

BIOLOGY

Unit 3 – Written Examination 1



2009 Trial Examination

SOLUTIONS

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

Question 1

Answer: B

Explanation:

The primary structure of a protein is the sequence of amino acids. The secondary structure of a protein is the shape that amino acids take after polymerisation which includes alpha helices and beta sheets, tertiary structure is the way a polypeptide is coiled or twisted and the quaternary shape includes more than 1 polypeptides bound together.

Question 2

Answer: C

Explanation:

Transcription is the process that produces messenger RNA. Although the initial product of transcription is called the primary transcript or pre mRNA, mRNA is produced when the introns are removed and exons are spliced together.

Question 3

Answer: C

Explanation:

Although some carbon dioxide does bind to haemoglobin, most carbon dioxide is transported as bicarbonate ions in plasma solution.

Question 4

Answer: A

Explanation:

The presence of the cholesterol molecules prevents the phospholipids from packing tightly together, decreasing the fluidity of the membrane and therefore making it more stable. B is wrong as cholesterol has nothing to do with acting as a channel, C is wrong as the presence of cholesterol increases the fatty nature of the membrane, making it less permeable to water soluble molecules. D is wrong as phospholipids have nothing to do with apoptosis.

Question 5

Answer: C

Explanation:

Solution 1 is isotonic to the cytosol and solution 2 is hypertonic. In solution 1 the solute concentration is the same inside and outside the cell. In solution 2 the solute concentration is higher outside the cell than inside.

Question 6

Answer: D

Explanation:

Substances are taken into cells faster if they are lipid soluble, small, uncharged or non-polar. D is the most correct as the molecule is lipid soluble.

Question 7

Answer: B

Explanation:

Diagram 1 shows passive transport as the molecules are moving from an area of high concentration to an area of low concentration. Diagram B is showing active transport as the molecules are moving against the concentration gradient through a protein channel.

Question 8

Answer: B

Explanation:

The equation shown is that of glycolysis, which takes place in the cytosol.

Question 9

Answer: A

Explanation:

Structure A is the grana where the light dependent reaction occurs. Structure B is the stroma which is where the light independent reaction occurs.

Question 10

Answer: A

Explanation:

NADP is the carrier for the H⁺ ions.

Question 11

Answer: B

Explanation:

Plants with green leaves reflect green light. Although other colours are absorbed, red and blue light is absorbed to the greatest extent. Since light is required for the light dependent reactions, increasing the absorption of light will increase the reaction rate.

Question 12

Answer: B

Explanation:

The rate of this reaction can only be established by measuring the products. Since the peroxide is in solution, water is already present, so it would be more accurate to measure the amount of oxygen produced by displacement.

Question 13

Answer: A

Explanation:

A is the most likely possibility. Although pathway C will still be working, since there are normally 3 pathways for this product, A will be used at a slower rate and could accumulate. B and C are incorrect because substances 2 and 3 respectively will be used up and not replenished. D is incorrect because if substance 1 accumulates then the synthesis of substance 1 will decrease to compensate.

Question 14

Answer: A

Explanation:

Coenzymes are organic, cofactors are inorganic.

Question 15

Answer: C

Explanation:

Since ADH is an amino acid hormone, it is large and not lipid soluble. Therefore signal transduction will be via the second messenger system. C is incorrect as in this system receptors are located on the external surface of the plasma membrane; receptors for lipid soluble (steroid) hormones would be located in the cytosol.

Question 16

Answer: C

Explanation:

ADH causes the collecting duct to become more permeable to water, increasing water reabsorption and decreasing urine volume. If ADH is inhibited then the collecting tubules are less permeable to water, so less water will be reabsorbed and more water will leave the body, meaning that large volumes of dilute urine will be produced.

Question 17

Answer: A

Explanation:

Ethylene is the plant hormone responsible for causing ripening.

Question 18

Answer: B

Explanation:

The temperature of an ectotherm varies in response to the external temperature, so animal 2 is an ectotherm.

Question 19

Answer: B

Explanation:

Complement is a non-specific antibacterial substance.

Question 20

Answer: D

Explanation:

The only specific response is the B cells undergoing clonal expansion.

