TSSM
Creating VCE Success

BIOLOGY 2020

Unit 3
Key Topic Test 7 – Cellular signals

Recommended writing time*: 45 minutes
Total number of marks available: 45 marks

SOLUTIONS

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

Question 1

Answer: D

Explanation:
A is incorrect as if they were both the same shape they would not fit together as they would not be complementary. B and C are incorrect as the signaling molecule does not change shape.

Question 2

Answer: C

Explanation:
T cells release cytokines as signaling molecules for an immune response.

Question 3

Answer: B

Explanation:
Endocrine signaling involves hormones moving through the blood to attach to specific receptors in another part of the body

Question 4

Answer: C

Explanation:
Transduction is the process of activation of secondary messengers within the cell to amplify the initial signal leading to a cellular response.

Question 5

Answer: B

Explanation:
A steroid hormone is lipid based and passes directly through the plasma membrane to bind to an internal receptor forming a transcription factor

Question 6

Answer: D

Explanation:
As insulin is a peptide-based hormone it attaches to an external receptor on the extracellular surface of the plasma membrane to initiate transduction.

Question 7

Answer: C

Explanation:
Cortisol must be a lipid-based hormone as it diffuses through the plasm membrane. Lipid based hormones attach to an internal receptor forming a complex that attaches to DNA in the nucleus and initiates gene expression. The complex is not itself transcribed into mRNA, so D is incorrect

Question 8

Answer: B

Explanation:
Hydrophobic molecules are lipid based and attach to intracellular receptors forming transcription factors which attached to DNA and initiate protein synthesis, so A is correct. Hydrophilic molecules attach to receptors on the surface of the cell however the question asks about clarity between the response not initiation, so C is incorrect

Question 9

Answer: D

Explanation:
Apoptosis is initiated by a death ligand which causes an organised cellular response to recycle the cell, which includes the formation of blebs. Cells are not ruptured and do not burst in this process as this would cause an inflammatory response. Rather the membrane bound blebs are recycled

Question 10

Answer: B

Explanation:
Cells undergoing apoptosis would not have blebs bursting or lysing as both would cause an inflammatory response. When apoptosis occurs, cells shrink as the cytoskeleton, nucleus and DNA are digested by caspases.

Question 11

Answer: C

Explanation:
In the mitochondrial pathway for apoptosis an internal cellular process occurs in response to DNA damage. The pathway begins with the release of Cytochrome C as the mitochondrial membrane becomes more permeable.

Question 12

Answer: D

Explanation:
Death ligands attach to external receptors, causing the activation of secondary messengers. A signal cascade activates caspases inside the cell initiating cellular breakdown. Caspases are present in the cytosol as they are not produced in the mitochondria. Cytochrome C is released in the mitochondrial pathway

Question 13

Answer: C

Explanation:
In apoptosis once caspases are activated the cytoskeleton is broken down forming blebs, then the nuclear membrane is broken apart and the DNA is fragmented.

Question 14

Answer: C

Explanation:
The body's immune system activates apoptosis through Tc cells to remove virally infected cells. Mitosis is regulated through checkpoints which can cause apoptosis however mutations can still occur.

Question 15

Answer: B

Explanation:
If healthy cells are removed, diseases may be caused

SECTION B: Short-answer questions

Question 1

a. Initiation (1) Transduction (1) Response (1)

3 marks

b. Pheromones would attach to a G protein coupled receptor (external) in the male antenna (1) as pheromones are hydrophilic peptide (protein)-based signal molecule (1) so cannot enter the cell (1)

3 marks

c. The pheromone would initiate secondary messengers (1) which would cause a signal cascade and the activation of enzymes within the antenna cells (1)

2 mark

d. Pheromones are transmitted though external environments like air or water (1)

1 mark

e. Male moths would be caught in the pheromone traps as they are attracted to the females releasing the pheromone (1) If the males are trapped they are not able to mate with the females reducing the number of larvae that eat the fruit therefore reducing crop damage (1)

2 marks

Question 2

a. Testosterone is hydrophobic (1) as it diffuses through the plasma membrane and attaches to a receptor in the cytosol (1)

2 marks

b. Once testosterone enters a cell it would attach to an internal receptor, becoming a transcription factor that moves to the nucleus, attaches to DNA and activates gene expression (1) Transcription and translation of the gene activated by the transcription factor would lead to the synthesis of growth hormones (1)

2 marks

c. When testosterone attaches to a receptor and becomes a transcription factor the complex can attach and activate different genes (1) resulting in different proteins being synthesized (1)

2 marks

Question 3

a. Intrinsic mitochondrial pathway (1) and extrinsic death ligand pathway (1)

2 marks

b. Intrinsic mitochondrial pathway

- DNA damage or stress cause mitochondrial membrane to become more permeable
- Cytochrome C diffuses from the mitochondria
- Cytochrome C causes the activation of caspases initiating apoptosis

3 marks

Extrinsic death ligand pathway

- Death ligand attaches to a G coupled receptor
- Secondary messengers activated causing a signal cascade
- The activation of caspases initiating apoptosis

3 marks

c. Caspases cause the digestion of the cytoskeleton causing blebs (1), initiate the condensation of the nuclear membrane and the digestion of DNA (1)

2 marks

d. HIV infects immune system cells including Th cells, macrophages and dendritic cells (1). Virally infected cells are targeted by Cytotoxic T cells initiating apoptosis in immune cells reducing the number of immune cells causing immune deficiency

2 marks

Question 4

a. The nucleus condenses, cytoskeleton cut up, the cell shrinks and blebs form, nuclear material cut up (any 2)

2 marks

b. Phagocytes recycle the cellular materials ensuring resources are not lost and remove potentially toxic material from escaping into the body

1 mark

Question 5

a. A hormone is secreted internally to regulate metabolism. Pheromones are secreted externally to regulate behavior.

1 mark

b. Pheromones like other signaling molecules are specific to the receptors on the target cells (1) European wasps have receptors for the European wasp pheromones while other wasps do not (1)

2 marks

c. Wash the site to remove the pheromone

1 mark

Total 45 marks