

**2007**

**BIOLOGY**

**Written examination 1**

**STUDENT NAME:**

**QUESTION AND ANSWER BOOK**

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

**Structure of book**

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
A	25	25	25
B	8	8	50
			Total 75

- Students are permitted to bring the following items into the examination: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring sheets of paper or white out liquid/tape into the examination.
- Calculators are not permitted in this examination.

**Materials provided**

- The question and answer book of 21 pages.
- An answer sheet for multiple-choice questions.

**Instructions**

- Write your **name** in the box provided.
- You must answer the questions 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 or any other electronic devices into the examination.**

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**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** for 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.

**Question 1**

Fats, oils and waxes are macromolecules also known as lipids. They are known for their lack of affinity with water. Triglycerides are a form of fat and are

- A. the only lipids which form a solid at room temperature.
- B. always composed of carbon, hydrogen, oxygen and nitrogen.
- C. made of a single fatty acid molecule to which three glycerides are attached.
- D. made of a single glycerol molecule to which three fatty acids are attached.

**Question 2**

The formula that represents a polysaccharide is compound

- A.  $C_{312}H_{520}O_{260}$
- B.  $C_{736}H_{1161}N_{184}O_{208}S_3$
- C.  $C_6H_{12}O_6$
- D.  $C_{51}H_{98}O_6$

**Question 3**

Myoglobin is an oxygen-binding protein found in the muscle tissue of vertebrates. Myoglobin does not have a quaternary structure because it

- A. exhibits no  $\beta$ -pleated sheets.
- B. only contains 153 amino acids in its chain.
- C. is a single-chain globular protein.
- D. demonstrates no peptide bonds in its structure.

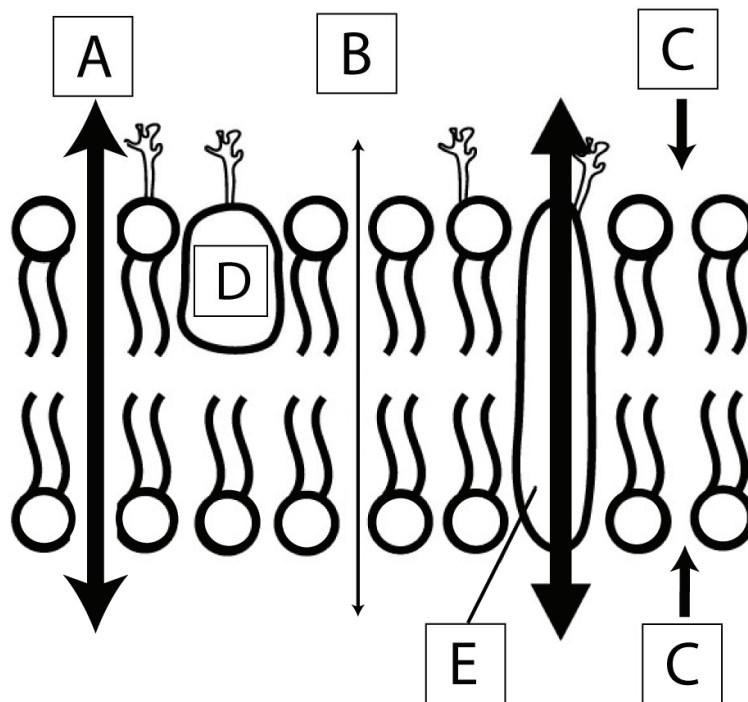
**Question 4**

Apoptosis and necrosis are both processes that result in cell death. Necrosis occurs as a result of significant chemical or mechanical damage to the plasma membrane of a cell. Apoptosis

- A. only occurs in cells of damaged tissue.
- B. occurs in response to signals via the mitochondrial pathway.
- C. occurs in response to signals via the ribosomal pathway.
- D. only occurs in embryos.

The following information is required for Questions 5 to 7.

Cells are capable of exchanging many substances across the plasma membrane. The plasma membrane can selectively control the movement of molecules entering and leaving the cell.



