



THE SCHOOL FOR EXCELLENCE
UNIT 3 BIOLOGY 2009
COMPLIMENTARY WRITTEN EXAMINATION 1 – SOLUTIONS

SECTION A – MULTIPLE CHOICE QUESTIONS

QUESTION 1	Answer is A
QUESTION 2	Answer is B
QUESTION 3	Answer is C
QUESTION 4	Answer is C
QUESTION 5	Answer is D
QUESTION 6	Answer is A
QUESTION 7	Answer is A
QUESTION 8	Answer is C
QUESTION 9	Answer is A
QUESTION 10	Answer is B
QUESTION 11	Answer is D
QUESTION 12	Answer is A
QUESTION 13	Answer is B
QUESTION 14	Answer is D
QUESTION 15	Answer is B
QUESTION 16	Answer is D
QUESTION 17	Answer is A
QUESTION 18	Answer is C
QUESTION 19	Answer is A
QUESTION 20	Answer is A
QUESTION 21	Answer is C
QUESTION 22	Answer is B
QUESTION 23	Answer is D
QUESTION 24	Answer is B
QUESTION 25	Answer is A

SECTION B: EXTENDED RESPONSE QUESTIONS

QUESTION 1

- (a) Plasmodesmata (singular: plasmodesma) are junctions that exist in plant cells to allow communication between adjacent cells. In spite of the thick cell wall. (1)
- (b) i. Structure A: cellulose. (1)
- ii. Cellulose is made up of unbranched chains of β -glucose molecules held together by 1,4 glycosidic links to form long chains. Parallel chains become cross linked with hydrogen bonds and form bundles of molecules called microfibrils. (1) Cellulose microfibrils provide strength to the cell wall. (1)
- (c) i. Phospholipid bilayer with proteins embedded in it. (1)
- ii. The phosphate 'head' of the molecule is attracted to water (hydrophilic) while the fatty acid tails extend away from water. (hydrophobic) (1) Because of these properties, the molecules align so that they develop double-layered sheets forming the cell membrane. (1)
- (d) A virus is a particle lacking cellular organisation and consisting of genetic material surrounded by a protein coat. They are only able to reproduce within a host cell (1) or non-cellular pathogen.
- (e) Viruses must enter the host cell where it uses components of the host cell to produce the proteins that it requires. Even though a virus has its own DNA (or RNA) it lacks the 'machinery' to operate it outside of the host cell (1). Using the host cell's DNA it will then synthesise the protein necessary to enlarge the plasmodesmata (1). Or virus particles (blue) cannot spread through the plasmodesmata unless these are modified by the virus.

For this purpose plant viruses express various movement proteins (red) which increases the size of the plasmodesmata.

- (f) Growing 'gall' tissue around the area containing the virus to prevent spread to other areas (1) or producing chemicals such as resins and tannins or producing 'gums' to seal of the wounded area or dropping the infected part (eg. leaf) to inhibit spread to other parts of the plant.

QUESTION 2

- (a) Enzymes increase rate of chemical reactions which would otherwise occur too slowly to sustain life (1) or lower the activation energy required for a reaction to proceed.
- (b) Zinc is a cofactor. A **cofactor** is a non-protein chemical compound that is bound to an enzyme and is required for the enzyme's biological activity (i.e. catalysis). They can be considered "helper molecules/ions" that assist in biochemical transformations. (1)
- (c) The carbonic anhydrase only reacts with its substrate, carbon dioxide. The active site of the carbonic anhydrase is complementary in shape to its substrate so it is able to bind to it. (1)
- (d) More surface area to transport oxygen and carbon dioxide. (1)
- (e) A decrease in carbon dioxide would cause the blood to become more acidic so there will be a decrease in pH. (1)

