

## QCE Biology Units 1&2

### Paper 1

#### SECTION 1 – MULTIPLE CHOICE QUESTIONS

	A	B	C	D
1.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
3.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
4.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
5.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
6.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
7.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
8.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
9.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
10.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
12.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
13.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
14.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

	A	B	C	D
16.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
17.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
18.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
19.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
21.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
23.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
24.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
25.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**QUESTION 1 B**

**B** is correct. The structure labelled X is a protein channel, as both ends of the protein are open and solute is being transferred from the exterior of the cell to the interior of the cell.

**A** is incorrect. Cholesterol molecules do not pass through the entire lipid bilayer.

**C** is incorrect. Glycoprotein molecules have a polypeptide chain attached.

**D** is incorrect. Phospholipid molecules make up the lipid bilayer.

**QUESTION 2 C**

**C** is correct. The light-dependent reaction requires light. It produces ATP, which is used during the light-independent reaction to fix carbon and produce glucose.

**A** is incorrect. Oxygen is released during the light-dependent reactions.

**B** is incorrect. Light energy is used to split water.

**D** is incorrect. Glucose is made during the light-independent reaction.

**QUESTION 3 B**

**B** is correct. The nervous system uses both electrical impulses along neurons and neurotransmitters at the nerve synapse (the chemical messengers) to transmit messages throughout the body.

**A** is incorrect. Nerve impulses travel in one direction.

**C** is incorrect. Impulses travel faster along myelinated axons.

**D** is incorrect. Neurotransmitters move through exocytosis.

**QUESTION 4 B**

**B** is correct. Moving air increases evapotranspiration from the stomata, increasing the amount of water vapour lost. Since stomata usually close during the hottest parts of the day, no water vapour will be lost in bright sunlight, but the stomata will be open in cooler, shady areas.

**A**, **C** and **D** are incorrect. Stomata close in bright sunlight and there is less transpiration in still air.

**QUESTION 5 D**

**D** is correct. The destruction of bacteria in saliva is an innate response. Therefore, the same action is taken regardless of the type of pathogen encountered.

**A** is incorrect. The production of antibodies by plasma cells is part of humoral immunity.

**B** is incorrect. Innate immunity is the same response for different pathogens.

**C** is incorrect. The presentation of material to a T cell by a phagocyte is a process in humoral immunity.

**QUESTION 6 B**

**B** is correct. Specialised cells contain different proportions of organelles depending on their particular function. Cell B could be a heart muscle cell because it contains a lot of mitochondria, which heart muscle cells need to contract and keep the heart pumping. It would not need chloroplasts since these are found in plant cells.

**A** is incorrect. Muscle cells contain lots of mitochondria.

**C** is incorrect. Chloroplasts are present in leaf cells.

**D** is incorrect. Chloroplasts are absent in root cells.

**QUESTION 7 C**

**C** is correct. Large fat deposits provide insulation for animals living in cold environments. This would help the endotherm retain the heat produced and maintain a constant temperature.

**A** is incorrect. The wrong term is used for this option; 'counter-current heat exchange' should be replaced with 'vasoconstriction' for this option to be correct.

**B** is incorrect. The wrong term is used for this option; 'vasodilation' should be replaced with 'vasoconstriction' for this option to be correct.

**D** is incorrect. Huddling is an example of a behavioural adaptation.

**QUESTION 8 D**

**D** is correct. Eukaryotes contain membrane-bound organelles and a membrane surrounding the DNA, where prokaryotes often contain DNA in the cell cytosol only. While prokaryotic cells do not have membrane-bound organelles, both prokaryotic and eukaryotic cells have a cell membrane.

**A** is incorrect. Cell walls are not found in all cells.

**B** is incorrect. Circular DNA is only found in bacteria.

**C** is incorrect. Ribosomes are not found in prokaryotes.

**QUESTION 9 C**

**C** is correct, and **A** and **B** are incorrect. In this sequence, body temperature decreases in response to the stimulus of high body temperature. In a negative feedback loop, specialised receptors detect a change in an internal condition and the response generated will be in opposition to the change that occurred. This is different to a positive feedback loop, which acts to amplify the original effect.

**D** is incorrect. While the sequence is an example of negative feedback, sweating and temperature change are the responses to the stimulus.

