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YEAR 12 *Practice Questions*

2020

UNIT 3 BIOLOGY

Reading time: 15 minutes
Writing time: 1 hour 30 minutes

STUDENT NAME:

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	25	25	25
B	7	7	50
			Total 75

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.
- No calculator is allowed in this examination.

Materials supplied
- Question and answer book of 23 pages
- Answer sheet for multiple-choice questions

Instructions
- Write your **name** in the box provided above on this page.
- Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.
- All written responses must be in English.

At the end of the examination
- Place the answer sheet for multiple-choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

SECTION A – Multiple-choice questions

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1; an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Question 1

Two purposes of proteins in a plasma membrane are to

A. create fluidity and to act as channels for the transport of certain molecules.

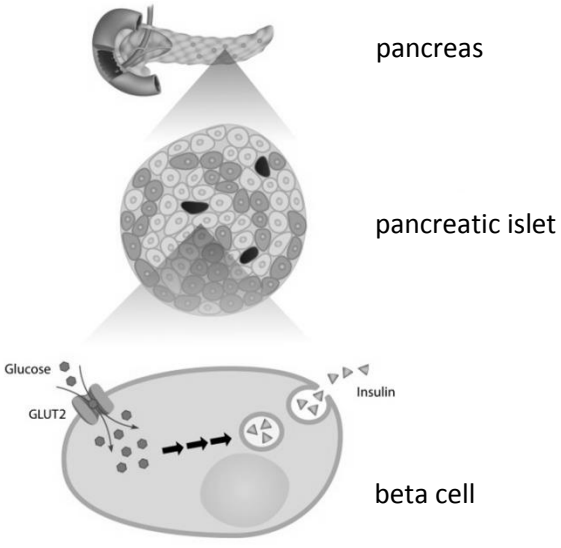
B. give it a mosaic structure and to create fluidity.

C. provide an impermeable barrier between the cytosol and the extracellular fluid and to provide reception for signalling molecules.

D. provide reception for signalling molecules and to facilitate diffusion of certain molecules across the membrane.

Question 2

Insulin is a hormone secreted by the beta cells of the pancreas. Insulin is secreted after being packaged into vesicles that fuse with the cell membrane.



Source: ID 27192401 © Alila07 | Dreamstime.com

This process of insulin secretion is best described as

A. active transport.

B. exocytosis.

C. endocytosis.

D. osmosis.

Question 3

Which one of the following options correctly matches the cell organelle with its function in the export of a protein from a cell?

	Cell organelle	Function
A.	nucleus	controls gene expression of the protein
B.	Golgi apparatus	site of protein synthesis
C.	rough endoplasmic reticulum	site of aerobic cellular respiration
D.	ribosome	modifies and packages the protein

Question 4

One difference between the structure of DNA and RNA is that

A. DNA is single stranded and RNA is double stranded.

B. DNA contains ribose sugar and RNA contains deoxyribose sugar.

C. DNA contains thymine and RNA contains uracil.

D. DNA contains phosphate and RNA does not.

Question 5

The reaction that converts fructose-6-phosphate into fructose-1,6-biphosphate in glycolysis is catalysed by the enzyme phosphofructokinase (PFK). PFK can be non-competitively inhibited by high levels of ATP in the cell.

Which one of the following statements best explains why PFK will be made inactive by ATP?

A. ATP binds to the active site of PFK, preventing the binding of the substrate fructose-6-phosphate.

B. When ATP binds to PFK, it changes the conformational shape of the enzyme, preventing fructose-6-phosphate from binding to the active site.

C. When ATP binds to PFK, it prevents fructose-6-phosphate from binding to the ATP binding site.

D. ATP binds to fructose-6-phosphate, changing its shape and preventing it from binding to the active site of PFK.

Question 6

DNA polymerase from the yeast *Saccharomyces cerevisiae* is composed of four polypeptide chains: Pol2, Dpb2, Dpb3 and Dpb4.

The structure of DNA polymerase is best described as

A. primary.

B. secondary.

C. tertiary.

D. quaternary.

Question 7

Which one of the following is a coenzyme involved in cellular respiration?

