

Trial Examination 2011

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

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

Ribose, glucose and fructose are monosaccharides. Sucrose is a disaccharide. The remaining carbohydrates are all polysaccharides.

Question 2 A

Chemical reactions that release energy when bonds are broken are exergonic. Bonds are broken in reaction *P*. In cells, some of the energy released by an exergonic reaction, such as *P*, is used to form bonds between ADP and phosphate, thus making ATP in reaction *O*. The energy stored in ATP is released exergonically in reaction *N*. This released energy is used to form bonds between molecules in reaction *M*. Reactions *O* and *M* are endergonic because energy is used to form bonds.

Question 3 C

Antibodies are made of protein and the units that are joined together by peptide bonds to make proteins are called amino acids.

Question 4 C

Antibodies are manufactured by B plasma cells in response to an antigen. Each antibody has two identical but specifically shaped antigen binding sites on the variable region of the antibody. This means each antibody will bind to an antigen that has a shape that is complementary to the antibody. The complex that is formed as a result can then be destroyed or removed from the body's immune system.

Question 5 A

The sequence of amino acids in a polypeptide chain is described as the primary structure of the polypeptide. The bond angles between successive amino acids and hydrogen-bonding between their side chains give rise to a helical or sheet-like secondary structure. Further interactions between side chains (including ionic and disulfide bonds) cause complex three-dimensional folding into the polypeptide's tertiary structure. If part of the surface of the polypeptide's tertiary structure catalyses a chemical reaction involving (an) other molecule(s), the polypeptide is called an enzyme and the catalytic surface is called the active site.

Question 6 B

The enzyme in this reaction is joining two substrates to make one product. This reaction is an anabolic reaction. A catabolic reaction breaks down substrates. The breakdown of polymers such as protein is termed a hydrolysis reaction. This reaction may be reversible but a different enzyme would be needed to carry out this role.

Question 7 B

Enzyme and substrate molecules move about randomly in water. They do not seek each other out but collide with each other. This is why chemical reactions often occur in compartmentalised environments such as the mitochondria because the concentration of substrates and enzyme would be higher. This means there would be a greater chance of collisions between the enzyme and the substrate and hence the reaction proceeds faster. The products often become substrates for another reaction and so it would be wrong to accept **D** as the answer.

Question 8 D

Phospholipid bilayers provide a stable (fluid) barrier between a cell and its external environment or an organelle and the cytosol. A phospholipid molecule has fatty acid tails which are non-polar and therefore do not mix well with water (hydrophobic). Phospholipids have polar phosphate heads that mix well with water (hydrophilic).

Question 9 C

For double-stranded DNA to unwind and unzip into single-stranded form (e.g. during DNA replication and the transcription phase of protein synthesis), the bonds between base pairs must be relatively weak inter-molecular attractions. Covalent (including phosphodiester) bonds are much stronger bonds that form between atoms. Phosphodiester bonds connect deoxyribose and phosphate units in the 'sugar-phosphate backbone' of DNA.

Question 10 D

The light-independent reactions of the Calvin Cycle are enzyme-controlled and therefore sensitive to temperature. The rate of these reactions is also increased by raising the concentration of the substrate (CO_2) in the air spaces of the leaf. Students should remember that oxygen is a competitive inhibitor of RuBP carboxylase, the key enzyme of the Calvin Cycle which 'fixes' CO_2 by catalysing its reaction with organic molecules.

Question 11 A

The electron transport chain is an important metabolic pathway through which ATP is synthesised in large amounts in cells. An electron transport chain forms part of the light-dependent reactions of photosynthesis, when light energy is captured and converted into chemical energy stored in the bonds of ATP. Another electron transport chain in mitochondria makes ATP using the energy released by the breakdown of glucose. This electron transport chain requires oxygen to function.

Question 12 A

This is a higher level definition question. Krebs's cycle certainly occurs in the mitochondrial matrix, however, the synthesis of proteins at the ribosome is translation (not transcription). The light-dependent reaction occurs on the thylakoid membranes and DNA replication occurs in the nucleus of eukaryotes.

