BIOLOGY

Unit 3 – Written examination 1

TSSM™
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2010 Trial Examination

SOLUTIONS

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

Question 1
Answer: B

Explanation:
This is a condensation reaction in which amino acids are joined together by a reaction between the carboxyl group of 1 amino acid and the amino group of the next. A water molecule is released during this process.

Question 2
Answer: D

Explanation:
Bacteria are unicellular and lack membrane-bound organelles which eliminates all options except D. Both bacteria and fungi have cell walls but they are made up of different substances.

Question 3
Answer: C

Explanation:
Transcription occurs in the nucleus, DNA is used as a template ultimately producing mRNA. Translation occurs at the ribosome in the cytosol, mRNA is read resulting in the synthesis of a polypeptide.

Question 4
Answer: C

Explanation:
Nucleic acids both contain carbon, nitrogen and oxygen. Proteins have disulphide bridges.

Question 5
Answer: D

Explanation:
The salt solution is hypertonic with respect to the cytosol; water diffuses out of the cell causing plasmolysis, the plasma membrane shrinking away from the cell wall. This makes the plasma membrane more visible.

Question 6
Answer: C

Explanation:
Water is hypotonic with respect to the tissues of the fish and the fish needs to get rid of it by excreting large volumes of dilute urine.

Question 7
Answer: B

Explanation:
2 ATP is produced during glycolysis. Like plants yeast cells produce ethanol and carbon dioxide.

Question 8
Answer: D

Explanation:
During glycolysis glucose is broken down into two 3 carbon molecules called pyruvate or pyruvic acid.

Question 9
Answer: B

Explanation:
Oxygen is the final acceptor of H^+ ions and is reduced to form water.

Question 10
Answer: A

Explanation:
The Kreb's cycle occurs in the mitochondrial matrix.

Question 11
Answer: D

Explanation:
Enzymes are reusable as they are released unchanged after binding with a substrate.

Question 12
Answer: B

Explanation:
Ions are inorganic requirements for enzyme catalysed reactions and are therefore cofactors rather than coenzymes.

Question 13
Answer: B

Explanation:
The light dependent stage of photosynthesis occurs in the thylakoid disks which are located within the grana of the chloroplast.

Question 14
Answer: D

Explanation:
When chlorophyll absorbs light energy electrons are excited and are transported down the electron transport chain producing energy.

Question 15
Answer: A

Explanation:
Impulses enter a neuron through the dendrite and then move along the axon.

Question 16
Answer: A

Explanation:
When sodium channels open sodium ions move into the cell causing depolarisation. If the ion channels remain open then depolarisation will be permanent preventing impulse transmission.

Question 17
Answer: D

Explanation:
Myelination increases the speed of impulse conduction in nerve as it acts as an insulator preventing loss of charge across the membrane.

Question 18
Answer: C

Explanation:
Infectious unenclosed proteins are known as prions.

Question 19
Answer: B

Explanation:
This precaution is taken as there is the concern that blood will contain prions. The action of this prion is to call cell degeneration and death leading to an alteration of brain structure and function.

Question 20
Answer: A

Explanation:
The immune system will detect foreign antigens on the transplanted organ leading to rejection. To prevent this, immunosuppressive drugs inhibit the ability of the immune system to detect non self antigens.

Question 21
Answer: C

Explanation:
Antibiotics are only useful against bacteria.

Question 22
Answer: A

Explanation:
Specific immunity refers to the immune systems ability to recognise a specific antigen and respond to it in the same manner. Specific immunity is carried out by T and B cells.

Question 23
Answer: B

Explanation:
Autoimmunity occurs when the immune system malfunctions and fails to recognise cells that belong to the body. The immune system attacks and damage cells that are "self".

Question 24

Answer: C

Explanation:
When the venom is injected into the horse, the horse produces antibodies which are subsequently collected. Antivenom acts quickly as it contains antibodies to the venom already.

Question 25

Answer: B

Explanation:
If clumping occurs when the anti-B is added to the blood then there must be type B antigens on the cells surface. Both type B and type AB cells have the B antigen.

SECTION B: Short-answer questions

Question 1

a. Quarternary (the hexamer contains 6 polypeptides)

1 mark

b. Insulin is stored as a hexamer as it is more stable in this form and will not degrade prior to use.

1 mark

AND
It is injected as a monomer because the monomer is the active form. Its smaller size enables it to be taken into the cell more rapidly.

1 mark

c. Insulin is a protein and if it were ingested it would be broken down by proteases in the stomach.

1 mark

AND
Insulin is an endocrine hormone and it is secreted into the circulatory system in order to reach target cells.

1 mark

d. Hormones are only able to bind to cells with the appropriate receptors; these are not present on all cells.

1 mark

e. Transcription and translation.
Note: both must be mentioned to get the mark.

f. Set up 4 sets of tissue culture flasks each set containing 5 flasks. All of the cells should be from the same origin and the same amount of glucose should be placed into each flask. The only difference between the flasks should be the type of insulin. One group should contain no insulin, one bovine insulin, one porcine insulin and one piscine insulin.

