Trial Examination 2006

VCE Biology Unit 3

Written Examination

Suggested Solutions

SECTION A: MULTIPLE-CHOICE QUESTIONS

1	**A**	B	C	D
2	A	**B**	C	D
3	A	B	C	**D**
4	A	B	C	**D**
5	A	B	**C**	D
6	A	B	C	**D**
7	A	B	**C**	D
8	A	B	C	**D**
9	A	B	**C**	D
10	A	B	C	**D**
11	A	B	**C**	D
12	A	**B**	C	D

13	**A**	B	C	D
14	A	B	**C**	D
15	A	B	C	**D**
16	**A**	B	C	D
17	A	B	**C**	D
18	**A**	B	C	D
19	A	B	**C**	D
20	A	B	C	**D**
21	A	**B**	C	D
22	A	**B**	C	D
23	A	B	**C**	D
24	A	**B**	C	D
25	A	**B**	C	D

Question 1 A

Molecule *W* is a dipeptide, consisting of two amino acid residues connected by a peptide bond. Of the major biomolecules, only proteins and nucleic acids consist of subunits containing nitrogen (N), but molecule *X* is a nucleotide.

Question 2 B

All four classes of biomacromolecules – carbohydrates, lipids, proteins and nucleic acids – are formed by the condensation of subunits.

Question 3 D

The haemoglobin molecule consists of four polypeptide chains, each enclosing a haem group. Protein molecules consisting of more than one polypeptide chain are said to show quaternary structure.

Question 4 D

I = phospholipid; II and III = proteins; V = glycolipid; VI = cholesterol.

Question 5 C

A nanometre (nm) is 1/1000th of a micrometre (μm), or 1 x 10^{-9} m. Membranes are incredibly fine structures, visible only using the most powerful electron microscopes. They are much smaller than cells, which are measured in μm.

Question 6 D

A = osmosis; **B** = facilitated diffusion/active transport; **C** = exocytosis. Non-polar gas molecules such as oxygen and carbon dioxide are small enough to diffuse through membranes without metabolic assistance.

Question 7 C

The final concentrations of these ions are much lower than the original concentrations, showing that the plants have taken up these ions in large quantities. All the other ions have increased in concentration in the solution.

Question 8 D

Photosynthesis involves the capture of light energy by chlorophyll. This energy is used to make ATP (a source of chemical energy) and to split water molecules (a source of hydrogen). In the Calvin cycle, the energy from the ATP is used to combine the hydrogen with carbon dioxide to manufacture carbohydrates.

Question 9 C

The pancreas is an animal organ. Animal cells store carbohydrate in the form of glycogen. Starch is only stored in plant cells. ATP is the ready-use 'energy currency' of the cell and cannot be stored, and in any case, ATP is not a polysaccharide.

Question 10 D

Amino acids are transferred from the cytosol (U) to the ribosomes (V) where they are joined together via peptide bonds to make 'raw' protein molecules. These proteins are transported through the endoplasmic reticulum (K) to the Golgi apparatus (L). Here, the proteins are modified into the form in which they will be secreted (inactive enzymes) and packaged into membrane-bound vesicles (Z). The vesicles bud off from the Golgi apparatus and migrate to the cell surface membrane (P). They fuse with it and release the enzymes they contain outside the cell by exocytosis.

Question 11 C

ADP and ATP are both based on a **single** nucleotide molecule called adenosine, and contain two and three phosphate groups respectively. The reaction is catabolic because the chemical bond between two of the phosphate groups in ATP has been broken to release energy. ATP is formed in mitochondria during aerobic respiration, so **D** is incorrect.

Question 12 B

Glycolysis is common to all forms of aerobic and anaerobic respiration. It achieves only incomplete oxidation of glucose and therefore requires no specialised organelle or location within an organelle. The Krebs cycle takes place in the mitochondrial matrix, and the electron transport chain (which is not shown on the diagram) operates in the cristae (folded regions of the inner mitochondrial membrane).

Question 13 A

The electron transport chain is the main ATP-producing stage of aerobic respiration, with only minor amounts being produced by both glycolysis and the Krebs cycle. At the end of the electron transport chain, electrons and hydrogen ions (protons) combine with oxygen (required for aerobic respiration as a 'terminal electron acceptor') to produce water. The electron transport chain is not shown on the diagram, so **D** cannot be correct.

