increasing (due to wasted energy that would be released from larger molecules); [1 mark]
- Energy can be used for many separate processes (simultaneously); [1 mark]
- ATP can be hydrolysed quickly/easily; [1 mark]
- ATP can be easily transported around the cell to where it is needed (due to its small size and solubility); [1 mark]

[Total: 1 mark]

2c

(c) The enzyme which catalyses the synthesis of ATP is...

- ATP synthase; [1 mark]

[Total: 1 mark]

2d

(d) ATP can be recycled in the cell as follows...

- Re-formation/condensation of ATP from ADP and P_i; [1 mark]
- In (cellular) respiration; [1 mark]

[Total: 2 marks]

The usefulness of ATP comes from the fact that it can be regenerated/recycled within the same cell that it is hydrolysed in. Hydrolysis is quick and efficient and releases ADP and P_i back into the cell for re-phosphorylation during the various stages of respiration.

3a

(a) The respiratory quotient (RQ) of malic acid is calculated as follows...

- ; [1 mark]
- (=) 1.3(33); [1 mark]

[Total: 2 marks]

The balanced chemical equation for the aerobic respiration of malic acid is shown in Fig. 1

$$C_4H_6O_5 + 3O_2 \rightarrow 4CO_2 + 3H_2O$$

Respiratory quotient (RQ) = $\frac{\text{moles of } CO_2 \text{ given out}}{\text{moles of } O_2 \text{ taken in}}$ [1 mark]

$= \frac{4}{3} = 1.3$ [1 mark]

[Total: 2 marks]

3b

(b) (i) The name of the piece of equipment used to measure RQ is...

- Respirometer; [1 mark]

(b) (ii) The major food group that substance X belongs to is...

- Lipids / fats; [1 mark]

[Total: 2 marks]

Whilst you do not have to memorise individual values of RQ, learning the rough ranges of RQs for the main 3 food groups (carbohydrates, lipids and proteins) is a good idea.

3c

(c) The purpose of soda-lime (sodium hydroxide solution) in a respirometer is...

- To absorb carbon dioxide CO_2; [1 mark]
- To create a pressure drop that can be measured (in a manometer) / to ensure that the carbon dioxide produced during respiration does not contribute to the pressure inside the equipment / to allow oxygen consumption alone to be measured; [1 mark]

[Total: 2 marks]

Pay close attention to the number of marks in a question. To simply answer 'to absorb CO_2' would only be enough to earn [1 mark]. The fact that the question is worth [2 marks] means that the examiners are looking for you to add another statement to expand upon your initial answer.

3d

(d) The teacher's choice of the germinating seeds was the better option because...

Any **two** of the following:

- Seeds are more readily available **OR** they may not be able to find woodlice; [1 mark]
- Seeds can be stored indefinitely before the experiment; [1 mark]
- There are no ethical issues with using seeds **OR** subjecting animals to the experiment can be considered inhumane/cruel/unethical; [1 mark]

[Total: 2 marks]