

Trial Examination 2007

VCE Biology Unit 3

Written Examination

Suggested Solutions

SECTION A: MULTIPLE-CHOICE QUESTIONS

1	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D
2	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
3	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D
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6	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
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8	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D
9	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D
10	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D
11	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
12	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D

13	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
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16	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input checked="" type="checkbox"/> D
17	<input type="checkbox"/> A	<input type="checkbox"/> B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> D
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25	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D

SECTION A: MULTIPLE-CHOICE QUESTIONS**Question 1** C

Condensation polymerisation is where small chemical units called monomers are linked together to form a polymer and water is produced as a by-product. **B** is clearly incorrect. **A** is a correct statement, but it does not relate to the question. **D** is incorrect as catabolic reactions are related to breaking down molecules rather than building them.

Question 2 B

Phospholipids are made of two fatty acid chains, glycerol and phosphate sub-units, so the whole structure is comprised of many atoms. A starch molecule is comprised of many glucose monomers and is comprised of many atoms. A protein is one or more chains (polypeptides) of amino acids and would logically have more atoms than a single amino acid. An amino acid is generally only a dozen or so atoms in size.

Question 3 C

Water is a polar molecule due to its shape. This means it carries partial charges and other like molecules can mix with it. Adjacent water molecules interact via hydrogen bonds. Water can absorb a large amount of heat because it takes a large amount of energy to break the hydrogen bonds. This excludes **A**. Water is a product of respiration, it is not a reactant.

Question 4 A

As DNA comprises two helices that are anti-parallel, the complimentary strand needs to have 'C's matching 'G's and 'A's matching 'T's. As the complimentary strand contains DNA nucleotides, the only correct answer is **A**. **C** and **D** are incorrect as U (uracil) is not a base found in DNA.

Question 5 D

Base pairing in DNA is achieved via hydrogen bonding. It is the double-helical structure of DNA molecule, rather than the rules of base pairing, that requires the strands to be anti-parallel. There are three hydrogen bonds between G and C and only two hydrogen bonds between A and T. Higher stability would be achieved with a higher proportion of G and C in the DNA of these 'thermo' bacteria.

Question 6 A

Hydrophobic molecules or parts of molecules do not dissolve in water. They will, however, mix easily with other hydrophobic molecules or parts of molecules, such as the fatty acid tails which occupy the middle regions of phospholipid bilayers. Polar, basic and hydrophilic molecules or parts of molecules usually do dissolve in water.

Question 7 D

The proteome refers to all the proteins and their functions within the cells of an organism. This includes the proteins involved with anabolic pathways (building-up) as well as metabolism (both anabolic and catabolic) and those that carry out any other function. Only a small proportion of the genome codes for proteins.

Question 8 C

Pure water has a pH of 7 and the amount of hydrogen ions and the amount of hydroxide ions will be the same. If the amount of hydrogen ions increases, the acidity of the solution will increase, reducing the pH.

Question 9 C

The grana and stroma are locations within a chloroplast and so are areas where certain aspects of photosynthesis occur. The Calvin cycle occurs in the light-independent stage of photosynthesis. Ribosomes provide the 'workbench' for protein synthesis. Here the mRNA is read in groups of three and the correct amino acid is placed into the correct position of the growing peptide.

Question 10 C

In this case, the hormone causes the secretion by exocytosis of a protein that has already been made by the cell. The raw polypeptides made by the ribosomes are modified into finished proteins in the endoplasmic reticulum. The endoplasmic reticulum also transports them to the Golgi apparatus, where they are packaged into vesicles for secretion. Pinocytosis refers to the bulk ingestion by the cell of extracellular fluid.

Question 11 B

To perform their transport functions, transmembrane proteins must be embedded in the phospholipid bilayer in the correct orientation. The carbohydrate groups of glycoproteins usually extend into the external environment, since they function as receptors or sensors for extracellular molecules. The inside of the phospholipid bilayer is furthest from the watery external environment of the cell, and consists of the hydrophobic fatty acid tails of the phospholipid molecules. Cholesterol is a vital component of animal plasma membranes, as it controls rigidity and surface tension.

