

Trial Examination 2010

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**

Glycogen is a carbohydrate that is used as a glucose storage polysaccharide in animal muscle and liver. It sounds very similar to glucagon which is a protein hormone involved in glucose regulation.

Question 2 A

The diagram illustrates how two amino acids are chemically bonded together. This is called a peptide bond. Phosphodiester bonds link nucleotides together and glycosidic bonds link monosaccharides together.

Question 3 A

The nucleus contains DNA and proteins called histones which, when combined, form chromatin. The ribosome translates mRNA in conjunction with tRNA (but not DNA) to make a protein and does not contain DNA, so **B** is incorrect. The lysosome contains digestive enzymes only making **C** incorrect. The Golgi is present to package and secrete chemicals. Secreting chemicals from a cell does not involve nucleotides as they are manufactured by cells for DNA replication and some aspects of protein synthesis.

Question 4 C

The question clearly states the complementary DNA strand which eliminates **B** and **D** as they contain the nucleotide U (uracil), which is a component of RNA. Guanine and cytosine are complementary to each other and thymine and adenine are complementary to each other.

So the solution is: G G T A A C C A T A G G A C T A G

Complementary to: C C A T T G G T A T C C T G A T C

Question 5 D

When the protein chain folds backwards and forwards the structural arrangement is referred to as a β sheet. The links between different parts of the protein chain are disulfide bonds that occur between cysteine amino acids if they are located close to each other. The final coiling structure is referred to as an α helix.

Question 6 C

As the chemicals are clustering around the rough endoplasmic reticulum they are likely to be involved in protein synthesis. As the chemicals are in the cytosol they are likely to be amino acids which would be the substrates for the manufacture of proteins at the ribosomes.

Question 7 A

The nucleus (V) would provide the blueprint for the synthesis of the hormone on the rough endoplasmic reticulum (W) to be transported to the Golgi (X) for packaging and secretion via small vesicles (Y). The mitochondria would provide energy for most of these processes and hence would be in action all the time.

Question 8 D

The fluid mosaic model of membranes shows the phospholipids move but due to the presence of water on either side of the membrane, the polar (hydrophilic) 'heads' of the phospholipids will always face the water and the non-polar (hydrophobic) 'tails' will face each other away from the water. Protein channels are embedded in the membrane, providing an avenue for hydrophilic (polar) molecules to travel through, however, small molecules can move across the bilayer as well. This means that II and III are the only correct statements, so **D** is correct.

Question 9 B

An increase in CO_2 provides more substrate for photosynthesis and – assuming the amounts of light, chlorophyll and water remain constant – the rate of photosynthesis would increase. CO_2 uptake would be aided by increased gas exchange but transpiration (water loss) would not be directly affected. If anything, water loss would be reduced due to water also being a substrate for photosynthesis.

Question 10 B

Glycolysis is the first part of cell respiration that occurs outside the mitochondria. This is when glucose is broken down to pyruvic acid which can be either be drawn into the mitochondria (if oxygen is present) or further broken down outside the mitochondria (if oxygen is absent). The space outside the nucleus that includes the organelles is referred to as the cytoplasm. The fluid between organelles is referred to as the cytosol.

Question 11 C

Oxygen is the ‘terminal electron acceptor’ of the electron transport chain, so if electron transport is inhibited oxygen consumption by the mitochondrion will decrease. Inhibition of electron transport will significantly reduce the production of ATP by a mitochondrion. This is what kills the insect.

Question 12 B

Ribulose biphosphate (RuBP) is the 5-carbon compound that reacts with carbon dioxide in the first step of the Calvin cycle. The product of this reaction is glycerate-3-phosphate (GP). The Calvin cycle (also known as the ‘light-independent reactions’ of photosynthesis) occurs in the stroma of the chloroplast. Its useful output for the plant is glucose. The chlorophyll-containing thylakoids of the grana are involved in the light-dependent reactions.

Question 13 B

The graph clearly shows that chlorophyll can and does absorb light of all visible wavelengths, but to different degrees. Since it is a green pigment, chlorophyll reflects most of the green light that shines on it while absorbing red and blue light particularly well. Red and blue are the most effective colours of light for photosynthesis. Chlorophyll molecules are not, however, organised into separate photosystems for absorbing red and blue light respectively.

Question 14 A

Low temperatures reduce the rate of enzyme-controlled reactions but do not damage the enzymes themselves so cells can recover from cooling. Raising human body temperature to 43°C ($6\text{--}7^\circ\text{C}$ above normal) irreversibly denatures enzymes and leads to cell death.

Question 15 C

Negative feedback is the process whereby a response tends to reduce or remove the stimulus that led to it. Only **C** describes this process. The increasing frequency and strength of contractions during childbirth is a classic case of positive feedback.

Question 16 B

Absciscic acid (ABA) is the hormone that promotes dormancy in seeds. The other hormones listed are, to varying extents, antagonistic to ABA and would tend to break seed dormancy and promote germination.

