

YEAR 12 *Practice Questions*

2020

UNIT 3 BIOLOGY

Worked solutions

This book presents:

- explanatory notes
- worked solutions
- mark allocations
- tips.

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SECTION A – Multiple-choice questions

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

Question 1

Answer: D

Explanatory notes

Option D is correct because some proteins act as receptor molecules on cell surfaces and other proteins facilitate diffusion through the membrane for polar molecules. Option A is incorrect because cholesterol contributes to fluidity, not proteins. Option B is incorrect because although proteins give a plasma membrane its fluid mosaic structure, that is not their purpose. Option C is incorrect because no plasma membrane is a totally impermeable barrier.

Question 2

Answer: B

Explanatory notes

Option B is correct because exocytosis is the only option where a vesicle fuses with the cell membrane and secretes molecules, in this case insulin, to the outside of the cell.

Question 3

Answer: A

Explanatory notes

Option A is correct because the transcription of genes from DNA occurs in the nucleus. Options B and D are incorrect because the Golgi apparatus modifies and packages proteins, while the ribosome is the site of protein synthesis. Option C is incorrect because the rough endoplasmic reticulum is involved in the transport of protein, not in the process of aerobic respiration.

Question 4

Answer: C

Explanatory notes

Option C is correct because uracil is substituted for thymine in RNA while the other three bases are the same as in DNA. Options A and B are incorrect because DNA is double stranded and contains deoxyribose sugar. Option D is incorrect because both molecules contain phosphate.

Question 5

Answer: B

Explanatory notes

Option B is correct because the conformational shape of the enzyme changes when a non-competitive inhibitor binds to an enzyme. Option A is incorrect because ATP binds non-competitively to PFK, which means that it binds to a site other than the active site of the enzyme. Option C is incorrect because the substrate binds to the active site of the enzyme, not the ATP binding site. Option D is incorrect because ATP binds to the enzyme, not to the substrate.

Question 6

Answer: D

Explanatory notes

Option D is correct because DNA polymerase is made up of more than one polypeptide chain and therefore must have a quaternary structure.

Question 7

Answer: B

Explanatory notes

Option B is correct because FADH_2 is a coenzyme involved in the Krebs cycle and electron transport chain stages of cellular respiration. Options A and C are incorrect because NADPH and NADP^+ are coenzymes involved in photosynthesis. Option D is incorrect because O_2 is not a coenzyme.

Question 8

Answer: C

Explanatory notes

Option C is correct because the regulator gene codes for a repressor protein that binds to the operator region of the operon in order to prevent RNA polymerase from transcribing the structural genes. The structural genes are responsible for making the enzymes that digest lactose.

Question 9

Answer: D

Explanatory notes

Option D is correct because it includes all of the outputs from the Calvin cycle. Options A, B and C are incorrect because they give inputs and outputs from one or both of the light-dependent and light-independent stages of photosynthesis.

Question 10**Answer: B****Explanatory notes**

The organelle shown is a mitochondrion and label A is pointing at the cristae of the inner mitochondrial membrane. Option B is correct because the electron transport chain in aerobic cellular respiration occurs within the inner mitochondrial membrane. Option A is incorrect because glycolysis occurs in the cytosol. Option C is incorrect because the Calvin cycle occurs in a chloroplast. Option D is incorrect because the Krebs cycle occurs in the matrix of the mitochondria.

**Tip**

- *Layers of thylakoid membranes (grana) are not shown in this image; therefore, the organelle cannot be a chloroplast. You should be familiar with the features of cell organelles and be able to recognise and associate them with the processes studied in Unit 3.*

Question 11**Answer: D****Explanatory notes**

Option D is correct because pheromones are signalling molecules that are secreted outside the body, often by insects, to signal to other members of the same species to carry out a specific task. Options A, B and C are incorrect because they all refer to signalling molecules that are secreted within the body to bring about internal biochemical responses.

Question 12**Answer: A****Explanatory notes**

Option A is correct because all antibodies have both a constant region and a variable region. Option B is incorrect because antibodies play a role in humoral, not cell-mediated, immunity. Option C is incorrect because antibodies are produced by plasma cells, not T helper cells. Option D is incorrect because the role of antibodies does not involve stimulating apoptosis.