A. NADPH

B. $FADH_2$

C. $NADP^+$

D. O_2

Question 8

The *lac* operon is an example of gene regulation in prokaryotes.

The role of the regulator gene is to make

A. the enzymes responsible for the digestion of lactose.

B. RNA polymerase.

C. a repressor protein that binds to the operator.

D. a repressor protein that binds to the structural genes.

Question 9

Which one of the following most accurately represents the outputs from the Calvin cycle?

A. glucose, water and NADPH

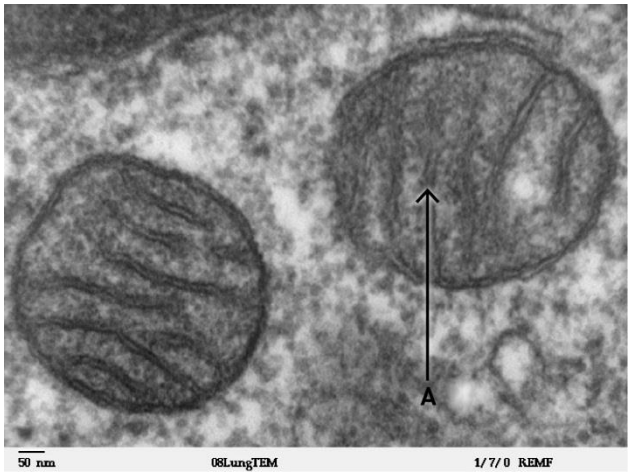
B. carbon dioxide, oxygen and ATP

C. NADPH, ATP and oxygen

D. $NADP^+$, ADP, inorganic phosphate, glucose and water

Question 10

The image below is a transmission electron microscope photograph of an organelle in a mammalian cell.



The biochemical process that occurs on structure A is

A. glycolysis.

B. the electron transport chain.

C. the Calvin cycle.

D. the Krebs cycle.

Question 11

Blind army ants carry out foraging raids to locate food. To help other ants follow their trail, these ants secrete two chemicals: methyl anthranilate and methyl nicotinate. Both chemicals need to be secreted for other army ants to follow the trail.

Methyl anthranilate and methyl nicotinate are examples of

A. cytokines.

B. neurotransmitters.

C. steroid hormones.

D. pheromones.

Question 12

Which one of the following is a correct statement about antibodies?

A. Antibodies are protein molecules composed of a constant region and a variable region.

B. Antibodies play a key role in cell-mediated immunity.

C. Antibodies are produced by T helper cells as signalling molecules.

D. Antibodies stimulate apoptosis in foreign eukaryotic cells.

Question 13

A patient presented at the emergency department of a hospital with signs of an infection. A blood test was completed and an infectious pathogen was identified. Under an electron microscope, and with chemical analysis, the pathogen was noted to have deoxyribose sugar, proteins, phospholipids, ribosomes and enzymes.

The pathogen was likely to be a

A. prion.

B. bacterium.

C. virus.

D. pollen.

Question 14

The endosymbiotic theory states that

A. chloroplasts and mitochondria originated as viruses in ancient cells because of the presence of DNA and ribosomes in the organelles.

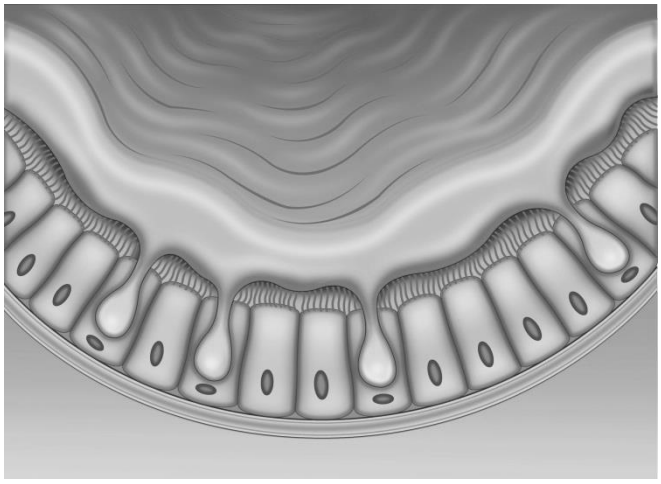
B. all organelles in a eukaryotic cell originated as bacteria that lived symbiotically in ancient cells.