Question 13 C

A synapse works due to exocytosis of neurotransmitters on the pre-synaptic side of the synapse. The neurotransmitters diffuse across the synapse and bind with receptors on the post-synaptic side of the synapse. This triggers an action potential in the next neuron. An action potential occurs due to the initial influx of sodium ions into the neuron followed by potassium ions moving out. A sodium/potassium pump restores the neuron to its resting state. This excludes **A** and **B** as answers. The action potential does indeed trigger calcium channels to open and this leads to exocytosis. **D** is incorrect because drugs that have the same shape could also mimic the natural neurotransmitter.

Question 14 B

Most plant hormones have a role in coordinating the life cycle of a plant by controlling specific aspects of its growth and development. Auxin can promote flowering and fruit formation, while ethylene promotes fruit ripening. As well as inducing leaf and fruit fall, abscisic acid promotes the dormancy of seeds and buds. Dormancy is broken by gibberellin.

Question 15 B

Experiment Q cannot be a control for Experiment R, since these experiments differ in relation to two experimental variables (position of glass barrier and presence/absence of light), not just one. Option C is therefore incorrect. Option D is also incorrect. Experiment Q is the control for Experiment S, showing that it is the effect of light, rather than the glass barrier, that reduces the production of IAA. Also, in Experiments P and Q, the concentrations of IAA in the agar blocks are almost identical. The impermeable glass barrier therefore has no effect on the production of IAA by the shoot tip or the diffusion of IAA from the shoot tip into the agar. In both R and S, which were experiments conducted in the presence of light, the concentrations of IAA in the agar were much lower than in P and Q, which were experiments conducted in darkness. Option A is therefore incorrect and option B is the most reasonable conclusion.

Question 16 A

Negative feedback is exerted by a hormone on the gland that produced it. The pituitary gland responds to TRH, not thyroxine, so D is incorrect. Option C is incorrect because the raised levels of thyroxine reduce the production of TRH by the hypothalamus, decreasing production of TSH by the pituitary gland. Human endocrine cascade systems such as this one generally employ stimulating, rather than inhibitory hormones.

Question 17 A

Peptide hormones do not pass through cell membranes because they are relatively large, water-soluble molecules. Instead, they bind to peptide hormone receptors which project from the extracellular surface of the cell membrane. Therefore, to exert its effect(s) inside a cell, the signal represented by a 'bound' peptide hormone must be changed (transduced) into a different chemical form in order for it to be conveyed across the cell membrane and into the cell. G proteins and adenylate cyclase are involved in signal transduction but are bound to the intracellular surface of the cell membrane, rather than found free in the cytosol. Cyclic AMP is often the 'second messenger' formed and found in the cytosol as the product of signal transduction.

Question 18 B

Viruses are non-cellular, so A is incorrect. Option D is incorrect because it describes chemical rather than structural difference; in any case some viruses contain DNA while bacteria transcribe DNA into RNA. Both viruses and bacteria possess antigens (surface molecules that can be recognised as 'foreign') so the only correct structural difference is the much smaller size of viruses.

Question 19 D

Options A and B are incorrect because bacteria and fungi can use a wide variety of sugars as respiratory substrates, including fructose and glucose (the monosaccharides found in honey). The solute concentration of honey is hypertonic, i.e. much higher than the solute concentration of the cytosol of most cells. Water will therefore move out of bacterial or fungal cells and into the honey by osmosis. This will kill the cells. Incidentally, this also explains why sugaring is an effective method for preserving some foodstuffs (e.g. fruit).

Question 20 B

This pathogen is ingested, so the first lines of defence against infection through the eyes, skin and lungs are irrelevant.

Question 21 D

Many students will rush (incorrectly) to select Option **A**. The constant region of IgE antibodies has a binding site for a receptor present on the surface of mast cells and the surfaces of mast cells are covered by the antigen-binding sites of these antibodies. These mast cell-bound antibodies have no effect until and unless they encounter allergens (i.e. antigens that cause allergic responses) that can bind to their antigen-binding sites. When this occurs, the mast cells to which they are attached explosively discharge histamines by exocytosis. Release of these histamines into the surrounding tissue causes local anaphylaxis: swelling, redness and itching.

