1.2 Organisation: 1-hour Pack

AQA 8461 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 The small intestine contains many villi which increase the surface area for absorption. State one adaptation of a villus that helps absorption.

(Total for Question 1 is 2 marks)

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2 Complete the table by naming the type of tissue in each row.

Row	Description	Type of tissue
A	Tissue made of cells that contract and allow movement.	?
B	Tissue that transports water and dissolved minerals in a plant.	?

(a) Row A **(1)**

(b) Row B **(1)**

(Total for Question 2 is 2 marks)

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3 A gardener measures the rate of water uptake by two plants. Plant A takes up 20 cm^3 of water in 10 minutes. Plant B takes up 30 cm^3 of water in 15 minutes.

Calculate the rate of water uptake for each plant in cm3 per minute and say which plant has the higher rate.

(a) Calculate the rate for Plant A. **(2)**

.....

(b) Calculate the rate for Plant B. **(2)**

.....

(c) State which plant has the higher rate or say if they are the same. **(1)**

(Total for Question 3 is 5 marks)

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4 The wall of the small intestine is lined with villi. Explain how the small intestine is adapted for the efficient absorption of digested food molecules into the blood.

(Total for Question 4 is 6 marks)

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5 A student used a potometer as part of the required practical to investigate the effect of moving air (from an electric fan) on the rate of transpiration from a leafy shoot. She measured the distance an air bubble moved along the capillary tube in a fixed time of 10 minutes. In still air, the bubble moved 24 mm. With the fan switched on, the bubble moved 60 mm.

(a) State why an air bubble is introduced into the capillary tube of a potometer. **(1)**

(b) Give two variables that should be controlled to make this a valid comparison. **(2)**

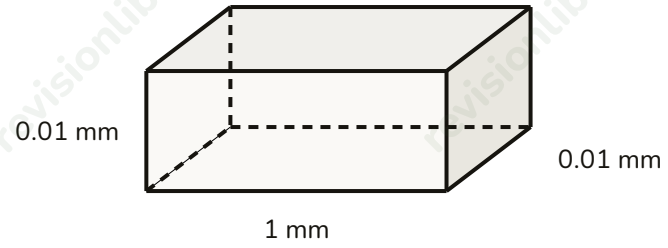
(c) Calculate the rate of water uptake, in mm per minute, in still air and with the fan switched on. **(2)**

(d) Using your answers to part c, explain the effect of moving air on the rate of transpiration in terms of water vapour molecules at the leaf surface. **(1)**

(Total for Question 5 is 6 marks)

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6 A root hair cell can be modelled as a cuboid (not accurately drawn).



(a) Calculate the surface area to volume ratio of the root hair cell. Give your answer as a ratio in its simplest whole-number form. Show your working. **(3)**

.....

(b) Explain why a large surface area to volume ratio is important for water uptake by root hair cells, and explain why mineral ions often need to be absorbed by active transport rather than diffusion. **(2)**

.....

.....

(Total for Question 6 is 5 marks)

7 A student used a light microscope as part of the required practical to observe onion epidermal cells. She measured the width of one cell on the eyepiece grid as 45 mm. The actual width of the cell is 0.03 mm.

(a) Calculate the magnification used to view the cell. Show your working. **(3)**

.....

(b) State one technique used to prepare a temporary mount of onion cells for viewing. **(1)**

(Total for Question 7 is 4 marks)

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8 Stem cells are undifferentiated cells that can divide to produce more cells like themselves, some of which can then become specialised.

(a) Define the term 'stem cell'. **(1)**

(b) Name one source of stem cells found in an adult human. **(1)**

(c) Name the structure from which embryonic stem cells are obtained. **(1)**

(d) Give one medical use of stem cells. **(1)**

(e) Discuss one ethical concern associated with using embryonic stem cells in medical research. **(2)**

(Total for Question 8 is 6 marks)

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9 In an investigation into an enzyme-controlled reaction, the rate of reaction was measured at temperatures between 0°C and 70°C. The enzyme's optimum temperature is 37°C. Between 0°C and 37°C the rate of reaction increased steadily. Above 40°C the rate fell rapidly, reaching zero by around 60°C.

(a) Explain, in terms of particles and collisions, why the rate of reaction increased steadily between 0°C and 37°C. **(3)**

(b) Explain, in terms of enzyme structure, why the rate of reaction fell rapidly above 40°C. **(3)**

(Total for Question 9 is 6 marks)

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10 Explain how the structure of the lungs and the circulatory system work together to supply oxygen to body cells and remove carbon dioxide. In your answer you should describe features of the lungs and blood and explain how they enable gas exchange and transport.