C. mitochondria and ribosomes arose from the bacteria that lived symbiotically in ancient cells because of the presence of DNA and ribosomes in these organelles.

D. the origin of chloroplasts and mitochondria in eukaryotic cells is due to bacteria providing DNA for the nucleus in ancient cells.

Question 15

The diagram below shows ciliated cells lining the bronchial duct. The role of these cells is to help remove microorganisms that enter the bronchi.



The cilia on these cells act as a

A. physical barrier to pathogens.

B. chemical barrier to pathogens.

C. physiological barrier to pathogens.

D. phagocytic barrier to pathogens.

Question 16

A dendritic cell can engulf a pathogen and present some of the foreign antigen on its cell membrane as a complex with major histocompatibility complex (MHC) II proteins.

Other cells that can present foreign antigens with their MHC II proteins in the human immune system are

A. naive B cells and macrophages.

B. naive B cells and T_H cells.

C. T_H cells and T_C cells.

D. macrophages and T_H cells.

Use the following information to answer Questions 17 and 18.

Catalase is an enzyme that converts the toxic chemical hydrogen peroxide into water and oxygen. A student set up an experiment to investigate the effect of pH on catalase activity. The experiment was performed at 30 °C. The results were recorded in a table, which is shown below.

Test tube	Amount of catalase (drops)	Amount of hydrogen peroxide (mL)	pH of solution	Reaction rate
1	10	3	1	None
2	10	3	1	None
3	10	3	1	None
4	10	3	3	Very slow
5	10	3	3	Slow
6	10	3	3	Very slow
7	10	3	7	Very fast
8	10	3	7	Fast
9	10	3	7	Very fast

Source: Commonwealth of Massachusetts.

Question 17

Which one of the following hypotheses is supported by the results?

A. If catalase is added to hydrogen peroxide at pH 3, then the reaction will run at its slowest.

B. If the amount of catalase added was increased to 20 drops, then at pH 7 the reaction rate would be halved.

C. If the reaction rate is slow, then more catalase needs to be added to the hydrogen peroxide.

D. If catalase is added to hydrogen peroxide at pH 7, then the reaction will run at its fastest.

Question 18

The independent variable in this experiment is the

A. amount of catalase.

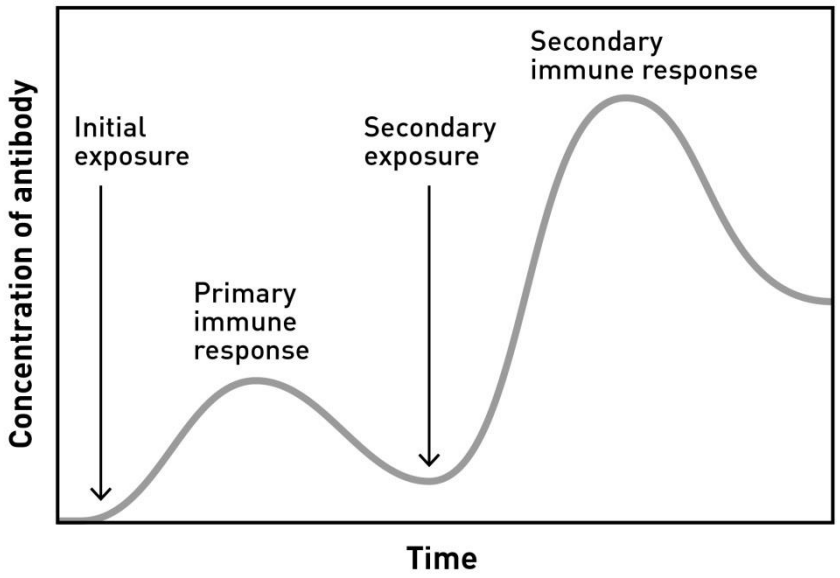
B. amount of hydrogen peroxide.