Question 12 B

The concentration of the ion needs to be higher within the cell (intracellular) compared to outside the cell (extracellular). The only ion at a higher intracellular concentration is K^+ .

Question 13 A

It is likely that the concentration differences for each of the ions are due to active transport. Otherwise, the concentrations of ions on each side of the membrane would equalise. So the correct answer can only be **A** or **C**. Since K^+ is higher within the cell, **A** is the correct explanation.

Question 14 B

The inputs for aerobic respiration are oxygen (O_2) and glucose ($C_6H_{12}O_6$). The products of aerobic respiration are carbon dioxide (CO_2) and water (H_2O). The chemical energy in glucose is converted to usable energy in the form of 36 ATP molecules. To achieve this, 36 inorganic phosphates (Pi) are put onto 36 ADP molecules.

Question 15 A

Since the organism is a freshwater protist, the lowest concentration would be most appropriate. At the 0.5% the contractile vacuole is active and removing excess water. At higher solute concentrations, water is lost by osmosis to the external environment and the contractile vacuole does not need to function. At these higher concentrations the cell could become shrivelled and die.

Question 16 D

The contractile vacuole is either not functioning within a living cell or the cell has died. At high concentrations, the internal solute concentration would be lower (higher water, hypotonic) compared to the outside solute concentration which would be higher (lower water, hypertonic). This excludes **B** and **C**. As the protist is a freshwater protist, the 2.0% solution being isotonic is likely to be incorrect. This excludes **A**. It is probable the cell has lost too much water to function effectively and has died.

Question 17 C

A typical hormone molecule binds to a specific cell surface receptor that corresponds to the shape of the hormone. The formation of the hormone–receptor complex then causes enzyme-controlled chemical changes inside the cell. These changes can be different in different cells, e.g. adrenalin causes relaxation of smooth muscle cells in the arteries of skeletal muscles, but increases the rate of contraction of cardiac muscle cells.

Question 18 B

Plant hormones (auxins) are produced in the meristematic regions of the plant, including the tips of the stems. These auxins initiate growth in the plant. If sunlight is normally found directly above the plant, the auxins are distributed evenly and the plant grows upwards. If, however, the light is found more on one side of the plant, more auxin will be produced on the side away from the light. The cells on that side elongate, causing the stem to bend towards the light.

Question 19 C

At 10^{-1} ppm, auxin promotes stem growth. Root growth is inhibited at all concentrations greater than 10^{-3} ppm, so **A** and **D** are incorrect. **B** is inaccurate, because stem growth is not inhibited until auxin concentration exceeds 10^2 ppm.

Question 20 A

Wider axons reduce electrical resistance to the impulse. The presence of the myelin sheath enables impulses to be transmitted rapidly by saltatory conduction between the Nodes of Ranvier.

Question 21 B

In the brain, the $-COOH$ group on levodopa is removed by an enzyme called amino acid decarboxylase, forming dopamine. Parkinson's disease is caused by a shortage of this neurotransmitter. None of the alternative solutions lead to an increase in dopamine. Option **A** is incorrect because neurotransmitters never diffuse **into** neurons, and it is the frequency (not the speed) of nerve impulses that promotes brain function.

Question 22 B

Fevers are normally accompanied by excessive sweating, so there is no evidence for a delay or defect in the body's response to elevated temperature. Heat produced via bacterial or viral reproduction is negligible. However, body cells killed by these pathogens release molecules (pyrogens) that reset the body's thermostat and elevate the basal metabolic rate so that temperature increases.

Question 23 A

Antibiotics are used to treat diseases caused by bacteria. They cannot be used as vaccines to induce immunological memory, since they do not contain the same antigens as the pathogen.

Question 24 D

Autoimmune disease is where the cells or cell products of the body's immune system attack 'self' cells. Neither interferons (molecules which interfere with viral entry into host cells) nor memory cells (which clone themselves following a second infection by an antigen) attack cells. MHC proteins are the proteins in the cell membranes of the body's cells that mark them as 'self'. These are not recognised by the immune system in autoimmune disease.