**QUESTION 10 A**

**A** is correct and **B** is incorrect. The folding of the cristae increases the surface area, which results in faster production of ATP during cellular respiration.

**C** is incorrect. The organelle shown is a mitochondrion, not a chloroplast.

**D** is incorrect. Double membranes do not increase surface area.

**QUESTION 11 C**

**C** is correct. Organelles are the smallest and least complex level, followed by cells, tissues, organs and systems.

**A**, **B** and **D** are incorrect. These options show the incorrect order of complexity.

**QUESTION 12 C**

**C** is correct. When the partial pressure of oxygen is 27 mm Hg, the oxygen saturation of haemoglobin is 50%.

**A** is incorrect. The oxygen saturation of haemoglobin in the lungs is close to 100%.

**B** is incorrect. When the partial pressure of oxygen is over 40 mm Hg, excess oxygen is released into the tissues.

**D** is incorrect. When the partial pressure of oxygen is 100 mm Hg, the volume of oxygen in the blood is 20 mL.

**QUESTION 13 D**

**D** is correct. Glycolysis is the first stage of cellular respiration because it needs to produce the pyruvate and NADH required by the reactions that create acetyl-CoA. These are used in the second stage, the Krebs cycle. The Krebs cycle produces the NADH and FADH<sub>2</sub> that are required for the electron transport chain, which is the final stage.

**A** is incorrect. Fermentation is anaerobic. This option confused the pyruvic acid cycle with the citric acid cycle.

**B** is incorrect. The pyruvic acid cycle and lactic acid cycle occur in anaerobic respiration.

**C** is incorrect. The stages listed in this option are not part of either mode of respiration.

**QUESTION 14 A**

**A** is correct. Xerophytes live in arid conditions and should have adaptations for minimising water loss. Such adaptations include having few stomata and a waxy cuticle to reduce transpiration.

**B** is incorrect. This is an adaptation to minimise water loss, but not all xerophytes possess this adaptation.

**C** is incorrect. This is an adaptation for halophytes.

**D** is incorrect. This is an adaptation for hydrophytes.

**QUESTION 15 C**

**C** is correct. The mosquito carries the plasmodium that causes malaria. Therefore, they are the vector of the disease, or the disease-carrying organism.

**A** is incorrect. Pathogens are the disease-causing organism.

**B** is incorrect. In this case, the host organism is a human.

**D** is incorrect. A parasitic insect is a parasitoid.

**QUESTION 16 B**

**B** is correct. The glomerulus, collecting duct, proximal tubule, Bowman's capsule, Loop of Henle and distal tubule have all been correctly identified.

**A** is incorrect. This option may be reached if the Bowman's capsule is confused with the glomerulus.

**C** is incorrect. This option may be reached if the Loop of Henle is confused with the capillaries.

**D** is incorrect. This option may be reached if the distal tubule is confused with the collecting ducts.

**QUESTION 17 B**

**B** is correct. Hormones are secreted by glands such as the ovaries and testes. It is common for hormones to affect target cells that are some distance from the glands, as hormones act slower than nerve impulses.

**A** is incorrect. Hormones are produced in glands and released into the bloodstream; synaptic gaps are used by neurotransmitters.

**C** is incorrect. Hormones are released into the bloodstream to be transported to another site.

**D** is incorrect. Hormones have a longer effect on their target cells than neurotransmitters.

**QUESTION 18 B**

**B** is correct. The release of histamines causes an increase in blood flow as the capillaries swell and become more permeable, leading to inflammation at the site of release.

**A, C and D** are incorrect. Phagocytes, antibodies and red blood cells are not involved in the inflammatory response.

**QUESTION 19 A**

**A** is correct. The immune system recognises antigens on the surface of cells (both self and non-self). For these vaccinations to be effective, the quick identification of antigens and the production of antibodies against those antigens will lead to the most effective immunity against COVID-19.

**B** is incorrect. Allergens illicit an inflammatory response that is part of innate immunity.

**C** is incorrect. Antibodies are not produced in innate immunity; antibodies are often confused with antigens.

**D** is incorrect. This option may be reached if complement proteins are confused with antibodies.

**QUESTION 20 B**

**B** is correct. Phloem cells contain cytoplasm so that water and dissolved minerals may travel more easily through the hollow tubes. Mature xylem cells do not contain cytoplasm.