C. pH of solution.

D. reaction rate.

Question 19

The graph below shows the immune response to antigen exposure over time.



Source: 'Primary and Secondary Antibody Response' by User OpenStax College available at https://commons.wikimedia.org/wiki/File:2223_Primary_and_Secondary_Antibody_Respons_new.jpg under a Creative Commons Attribution-Share Alike 3.0 license. Full terms at https://creativecommons.org/licenses/by-sa/3.0/deed.en

The secondary immune response is faster and greater than the primary immune response because

A. plasma cells rapidly differentiate to produce B memory cells upon exposure to the antigen a second time.

B. B memory cells rapidly differentiate into plasma cells upon the secondary exposure to the antigen.

C. when exposed to the antigen a second time, cytotoxic T cells rapidly differentiate into plasma cells, which release enormous numbers of antibodies.

D. upon the secondary exposure to the antigen, B memory cells rapidly differentiate into T helper cells which triggers the production of enormous numbers of plasma cells.

Question 20

The human immunodeficiency virus (HIV) leads to an immunodeficient disease called acquired immunodeficiency syndrome (AIDS).

AIDS is an immunodeficient condition because

A. the immune system's production of autoantibodies leads to the destruction of T_H cells.

B. the destruction of T_H cells by HIV leads to an inability by the adaptive immune system to combat other infections or tumours.

C. the destruction of B cells by HIV leads to an inability to produce enough antibodies to destroy other infections and tumours.

D. antibodies attack HIV, which in turn reduces the ability to develop immunological memory against future HIV infection.

Question 21

A very effective vaccine has been developed against Ebola, one of the deadliest viruses in the world. Scientists created a genetically modified vesicular stomatitis virus that is incapable of reproducing in human cells. This recombinant DNA virus was genetically modified to express a surface glycoprotein of Zaire Ebola virus known as VSV-EBOV. A study of this vaccine has shown it to be 95–100% effective against the Ebola virus.

The reason for the effectiveness of the VSV-EBOV vaccine is that

A. the human immune system has been actively exposed to the Ebola virus and this leads to a very effective antibody response in the body.

B. very large numbers Ebola antibodies were injected into people exposed to the disease.

C. the human immune system has been exposed to the specific Zaire Ebola virus antigen and this leads to the production of antibodies and memory cells against the Ebola virus.

D. the human immune system has been exposed to antigens of the vesicular stomatitis virus and this enables immunity against the Zaire Ebola virus.

Question 22

Monoclonal antibodies are produced outside the human body and are specific to a single antigen (e.g. a tumour cell antigen). It is possible to attach a drug molecule or a radioactive molecule to the monoclonal antibody and then deliver it to the tumour cell due to the specificity of the antibody's variable regions for the tumour cell antigens.

One advantage of using monoclonal antibodies over traditional chemotherapy or radiotherapy is that

A. the localised effect of the drug or radiation limits damage to healthy cells in the body and the patient will not suffer as many side effects of treatment.

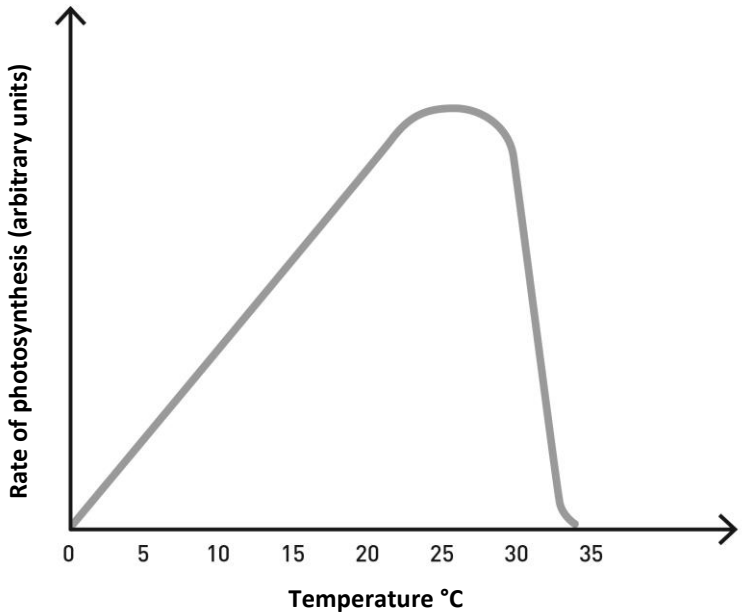
B. a single injection of monoclonal antibodies can target different kinds of tumour cells at the same time, thereby making the treatment much more effective.