Question 22 C

Option **A** is incorrect because the mother is Rh positive. Fetuses and newborn babies do not make their own antibodies because they have incompetent immune systems, so **D** is wrong. While **B** is an accurate statement, it is not a correct answer. The question does not say that maternal red blood cells have entered the baby and in any case Option **B** does not explain how this would endanger the baby. Antibodies can pass across the placenta from mother to baby during pregnancy. The passive immunity thus acquired by the baby will protect it in the months following birth while the baby's immune system is incompetent. However, in the case of anti-Rh antibodies, this puts the baby at risk of haemolytic anaemia of the newborn, as described in Option **C**.

Question 23 A

Fungi, when grown in culture have a generally fibrous appearance. These are the structures that move through their environment secreting chemicals that make the absorption of nutrients possible. Prions and virus would not grow on culture medium. An endoparasite causes infection inside the host and this disease is on the surface of the leaf.

Question 24 B

Cytotoxic T cells are cells of the specific immune system. Upon being selected the correct T cell clones and differentiates into cytotoxic cells which upon specific interaction with the target cell will release perforins that leads to the destruction of that cell. The perforins would be released by exocytosis and the perforins are not a type of antibody.

Question 25 D

Option **A** is incorrect because the deliberate inoculation of the body with antigens stimulates the active production of lymphocytes and antibodies and confers long-term immunity through the formation of memory lymphocytes. Anti-histamines oppose the effects of histamines, which are produced to promote inflammation as part of the immune response, so **C** is incorrect. Likewise **B** is wrong because interferons 'interfere' with viral replication in cells and are often administered as drug treatments, e.g. against HIV/AIDS.

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

- a. Exocytosis. 1 mark
- b. X = (secretory) vesicles
Y = rough endoplasmic reticulum OR ribosome
Z = Golgi apparatus or Golgi body 2 marks
Award two marks if all three are correctly identified and one mark for only two correct
- c. Amino acids are bonded together into polypeptides on the ribosomes of the rough ER. 1 mark
These polypeptides are modified in the rough ER into amylase molecules which are carried to the Golgi apparatus to be packaged into membrane-bound vesicles. 1 mark
The vesicles migrate to, and fuse with, the cell membrane, thus secreting the amylase to act as a digestive enzyme outside the cell. 1 mark

Question 2

- a. Transcription. 1 mark
- b.

Biomolecule	Difference 1	Difference 2
RNAP	globular	amino acids
RNA	single strand	A G C U
DNA	double strand	A G C T

3 marks

*Subtract a mark for each mistake**Note: There are other answers that could be included*

- c. The enzyme would slow down and collide less frequently with the substrate, lessening the activity of the enzymes. 1 mark
- d. The RNAP could have several active sites.
OR
The RNAP could have several polypeptide units (quaternary structure). 1 mark