Question 13**Answer: B****Explanatory notes**

Option B is correct because only bacteria have all the listed features. Option A is incorrect because a prion is a protein and does not have the other features. Option C is incorrect because a virus does not have ribosomes or enzymes and may only contain phospholipids if it is enveloped. Option D is incorrect because pollen is not a pathogen.

Question 14

Answer: C

Explanatory notes

Option C is correct because the endosymbiotic theory suggests that bacteria lived symbiotically in ancient cells and eventually became the chloroplasts and mitochondria. The evidence is the presence of DNA and ribosomes in these organelles. Option A is incorrect because viruses do not contain ribosomes and not all viruses contain DNA. Option B is incorrect because the theory only applies to the origin of mitochondria and chloroplasts. Option D is incorrect because the theory applies to the origin of mitochondria and chloroplasts, not to nuclear DNA.

Question 15

Answer: A

Explanatory notes

Option A is correct because the cilia are part of the physical structure of the cells lining the bronchi. Their role is to move microorganisms, and therefore they act as a physical barrier.

Question 16

Answer: A

Explanatory notes

Major histocompatibility complex (MHC) II proteins are only found on antigen-presenting cells, which include B cells, macrophages and dendritic cells. Therefore, only Option A is correct.

Question 17

Answer: D

Explanatory notes

Option A is incorrect because the reaction runs at its slowest at pH 1. Option B is incorrect because the results do not give any indication of what would happen with 20 drops of catalase. Option C is incorrect because it is not a prediction. Option D is correct because the data clearly shows that the reaction runs at its fastest at pH 7.

Question 18**Answer: C****Explanatory notes**

Option C is correct because the student chose to vary the pH, which makes it the independent variable. Options A and B are incorrect because neither of these factors were varied over the course of the experiment. Option D is incorrect because the reaction rate was the dependent variable.

**Tip**

- *You are expected to be able to interpret scientific data and understand terms relating to the methodology of scientific experiments. These terms include independent and dependent variables, qualitative and quantitative data, multiple trials, controlled variables and the control.*

Question 19**Answer: B****Explanatory notes**

Option B is correct because B memory cells are formed after the initial exposure to an antigen and respond rapidly after the secondary exposure to the antigen by differentiating into a very large number of plasma cells that produce much greater numbers of antibodies than in the initial exposure to the antigen. Option A is incorrect because plasma cells do not differentiate to produce B memory cells. Option C is incorrect because cytotoxic T cells, even if they were formed after the initial exposure to an antigen, play no role in forming antibodies or forming plasma cells. Option D is incorrect because B memory cells do not differentiate into T helper cells.

Question 20**Answer: B****Explanatory notes**

Option B is correct because HIV infects and destroys T_H cells. The number of T_H cells is therefore significantly reduced, which leads to reduced humoral and cell-mediated responses to other infections and tumours.

**Tip**

- *It is important that you know the difference between autoimmunity and immune deficiency.*

Question 21*Answer: C***Explanatory notes**

Option C is correct because when the immune system is exposed to the Ebola antigens (surface glycoproteins) on the vesicular stomatitis virus, the adaptive immune response is stimulated to produce antibodies and memory cells against Ebola. Option A is incorrect because people were not injected with the Ebola virus. Option B is incorrect because antibodies were not injected into people. Option D is incorrect because the antigens on the vesicular stomatitis virus will not induce an immune response against the Ebola virus, which has different antigens.

Question 22*Answer: A***Explanatory notes**

Option A is correct because the antibodies can precisely deliver a drug or radiation to a tumour cell and therefore the drug or radiation does not affect many of the healthy cells in the body. Option B is incorrect because monoclonal antibodies can only interact with one kind of antigen on one type of tumour cell. Option C is incorrect because injecting antibodies does not stimulate the humoral immune system to produce more antibodies of the same type. Option D is incorrect because it is more likely that apoptosis will be initiated rather than inhibited in the target cell.

Question 23*Answer: C***Explanatory notes**

Option C is correct because the graph shows the rate of photosynthesis dropping to 0 at 34 °C, which would be a result of the denaturing of the enzymes controlling the photosynthetic reactions. This denaturing involves the breaking of the H bonds holding the amino acid chain in the correct functional shape. Option A is incorrect because the optimum temperature is around 25 °C. Option D is incorrect because the peptide bonds could not be broken at a temperature of 34 °C. Option B is incorrect because oxygen is an output, not an input, of photosynthesis.

