Neap

Trial Examination 2022

Suggested Solutions

QCE Biology Units 1&2

Paper 2

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SECTION 1

QUESTION 1 (4 marks)

For example, any two of:

Physical defence strategies:

- Cell walls provide strength and flexibility.
- Dense, waxy cuticles on the outside layers of the epidermis. The thicker the cuticle, the harder it is for pathogens to enter the cells.
- Thick layers of bark provide an external barrier.
- Lignified cell walls produce a fibrous, 'woody' appearance that is impervious to water, which makes it harder for insects to chew through. If undamaged, it is impenetrable to pathogens.
- Plants can close the stomata to deny pathogens entry.
- Vertically positioned leaves ensure that water does not accumulate on the surface of leaves, which avoids encouraging the growth of moulds and other water-loving pathogens.

Chemical defence strategies:

- Saponins have soap-like properties that break down lipids and so disrupt the phospholipid bi-layer of the cell membrane and can result in cell lysis.
- Terpenes are essential oils produced by plants. Pyrethrin, one example of a type of terpene, is toxic to many kinds of insects and is used in human-made insecticides.
- Phenolics include flavonoids, tannins and phytoalexins. This group of compounds disrupts cellular metabolism in the pathogen.
- Alkaloids are commonly found in the leaves, bark and roots of plants and are toxic to a range of organisms from bacteria to humans. Caffeine, nicotine, morphine and capsaicin are all examples of alkaloids produced in plants. In high dosages, alkaloids can be fatal to a wide range of pathogens.
- Cyanogenic glycosides are compounds often found in the edible parts of plants, such as the fruit. They break down to form cyanide, which disrupts cellular respiration and is very toxic to a wide range of organisms, including pathogens.

[4 marks]
1 mark for naming each appropriate example.
1 mark for describing each appropriate example.
Note: Accept any combination of physical and/or chemical defence strategies.

QUESTION 2 (4 marks)

a) The endotherm is *Pseudomys*. As shown in the graph, this organism has a stable body temperature that does not fluctuate with the surrounding environment.

[1 mark]
1 mark for identifying Pseudomys as the endotherm with reference to the graph.

b) *For example, any three of:*

Behavioural mechanisms:

- In cold periods, animals may huddle together in groups to increase the retention of body heat.
- When it gets too hot, animals may find shade or alter the time of day they are active, such as coming out at night and sleeping during the day when it is the hottest.
- Some animals bathe or cover themselves in water to increase evaporative cooling.
- Some animals decrease activity levels so that less heat is produced.

Physiological mechanisms:

- Some animals can thermoregulate using a negative feedback loop. If the animal gets too hot, it can sweat to increase evaporative cooling from the skin's surface, resulting in reduced body temperature.
- Sweating stops once the body temperature decreases to the optimal level.
- The diameter of blood vessels can increase and move closer to the surface of the skin to radiate excess heat to the animal's surroundings.
- If the animal gets too cold, it can begin shivering to produce heat and its hair stands on end to increase the retention of warm air.
- Blood vessels constrict and move away from the surface of the skin so less heat is lost.

[3 marks]
1 mark for providing each appropriate mechanism.
Note: Accept any combination of behavioural and/or physiological mechanisms.

QUESTION 3 (4 marks)

For efficient gas exchange to occur, the surface area should be large as possible. This increases the surface area to volume ratio, enabling faster diffusion to occur.

The cell membrane should be as thin as possible and should consist of a material that allows the gas to pass through the barrier easily (such as a moist surface).

There should be an adequate supply of the gas being transferred. If the respiratory surface is not adequately ventilated, the rate of exchange drops.

To maximise the exchange of oxygen and carbon dioxide, a large network of capillaries surrounds the respiratory surfaces of the lung and gill, which further increases the rate of diffusion.

[4 marks]
1 mark for explaining that a large surface area increases gas exchange.
1 mark for explaining that thin membranes maximise gas exchange.
1 mark for explaining that an adequate supply of gas to the respiratory surface is required.
1 mark for explaining that a large network of capillaries increases diffusion.

QUESTION 4 (4 marks)

a) FOV area at ×100:

$$A = \pi r^2$$
$$= \pi \times (0.4)^2$$
$$= 0.5026$$
$$\approx 0.503$$

[2 marks]
1 mark for showing correct working.
1 mark for calculating the area.

b) Stomatal density at ×100:

$$\frac{6}{0.503} = 11.9 \text{ stomata per mm}^2$$

[2 marks]
1 mark for showing correct working.
1 mark for calculating the stomatal density.
Note: Allow follow through errors. For example, award 1 mark if the calculation uses the FOV diameter instead of the FOV area but shows correct progress towards stomatal density.

