



Trial Examination 2021

Suggested solutions

QCE Biology Units 1&2

Paper 2

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SECTION 1

QUESTION 1 (4 marks)

Method A: facilitated diffusion, as molecules are moving along/with the concentration gradient using carrier proteins [1 mark]

Method B: simple diffusion, as molecules are moving along/with the concentration gradient and using no carrier proteins [1 mark]

Method C: simple diffusion, as molecules are moving along/with the concentration gradient and using no carrier proteins [1 mark]

Method D: active transport, as molecules are moving against the concentration gradient using carrier proteins and energy (adenosine triphosphate [ATP]) [1 mark]

QUESTION 2 (4 marks)

In the light-dependent stage of photosynthesis, stage 1, light energy is transformed into chemical energy stored in the ATP produced, which is required to provide energy for stage 2 of photosynthesis. [1 mark]

Water molecules (input) are split by the light energy into H^+ ions, also needed for stage 2, and oxygen, which is released as an output. [1 mark]

In the light-independent stage of photosynthesis, stage 2, the ATP from stage 1 provides the energy to join the H^+ ions to carbon dioxide (input) to produce glucose and water. [1 mark]

The energy released from ATP is transformed into chemical energy stored in the bonds of the glucose molecules (output), and so overall no net ATP is produced at the end of the photosynthesis reaction. [1 mark]

QUESTION 3 (4 marks)

a) The earlier lock and key model suggested that the active shape was rigid in shape and the substrate fit perfectly into it. [1 mark]

However, the more recent ‘induced fit model’ suggests that, when the substrate enters the active site, the active site changes shape slightly so that the substrate will fit more snugly and the reaction will proceed more readily. [1 mark]

b) In both the lock and key model and the induced fit model, the enzyme has a binding site (the active site or ‘keyhole’), a cleft in the enzyme into which the substrate molecule (the ‘key’) will fit and bind. [1 mark]

c) The active site provides a position for reactants to come closer together and orientates the reactants so the reactive regions are closer together, thereby speeding up the rate of the reaction. [1 mark]

QUESTION 4 (5 marks)

a) xylem and phloem [1 mark]

b) blood circulatory system and lymphatic system [1 mark]

c) *For example, any three of:*

- The transport systems for liver cells (circulatory and lymphatic) empty into one another, so the fluids (blood and lymph) mix. The transport systems for leaf cells (xylem and phloem) are separate and the fluids do not mix.
- The transport systems for liver cells are both made up of living cells. In the transport systems for leaf cells, the phloem is made up of living cells, but the xylem contains dead xylem vessels and tracheid cells.
- The transport systems for liver cells carry gases dissolved in their fluids. The transport systems for leaf cells do not carry dissolved gases.
- The transport systems for liver cells contain cells within their fluids. The transport systems for leaf cells do not contain cells within their fluids.
- The transport systems for liver cells require energy for movement to be provided by the organism's cells. In the transport systems for leaf cells, the phloem requires energy for movement to be provided by the organism's cells, but the xylem requires energy from the Sun for movement.
- The transport systems for liver cells maintain movement in one direction only. In the transport systems for leaf cells, movement in the xylem is in one direction, but movement in the phloem is in both directions.

[3 marks]

QUESTION 5 (4 marks)

- a) i) The renal : plasma ratio for chloride ions decreases rapidly before remaining constant in the distal tubule as reabsorption of chloride ions occurs. [1 mark]
- ii) The renal : plasma ratio for urea increases rapidly in the distal tubule, as urea is being pumped from the blood into the renal fluid by active secretion. [1 mark]
- b) Beyond point X, no more glucose is reabsorbed, as all the glucose in the renal fluid has already been reabsorbed. [1 mark]
- c) The molecules of proteins in the blood plasma are very large and cannot be filtered across in the Bowman's capsule, so no renal : plasma ratio for protein can be represented on the graph. [1 mark]

QUESTION 6 (4 marks)

- a) If the leaf was oriented this way in nature then the stomata would be exposed directly to the sun, which would result in a higher rate of transpiration. This may result in wilting and reduced photosynthesis if the stomata close. [1 mark]
- b) In set-up II in still air, the rate of transpiration would be lower than in set-up I in moving air. The moving air blows away the transpired water vapour from around the leaf, increasing the water vapour concentration gradient, which increases the rate of water loss and therefore water uptake. [1 mark]
- c) Grease on the underside of the leaves will block the stomata, which will decrease transpiration and therefore water loss markedly, as the stomata are the main place of transpiration. Moving air, as in IV, or still air, as in III, will cause little difference in water loss in this situation. [1 mark]