1 mark

Leave the flasks for a period of 24 hours and then measure the concentration of glucose in each flask.

1 mark

If the hypothesis is correct the flask with the porcine insulin should contain the lowest concentration of glucose and the flask with the piscine insulin should contain the highest concentration of glucose.

1 mark

Any other reasonable answer can be supplied. However, the first mark refers to the experimental conditions, the second mark refers to the method of measuring the results and the third mark refers to linking the results with the hypothesis.

Total 10 marks

Question 2

a. In the case of respiration, glucose being a molecule contains electrons and can be used to produce energy in the form of ATP.

1 mark

AND

In the case of photosynthesise light does not contain electrons and therefore these must be obtained from another source.

1 mark

b. Glucose

1 mark

c. NADP is a carrier molecule responsible for carrying hydrogen from the light dependent stage in the grana to the light independent stage in the stroma.

1 mark

d. Carbon dioxide has a greater effect on the rate of photosynthesis than temperature does.

1 mark

AND

When the concentration of carbon dioxide is low, changing the temperature also has little effect on the rate of photosynthesis.

1 mark

e. Photosynthesis and cellular respiration are metabolic reactions that are essential for survival.

1 mark

AND

The presence of the cristae and thylakoid disks increases the surface area available for these reactions to occur on.

1 mark

f. Photosynthesis is catalysed by the enzyme chlorophyll.

1 mark

Decreasing the temperature decreases the kinetic energy of the enzyme and substrate which causes the reaction rate to decrease.

1 mark

Total 10 marks

Question 3

a. Neurohormone

1 mark

b. Positive feedback.

1 mark

AND

When the child continues to suckle the production of oxytocin increases as does milk production. The response is acting in the same direction as the stimulus rather than opposite direction.

1 mark

c. Oxytocin is an amino acid hormone so signal transduction occurs via the second messenger system.

1 mark

AND

Oxytocin binds to a receptor on the external surface of the plasma membrane. This causes the release of a second messenger such as cyclic AMP which then initiates a metabolic cascade altering cellular function.

1 mark

d. Stimulus: Action of infant suckling
Receptor: Pressure receptors
Control centre: Hypothalamus
Effector: Muscles surrounding milk ducts
Response: Contraction of muscles causing release of milk

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

Question 4

a. Any of the following:

- Mucus
- Intact skin
- Natural flora
- Ear wax
- Ciliated membranes
- Any other appropriate answer

1 mark

b. One of the following:

- Physical barriers such as thickened cell walls
- Sealing off infected areas by forming galls
- Abscission of affected leaves
- Any other appropriate answer

1 mark

c. One of the following:

- Direct contact
- Blood transfusion containing viruses
- Use of an infected needle
- Any other reasonable answer

1 mark

d. The HIV virus targets T helper cells

1 mark

T helper cells are responsible for presenting antigens to immature B cells, without T helper cells a person is unable to produce antibodies rendering them vulnerable to infection.

1 mark

e. Attenuated means weakened, virulence is decreased.

1 mark

f. People with AIDS are immunocompromised.

1 mark

Attenuated viruses are still living and may still be able to affect people who have AIDS.

OR

It is possible that an attenuated virus may mutate back into a virulent form.

1 mark

Total 8 marks

Question 5

a. All nucleated human cells have a MHC (major histocompatability complex) marker which identifies cells as self.

1 mark

b. The innate immune system.

1 mark

AND

The response to an antigen is caused by the release of histamines. The release of histamine will be the same in each case.

1 mark

c. An allergen comes into contact with an immature B cell which divides to produce antibodies that coat mast cells.

1 mark

AND

If the allergen is encountered again the allergen binds to the antibodies coating the mast cell. This causes degranulation (vesicles in the mast cell release histamine molecules) which causes the symptoms associated with hypersensitivity.

1 mark

d. The purpose of the skin scratch test is to try to identify which of the allergens cause the hypersensitivity reaction.

1 mark

AND

If a person is sensitive to the allergen there should be some kind of response such as swelling, development of a rash or itching.

1 mark

e. A hypersensitivity reaction cannot occur unless a B cell has previously encountered an allergen and produced antibodies against it.

1 mark

Total 8 marks

Question 6

a. Glycoprotein or receptor protein.

1 mark

AND

These molecules act as markers such as the MHC markers which identify a cell as being self.

b. Facilitated diffusion.

1 mark

The glucose is unable to diffuse directly into the cell, transport is protein mediated. However, no energy is required so the process of glucose transport is passive.

1 mark

c. The hydrogen ions will be transported out of the cell and accumulate in the extracellular fluid

1 mark

AND

The hydrogen ions then diffuse back into the cell enabling the transport of glucose into the cell, causing the concentration of glucose inside the cell to increase.

1 mark

Total 6 marks