C. the monoclonal antibodies will stimulate further production of antibodies against the tumour cells in the person.

D. the monoclonal antibodies will inhibit apoptosis, thereby allowing phagocytes to more effectively destroy the tumour cells.

Use the following information to answer Questions 23 and 24.

A student wished to investigate the effect of temperature on the rate of photosynthesis in *Chlorella*. *Chlorella* are a group of single-celled green algae that are non-motile. They contain the photosynthetic pigments chlorophyll a and chlorophyll b. The results of the student's experiment are shown in the graph below.



Question 23

It can be reasonably concluded from this data that

A. the optimum temperature for photosynthesis in *Chlorella* is 20 °C.

B. there is a steady uptake of oxygen for the light-dependent reaction from 0 °C to 20 °C.

C. the enzymes involved in the light-dependent and light-independent stages of photosynthesis have been denatured at 34 °C.

D. the peptide bonds making up the polypeptide chain of the enzymes in the Calvin cycle have been hydrolysed at 34 °C.

Question 24

In designing the experimental method for the investigation, which one of the following is **not** a necessary consideration for the student?

A. incorporating multiple trials of the experiment to ensure reliability of results

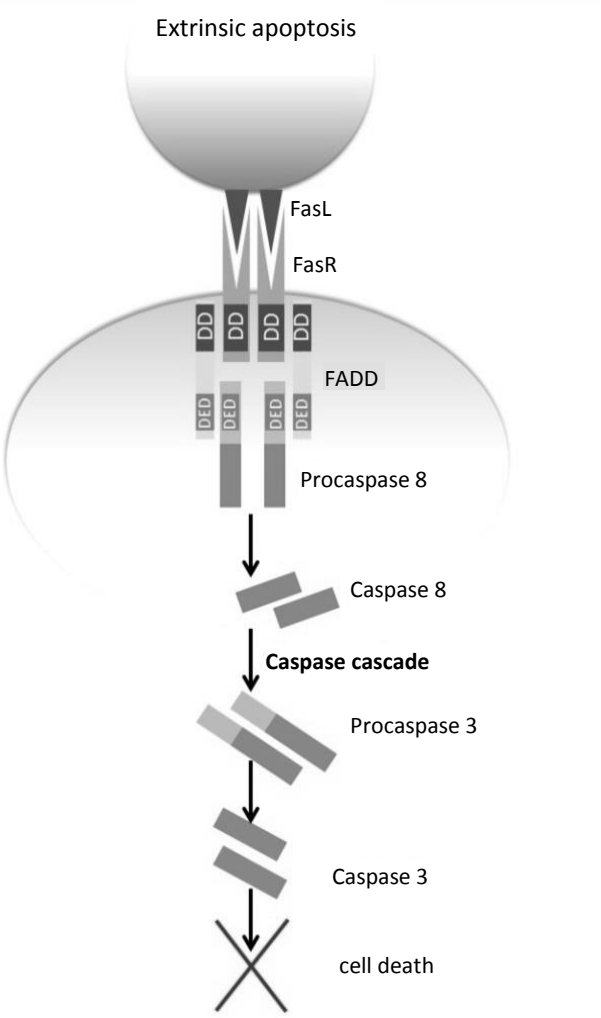
B. incorporating a control to ensure that temperature is affecting the rate of photosynthesis

C. ensuring that systematic errors are held to a minimum to ensure reliability of results

D. working in a team to achieve accurate results

Question 25

The diagram below illustrates one of the pathways that brings about apoptosis in a cell.