Question 14 C

The extracellular environment is the area on the outside of cells (region 3). The intracellular environment is the area on the inside of cells, both the cytoplasm (region 2) and the nucleus (region 1). The boundary between these environments is the plasma membrane.

Question 15 D

As human body cells are homeostatic for temperature as well as water content you would expect stability both inside and outside of cells. All regions should have those stable conditions with only slight fluctuations.

Question 16 A

At 3 hours the level of glucose in increasing and it must have come from body stores as the person is fasting. These supplies are provided from glycogen stores in the body (not protein). Insulin will decrease the levels further as will the conversion of glucose to glycogen.

Question 17 C

The graph shows that the blood glucose concentration is relatively stable. The scale of the graph magnifies any deviations. The graph depicts glucose levels and so endothermy is irrelevant as this is to do with temperature. It is hormonal and not related to the nervous system. Positive feedback would lead to a further reduction in glucose levels and this clearly does not happen. The answer is homeostasis.

Question 18 A

A hormone binds to either membrane surface or intracellular receptors. This leads to some kind of cellular change. In this case, hormones are released into the bloodstream but do not move directly to target cells. This process is slow and as the secretion is internal, it is regarded as endocrine not exocrine.

Question 19 C

Potassium ion accumulation inside these stomata cells makes them hypertonic and will lead to turgidity and gas exchange. An inhibitor would reduce accumulation of potassium ions and reduce gas exchange. When the plant is exposed to light it would be expected CO_2 would be moving into, not out of, a leaf.

Question 20 D

Tropisms are a growth response. Phototropism is the process where plants respond to light. If it was negative phototropism the plant would bend away from the light source. So the answer has to be positive phototropism.

Question 21 B

Auxin produced in the apical bud promotes elongation of the cells just below the bud. Further away from the bud are lower axillary (lateral) buds - and the auxin acts as an inhibitor to their growth. If you remove the apical tip it will promote lateral growth.

Question 22 B

A fungicide may remove the disease from that elm tree but by eradicating the beetle you will remove the chance of spreading the disease to other elm trees. **C** is incorrect as the beetles may still be alive and thus able to continue spreading the spores when they emerge from the wood. **D** is incorrect as this is not the entry pathway of the spores as indicated in the diagram.

Question 23 C

A fungus is neither prokaryotic (no nucleus, small, simple cells) or autotrophic (able to convert inorganic into organic using an external energy source). This fungus must be multicellular as it grows hyphae and is visible to the naked eye.

Question 24 B

Mast cells are involved with allergic responses by producing histamines. Dendritic cells are there for antigen recognition. Macrophages engulf and destroy cellular material. Natural Killer cells detect the interleukins released by virus-infected cells and destroy the virus-infected cells.

Question 25 B

Antibodies have two antibody/antigen reaction sites. Both of them must be the same - so **B** is the only possible answer.

SECTION B: SHORT-ANSWER QUESTIONS

Question 1

a. **i.** A very large molecule comprising a chain of many similar or identical subunits (monomers) which have bonded together. 1 mark

ii. A chain of amino acid subunits bonded together by peptide bonds. 1 mark

b. The bacterium takes up water by osmosis and increases in volume (1). The swelling is not limited by the cell wall so the cell membrane ruptures (1). 2 marks

c. **i.** Messenger ribonucleic acid (mRNA). 1 mark

ii. mRNA is produced by transcription and is the form in which the genetic code is carried from the nucleus to the ribosome (1). Without it, amino acids cannot be assembled into proteins by the ribosome (1). 2 marks

Total 7 marks

Question 2

a. **i.** Glycerol and fatty acids. 1 mark

ii. Thermal insulation OR long-term low-bulk energy store OR waterproofing. 1 mark

b. **i.** α–helix or alpha helix. 1 mark

ii. The tertiary structure determines the three-dimensional shape (conformation) of the protein molecule (1) and so determines the (three-dimensional) shape of the active site or the specificity of the enzyme (1). 2 marks

iii. It will after the three-dimensional shape of the active site preventing it from binding with the triglyceride (1), thus preventing lipase from functioning (1). 2 marks