**A, C and D** are incorrect. Both mature xylem cells and mature phloem cells are found in vascular bundles and leaves, and both have cell walls.

**QUESTION 21 A**

**A** is correct. The structure labelled 1 represents the substrate, which is broken down into two products in the final step.

**B** is incorrect. The structure labelled 2 is the enzyme.

**C** is incorrect. The structure labelled 3 is the substrate-enzyme complex.

**D** is incorrect. The structures labelled 4 are the products of the reaction.

**QUESTION 22 B**

**B** is correct. Pathogenic bacteria can be engulfed and destroyed by phagocytes, which is referred to as phagocytosis.

**A** is incorrect. Vaccination provides active acquired immunity against pathogens, including bacteria, but it does not 'engulf' the pathogen.

**C** is incorrect. The production of antibodies can eventually lead to the destruction of bacteria through cell signalling to NK cells and phagocytes, but it does not directly destroy them.

**D** is incorrect. Exocytosis is the process through which contents of the cell vacuole are released to the exterior of the cell.

**QUESTION 23 C**

**C** is correct. A zoonotic disease is one that is able to be spread from animals to humans and may have multiple hosts acting as reservoirs. Transmission from human to human does not occur.

**A** is incorrect. A pandemic is the occurrence of an infectious disease over a whole country or the world at a particular time; there is no information to suggest that this is the case for the Hendra virus.

**B** is incorrect. A vector is an organism, typically a biting insect or tick, that transmits a disease or parasite from one animal or plant to another. Bats are the vector for the Hendra virus.

**D** is incorrect. A reservoir is a population that is chronically infected with a pathogen and can act as a source of further infection. An infected population of bats would be the reservoir of infection for the Hendra virus.

**QUESTION 24 D**

**D** is correct. Capillaries with walls one-cell thick enable fast exchange of gases, which is vital within the lung to enable efficient oxygen exchange.

**A** is incorrect. Humans use concurrent oxygen exchange, not counter-current.

**B** is incorrect. While capillary walls are thin and flexible, this is not to allow the passage of oxygen.

**C** is incorrect. Contracting to create negative pressure within the lungs is the role of the diaphragm and occurs in order for air to be inhaled into the lungs.

**QUESTION 25 A**

**A** is correct. Effectors are cells or organs that act in response to a stimulus. The pancreas releases insulin in response to increasing blood glucose levels to remove glucose from the blood, and stores insulin for later use when blood sugar levels decrease.

**B** is incorrect. The pancreas releases glucagon in response to low blood sugar levels.

**C** is incorrect. Glucose is released by the liver after the breakdown of glycogen in response to low blood sugar.

**D** is incorrect. The liver breaks down glycogen or stores it; it does not release it.

**SECTION 2****QUESTION 26 (3 marks)**

Herd immunity is the resistance to the spread of an infectious disease within a population that is based on the pre-existing immunity of a high proportion of individuals due to previous infection or vaccination.

Herd immunity will reduce the transmission of an infectious disease because the large portion of the population that has immunity will not be able to infect others. This usually occurs due to mass vaccination. Herd immunity results in protection for those individuals who cannot be vaccinated; their chances of coming into contact with an infected person is reduced because the disease is not circulating in the community.

An example of herd immunity is the mass vaccination against smallpox, which resulted in the eradication of the disease.

[3 marks]

*1 mark for defining herd immunity.*

*1 mark for explaining the decrease in transmission due to herd immunity.*

*1 mark for providing an example of herd immunity.*

*Note: Accept mass vaccination or mass exposure to infectious disease as the rationale for herd immunity.*

**QUESTION 27 (4 marks)**

a) eukaryote, animal cell

[1 mark]

*1 mark for circling both correct options.*

b)

	Organelle name
1	nucleolus
2	rough endoplasmic reticulum
3	mitochondria
4	Golgi body
5	vacuole
6	ribosomes

[3 marks]

*Award 3 marks for identifying all 6 organelles.*

*Award 2 marks for identifying 4–5 organelles.*

*1 mark for identifying 2–3 organelles.*

**QUESTION 28 (4 marks)**

a) Reactions in the body are catalysed by enzymes, which reduce the activation energy of a reaction. Different enzymes have different optimal ranges for conditions such as pH and temperature. At low temperatures, enzyme activity is low. Activity of the enzyme increases until a peak or optimal temperature is reached, where the rate of cellular respiration is maximised. After this point, the activity drops as the increased temperature denatures the enzymes and they can no longer function.