Source: 'Extrinsic apoptosis' by User B1357M available at https://commons.wikimedia.org/wiki/File:Extrinsic_apoptosis.jpg under a Creative Commons Attribution-Share Alike 3.0 license. Full terms at https://creativecommons.org/licenses/by-sa/3.0/deed.en

Which one of the following statements best relates to this diagram?

A. Cytotoxic T cells produce death-signalling ligands that are transduced into a signal cascade that leads to the death of the cell.

B. Plasma cells produce antibodies that bind to this target cell, which causes activation of caspases leading to the death of the cell.

C. An internal signal causes the mitochondria of this cell to release cytochrome c, which activates caspases leading to the death of the cell.

D. Cell death in the target cell is brought about by necrosis induced by the death-signalling ligand.

END OF SECTION A

CONTINUES OVER PAGE

SECTION B

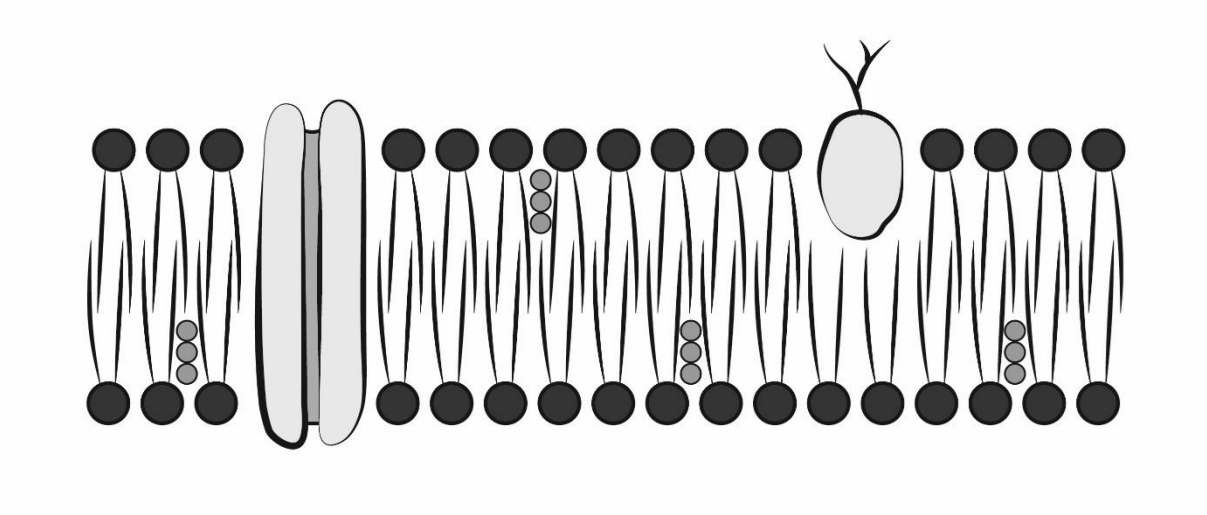
Instructions for Section B

Answer **all** questions in the spaces provided. Write using blue or black pen.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Question 1 (11 marks)

The diagram below is a simplified representation of a plasma membrane.



a. **i.** Clearly label the following on the diagram above: channel protein, phospholipid and cholesterol.

3 marks

ii. Clearly label the hydrophobic section of the membrane on the diagram above.

1 mark

GLUT1 is a common carrier protein in plasma membranes. GLUT1 facilitates the transport of glucose across the plasma membranes of red blood cells around 50 000 times faster than uncatalysed transmembrane diffusion. GLUT1 has a protein structure with both hydrophobic and hydrophilic sections.

b. Define the term 'facilitated diffusion' and explain the need for this type of transport across plasma membranes.

2 marks

_____

_____

_____

_____

_____

c. Glucose is a polar molecule.

Explain where in the GLUT1 protein you might expect to find the hydrophilic and hydrophobic parts of the molecule.

2 marks

The diagram below represents the protein structure of GLUT1.

d. Identify the secondary structure that makes up most of this protein.

1 mark

e. The GLUT1 transporter protein is encoded by the SLC2 gene.

Explain what this means.