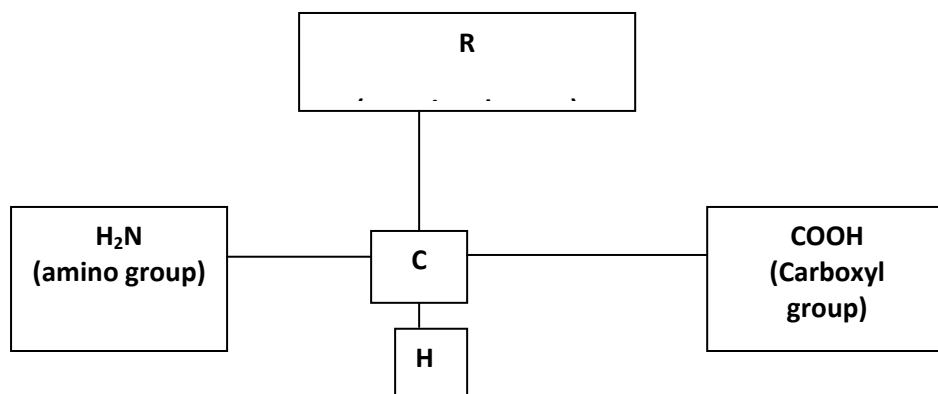
- (f) The condition of a relatively stable internal environment, maintained within narrow limits. When an increase or decrease occurs in the internal environment of an organism, homeostatic mechanisms would operate, in this case to increase the blood pH. (1)
- (g) As **carbonic anhydrase** catalyzes the rapid conversion of carbon dioxide to bicarbonate and protons, an inhibitor would prevent this occurring (1) so that carbon dioxide levels would not fall so rapidly in the high altitude environment, preventing mountain sickness from occurring. (1)

QUESTION 3

- (a) Protein. (1)
- (b) Facilitated Diffusion. (1)
- (c) Passive Diffusion or Osmosis. (1)
- (d) Relatively large size or charge or non polar (1)
- (e) Considering the importance of water transport in a number of diseases (eg kidney disease), if aquaporins could be manipulated, potentially many medical problems could be solved (1)
- (f) Renal tubule cells would be expected to have large numbers of aquaporins compared to other body cells because of their specific function in the body. (1) Eg. renal tubules are from the kidneys which reabsorb water.
- (g) That the eggs expressing an aquaporin, following injection of aquaporin RNA, will absorb water, swell, and burst (1) but eggs without the aquaporin will not swell. (1)

QUESTION 4

(a)



(2)

- (b) Relenza acts as a neuraminidase inhibitor. It interacts with the active site of the neuraminidase and the virus is trapped at the surface of the cell. (1) As the virus is prevented from infecting other cells, there is no massive increase in numbers of the virus as usually occurs so influenza symptoms fail to develop. (1)

- (c) Any first line of defence such as INTACT skin, mucus membranes, natural secretions which prevent the virus from entering the body in the first place. (1)

Interferons are secreted by some viral-infected cells, and act on uninfected cells making them more resistant to the virus. Interferons are important if a virus has not far to travel.

If a person has developed flu symptoms then interferon has failed to prevent infection.

(1)

- (d) The group who were given the placebo acted as a control so that any effects on the experimental group could be validly attributed to the administration of relenza. (1)
- (e) Relenza resulted in a shorter duration of influenza symptoms by 2.5 days. (1)

QUESTION 5

- (a) Calvin Cycle or Calvin-Bensen Cycle. (1)
- (b) Stroma of the chloroplast. (1)
- (c) Water. (1)
- (d) Carbon dioxide from the atmosphere (1)
- (e) Krebs Cycle- First, each 3-carbon pyruvic acid molecule has a CO₂ broken off and the other two carbons are transferred to a molecule called acetyl coenzyme A, while a molecule of NADH is formed from NAD⁺ for each pyruvic acid (= 2 for the whole glucose). (1) These acetyl CoA molecules enter the actual cycle, and after the coenzyme A is released, each 2-carbon piece is broken apart into two molecules of CO₂. In the process, for each acetyl CoA that goes into the cycle, three molecules of NADH, one molecule of FADH₂, and one molecule of ATP are formed (= 6 NADH, 2 FADH₂, and 2 ATP per whole glucose). (1)
- (f) Glucose. (1)