Question 24

Answer: D

Explanatory notes

Option D is the correct answer because, although working in a team may be desirable for a range of reasons, it is not necessary for sound experimental design and does not ensure accuracy. Options A, B and C are incorrect responses because these are all important considerations in designing sound scientific experiments.

Question 25

Answer: A

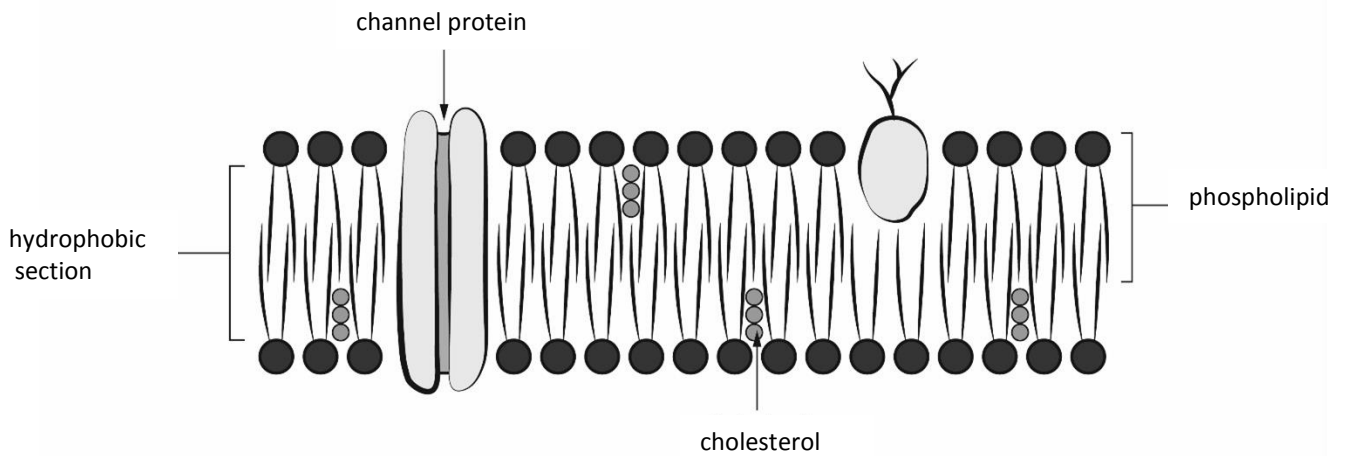
Explanatory notes

Option A is correct because the diagram shows how cytotoxic T cells bring about the death of a foreign cell. Option B is incorrect because antibodies do not induce apoptosis in target cells. Option C is incorrect because the diagram illustrates the extrinsic apoptotic pathway, not the intrinsic apoptotic pathway. Option D is incorrect because the diagram illustrates apoptosis, not necrosis.

SECTION B

Question 1a.i. and 1a.ii.

Worked solution



Mark allocation: 4 marks

- 1 mark for each correct label (up to 4 marks)

Question 1b.

Worked solution

Facilitated diffusion is the passive movement of molecules (or the movement of molecules from a high concentration to a low concentration) across a plasma membrane via the aid of a membrane protein.

Facilitated diffusion is needed to transport polar (or large, or lipid insoluble) molecules that are hydrophilic across an essentially hydrophobic membrane.

Mark allocation: 2 marks

- 1 mark for defining facilitated diffusion
- 1 mark for explaining that facilitated diffusion is needed for moving either polar, large or lipid insoluble molecules, which are usually hydrophilic, across an essentially lipid or hydrophobic membrane

Question 1c.**Worked solution**

The inside of the protein would be hydrophilic because it is in contact with glucose. The outside of the protein would be hydrophobic because it is in contact with the hydrophobic fatty acid chains of the phospholipids.

Mark allocation: 2 marks

- 1 mark for stating that the inside of the protein would be hydrophilic because it is in contact with glucose
- 1 mark for stating that the outside of the protein would be hydrophobic because it is in contact with the hydrophobic fatty acid chains of the phospholipids

**Tip**

- *You may include annotated diagrams in questions such as this one to help clarify your answer.*

Question 1d.**Worked solution**

alpha helices or alpha helix

Mark allocation: 1 mark

- 1 mark for stating alpha helices or alpha helix

Question 1e.**Worked solution**

The SLC2 gene contains the base sequence that leads to the transcription of mRNA and then the translation of the GLUT1 protein.