[2 marks]

*1 mark for explaining the reaction rate at a low temperature.*

*1 mark for explaining the denaturing of a heated enzyme.*

- b) The enzyme is likely from a human as the optimal temperature for the enzyme is around 37°C (as shown in the graph). The enzyme cannot be from the axolotl because the action of the enzyme at 16°C is minimal. The body temperatures of the blue-tongue lizard and hummingbird are higher than the optimal temperature of the enzyme, so these organisms are unlikely to be the source.

[2 marks]

*1 mark for identifying that the enzyme is from a human.  
1 mark for explaining the response with reference to the data.*

**QUESTION 29 (2 marks)**

The active site of an enzyme is the point at which the substrate binds to the enzyme. Using the lock-and-key model for enzyme action, the 'lock' (substrate) is shaped to fit the 'key' (active site of the enzyme), after which the enzyme catalyses the reaction and the product is formed.

[2 marks]

*1 mark for describing that the shape of the enzyme's active site fits the substrate.  
1 mark for identifying the active site as the point connecting substrate and enzyme.*

**QUESTION 30 (2 marks)**

Antibiotic A should be prescribed for this infection. Examining the diagram, antibiotic A has the largest zone of inhibition and, thus, is the most effective at killing bacteria. (*A broad-spectrum antibiotic may also be considered if the wound contains other types of bacteria.*)

[2 marks]

*1 mark for identifying antibiotic A.  
1 mark for justifying the response with reference to the largest area of inhibition.*

**QUESTION 31 (5 marks)**

- a) Surface area to volume ratio for 1 cm cell:

SA : V

$$6 \text{ cm}^2 : 1 \text{ cm}^3$$

6 : 1

- Surface area to volume ratio for 2 cm cell:

SA : V

$$24 \text{ cm}^2 : 8 \text{ cm}^3$$

24 : 8

3 : 1

- Surface area to volume ratio for 3 cm cell:

SA : V

$$54 \text{ cm}^2 : 27 \text{ cm}^3$$

54 : 27

2 : 1

[3 marks]

*1 mark for calculating the surface area to volume ratio for the 1 cm cell.  
1 mark for calculating the surface area to volume ratio for the 2 cm cell.  
1 mark for calculating the surface area to volume ratio for the 3 cm cell.*



- b) The 1 cm cell would maximise gas exchange with the surrounding environment as it has the largest surface area to volume ratio.

[2 marks]

*1 mark for identifying the correct cell.*

*1 mark for justifying the response.*

**QUESTION 32 (5 marks)**

- a) Guard cells are specialised plant cells that make up the stomata. Guard cells control the opening and closing of the stomata to exchange gases between the plant and the surrounding atmosphere.

In order for photosynthesis to take place, CO<sub>2</sub> must be absorbed from the surrounding atmosphere through the stomata, which have to be open for the CO<sub>2</sub> to enter. However, if the stomata remain open, excess water vapour will be lost.

The 'trade-off' is between maximising photosynthesis and respiration by having the stomata open and minimising water loss by having the stomata closed.

[3 marks]

*1 mark for explaining the role of the stomata in transpiration.*

*1 mark for explaining the role of stomata in photosynthesis and respiration.*

*1 mark for explaining the trade-off between maximising photosynthesis and respiration and minimising water loss.*

- b) It is likely that sample C is from a rainforest plant. This sample has the highest stomatal conductance of around 100 mmol m<sup>-2</sup> s<sup>-2</sup>. Plants from wet and humid environments are not at risk from the loss of water vapour from the stomata, since water is plentiful. These plants can maximise photosynthesis by leaving the stomata open for long periods. Hence, the stomatal conductance is greater for these plants.

[2 marks]

*1 mark for identifying sample C.*

*1 mark for explaining that the stomata of rainforest plants remain open, so their conductance is greater.*