# BIOLOGY

## Unit 3 – Written examination 1

## 2011 Trial Examination

## ***SOLUTIONS***

**SECTION A: Multiple-choice questions (1 mark each)**

**Question 1**

*Answer:* C

*Explanation:*

Carbon dioxide dissolves in water producing carbonic acid; if blood pH decreases this can affect the conformation of proteins such as enzymes.

**Question 2**

*Answer:* B

*Explanation:*

A peptide bond is the bond that forms between 2 amino acids when the carboxyl group of one molecule reacts with the amino group of the next. The products are a dipeptide and a water molecule.

**Question 3**

*Answer:* D

*Explanation:*

The tertiary structure refers to the 3 dimensional shape of a single polypeptide.

**Question 4**

*Answer:* C

*Explanation:*

DNA contains deoxyribose and RNA contains ribose.

**Question 5**

*Answer:* D

*Explanation:*

Subunit 1 is a monosaccharide and subunit 2 is an amino acid.

**Question 6**

*Answer:* A

*Explanation:*

A is a ribosome (or could be interpreted as being rough ER) which is the site of protein synthesis.

**Question 7**

*Answer:* D

*Explanation:*

Of all of the atoms, only sulphur is unique to proteins (nitrogen is found in both proteins and nucleic acids).

**Question 8**

*Answer:* A

*Explanation:*

Each amino acid is coded for by a codon which is made up of a triplet of nucleotides. Since there are 15 amino acids there must be three times that many nucleotides.

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**Question 9**

*Answer:* D

*Explanation:*

The only way of independently comparing the action of the 2 types of toothpaste are if half of the people test 1 type and the other half tests the other type.

**Question 10**

*Answer:* C

*Explanation:*

Dialysis is based on the process of diffusion. The only way for urea to be eliminated from the blood is if the concentration is higher in the blood than in the dialysis fluid. Urea will then diffuse down the concentration gradient from the blood into the dialysis fluid.

**Question 11**

*Answer:* D

*Explanation:*

If the solution is hypertonic then the potato strip will decrease in mass. The only solution that causes a decrease in mass is the 0.5M solution.

**Question 12**

*Answer:* B

*Explanation:*

Boiling water will denature enzymes which stops the process whereby sugar is converted into starch.

**Question 13**

*Answer:* B

*Explanation:*

At points A and B the enzyme will retain its original shape. At point C the enzyme will have denatured so its shape is changed.

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**Question 14**

*Answer:* A

*Explanation:*

FAD is a hydrogen acceptor and transports hydrogen ions and high energy electrons from the Krebs cycle to the electron transport chain.

**Question 15**

*Answer:* B

*Explanation:*

The rate of photosynthesis graph most closely follows the absorption by chlorophyll b indicating that it is the primary pigment for photosynthesis.

**Question 16**

*Answer:* A

*Explanation:*

The light dependent phase generates ATP during cyclic phosphorylation; electrons lost from photosystem II are replaced by those from photosystem I generating ATP.

**Question 17**

*Answer:* B

*Explanation:*

The light dependent stage of photosynthesis generates ATP.

**Question 18**

*Answer:* C

*Explanation:*

Acetylcholine is not being broken down so action potentials continue to be generated.

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**Question 19**

*Answer:* A

*Explanation:*

When the electrical impulse reaches the pre synaptic terminal, neurotransmitters are released into the synapse. They diffuse across the synapse are taken up by the post synaptic terminal and cause the production of an electrical impulse in the next neuron.

**Question 20**

*Answer:* A

*Explanation:*

The receptor is inside the cytoplasm which means that the hormone must have been able to diffuse across the plasma membrane, therefore it has to be a steroid.

**Question 21**

*Answer:* C

*Explanation:*

A pheromone is a chemical produced by a living organism, usually designed to cause a response in others of the same species. The female wasp secretes this pheromone to attract males and the plant is mimicking the pheromone to attract male wasps so it can be pollinated.

**Question 22**

*Answer:* D

*Explanation:*

Negative feedback involves a response which is in the opposite direction to the stimulus. When blood glucose levels are too high insulin is secreted to bring them back to normal.

**Question 23**

*Answer:* D

*Explanation:*

Passive immunity involves being supplied with antibodies rather than manufacturing them yourself. As the antibodies are provided via a transfusion they are artificially acquired.

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**Question 24**

*Answer:* C

*Explanation:*

Only B and T cells are involved in the third line of defence. B cells mature in bone marrow, T cells mature in the thymus.

**Question 25**

*Answer:* A

*Explanation:*

Swelling does not occur until after mast cells secrete histamine, macrophages secrete cytokines that attract other leukocytes, but do not target vascular tissue, interferon targets viruses, not bacteria.

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## SECTION B: Short-answer questions

### Question 1

**a.** Cofactor

1 mark

AND
Cofactors alter the shape of the enzyme either by completing the active site or making it more reactive.

1 mark

**b.** Blood pH would decrease (become more acidic) due to an increase in the concentration of carbonic acid.

1 mark

**c.** It will decrease from approximately 150mmHg to 80mmHg.

1 mark

**d.** An increase in ventilation increases the concentration of oxygen ultimately resulting in an increase of carbon dioxide.