Mark allocation: 2 marks

- 1 mark for stating that the SLC2 gene contains the base sequence or triplets
- 1 mark for stating that this information leads to the transcription of mRNA and then the translation of the GLUT1 protein

Note: It would also be acceptable to include that this leads to the synthesis or production of the GLUT1 protein.

**Tip**

- *You should use the mark allocation for the question to determine the number of points needed in the answer. A question asking for two marks usually indicates that two points need to be included.*

Question 2a.**Worked solution**

There is more than one codon that codes for most amino acids.

Mark allocation: 1 mark

- 1 mark for stating that there is more than one codon that codes for most amino acids

Question 2b.**Worked solution**

T	A	C	A	A	A	C	G	T	T	T	T	T	G	G	A	G	A
A	U	G	U	U	U	G	C	A	A	A	A	A	C	C	U	C	U

Mark allocation: 1 mark

- 1 mark for the entire correct sequence

Question 2c.**Worked solution**

met phe ala lys

Mark allocation: 1 mark

- 1 mark for stating all four amino acids correctly

**Tip**

- *In questions that involve reading the genetic code of mRNA to determine an amino acid sequence, make sure you read the codon sequence carefully. Placing a line at the end of every three bases can help you read it accurately.*

Question 2d.**Worked solution**

Alpha amylase is an enzyme that binds amylose (the substrate) to its active site to form an enzyme–substrate complex. This lowers the activation energy required to hydrolyse amylose into its maltose sub-units. This causes amylose to break apart into maltose.

Mark allocation: 3 marks

- 1 mark for stating that amylose binds to the active site of alpha amylase
- 1 mark for stating that this lowers the activation energy required to hydrolyse (or break apart) amylose
- 1 mark for stating that the products of the reaction are maltose or maltose sub-units

Question 3a.**Worked solution****Mark allocation: 2 marks**

- 1 mark for stating the correct reactants
- 1 mark for stating the correct products

Question 3b.**Worked solution**

NADH provides an input of hydrogen from glycolysis in the cytosol to the electron transport chain on the cristae of the inner mitochondrial membrane. NADH and FADH₂ both transport hydrogen from the Krebs cycle in the matrix of the mitochondria to the electron transport chain on the cristae of the mitochondria.

Mark allocation: 3 marks

- 1 mark for stating that NADH provides an input of hydrogen from glycolysis in the cytosol to the electron transport chain on the inner mitochondrial membrane
- 2 marks for stating that NADH and FADH₂ both provide an input of hydrogen taken from the Krebs cycle in the matrix of the mitochondria to the electron transport chain on the inner mitochondrial membrane

Note: All requirements of the question must be satisfied for each mark (i.e. the name of the coenzyme, the name and location of the stage, and the destination of the hydrogen).

Question 3c.**Worked solution**

Fermentation involves the conversion of glucose into ethanol, carbon dioxide and net two ATP molecules.

Mark allocation: 2 marks

- 1 mark for stating the reactant, glucose
- 1 mark for stating the products, which should include two ATP molecules

Note: Since the full balanced equation was not asked for, it is not necessary to include ADP and Pi in the reactants; however, the answer is not incorrect if these are included.

Question 4a.**Worked solution**

1. vesicle
2. neurotransmitter
3. receptor
4. calcium ion channel

Mark allocation: 4 marks

- 1 mark for each correct answer (up to 4 marks)

Question 4b.**Worked solution**

Neurotransmitters are hydrophilic because they are shown binding to an extracellular receptor, which indicates that they are unable to diffuse across the plasma membrane, and so are not lipid soluble.

Mark allocation: 2 marks

- 1 mark for identifying that neurotransmitters are hydrophilic because they are shown binding to an extracellular receptor
- 1 mark for stating that neurotransmitters are not lipid soluble

Question 4c.**Worked solution**

reception, transduction and cellular response

Mark allocation: 1 mark

- 1 mark for all three correct stages

Question 4d.**Worked solution**

The neurotransmitters diffuse across the synaptic gap and bind to receptors in the postsynaptic neuron.