Question 25 A

Reduced immune response in relation to viruses only suggests a failure of the specific immune response. Macrophages are phagocytes, which are part of the body's non-specific immune response. B cells clone themselves into plasma cells and produce antibodies against bacteria and 'free' virus particles. However, the body's main protection against viruses is the destruction of virus-infected cells by cytotoxic 'killer' T cells. These cells are lacking in this patient.

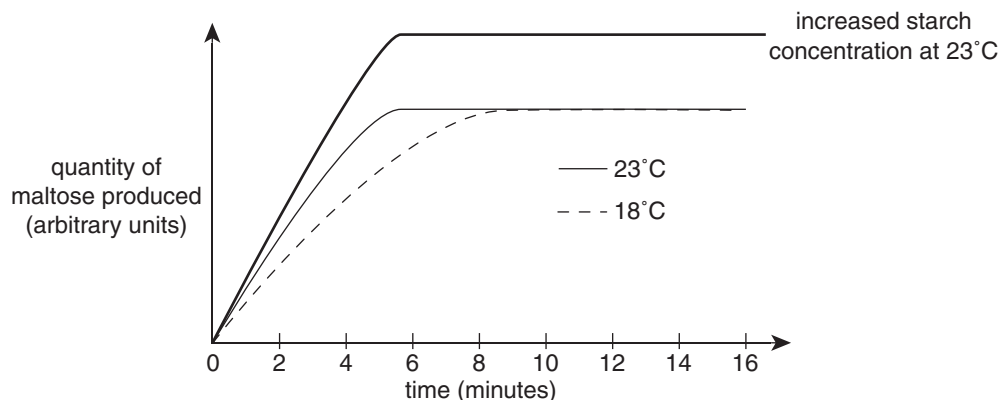
SECTION B: SHORT-ANSWER QUESTIONS**Question 1**

- a. i. A substrate is an input. Photosynthesis has carbon dioxide as a substrate. 1 mark
- ii. $6\text{CO}_2 + 12\text{H}_2\text{O} \xrightarrow{\text{light energy / chlorophyll}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$ 2 marks
1 mark for the correct inputs
1 mark for the outputs
A penalty of 1 mark if the equation is in word format
- iii. As carbon dioxide is a substrate for photosynthesis, more carbon dioxide will give a greater rate of photosynthesis. 1 mark
 This will provide more glucose for the plant to invest in growth and any other endergonic process. 1 mark
- b. i. As the CO_2 level increases, the rate of exchange of gases decreases. 1 mark
- ii. $1.5 \text{ mm}^3 \text{ CO}_2$ per min (allow a leeway of ± 0.5) 1 mark
- iii. Any two of:
- light intensity;
 - humidity;
 - water availability;
 - temperature of air; or
 - any other relevant factor that should be kept constant.
- 1 mark
1 mark for two correct responses
0 marks for one correct response
 Total 8 marks

Question 2

- a. i. glycosidic bond 1 mark
- ii. Before adding the enzyme, the iodine solution would turn the starch blue-black. Afterwards, the colour would be orange-yellow (or red-brown). 1 mark
1 mark for both correct colours
0 marks for one correct colour
- b. i. All the starch/substrate has been used up/converted to maltose. 1 mark
- ii. At higher temperatures, molecules move around faster and collide more often/enzyme-substrate complexes form more often so starch is converted to maltose quicker. 1 mark
 1 mark

c.