Question 17 C

In an allergic reaction (hypersensitivity), antibodies produced in response to an allergen bind to receptors on mast cells. These cells are thus stimulated to produce histamines. These molecules cause inflammation and swelling. Option **A** refers to an autoimmune disorder, while **B** and **D** are disorders of hyposensitivity/insensitivity.

Question 18 D

Acetylcholine binds to receptors on the post-synaptic cell membrane and causes ion channels in this membrane to open so that the post-synaptic neuron becomes de-polarised and the nerve impulse can continue along it. Cholinesterase slowly hydrolyses the bound acetylcholine so that it leaves the receptors. The ion channels then close, the post-synaptic neuron becomes re-polarised and the synapse is 'reset'. A substance blocking the active site of cholinesterase would prevent this from happening.

Question 19 C

Hormones are generally not produced by the cells upon which they act, so **D** is incorrect. A peptide hormone, such as MSH, is a short-lived hydrophilic molecule that binds to a specific receptor molecule on the cell membrane. The formation of this hormone–receptor complex causes molecules inside the cell ('secondary messengers') to bring about changes in the cell's metabolism. In this case, intracellular enzymes are activated that lead to the formation of melanin.

Question 20 B

When an organ (or tissue) is transplanted into a donor, the immune system of the donor will recognize the cells of the transplanted tissue as 'non-self' or 'foreign'. The immune system will generate (mainly) a T cell response against the transplant which will lead to its rejection. To prevent this, anti-rejection drugs that suppress the T cell response are given.

Question 21 C

The endophytes are organisms present within the plant. This is not a physical factor such as wax or thick bark. It does not move from plant to plant so cannot be a pheromone. Because the endophytes prevent pathogenic organisms from causing disease it must be non-specific because there is no reference to a specific response to a specific disease.

Question 22 D

Myelin acts as an insulating wrap around axons and allows nerve messages to be transported along them more rapidly. MS leads to the destruction of myelin so nerve messages are slowed.

Question 23 B

The correctly shaped ligand (*I*) would bind to a protein receptor on the surface of the cell (*III*). This will cause a change in the protein which in this case releases a small factor (*IV*) which binds to the enzyme and activates it to catalyse the conversion of substrate to product.

Question 24 D

The drug that mimics the shape of the substrate molecule, thereby preventing an enzyme or other protein from interacting with that substrate molecule, is a competitive inhibitor. A co-factor is a molecule that interacts with an enzyme to enhance its catalytic function rather than reduce it. Retroviruses are RNA-containing viruses, so this option was an irrelevant distractor.

Question 25 A

Antigens are macromolecules that elicit an immune response in the body. They exist on the cell membranes of transplanted tissue. The initial immune response to any antigen requires that the antigen be recognised by a T lymphocyte ('helper' T cell) which will release cytokines that stimulate both cytotoxic T cells and plasma cells (antibody-secreting B lymphocytes). Options **B** and **C** incorrectly attribute antibody production to T cells. Option **D** is not correct because it suggests that T cells have nothing to do with the stimulation of B cells, and that antigen recognition and antibody production happen exclusively and at the same time.

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

- a. Catabolic – it represents the hydrolytic breakdown of a disaccharide into two monosaccharide molecules. 1 mark
- b. $C_{12}H_{22}O_{11}$ 1 mark
- c. i. blood glucose concentration 1 mark
- ii. Any two of:
- the amount of lactose each subject was given to drink;
 - the ages of the subjects;
 - the time since each subject had last eaten;
 - the experiment should be undertaken after both the subjects have fasted. 1 mark
- d. i. His blood glucose concentration increased to reach a peak of approximately 6.6 mol dm^{-3} after 45 minutes, and decreasing thereafter. 1 mark
- The description must refer to concentration of glucose and time to gain credit.*
- ii. The lactose intolerant man cannot synthesise lactase, therefore lactose is not digested and additional glucose is not produced. 1 mark
- No additional glucose is absorbed therefore the concentration in blood stays the same/does not rise. 1 mark

Question 2

- a. Measure diameter or radius or area of the clear zone where the amylase has digested the starch; 1 mark
- the larger the clear zone, the more effective the enzyme/the greater the enzyme activity. 1 mark
- b. No measurements at intermediate pH values i.e. 5–7, 7–9. 1 mark
- c. At pH 11: the enzyme is denatured or the tertiary structure altered; ionic or hydrogen bonds are broken; 1 mark
- the substrate cannot bind to active site. 1 mark
- d. Use of denatured or boiled enzyme, at all pH values; 1 mark
- comparison or proof that it is the active amylase enzyme that causes the digestion of starch or colour change when iodine solution is added. 1 mark