QUESTION 6

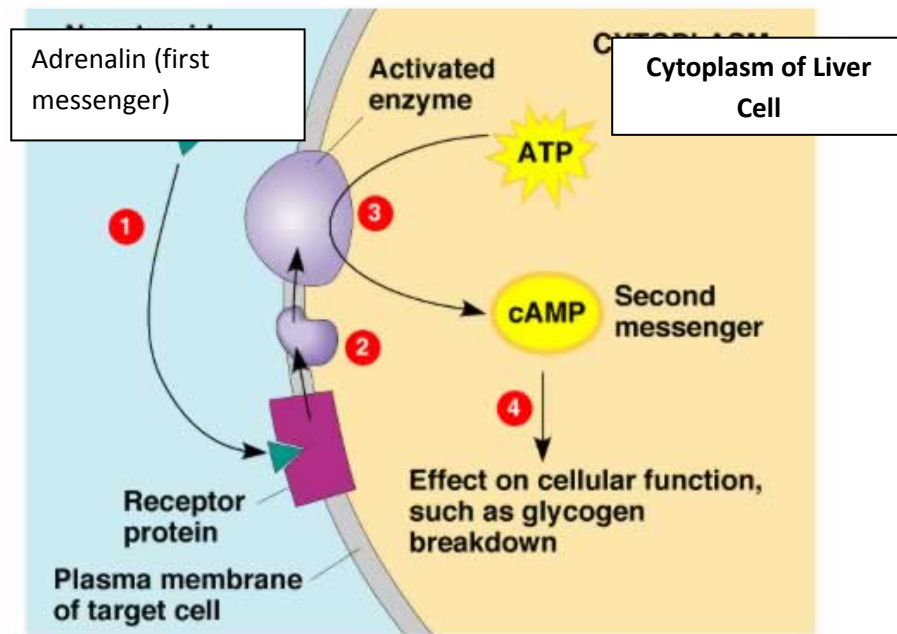
Various answers possible:

Signal transduction refers to the series of events that occur after the receipt of a specific extracellular signal and which result in a cellular **response**. (1)

The answer needs to highlight, at the **molecular** level, the transfer of information from one form into another, which is then understood by the cell to produce a **response**. (1)

A sample answer could be:

In the fight-or flight response, the signal is the hormone adrenalin (epinephrine). Soon after a stressful event is encountered, the adrenal glands release adrenalin into the bloodstream. In the signal transduction pathway in a liver cell - the first phase (signal reception), adrenalin acts as a ligand by binding to a receptor on the cells surface. In the second phase (signal transduction), the activated receptor triggers a cascade of biochemical reaction within the cell. This cascade involves a G protein, the second messenger cyclic AMP (cAMP), and a number of enzymes. In the third phase (cellular response), the liver breaks down glycogen into glucose and releases glucose into the bloodstream.



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QUESTION 7

- (a) Because her body contains double the normal number of HLA haplotypes, it means that Jane has a much greater chance of finding a suitable donor kidney (1).
- (b) The HLA complex, which encode many different immune proteins, including cell surface proteins that immune cells use to distinguish the body's own tissues from foreign material (1) so the closer the match between two people's HLA haplotypes, the lower the risk of a transplant between them being rejected.
- (c) Son 2, as both have (2,5) halotypes. (1)
- (d) Both of: in the cell mediated immune response, T-cell mediated rejection response occurs and macrophage presents antigen from transplanted kidney on its surface and releases cytokine (interleukin-1) to attract helper cells (1) T-helper cells activate cytotoxic T-cells and/or NK (natural killer) cells ,cytotoxic chemicals are produced which destroy foreign cells . Macrophages engulf destroyed cells (3)

NB: On a similar question on the 2008 paper, most students incorrectly treated this question as a humoral immune response, while others mentioned all possible types of cells involved in immune responses and therefore did not score any marks. Students should use the correct terms for T-cells; either cytotoxic, helper or NK (natural killer) cells, not, for example, 'killer T-cells'.