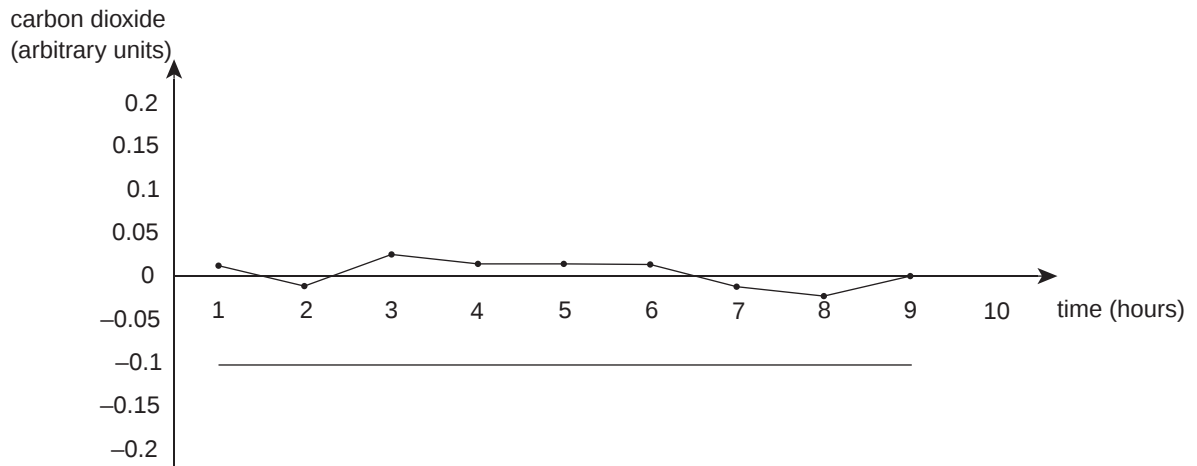
Question 3

- a. Carbon dioxide 1 mark
- b. $C_6H_{12}O_6 + 6O_2 + 36 - 38 ADP + 36 - 38 P_i \rightarrow 6CO_2 + 6H_2O + 36 - 38 ATP$ 2 marks
One mark for each correct side of the equation
- c. As oxygen in the flask is used up, the rate of aerobic respiration slows down; 1 mark
carbon dioxide is produced more slowly so the water rises less quickly. 1 mark
- d. After 8 hours, all the oxygen in the flask has been absorbed by the pyrogallate so the water level stops rising. Instead, the carbon dioxide produced by anaerobic respiration in the seeds forces the water level down again. 1 mark

Question 4

- a. 0.01 arbitrary units of carbon dioxide. 1 mark
- b. The rate of carbon dioxide input equals the amount of carbon dioxide output because the rate of photosynthesis is equal to the rate of respiration. 1 mark

c. i.