QUESTION 5 (8 marks)

a) Person Y may take less time to recover from a subsequent infection due to the production of memory cells from the first infection. These memory B cells and memory T cells 'remember' the antigens on the surface of the virus, which enables the fast production of antibodies when the immune system encounters the same virus again.

[2 marks]
1 mark for identifying memory cells.
1 mark for explaining the ability to rapidly produce antibodies.

b) Person Z could get sick if exposed to a different virus because each virus has specific antigens on the outside surface. The same virus can also develop different strains or variants that have slightly different antigens, helping the virus escape detection. Being exposed to one type of virus does not give any protection against a different virus, since antibodies produced by memory cells are specific to one type of antigen.

[2 marks]
1 mark for explaining the specificity of antigens on the surface of the virus.
1 mark for explaining that antibodies are specific to one antigen.

c) Injecting a pathogenic virus into individuals is not an effective immunisation strategy. The injection of live pathogens into individuals results in infection, which, depending on the virus in question, could range from mild to life-threatening. The safer and more effective way to immunise a community is through vaccination. The vaccines that are used today contain inactivated viruses or virus particles that are administered to produce an immune response, creating antibodies. Mass vaccination results in community protection.

[4 marks]
1 mark for explaining that injecting live pathogens leads to infection.
1 mark for explaining that mass infection is not an effective method for immunising a community.
1 mark for explaining vaccination as the injection of inactivated pathogens to create antibodies.
1 mark for identifying vaccination as the more effective method and explaining that mass vaccination results in community protection.

QUESTION 6 (3 marks)

The high-energy molecules produced by the light-dependent reaction are ATP and NADPH.

They are released into the stroma of the chloroplast where they provide energy to drive a biochemical pathway known as the light-independent reaction. In the light-independent reaction, light is not required for the reactions to take place because the energy for the reactions is taken from the ATP and NADPH. Without access to these molecules, the plant would use up all its available ATP, resulting in energy loss and starvation.

[3 marks]
1 mark for identifying ATP and NADPH.
1 mark for explaining that products from the light-dependent reaction are needed for the light-independent reaction to take place.
1 mark for explaining that death could occur if ATP and NADPH are absent because the plant would not be able to produce glucose.

QUESTION 7 (4 marks)

	Explanation
Glomerulus	Blood first flows into the glomerulus under pressure, and water and small molecules are filtered to be collected in the Bowman's capsule.
Bowman's capsule	The Bowman's capsule collects the filtered blood from the glomerulus, which contains water and small molecules such as nitrogenous wastes.
Loop of Henle	The Loop of Henle enables the concentration of urine by creating a concentration gradient within the inner medulla and outer cortex of the kidney. This results in the creation of urine that is more concentrated than the blood.
Collecting tubule	Water passes from the collecting tubule back into the kidney and into blood vessels, further concentrating the urine produced.

[4 marks]
1 mark for providing each correct explanation.

QUESTION 8 (3 marks)

Water is able to move freely between both sides of the semi-permeable membrane due to osmosis. In osmosis, water moves from the side with the highest concentration of water (lowest concentrate of solute) to the lowest concentration of water (highest concentration of solute). This will result in the movement of water from the left side of the tube to the right side of the tube.

If starch were able to pass the membrane, it would move from the right-hand side to the left-hand side as this is down the concentration gradient. However, starch is unable to pass through the semi-permeable layer as it is a large, polar molecule. This will result in an increase in the volume of solution on the right side of the tube.

[3 marks]
1 mark for identifying that water moves from left to right through osmosis.
1 mark for explaining that no movement of starch can occur from right to left.
1 mark for identifying the increase in the volume of the right side of the tube.

QUESTION 9 (6 marks)

a)

	Component name
A	dendrite
B	soma
C	axon
D	axon terminal

[4 marks]
1 mark for each correct component name.

b) The main function of sensory neurons is to send sensory signals from sensory organs to the central nervous system. The function of motor neurons is to send motor commands from the central nervous system to the sensory organs.

[2 marks]
1 mark for stating the function of sensory neurons.
1 mark for stating the function of motor neurons.

QUESTION 10 (5 marks)

1. Prokaryotic cells lack internal membrane-bound organelles such as mitochondria or chloroplasts.
2. Prokaryotic cells do not have a nucleus.
3. Prokaryotic cells are significantly smaller than eukaryotic cells.
4. Prokaryotic cells usually have a singular circular chromosome called a plasmid, which are rare in eukaryotic cells.
5. Prokaryotes are all single-celled and eukaryotes can be single-celled or multi-celled.

[5 marks]
1 mark for providing each appropriate difference.