1 mark

AND
In order to maintain blood pH carbon dioxide would be converted to carbonic acid and then to bicarbonate ions. These cannot be retained as they would cause blood pH to increase and they cannot be converted back into carbon dioxide as there is already too much of it as a result the ions are excreted in urine.

1 mark

### Question 2

The diagram should be complementary to neuraminidase and look something like this. (The shape of the section not touching the neuraminidase is irrelevant.)

**a.**

1 mark

**b.** Proteomics is the study of the proteins and the proteome.

1 mark

AND
Rational drug design is an outcome of proteomics. The premise behind rational drug design is that if the shape of an antigen such as neuraminidase is known then a drug with a complementary shape can be produced which will bind to and inhibit the antigen.

1 mark

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**c.** The secondary level

1 mark

Beta sheets provide stability, toughness, or slight elasticity.

1 mark

**Question 3**

**a.** Enzymes are released unchanged after reacting with a substrate.

1 mark

**b.** Enzymes are denatured when placed into hot water.

1 mark

AND
If hot water is used the enzymes will not break down the stains on the clothing.

1 mark

**c.** The plasma membrane.

1 mark

AND
Lipases break down lipids and the plasma membrane consists of a phospholipid bilayer which also contains the steroid cholesterol.

1 mark

**d.** Hypersensitivity is when the body produces an exaggerated immune response to a foreign substance.

1 mark

AND
Possible solutions include:

- Coat the particles to prevent dust from collecting
- Convert the laundry powder into a liquid form
- Any other reasonable suggestion

1 mark

**Question 4**

**a.** 3

1 mark

**b.** The mitochondrial matrix

1 mark

*Note: mitochondria is not sufficiently specific.*

**c.** Chemical D is water

1 mark

AND
High energy electrons are passed from one carrier molecule to the next. Each time they are passed on they lose energy. This energy is used to phosphorylate ADP producing ATP.

1 mark

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**Question 5**

**a.** Rejection occurs as the immune system detects the transplanted organ as being non self (it doesn't have the correct MHC markers). NK cells attack the transplanted organ.

1 mark

AND

Since the organ has been rebuilt using stem cells from the recipient, scientists believe that the organ will be recognised as self and not provoke an immune response.

1 mark

**b.** Immunosuppressive drugs

Finding a donor with a high MHC compatibility with the recipient.

1 mark

**c.** Immunosuppressive drugs suppress the activity of lymphocytes or suppress the production of lymphocytes.

OR

The greater the similarity between the MHC of the donor and recipient, the less chance that the organ will be detected as foreign and rejected.

1 mark

**d.** Natural killer cells

1 mark

**Question 6**

**a.** The virus particle comes into contact with a host cell that has the CD4 surface protein. Spikes on the surface of the virus stick to the CD4 protein.

1 mark

AND

The virus fuses with the plasma membrane and releases its contents into the cytosol.

1 mark

**b.** They are interested in the T cell count because helper T cells present antigens to immature B cells.

1 mark

**c.** HIV particles target CD4 positive cells (T helper cells).

1 mark

AND

These cells are responsible for presenting antigens to immature B cells which proliferate into many antibody producing plasma cells and a few memory cells. Killing of the T helper cells prevents a person from producing antibodies leaving them vulnerable to infection.

1 mark

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**d.** Attenuated means weakened or less virulent.

1 mark

AND
It is too dangerous to produce live vaccines for HIV as viruses frequently mutate and it is possible that an attenuated virus would mutate into a virulent form.

1 mark

**e.** Lymph nodes

1 mark

AND
Lymph nodes act as filters and catch infectious particles. They are also the location of the lymphocytes; which are the cells responsible for the 3rd level of defence. When an infection occurs lymphocytes proliferate in response.

**f.** The first level of defence includes:

- Intact skin
- Mucus
- Ciliated cells
- Tears
- Any other reasonable response.

1 mark

AND
The virus is able to bypass the first level via such means as infected needles.

1 mark

**Question 7**

**a.** The charge is comparatively positive outside the cell and comparatively negative inside the cell.

1 mark

**b.** Initially sodium channels open allowing sodium ions to move into the cell causing depolarisation.

1 mark

AND
Subsequently the potassium channels open allowing potassium ions to flow out, causing repolarisation.

1 mark

**c.** Nervous impulses need to be fast as nervous reactions are used to prevent our bodies from becoming damaged.

1 mark

**d.** Substance A is a neurotransmitter such as acetylcholine.

1 mark

**e.** Diffusion

1 mark

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**f.** The problem must lie with the central nervous system.

1 mark

AND

People with CIPA can still detect stimuli such as texture, this indicates that their sensory receptors work. The problem lies with the interpretation of the sensory input.

1 mark

**g.** People with CIPA are unable to detect extreme temperatures.

1 mark

AND

If they are unable to detect the stimulus then their bodies do not undertake measures to bring their core temperature back to normal. This is exacerbated by their inability to sweat.

1 mark

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