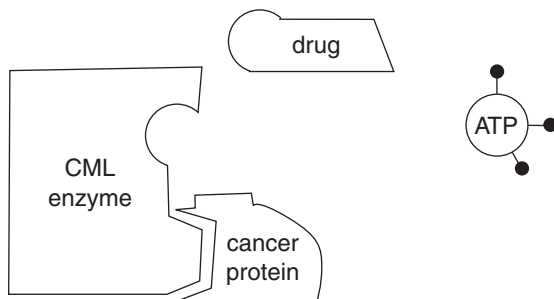
1 mark

- d. Amylase enzyme has an active site with a specific three-dimensional shape and only starch will fit into it. 1 mark
 A protein will not be able to enter the active site so no reaction can be catalysed 1 mark
 Total 8 marks

Question 3

- a. i. The order of amino acids in the protein. 1 mark
 ii. If the sequence of nucleotides in the gene coding for the enzyme was different, a different mRNA could be produced, which could be translated into a different order of amino acids. This would produce an enzyme such as the CML enzyme. 1 mark
 b. i. The CML enzyme provides an active site that enables ATP and the 'cancer protein' to bind to it. This leads to the activation of the cancer protein. 1 mark
 ii. ATP acts as a co-enzyme.
 OR
 ATP provides energy to drive the reaction at the CML enzyme. 1 mark

c.



2 marks

1 mark for showing the cancer protein binding to CML enzyme and the drug and ATP competing for the other binding site on the enzyme
1 mark for showing the cancer protein is not activated and so is not able to trigger CML
 Total 7 marks

Question 4

- a. presence of oestrogen and progesterone 1 mark
 b. High LH/FSH levels lead to a release of testosterone, which inhibits the release of LH/FSH. 1 mark
 OR
 High LH/FSH levels lead to a release of testosterone, which inhibits the release of GnRH, which in turn leads to lower LH/FSH secretion. 1 mark
 c. i. smooth endoplasmic reticulum 1 mark
 ii. exocytosis 1 mark
 iii. Target cells have receptors (generally intracellular with steroids) that are shaped to detect that steroid and to trigger a response. 1 mark
 d. reduced testosterone/oestrogen/progesterone levels
 OR
 reduced sperm or ova production 1 mark
 e. LH and FSH levels would be higher than normal. GnRH would also increase. 1 mark
 f. Control group left alone **and** variable group provided high levels of oestrogen. 1 mark
 Repeat control and variable group many times **and** control other factors such as age/weight/health of subjects. 1 mark
 Measure number in each group ovulating **and** compare groups. 1 mark

Total 11 marks

Question 5

- a. A DNA or RNA core and a protein coat. 1 mark
- b. HPV is a DNA virus that inserts its genome (into the chromosomal DNA of) cervical cells so that viral DNA is transcribed and translated to make new virions. 1 mark
The inserted DNA 'switches on' the genes for cell reproduction or 'switches off' the genes that are preventing cell division. The cervical cell then reproduces uncontrollably. 1 mark
- c. A molecule (usually a protein) that triggers a (specific) immune response by the lymphocytes.
- OR**
A molecule that is recognised and bound by a specific antibody. 1 mark
- d. In responding to the VLPs in the drug, the immune system produces memory B cells and memory T cells capable of responding to antigens/L1 protein types 6, 11, 16 and 18. 1 mark
If the body is later challenged by these antigens on HPV virions, the memory B cells produce a massive and immediate antibody response against the virus, preventing disease. 1 mark
- e. HPV types 31 and 45 carry different antigens that are not recognised by the memory cells, so no secondary immune response is induced. 1 mark

Total 8 marks

Question 6

- a. The (three) antibodies in the kit (capture, detecting and secondary) are all proteins (immunoglobulins) that will become denatured at (prolonged) high temperatures. 1 mark
- b. The anti-venom molecule (like an antibody) has specific variable regions that bind to the venom molecules. 1 mark
The venom molecules cannot then bind to receptors on the cell membranes of red blood cells, preventing them from becoming agglutinated. 1 mark
- c. i. a tiger snake 1 mark
ii. The positive control contains capture antibodies for all five venom types and should turn coloured if any venom is present. 1 mark
A negative result will indicate that the kit is not working properly/that the antibodies or the colour-producing enzyme have denatured. 1 mark
- d. Polyvalent anti-venom contains a mixture of antigenic/non-self proteins most of which will not be used up binding to the venom molecules. 1 mark
These proteins may induce an allergic/anaphylactic reaction or an autoimmune response. 1 mark

Total 8 marks