This activates secondary messengers in the postsynaptic neuron, which leads to a cascade of reactions, the response of opening sodium ion channels and starting a new action potential.

Mark allocation: 3 marks

- 1 mark for stating that the neurotransmitters diffuse across the gap and bind to receptors in the postsynaptic neuron
- 1 mark for stating that this activates secondary messengers in the postsynaptic neuron
- 1 mark for stating that this leads to a cascade of reactions that causes the response of opening sodium ion channels and starting a new action potential

Question 4e.**Worked solution**

Signal amplification is where a low concentration or small number of signalling molecules can activate many more molecules in the transduction process (or downstream from the initial signal).

Mark allocation: 1 mark

- 1 mark for stating that a low concentration or a small number of signalling molecules can activate many more molecules in the transduction process

Question 5a.**Worked solution**

After arriving in the area, Maria will have been exposed to Paterson's curse pollen, which will have stimulated the production of immunoglobulin E (IgE) antibodies.

These antibodies will have bound to Maria's mast cells.

Upon second or further exposure to the pollen, the pollen will have formed crosslinks between antibodies on the mast cells and caused the release of histamine.

The histamine will have caused the inflammation (red eyes), mucus production and itchiness.

Mark allocation: 4 marks

- 1 mark for stating that Maria will have been exposed to Paterson's curse pollen, which will have stimulated the production of IgE antibodies
- 1 mark for stating that the antibodies will have bound to Maria's mast cells
- 1 mark for stating that upon second or further exposure to the pollen, the pollen will have formed crosslinks between antibodies on the mast cells and caused the release of histamine
- 1 mark for stating that the histamine will have caused the inflammation (red eyes), mucus production and itchiness

Note: You may include labelled diagrams to assist your explanation.

**Tip**

- *In your response, it is important to show that you understand and can explain that the symptoms do not occur after the first exposure to the allergen and that the symptoms occur only after the second or consequent exposure, when the IgE antibodies have been crosslinked by the pollen.*

Question 5b.**Worked solution**

antihistamine or a drug that prevents the release of histamine from the mast cells

Mark allocation: 1 mark

- 1 mark for stating antihistamine or a drug that prevents the release of histamine from the mast cells

Question 6**Worked solution**

Any three of the following:

- agglutinate antigens on the surface of pathogens, thereby clumping and inactivating the pathogens
- bind to toxins and neutralise them
- precipitate soluble antigens
- contribute to opsonisation of bacteria

Mark allocation: 3 marks

- 1 mark for each correct point listed above (up to 3 marks)

Question 7a.**Worked solution**

Independent variable: the concentration of tetracycline

Dependent variable: the size of the zone of inhibition

Mark allocation: 2 marks

- 1 mark for stating that the independent variable is the concentration of tetracycline
- 1 mark for stating that the dependent variable is the size of the zone of inhibition

**Tip**

- *When answering questions relating to your understanding of scientific investigations and methodology, you should make sure you carefully read the background to the question to understand the data presented.*

Question 7b.**Worked solution**

The control is the disc with 0 mg/mL of tetracycline.

Mark allocation: 1 mark

- 1 mark for identifying the disc with 0 mg/mL of tetracycline

Question 7c.**Worked solution**

Any two of the following:

- temperature
- size of the filter discs
- time discs were soaked in tetracycline
- all equipment needing to be sterile

Mark allocation: 2 marks

- 1 mark for each of the points listed above (up to 2 marks)

Question 7d.**Worked solution**

The minimum inhibitory concentration is 0.13 mg/mL of tetracycline.

Any zone of inhibition less than 6 mm is considered ineffective so 0.13 mg/mL is the lowest concentration that gives a zone of inhibition that is closest to (but not below) 6 mm in this experiment.

Mark allocation: 2 marks

- 1 mark for stating the correct minimum inhibitory concentration is 0.13 mg/mL
- 1 mark for fully justifying the figure of 0.13 mg/mL by stating that a zone of inhibition less than 6 mm is considered ineffective and that 0.13 mg/mL is the lowest concentration that gives a zone of inhibition closest to (but not below) 6 mm in this experiment

END OF WORKED SOLUTIONS