Total 7 marks

Question 3

a. To absorb the heat radiating from the lamp OR to prevent the lamp from heating the chamber. 1 mark

b. $\underset{(1)}{6CO_2 + 12\ H_2O} \xrightarrow[\text{chlorophyll}]{\text{light}} \underset{(1)}{C_6H_{12}O_6 + 6O_2 + 6H_2O}$ 2 marks

c. Oxygen production is increased by only 3.2 cm^3h^{-1} as the light intensity was increased from 6 to 100 units (1) but then increased steeply (by 48.5 cm^3h^{-1}) as the light intensity increased from 100 to 400 units (1). 2 marks

d. The oxygen evolved has been produced by the 'splitting' of the 'labelled' water OR the oxygen does not come from the carbon dioxide gas supplied to the plant (1) and light was required for the process (1). 2 marks

e. **i.** In the thylakoids of the chloroplasts. 1 mark

ii. Both plants should have the same number of leaves or the same area of leaves OR the results for oxygen production should be reported as $cm^3h^{-1}cm^{-2}$ of leaf surface area. 1 mark

Total 9 marks

Question 4

a. **i.** To receive messages (from other neurons or some type of receptor) and transfer them to other neurons (or effectors). 1 mark

ii. THC triggers the response and so is the stimulus. 1 mark

b. Neurotransmitters are released by exocytosis (1) which diffuse across the synapse to the neurotransmitter receptors on the post-synaptic membrane OR dendrite OR effector cell (1). 2 marks

c. Proteins have specific functions within the cell (enzyme, membrane protein etc.) (1) and if these are not synthesised properly it may disrupt metabolism (enzymes) or movement (1). 2 marks

Total 6 marks

Question 5

a. **i.** A variety of ethylene concentrations were used OR many apples used per test. 1 mark

ii. Tasting only involved two apples OR tasting was open to opinion. 1 mark

iii. 150 ppm ethylene (1) at 20 degrees Celsius (1) (not 500 ppm ethylene as 150 provides the same result and so would be cheaper). 2 marks

b. **i.** Small quantities of ethylene promote the ACC gene to produce ACC synthase which in turn leads to the production of more ethylene. More ethylene promotes the ACC synthase gene to produce even more ACC synthase, leading to more ethylene and so on (1). This is an example of positive feedback as the response enhances the original stimulus (1).

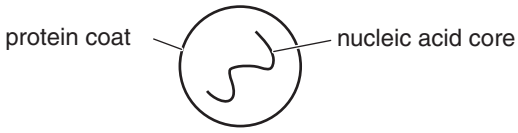
2 marks

ii. At lower temperatures the action of enzymes slows down (1) and so there will be reduced levels of ethylene, leading to a slower rate of ripening of the fruit (1). 2 marks

Total 8 marks

Question 6

a. Protein coat with a nucleic acid core.



2 marks

b. Different nucleic acid codes for different amino acid sequences and hence proteins. This means the protein coats will be different (1). 1 mark

c. The percentage of mortality has decreased. 1 mark

d. **i.** A vaccine retains the antigen but through various methods, the nucleic acid core is removed OR changed. 1 mark

ii. Memory cells recognise antigens on the virus (1) and clone into plasma cells (1) that produce large quantities of antibodies (1). This leads to the eradication of the virus. 3 marks

Total 8 marks

Question 7

a. Components (protein) on transplanted cells or the blood within transplanted tissue that would be recognised by the recipients immune system as foreign. 1 mark

b. Person 2, as their blood type is the same and this is more important according to the information. 1 mark

c. There are only eight factors used to determine compatibility, so other antigens may exist in the transplanted tissue that were not accounted for when determining compatibility (1) thus there is a risk of rejection as the immune system will be stimulated to act against the other antigens (1).

2 marks

d. Since rejection involves an immune response against the transplanted organ, a measure to be taken would be to suppress the immune system by taking some kind of medication (1) that stops the immune system working OR give the person immunosuppressant medication. A substance found on the surface of red blood cells and other transplanted tissues that is capable of causing a human to produce antibodies. 1 mark

Total 5 marks