### Question 5

The movement of substances across the plasma membrane, represented by arrows **A**, **B** and **C**, is best described as

- A. bulk transport.
- B. endocytosis.
- C. exocytosis.
- D. diffusion.

### Question 6

Crossing the plasma membrane occurs via many processes including passive and active transport. Arrows represent the pathways of lipid-soluble molecules (**A**), small uncharged molecules (**B**) and most water-soluble molecules (**C**) across a plasma membrane. The substances crossing the plasma membrane at **A**, **B** and **C** are most likely to be

- A. proteins (**A**), sugars (**B**), chloroform (**C**).
- B. alcohol (**A**), urea (**B**) and proteins (**C**).
- C. ions (**A**), water (**B**) and carbon dioxide (**C**).
- D. sugars (**A**), alcohol (**B**) and amino acids (**C**).

**Question 7**

The plasma membrane is comprised of many structures, all of which contribute to its functioning. In order, the structures labelled **D** and **E** represent

- A. cholesterol and protein channel.
- B. phospholipid and glycoprotein.
- C. protein channel and cholesterol.
- D. glycoprotein and protein channel.

**Question 8**

Proteomics is the name given to the study of the proteome of an organism. A proteome is best described as all the

- A. proteins produced by a single cell or organism in a particular environment.
- B. genes produced by a single cell or organism in a particular environment.
- C. polysaccharides produced by a single cell or organism in a particular environment.
- D. glycoproteins produced by a single cell or organism in a particular environment.

**Question 9**

Scientists have moved away from studying components of the proteome in isolation because

- A. there are too many components and research funding is not readily available.
- B. proteomes are too complex in structure to study in isolation.
- C. proteomes do not act in isolation from each other.
- D. there are only a few components and it is more efficient to group them together.

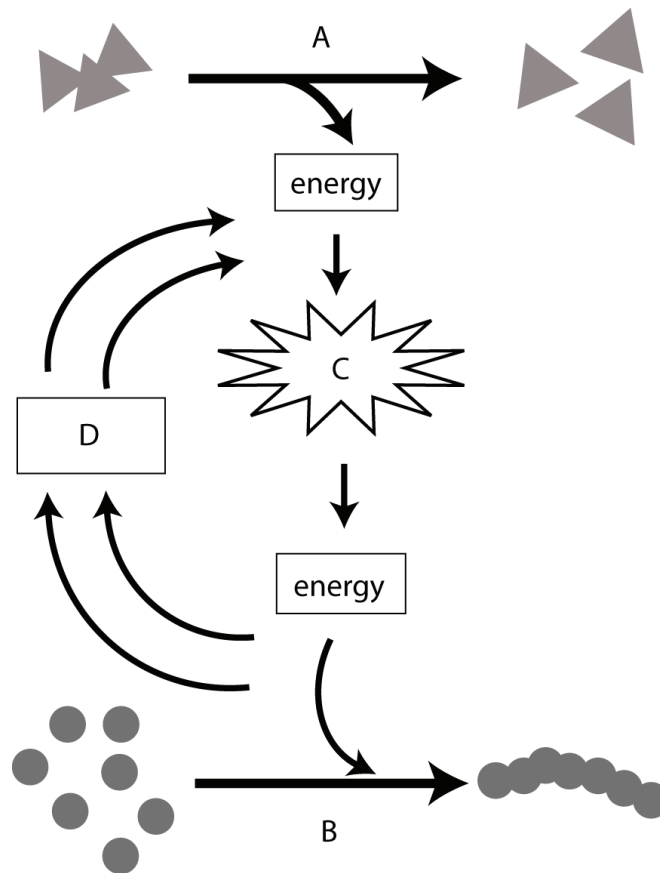
**Question 10**

In order to function, living cells link amino acids to make proteins. The organelles directly responsible for the assembly of proteins include

- A. ribosomes, chloroplasts and Golgi apparatus.
- B. ribosomes, chloroplasts and lysosomes.
- C. ribosomes, mitochondria and chloroplasts.
- D. ribosomes, mitochondria and the nucleus.