(Total for Question 10 is 6 marks)

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Mark scheme · 1.2 Organisation: 1-hour Pack

Question 1

thin wall (one cell thick) so short diffusion distance, or many capillaries to carry absorbed molecules away, or large surface area due to microvilli, oe	**B1**
contains blood vessels to transport absorbed nutrients away, oe	**B1**

Answer: Any one of: thin wall (one cell thick) for short diffusion distance; many capillaries to take away absorbed molecules; or microvilli increasing surface area.

Question 2

(a) muscle tissue cao	**B1**

(a) Answer: muscle tissue

(b) xylem or xylem tissue cao	**B1**

(b) Answer: xylem

Question 3

(a) substitutes: 20 cm^3 / 10 min or shows method	**M1**
(a) 2.0 cm^3 per minute cao	**A1**

(a) Answer: 2.0 cm^3 per minute

(b) substitutes: 30 cm^3 / 15 min	**M1**
(b) 2.0 cm^3 per minute cao	**A1**

(b) Answer: 2.0 cm^3 per minute

(c) they are the same (both 2.0 cm^3 per minute) cao	**B1**

(c) Answer: They are the same; both 2.0 cm^3 per minute.

Question 4

Level 1 Simple statement(s) about villi, e.g. that they increase surface area, with little or no linkage to the mechanism of absorption. Answer may be a list with limited scientific detail.	**1-2**
Level 2 Some relevant structural adaptations of villi are described (e.g. large surface area, thin walls, good blood supply) with a partial explanation of how at least one adaptation increases the rate of absorption/diffusion.	**3-4**
Level 3 A detailed and coherent explanation linking several structural adaptations of villi (large surface area, single layer of thin epithelial cells, dense capillary network maintaining a steep concentration gradient, and/or microvilli) to the mechanisms of absorption (diffusion and, where relevant, active transport), with clear logical reasoning throughout.	**5-6**

Indicative content:

- Villi greatly increase the surface area of the small intestine wall available for absorption
- The wall of each villus is only one cell thick (thin epithelium), reducing the diffusion distance between the intestine and the blood
- Villi have a dense network of capillaries, which maintains a steep concentration gradient (removing absorbed molecules quickly), increasing the rate of diffusion
- Villi have a lacteal (part of the lymphatic system) for the absorption of fatty acids and glycerol
- Microvilli on the epithelial cells further increase the surface area for absorption
- Some nutrients (e.g. some glucose and amino acids) are absorbed by active transport against a concentration gradient, using energy from respiration, so absorption can continue even when concentration inside the blood is higher than in the gut

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Question 5

(a) to act as a marker so the distance moved (and hence the rate of water uptake, used to estimate the rate of transpiration) can be measured (oe) **B1**

(a) Answer: It acts as a marker so the rate of water uptake can be measured.

(b) temperature (oe) **B1**

(b) light intensity, OR humidity, OR using the same shoot/leaf area, OR starting the bubble from the same position each time (any one different valid control, oe) **B1**

(b) Answer: For example: temperature and light intensity kept the same in both readings.

(c) correct method shown: distance / time for at least one condition **M1**

(c) still air = 2.4 mm/min AND with fan = 6.0 mm/min (both required, cao) **A1**

(c) Answer: Still air: 2.4 mm/min. With fan: 6.0 mm/min.

(d) moving air removes water vapour from around the leaf/stomata more quickly, maintaining a steeper concentration gradient of water vapour between the leaf air spaces and the air outside, which increases the rate of diffusion of water vapour out of the leaf (and so increases the rate of water uptake), consistent with the higher rate (6.0 vs 2.4 mm/min) measured (oe) **B1**

(d) Answer: Moving air removes water vapour from the leaf surface faster, maintaining a steeper concentration gradient and increasing the rate of diffusion (transpiration), which matches the higher rate of water uptake measured with the fan.