2 marks

Question 2 (6 marks)

The table below summarises the genetic code.

Second letter

First letter	U	C	A	G	Third letter
U	UUU phe UUC phe UUA leu UUG leu	UCU ser UCC ser UCA ser UCG ser	UAU tyr UAC tyr UAA STOP UAG STOP	UGU cys UGC cys UGA STOP UGG trp	**U** **C** **A** **G**
C	CUU leu CUC leu CUA leu CUG leu	CCU pro CCC pro CCA pro CCG pro	CAU his CAC his CAA gln CAG gln	CGU arg CGC arg CGA arg CGG arg	**U** **C** **A** **G**
A	AUU ile AUC ile AUA ile AUG met	ACU thr ACC thr ACA thr ACG thr	AAU asn AAC asn AAA lys AAG lys	AGU ser AGC ser AGA arg AGG arg	**U** **C** **A** **G**
G	GUU val GUC val GUA val GUG val	GCU ala GCC ala GCA ala GCG ala	GAU asp GAC asp GAA glu GAG glu	GGU gly GGC gly GGA gly GGG gly	**U** **C** **A** **G**

a. What is meant by saying the genetic code is degenerate?

1 mark

_____

_____

b. The table below contains part of the DNA template strand base sequence that codes for the enzyme amylase in the bacterium *Bacillus subtilis*.

Write the mRNA sequence that would be transcribed from this base sequence in the boxes provided.

1 mark

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

c. Use the table to determine the first four amino acids coded for by this sequence.

1 mark

_____

d. Alpha amylase digests amylose (a form of starch) into maltose subunits.

Explain how alpha amylase performs this function.

3 marks

_____

_____

_____

_____

Question 3 (7 marks)

a. Write the full balanced summary equation for aerobic cellular respiration.

2 marks

_____

_____

b. Describe the role played by the coenzymes involved in transporting hydrogen between the different stages of aerobic cellular respiration. In your response, identify the coenzymes, name the stages and state the locations of the different stages in the cell.

3 marks

_____

_____

_____

_____

_____

_____

c. Yeast cells are capable of anaerobic fermentation.

Outline this process, including the energy output.

2 marks

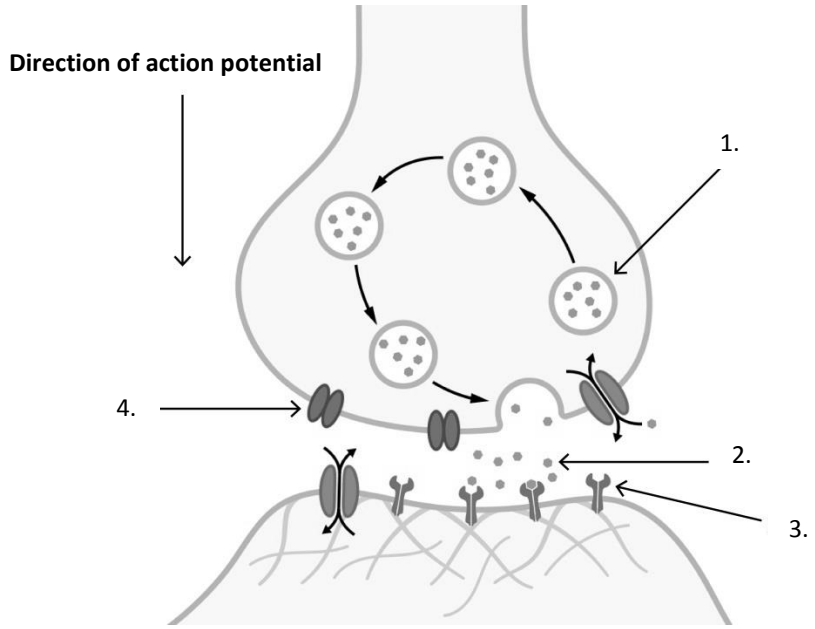
_____

_____

_____

Question 4 (11 marks)

The diagram below is an illustration of a nerve synapse.