The following information is required for Questions 11 and 12.

Thousands of metabolic reactions occur simultaneously within living cells. Some of these reactions release energy while others require energy to proceed.



### Question 11

In the diagram, **A** could be an example of

- A. photosynthesis.
- B. cellular respiration.
- C. reduction.
- D. anabolism.

### Question 12

In the diagram, **C** and **D** respectively are examples of

- A. ATP and  $ADP + P_i$
- B. ATP and  $ADP_i$
- C.  $ADP_i + P$  and ATP
- D.  $ADP_i$  and ATP

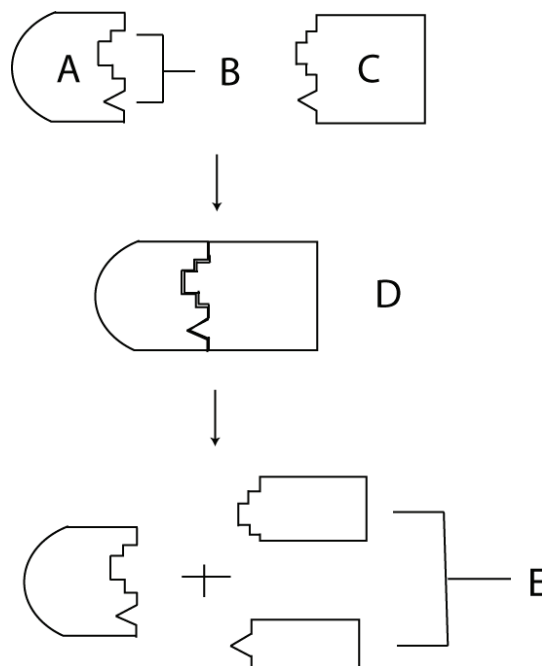
**Question 13**

Enzymes are biological catalysts which are highly specific in their action and reduce the amount of energy required to enable metabolism in living organisms. Which of the following statements is **not** correct?

- A. There are two theories of enzyme action: 'lock-and-key' and 'induced-fit'.
- B. Enzyme activity is affected by pH, temperature and concentration of enzyme and substrate.
- C. Enzymes are made exclusively of protein.
- D. Enzyme inhibition can occur if a compound binds competitively with the active site of enzymes.

**Question 14**

Compound **A** is a protein.



The correct names of the parts **B**, **C**, **D** and **E** in order are

- A. substrate, active site, enzyme-substrate complex, products.
- B. active site, substrate, products, enzyme-substrate complex.
- C. active site, enzyme-substrate complex, substrate, products.
- D. active site, substrate, enzyme-substrate complex, products.

**Question 15**

Photosynthesis is a metabolic process in which autotrophic organisms harness radiant energy to produce organic compounds from inorganic substances. The process occurs in two stages. Photosynthetic pigments, which include chlorophylls, carotenoids and phycobilins, are integral to the process of harnessing radiant energy. Radiant energy is converted to chemical energy. Trapping of radiant energy is known as the \_\_\_\_\_ - \_\_\_\_\_ and occurs within the \_\_\_\_\_ of the \_\_\_\_\_ on the \_\_\_\_\_.

- A. light-dependent reaction, chloroplasts, thylakoid membranes, grana.
- B. light-dependent reaction, grana, chloroplasts, thylakoid membranes.
- C. light-independent reaction, thylakoid membranes, grana, chloroplasts.
- D. light-independent reaction, grana, chloroplasts, thylakoid membranes.

**Question 16**

The second stage of photosynthesis is reliant on some of the outputs from the conversion of radiant energy to chemical energy. These outputs are

- A. NADPH and ATP.
- B. NADPH, ATP and CO<sub>2</sub>.
- C. NADP<sup>+</sup>, ATP and CO<sub>2</sub>.
- D. NADP<sup>+</sup> and ADP + P<sub>i</sub>.