Question 21

Answer: B

Explanation:

Viruses have a protein coat called a capsid, prions are uncoated proteins.

Question 22

Answer: D

Explanation:

Attenuated vaccines contain antigens which stimulate antibody production, a specific response.

Question 23

Answer: D

Explanation:

Autoimmune diseases occur when the immune system fails to recognise self tissue.

Question 24

Answer: C

Explanation:

After infection macrophages present antigens to T helper cells, which present the antigens to immature B cells, which then produce specific antibodies.

Question 25

Answer: D

Explanation:

Transplanted tissue is non-self. To help prevent rejection of the transplant, drugs which suppress the immune system are provided.

SECTION B: Short-answer questions

Question 1

- a. A glycoprotein is a biological molecule containing a protein component and a carbohydrate component. 1 mark
- b. Proteomics 1 mark
- c. Fibrinogen is the precursor for the protein fibrin, which is responsible for producing blood clots. 1 mark

AND

Thrombosis is caused by blood clotting and the presence of high levels of fibrinogen would indicate the ability to produce excessive amounts of fibrin, causing thrombosis. 1 mark

- d. Immunological proteins include antibodies, interferon and complement. 1 mark

AND

Regulatory proteins include: any amino acid based hormone 1 mark

- e. Molecule 2 1 mark

AND

The presence of phosphorus combined with carbon, hydrogen, oxygen and nitrogen indicates this is a nucleic acid as each nucleotide in a nucleic acid contains a phosphate group. Nucleic acids do not contain sulphur. 1 mark

Total 8 marks

Question 2

- a. $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6 H_2O + 36-38ATP$
Note: the equation must contain an appropriate amount of ATP, not just ATP or energy. 1 mark
- b. Cytosol has a water concentration of 60% or higher. A low water concentration outside the cells sets up a concentration gradient. 1 mark
- AND
Water diffuses out of the bacterial cells; they become flaccid and are unable to continue functioning. 1 mark
- c. The oxygen level has decreased as oxygen is used as a substrate for cellular respiration 1 mark

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AND

The carbon dioxide level has increased as carbon dioxide is a product of cellular respiration

1 mark

- d. Immediately after being turned the oxygen concentration will have increased because turning the soil will aerate it.

1 mark

AND

After 24 hours the concentration of oxygen will have decreased as oxygen is a substrate for cellular respiration

1 mark

- e. Obtain some seeds all from the same source. All conditions the seeds are grown in should be the same including the soil, type of pot, lighting length of growing time and amount of water.

1 mark

Half of the seeds should have been placed into a hot compost pile prior to planting while the other half were kept at atmospheric temperature. There should be several pots set up for each type of seed, with each pot containing at least 5 seeds.

1 mark

If the hypothesis is valid then the germination rate of seeds from the compost heap will be lower than that of the seeds that had been kept at atmospheric temperature.

1 mark

- f. Fermentation or anaerobic respiration

1 mark

- g. Ethanol and carbon dioxide

1 mark

Total 12 marks

Question 3

- a. It is important to have a rapid response to stimuli such as pain and the nervous system is able to respond more rapidly than the hormonal system.

1 mark

- b. A reflex arc.

1 mark

- c. In order for a nervous response to occur the stimulus must be greater than the minimum threshold.

1 mark

AND

In this case the temperature of the first cup was sufficient to pass the threshold, so a response occurred and the temperature of the second cup was insufficient so no response occurred.

1 mark

- d. Substance A is a neurotransmitter which is responsible for signal transduction across the synapse.