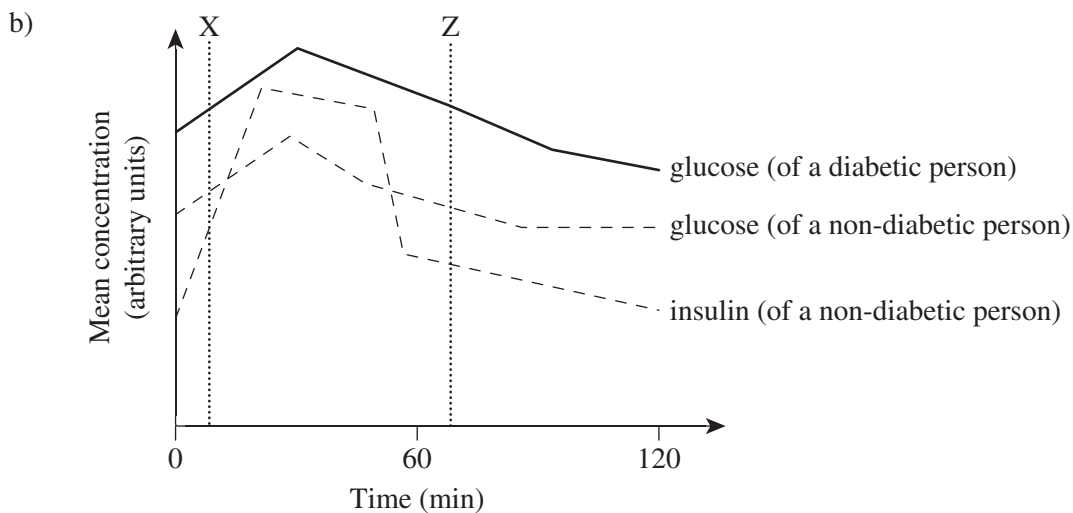
- d) This is a controlled experiment, as there was only one independent/altere d variable in each pair of set-ups, with all other factors (same plant, same number of leaves, same environmental conditions) kept the same. [1 mark]

QUESTION 7 (4 marks)

- a) Homeostasis is the maintenance of a relatively constant internal environment, despite changes in the external environment, to maintain optimum conditions for cell functioning. [1 mark]
- b) **Hypothalamus:** As it was a hot day and the boy was running, he would be sweating and losing water. As he drank no water, his blood solute concentration would increase and this stimulus would be detected by the osmoreceptors in his hypothalamus. [1 mark]
- Anterior pituitary:** Anti-diuretic hormone (ADH) produced in the hypothalamus would pass to the anterior pituitary gland and be released into the blood to travel to the kidneys. [1 mark]
- Kidney:** ADH will stimulate the cells of the kidney tubules to increase water reabsorption back into the blood, thereby lowering the solute concentration back towards the norm. [1 mark]

QUESTION 8 (4 marks)

- a) The pancreas produces insulin when blood glucose concentration is increasing as at X. [1 mark]
The insulin causes the cell membranes of body cells to become more permeable to glucose and thus absorb more glucose, thereby lowering the blood glucose back to the norm, as seen at point Z. [1 mark]



[1 mark]

The initial high blood glucose concentration would increase even higher after ingestion of the glucose solution, then would decrease but remain high due to the lack of insulin production in the body. [1 mark]

QUESTION 9 (4 marks)

- a) The antimicrobial peptides produced by the lung cells are part of the innate immune system. [1 mark]
They are first level and non-specific, as they provide a chemical defense to any foreign invader before it can pass the first physical barrier of defense and infect the host. [1 mark]

- b) The presence of the capsule in *Pneumococcus* bacteria decreases the virulence of these bacteria. When it was removed by the enzyme in the antibiotic, the bacterial survival and invasion was promoted as they evaded the antibacterial peptides in the lungs more successfully. [1 mark]
- c) Many viruses have attachment structures or produce adhesin protein so that they can adhere to specific receptors of the host cell and inject their nucleic acid, thus infecting more host cells and increasing their virulence. [1 mark]

QUESTION 10 (4 marks)

- a) The person was exposed to two different antigens during the period, as there are two separate lines on the graph. [1 mark]
- b) Peak W is the primary/initial antibody response, which also produced B memory cells specific to this antigen. [1 mark]
Peaks X and Y are subsequent antibody responses and, due to the specific B memory cells already present, were more rapid and greater responses. [1 mark]
- c) On exposure to the antigen, specific B lymphocytes recognised the antigen and were stimulated by T helper cells to clone and differentiate. The cloned cells differentiated into B memory cells and plasma cells that produced large quantities of the antibody. [1 mark]

QUESTION 11 (4 marks)

- a) **Method I:** artificial active, as a treated antigen was injected and the person would then produce their own antibodies [1 mark]
Method II: artificial passive, as the person did not make their own antibodies and they were produced in another animal [1 mark]
- b) If the boy stepped on a rusty nail and it was not known when his last tetanus injection was, he should be given an injection by method II to provide his body with the specific antibodies to immediately combat the tetanus bacteria (even though it is short-term protection). [1 mark]
- c) A booster injection for tetanus is required as the tetanus antibodies and memory cells decline over 10 years, whereas they do not for other diseases such as diphtheria. [1 mark]