**Question 17**

Homeostatic mechanisms regulate the internal environment of birds and mammals and can be described as stimulus-response mechanisms. In a stimulus-response model, a change (stimulus) in the external and internal environment is detected by receptors and a response is produced by effectors. There are two types of stimulus-response model: the negative feedback and the positive feedback systems. Which of the following is **not** true about negative feedback systems?

- A. Negative feedback mechanisms act to restore the original homeostatic state of an organism.
- B. Negative feedback mechanisms act to increase the effect of the original disturbance.
- C. Most negative feedback systems operate as proportional control systems.
- D. Some negative feedback systems operate as on-off control systems.



**Question 18**

Endocrine glands are ductless glands that produce hormones and release them directly into the bloodstream. Sometimes in mammals, endocrine glands may not function appropriately, resulting ultimately in detrimental effects. Which of the following accurately represents an endocrine defect with its likely effect?

	<b>DEFECT</b>	<b>EFFECT</b>
<b>A.</b>	overactive pituitary	decrease in metabolic rate
<b>B.</b>	underactive thyroid	overproduction of thyroxine
<b>C.</b>	overactive adrenal gland	prolonged fight-or-flight response
<b>D.</b>	overactive parathyroid gland	decrease in blood calcium levels

*The following information is required for Questions 19 to 21.*

Cells can communicate with each other through signalling molecules, which are chemicals that can act on nearby cells, travel to another location within the body or even interact with cells in another organism.

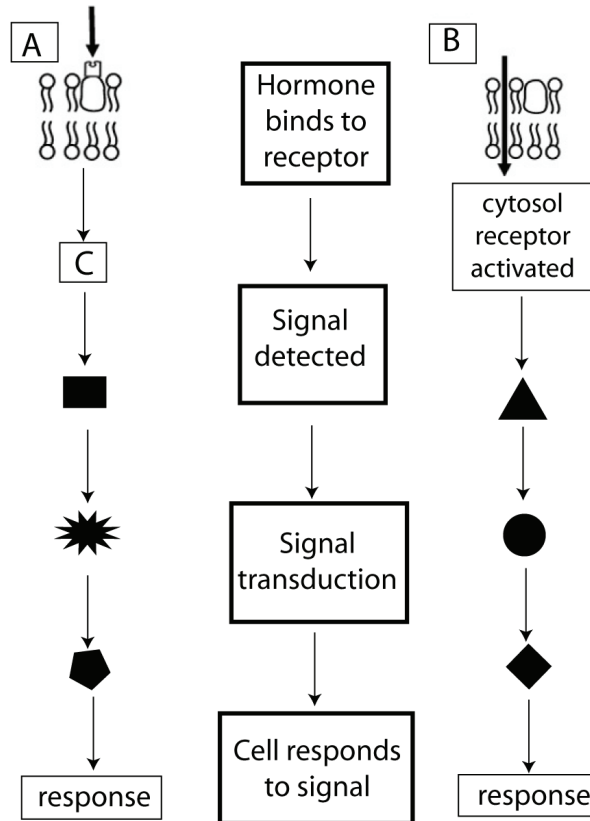
**Question 19**

Hormones are signalling molecules and, based on their chemical structures, are classified into three groups. Which of the following is correct about the synthesis and life span of the three groups of hormones?

	<b>AMINO ACID DERIVATIVES</b>	<b>STEROID HORMONES</b>	<b>PEPTIDE HORMONES</b>
<b>A.</b>	synthesised in advance, short life span	synthesised on demand, long life span	synthesised in advance, short life span
<b>B.</b>	synthesised on demand, long life span	synthesised in advance, short life span	synthesised on demand, long life span
<b>C.</b>	synthesised in advance, short life span	synthesised in advance, short life span	synthesised on demand, long life span
<b>D.</b>	synthesised on demand, long life span	synthesised on demand, long life span	synthesised on demand, long life span

**Question 20**

The chemical nature of hormones influences the manner in which they transmit signals to the inside of a cell. The diagram indicates the sequence of events that occurs in signalling pathways, depending on the chemical nature of the hormone. The pathway at **A** is taken by water-soluble hormones and the pathway at **B** is taken by lipid-soluble hormones.