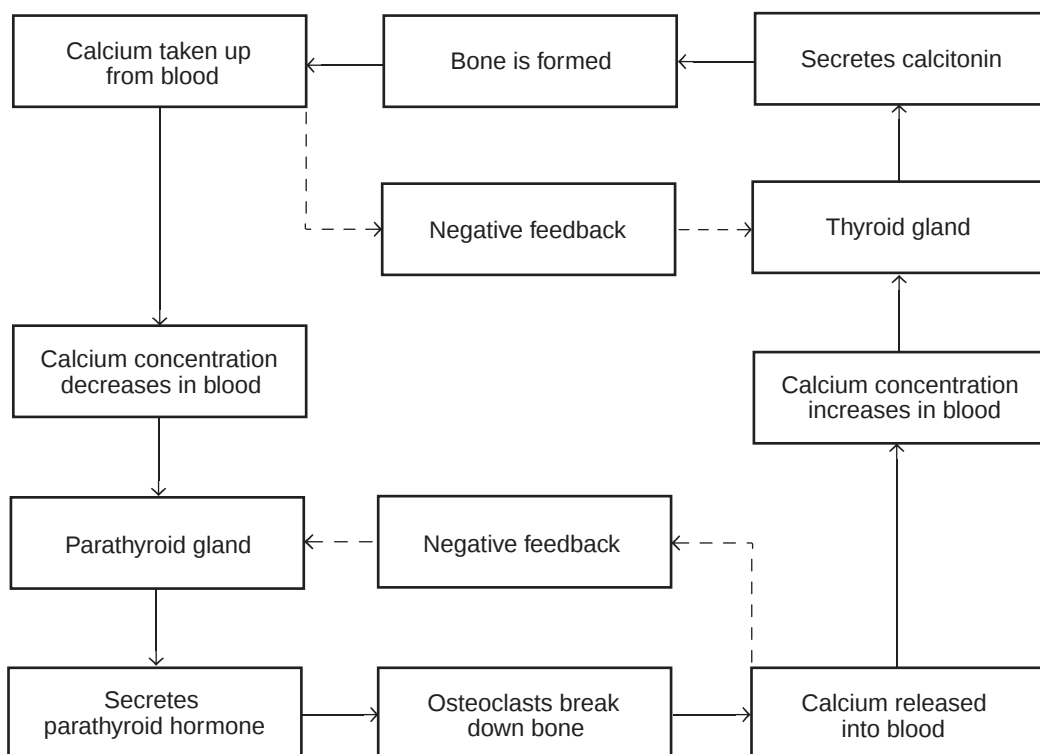


1 mark

- ii. More light means more photosynthesis and so carbon dioxide would be taken up by the plant. This means that the levels in the enclosed environment would decrease. 1 mark

Question 5

a.



3 marks

One mark for correct labels in flowchart
 One mark for correct connections between labels
 One mark for correct indication of negative feedback

- b. Negative feedback is the reduction or removal of the stimulus by the response to that stimulus. 1 mark
- c. Normal oestrogen levels could *either* inhibit the secretion of parathyroid hormone by the parathyroid gland
AND/OR
oestrogen might act as an inhibitor of parathyroid hormone in its effect on bone cells. 1 mark
In either case this would lead to a reduction in the net loss of bone mass. 1 mark
- d. Taking calcium supplements would increase the calcium concentration in the blood, causing increased secretion of calcitonin by the thyroid gland and the formation of new bone in opposition to the osteoporotic bone degeneration. 1 mark
- e. Stimulating osteoclasts with vitamin A would increase bone desorption and raise the calcium concentration in the blood. 1 mark

Question 6

- a. Pheromones are chemicals released from one organism that travel through the air and bind to target receptors on other organisms of the same species to influence their behaviour. 1 mark
- b. Andosterone would move through cell membranes to bind to a receptor in the cytosol. This will lead to the expression of a gene. 1 mark
- c. Obtain 20 female truffle hunting pigs and divide them into two groups of 10. One group (one pig at a time) is placed in an enclosed environment with buried truffles (variable). The other group (one pig at a time) is placed in an enclosed environment without truffles (control). 1 mark
Observe the number of time pigs in either paddock assume the mating stance and their location with respect to the truffle. 1 mark
Ensure other factors such as temperature, humidity and light availability are constant. 1 mark

Question 7

- a. A factor such as prothrombin OR fibrinogen. 1 mark
A factor such as prothrombin converts to thrombin which activates fibrinogen.
OR
Fibrinogen converts to fibrin which forms a network over the breach. 1 mark
- b. i. A protein that has a carbohydrate component. 1 mark
ii. A cluster of proteins in the plasma react to signals such as cytokines to combine on the surface of the target cell causing a hole in the cell. 1 mark
iii. The glycolipid (protectin) is either not needed OR not present OR functioning normally in other cells. 1 mark
- c. Monoclonal antibodies are produced in a cell line of fused tumour/B cell hybrids, 1 mark
to produce a limitless supply of specific antibody against a particular antigen. 1 mark
- d. Solaris is significantly more effective than pre existing drugs. 1 mark
OR
Testing on humans has minimal side effects. 1 mark

Note: there may be other benefits.

Question 8

- a. High fever: pyrogens released from macrophages once bacteria is recognised as foreign. This could lead to faster immune responses as well as be harmful to the bacteria. 1 mark

Inflammation: interleukins are released by macrophages upon recognition of the bacteria as foreign and promote vasodilation of blood vessels as well as capillary permeability for a variety of white blood cells for faster removal of bacteria. 1 mark

- b. Non medical factors such as:

- isolation – decreases the chance of bacteria passing from host via breathing
- no kissing – reduces exchange of throat secretions limiting bacterial spread
- face masks – reduces spread through breathing.

1 mark

Note: There are several possible answers here. They should be non medical (not prescription antibiotics or vaccinations).

- c. Antigens on the surface of the 'attenuated' bacteria are recognised as foreign. 1 mark
Helper T cells trigger the correct B cell to clone. 1 mark
B cells clone to plasma cells (antibodies) and memory cells (for future use). 1 mark