Source: 'SynapseSchematic lines' by User Thomas Splettstoesser available at
Source: '4pyp_glut1' by User A2-33 available at
https://commons.wikimedia.org/wiki/File:SynapseSchematic_lines.svg under a
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a. Name each of the structures or molecules in the diagram above.

4 marks

1. _____

2. _____

3. _____

4. _____

b. Using the information in the diagram, identify whether neurotransmitters are hydrophobic or hydrophilic signalling molecules. Justify your response.

2 marks

_____

_____

_____

_____

c. Name the three stages of signal transduction.

1 mark

_____

d. Using your understanding of signal transduction, outline the series of events that occur after the secretion of neurotransmitters and describe the response that occurs in the postsynaptic neuron.

3 marks

_____

_____

_____

_____

_____

_____

e. What is meant by signal amplification in relation to cellular signalling?

1 mark

_____

_____

Question 5 (5 marks)

Maria recently moved to a town in rural Victoria and almost immediately began to experience symptoms that included red eyes, runny nose, sneezing and itchy eyes, ears and throat. A very common plant called Paterson's curse grows in this area. Maria's doctor suggested that she may be suffering from allergic rhinitis caused by the highly allergenic pollen of Paterson's curse.

a. Explain the sequence of events involved in the allergic response, from Maria's initial exposure to the pollen to the symptoms she is experiencing.

4 marks

_____

_____

_____

_____

_____

_____

b. Suggest a type of medication that the doctor could prescribe for Maria.

1 mark

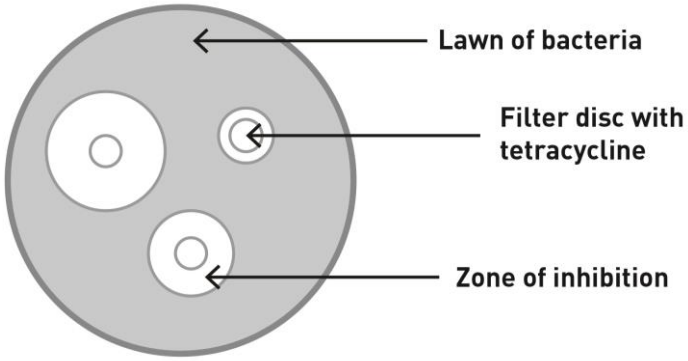
_____

Question 6 (3 marks)

Outline three functions of antibodies in the human immune system.

Question 7 (7 marks)

Five groups of students wished to investigate the effectiveness of the antibiotic tetracycline on a species of bacteria. Each group was provided with five different concentrations of tetracycline on small filter discs, and each group placed their discs onto a lawn of bacteria in a Petri dish. After incubating the bacteria at 33 °C for 24 hours, the students measured the distance from the edge of each disc to the edge of the zone of inhibition, which is the area around the tetracycline discs where bacteria have not grown. The greater the zone of inhibition, the more effective the tetracycline was at killing the bacteria. Anything less than 6 mm was considered an ineffective concentration.



The results of the experiment are in the table below.

Group	**Tetracycline concentration (mg/mL)**						
	0.5	**0.25**	**0.13**	**0.06**	**0.03**	**0**	
1	14	9	7	4	2	0	**Zone of inhibition (mm)**
2	15	9	6	3	2	0	
3	15	10	8	4	3	0	
4	13	9	9	5	2	0	
5	11	8	8	4	3	0	
Average	**13.6**	**9.0**	**7.6**	**4.0**	**2.4**	**0.0**	

a. State the independent and the dependent variable in this experiment.

2 marks

Independent variable _____

Dependent variable _____

b. Identify the control in this experiment.

1 mark

_____

c. List **two** other variables that would need to be controlled to ensure the experiment produced valid results.

2 marks

1. _____

2. _____

d. Scientists who study the effect of antibiotics on bacteria refer to the minimum inhibitory concentration of an antibiotic. This is a measure of the lowest concentration of antibiotic that is effective at killing the bacteria.

Using the information provided in the question and the table, what is the minimum inhibitory concentration of tetracycline in this experiment? Justify your response.

2 marks

_____

_____

_____

_____

END OF QUESTION AND ANSWER BOOK