Pathway **B** would be taken by

- A. amino acid derived hormones.
- B. protein hormones.
- C. steroid hormones.
- D. peptide hormones.

**Question 21**

Water-soluble hormones bind with receptors found on cell membranes. This activates a cascade of chemical reactions, also known as signal transduction, which is sustained by water-soluble molecules. At **C**, signal transduction could be initiated by a

- A. relay molecule.
- B. G protein.
- C. transduction molecule.
- D. primary messenger.

**Question 22**

An axon is an extension of a nerve cell along which nerve impulses are transmitted. Axons can range from a few millimetres to over a metre in length and can be linear or branching. The presence of a myelin sheath provides insulation which increases the rate at which an impulse is conducted along the axon. When a nerve impulse reaches an axon terminal, the next event is

- A. transmitter substance binds to a receptor molecule on the muscle cell membrane.
- B. transmitter substance is inactivated by an enzyme.
- C. transmitter substance is secreted from a neuron.
- D. the muscle cell contracts.

**Question 23**

Neuron transmission can be interrupted by adverse events. Substances such as venom contain toxins that can act on the nervous system to affect the neuromuscular synapses or to block the transmission of an impulse along an axon. Compounds known as antivenoms can be used to rapidly reverse the effects of venom. Antivenoms contain

- A. antigens which bind with antibodies in the venom to form an antigen–antibody complex.
- B. antibodies which bind with antigens in the venom to form an antigen–antibody complex.
- C. toxoids which are capable of destroying the active site of the venom.
- D. plasma cells which are capable of producing antibodies to act against the venom.

**Question 24**

A group of proteins that are important in immunity are interferons. Interferons are released by some cells when the cells have been infected with virus particles. Interferons act on uninfected cells by making them more resistant to the infecting virus. Other important proteins associated with non-specific immunity include

- A. complement proteins and cytokines.
- B. complement proteins and MHC markers.
- C. cytokines and antibodies.
- D. cytokines and immunoglobulins.

**Question 25**

A woman is exposed to chicken pox (*Varicella zoster virus*) in her second month of pregnancy. She has never been exposed to chicken pox or immunised against it. She consults her health practitioner who recommends treatment with varicella-zoster immunoglobulin (VZIG), a substance that triggers an immune response against the virus. This method of treatment will provide the woman with

- A. natural passive immunity.
- B. natural active immunity.
- C. induced passive immunity.
- D. induced active immunity.

**END OF SECTION A  
TURN OVER**

**SECTION B – Short-answer questions****Instructions for Section B**

Answer this section in **pen**.

Answer **all** questions in the spaces provided.

**Question 1**

The molecules that living organisms are composed of can be grouped into five principle classes. Interactions occur between these molecules constantly and ultimately their shapes determine their function. The functions of some of these molecules are outlined in the table below.

- a. Complete the table by identifying each of the biological molecules described.

<b>Biological Function</b>	<b>Biological Molecule</b>
solvent, support, turgor, site for metabolic reactions	
insulation, source of energy, structural	
provide information about construction and function	
structural, energy storage, cellular recognition	

2 marks

- b. What is one form of bonding that holds the tertiary structure together?

\_\_\_\_\_

1 mark

Proteins are produced in their simplest form at the ribosomes. They can, however, have other biological molecules added to them and they become modified to form conjugated proteins. An example of a conjugated protein is a glycoprotein.

- c i. What is a glycoprotein?

\_\_\_\_\_

- ii. Describe **one** role of a glycoprotein.

\_\_\_\_\_

1 + 1 = 2 marks

If its three-dimensional structure changes, the biological function of the protein is almost always permanently lost.

- d i. What is the name given to this process?

\_\_\_\_\_

- ii. Identify **one** agent that can cause the loss of three-dimensional structure in a protein.