Question 6

(a) correct surface area method: 2 x [(1 x 0.01) + (1 x 0.01) + (0.01 x 0.01)] = 0.0402 mm^2 (ft to final ratio if only arithmetic slip made) **M1**

(a) correct volume method: 1 x 0.01 x 0.01 = 0.0001 mm^3 **M1**

(a) 402 : 1 (cao) **A1**

(a) Answer: 402 : 1

(b) a large surface area to volume ratio maximises the area of membrane in contact with the soil water, increasing the rate of diffusion/osmosis of water into the root hair cell (oe) **B1**

(b) the concentration of mineral ions is often lower in the soil than inside the root hair cell, so ions cannot move in down a concentration gradient by diffusion; they must be absorbed by active transport, which requires energy released by respiration (in mitochondria) (oe) **B1**

(b) Answer: A large surface area to volume ratio increases the rate of water uptake by diffusion/osmosis. Mineral ions are often more concentrated inside the root hair cell than in the soil, so they must be moved in against the gradient by active transport, using energy from respiration.

Question 7

(a) correctly states or uses magnification = image size / actual size (oe) **M1**

(a) correct substitution: 45 / 0.03 **M1**

(a) x1500 (cao, no units for magnification) **A1**

(a) Answer: x1500

(b) e.g. adding a stain such as iodine to increase contrast, OR lowering the coverslip at an angle to avoid trapping air bubbles (oe, any one valid technique) **B1**

(b) Answer: Adding iodine stain to increase contrast (or lowering the coverslip at an angle to avoid air bubbles).

Question 8

(a) an undifferentiated cell that can divide (by mitosis) to produce more cells of the same type, which can then differentiate into different cell types (oe) **B1**

(a) Answer: An undifferentiated cell that can divide and become specialised.

(b) bone marrow (oe, e.g. certain adult tissues) **B1**

(b) Answer: Bone marrow.

(c) (early) embryo / blastocyst **B1**

(c) Answer: The embryo (blastocyst).

(d) e.g. treating diabetes, replacing damaged tissue after paralysis/spinal injury, treating some blood disorders/leukaemia via bone marrow transplant (oe, any one valid use) **B1**

(d) Answer: For example, treating some forms of paralysis by replacing damaged nerve cells.

(e) identifies a valid concern, e.g. the embryo is destroyed in the process, which some people believe is destroying a potential life (oe) **B1**

(e) links the concern to a balanced consideration, e.g. this must be weighed against the potential medical benefits to patients, so views on its acceptability differ (oe) **B1**

(e) Answer: Using embryonic stem cells destroys the embryo, which some consider morally wrong; this must be weighed against the medical benefits.

Question 9

(a) as temperature increases, enzyme and substrate particles gain (more) kinetic energy and move faster (oe) **B1**

(a) particles collide more frequently (oe) **B1**

(a) more successful collisions between enzyme active site and substrate (per unit time), forming more enzyme-substrate complexes, so the rate of reaction increases (oe) **B1**

(a) Answer: Increased kinetic energy causes more frequent, successful collisions between enzyme and substrate, increasing the rate of enzyme-substrate complex formation.

(b) above the optimum temperature, the enzyme gains too much energy and its structure/active site starts to change shape (oe) **B1**

(b) the enzyme is described as denatured; the active site is no longer complementary to the substrate (oe) **B1**

(b) the substrate can no longer bind to the active site, so enzyme-substrate complexes cannot form and the reaction rate falls to zero (oe) **B1**

(b) Answer: Above the optimum temperature the enzyme denatures: its active site changes shape so the substrate no longer fits, and the rate falls to zero.

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Question 10

Level 3 Detailed explanation that links lung structure and blood transport. Describes features such as alveoli with large surface area, thin walls, good blood supply; explains diffusion of oxygen into blood and carbon dioxide out; explains how oxygen is carried by red blood cells and carbon dioxide is carried away, and links these to supplying cells with O_2 for respiration and removing CO_2.	**5-6**
Level 2 Some explanation with clear descriptions of at least two relevant features. May describe alveoli structure and mention blood transport but with limited linking of how these lead to efficient gas exchange.	**3-4**
Level 1 Simple statements about lungs or blood, e.g. air enters lungs and blood carries oxygen, with little or no explanation of how structure supports function.	**1-2**

Indicative content:

- Alveoli provide a large surface area for gas exchange; many alveoli give a large total area
- Alveoli and capillaries have thin walls (one cell thick) to give a short diffusion distance for gases
- Good blood supply around the alveoli (dense capillary network) maintains concentration gradients
- Oxygen diffuses from alveoli into blood and is carried by red blood cells (haemoglobin) to body cells
- Carbon dioxide diffuses from blood into alveoli to be exhaled; CO_2 is transported in blood plasma or as hydrogen carbonate ions
- These features together ensure oxygen reaches cells for respiration and CO_2 is removed, maintaining efficient gas exchange

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