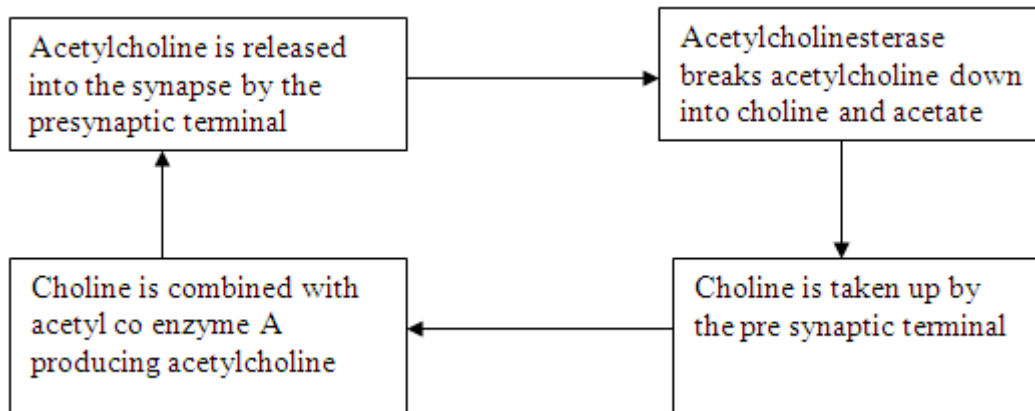
1 mark

AND

Area X is the synapse or gap between 2 nerves.

1 mark

- e. The diagram produced should look like this:



4 correct: 2 marks
 2 or 3 correct: 1 mark
 0 or 1 correct: 0 mark

f. A neurotransmitter

1 mark

g. Acetylcholinesterase is an enzyme which is denatured by the high core temperature.

1 mark

AND

As a result acetylcholine is not broken down into choline and acetate and cannot be used to produce more acetylcholine, so nervous impulses are not conducted, leading to loss of motor control.

1 mark

Total 11 marks

Question 4

a. Attenuated viruses are weakened.

1 mark

AND

Subunit vaccines contain only antigenic fragments, rather than complete viruses. There is a chance that an attenuated virus may back mutate into a more virulent form, there is no possibility an antigenic fragment will do so.

1 mark

b. Children are the natural reservoir for this pathogen, so those age groups most in contact with children will be most likely to become infected

1 mark

c. The incidence of HIB decreased from 250 per 100,000 to 25 per 100,000.

1 mark

AND

A vaccine programme for HIB was introduced.

1 mark

d. Adults initially benefitted from herd immunity

1 mark

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AND

When the rate of infection in children decreased, fewer adults were exposed to the bacterium, so their antibody levels were no longer being boosted, then when the infection rate in children began to increase again adults were less able to fight off the infection.

1 mark

- e. Initially the B cells are unable to recognize the antigen and the pathogen has to be engulfed by a macrophage, and the antigenic fragment is presented to an immature B cell by a T helper cell. This takes about 24 days to reach peak antibody production.

1 mark

AND

After the first exposure B memory cells remain in circulation. These have the specific antibody embedded into their plasma membrane and are able to recognize the antigen immediately, dramatically shortening the process and increasing the response

1 mark

- f. Any of the following
- Thick waxy cuticle
 - Closed stomata
 - Thick bark
 - Any other reasonable suggestion

1 mark

Total 10 marks

Question 5

- a. The cow is the secondary host

1 mark

- b. The cyst can remain in a dormant state between hosts.

1 mark

OR

Worms are vulnerable to dehydration. The cyst protects them from becoming dehydrated after being excreted.

1 mark

- c. Any of the following

Presence of suckers

1 mark

AND

The suckers enable the worm to attach to the host and prevent it from being dislodged.

1 mark

OR

Flattened body

1 mark

AND

This increases the SA:V ratio of the worm enabling it to take up nutrients, oxygen and water more effectively.

1 mark

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- d.** The primary defence system is made up of physical and chemical barriers designed to prevent the entry of foreign organisms. 1 mark

AND

As an immature form of the worm is ingested the majority of the physical and chemical barriers are bypassed, the cyst stage limits the effectiveness of the acids in the digestive system.

1 mark

- e.** Cooking meat completely will kill the parasite.

1 mark

- f.** The function of the digestive system is to mechanically and chemically break down food. The host has already done this, so it is unnecessary for the worm to have the ability to do so as well.

1 mark

- g.** Ectoparasites will have the most complex form of locomotion as they need to be able to move themselves between different hosts whereas endoparasites are frequently contained in food consumed by the host so therefore does not need a complex form of locomotion.

1 mark

Total 9 marks