\_\_\_\_\_

1 + 1 = 2 marks

Total 7 marks

**SECTION B – continued**

**Question 2**

Cardiovascular disease (CVD) is a complex disease state which the World Health Organisation cites as the principle cause of death in humans worldwide. CVD is caused by atherosclerosis in which fatty deposits build up along the endothelial lining of blood vessels resulting in formation of blood clots. CVD can occur in the form of heart attack, stroke and heart failure, and is related to factors such as lifestyle, diet, genetics, age and high blood pressure. During a heart attack or a stroke, blood flow to surrounding tissue is blocked; however, the cells which make up the tissue continue to metabolise for some time.

- a. Explain how cellular function can continue during a heart attack or stroke.

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1 mark

If blood flow to the affected area is restored, reactive oxygen species (radicals) form. The presence of these free radicals can cause serious damage to essential cellular components because they can form preferential bonds with nucleic acids, lipids and proteins. Knowledge of this aspect of the molecular mechanism associated with CVD means that it is possible to develop a drug to treat it.

- b i. What is the name given to this process of drug development?

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- ii. What is a disadvantage associated with this process?

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1 + 1 = 2 marks

- c. Using the information provided above, explain on a molecular basis, how foods rich in flavonoids might contribute to the low incidence of CVD?

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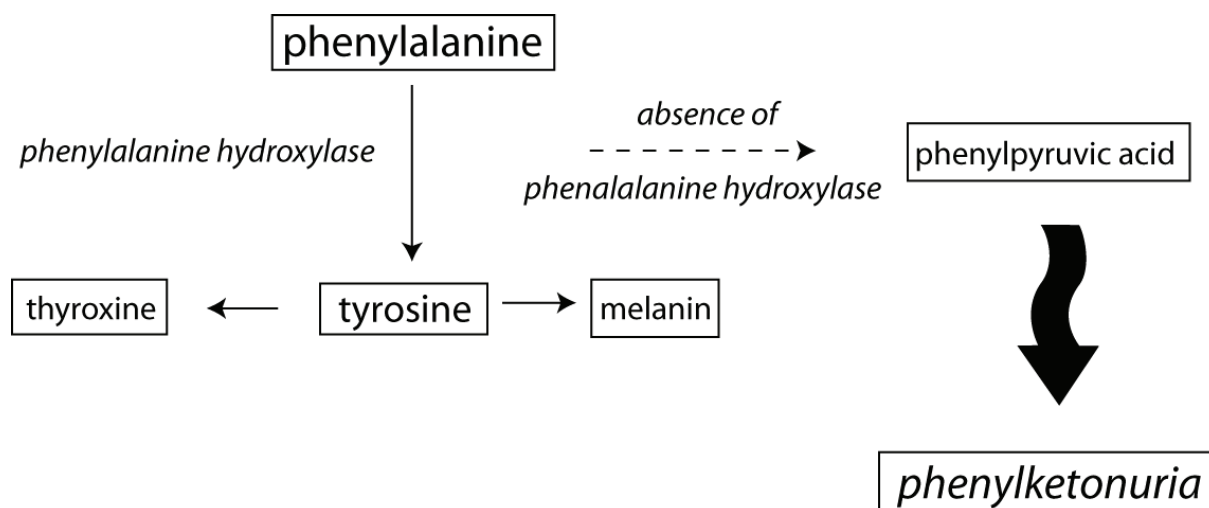
1 mark

Total 4 marks

**SECTION B – continued**  
**TURN OVER**

### Question 3

Metabolic pathways form a complex network in the regulation of homeostasis in an organism. Metabolic disorders arise when there are errors in the normal pathway. Phenylketonuria (PKU) is a condition that occurs when the amino acid phenylalanine (phe) is not converted to tyrosine and affects one in every 10,000 babies. Instead, the unconverted phenylalanine becomes metabolised to another compound known as phenylpyruvic acid. The accumulation of phenylpyruvic acid causes various symptoms including mouse-like body odour, light skin colour, pronounced muscle tension and activity and eczema. A partial description of the metabolism of phenylalanine is presented in the following diagram.



- a i. In which group of biomacromolecules is phenylalanine found?

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- ii. Phenylalanine hydroxylase is a specific biological compound. What is the name given to this compound?