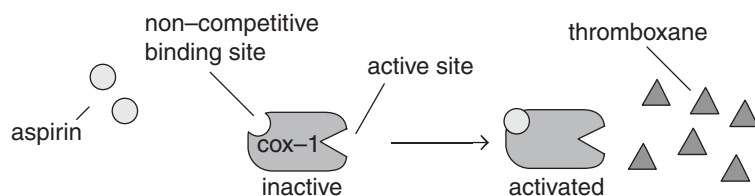
Question 3

- a. Incorrect blueprint in DNA leading to incorrect transcription of mRNA, which will translate to an incorrect sequence of amino acids. 1 mark
- This will be a protein (in this case an enzyme pyruvate dehydrogenase) with an incorrect tertiary structure meaning it will be unable to function properly. 1 mark
- b. i. one 1 mark
- ii. The electron transport chain uses it to put H^+ into the space between both mitochondrial membranes. 1 mark
- c. i. the cytosol 1 mark
- ii. Less ATP generated per glucose molecule as aerobic breakdown is not occurring. 1 mark
- Less ATP available to think or move, leading to lethargy. 1 mark

Question 4

- a. Inflammation allows more blood to the site of infection. Blood carries a variety of infection-fighting macrophages which can fight the infection. More are carried to the infected site. 1 mark

b.



2 marks

1 mark for illustrating the non-competitive nature of aspirin

1 mark for including the correct labels, using the specific examples in the question

- c. Any three of:
- reduced pain;
 - reduced fever;
 - reduced inflammation;
 - reduced platelet aggregation.
- 1 mark

Question 5

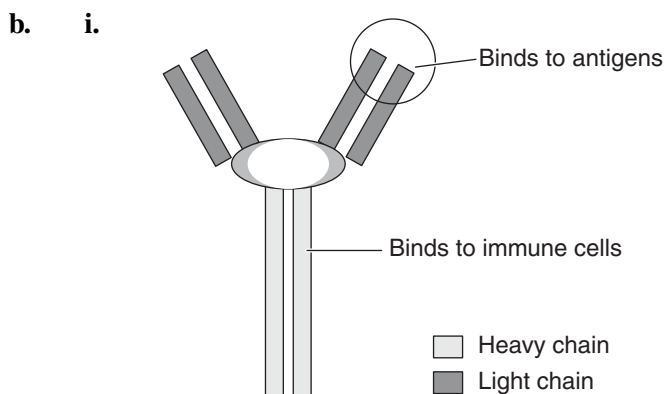
- a. Auxin promotes elongation/increase in size/increase in volume of cells in shoot tips and stems. 1 mark
- b. i. Sucrose is used in respiration or as an energy source. 1 mark
- ii. *Q* contains tip/site of IAA production so the addition of further IAA has little effect. The converse is true for *P*. 1 mark
- iii. Light (*any one of*):
- inhibits growth of both *P* and *Q* in sucrose solution only;
 - stimulates growth of both in sucrose and IAA solution;
 - has a greater effect on *P* than *Q*.
- 1 mark
- c. i. Uptake occurs by active transport which requires ATP produced by mitochondria. 1 mark
- The evidence is that DNP-treated wild type has lower uptake. 1 mark
- ii. Mutation increases the number or frequency of protein channels in cell membranes, so more IAA can be taken up by active transport or facilitated diffusion. 1 mark
- d. The wild type fungus takes up less IAA so will grow better in host tissues. 1 mark

Question 6

- a. i. Atraxotoxin would act on side A since vesicles of neurotransmitter molecules are found in the pre-synaptic cell. 1 mark

The answer must refer to atraxotoxin's mode of action.

- ii. Rabbit neurons have no receptors for atraxotoxin so the venom cannot affect the vesicles of the neurotransmitter. 1 mark



2 marks

1 mark for the correct shape and correct components

1 mark for the correct labelling

- ii. The antibody could bind to atraxotoxin molecules so they can be identified, engulfed and digested by phagocytes. 1 mark
- Alternatively: The antibody could prevent atraxotoxin molecules from binding to the neuron receptors and inducing the vesicles to empty. 1 mark
- c. Passive, because the antibody is injected rather than produced by the body's own immune system. 1 mark
- d. The person will have no ongoing immunity because his/her body has not produced specific B lymphocytes capable of making antibodies to atraxotoxin. 1 mark
- No memory B cells have formed that can multiply to produce these antibodies if the atraxotoxin/antigen is encountered again. 1 mark

Question 7

- a. The internal part of a membrane is hydrophobic and the external part is hydrophilic. 1 mark
- The protein will be comprised of hydrophobic amino acids in the region in contact with the membrane and hydrophilic amino acids in the region protruding outside the cell. This will hold the protein in place. The carbohydrate will protrude outside. 1 mark

- b. i. The B protein on the bacteria is recognized as non-self. 1 mark

ii.

Blood Type	Antibodies Produced
A	Antibodies against B
B	Antibodies against A
O	Antibodies against A and B
AB	No antibodies

2 marks

If students make one error then they can only score 1 mark

- c. The antibodies against A have passed across the placenta from mother to baby. 1 mark
- These antibodies will bind to the A proteins on the baby's red blood cells leading to ABO HDN. 1 mark