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1 + 1 = 2 marks

After birth, the accumulation of phenylpyruvic acid in the body, particularly in brain tissue, can cause severe damage in a developing child.

- b. Why does this disorder only develop in infants after birth?

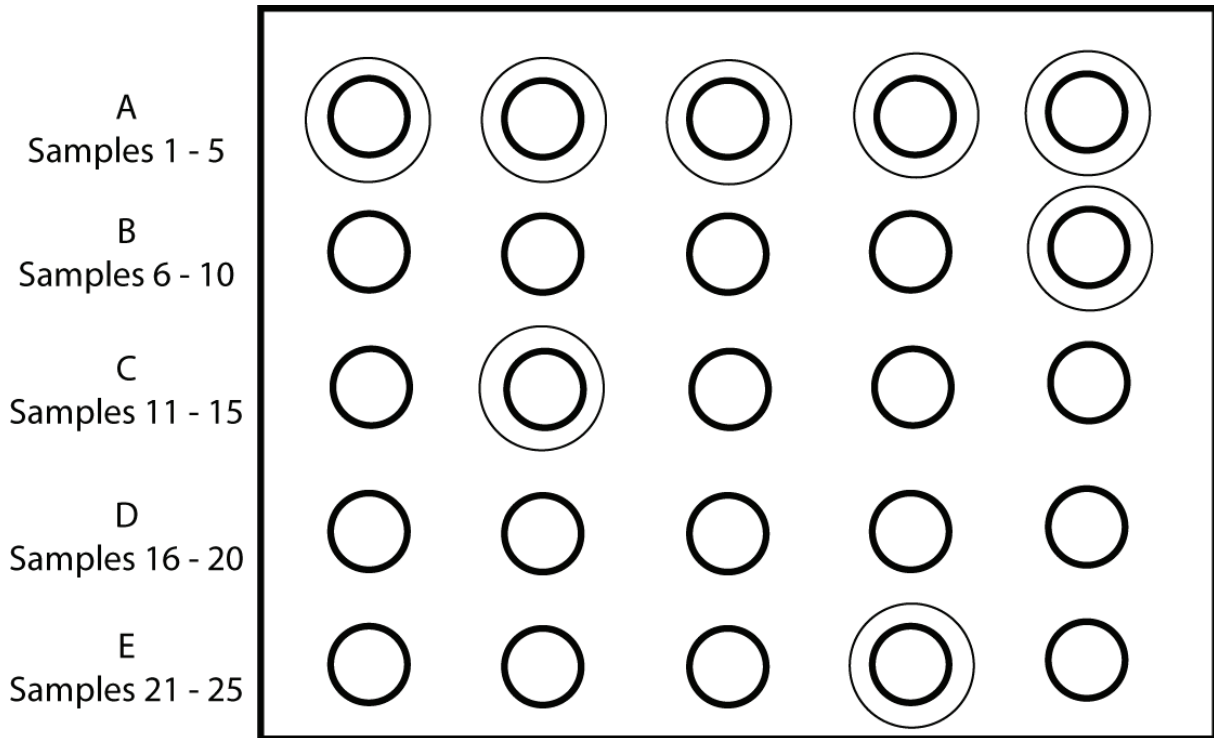
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2 marks

To determine whether a newborn has PKU, a heel prick blood test is performed shortly after birth and the levels of phenylalanine in the blood are determined. A technique that was previously used to diagnose the condition involved the use of Guthrie plates on which discs containing blood samples were tested for high levels of phenylalanine. The plates were coated with agar which contained a strain of bacteria that would only grow in the presence of phenylalanine. Growth occurred in a ring around the disc which was placed on the agar. The diagram shows the results of a series of tests.



The discs in Row A all show a distinct band of growth around them.

- c i. Explain the likely purpose of the discs in Row A and indicate what is known about them.

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- ii. What conclusion can be drawn about Samples 10, 12 and 24?

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2 + 1 = 3 marks

Once a diagnosis of PKU is made, the condition can be managed.

- d. Suggest **one** strategy that can be used in the management and treatment of PKU.

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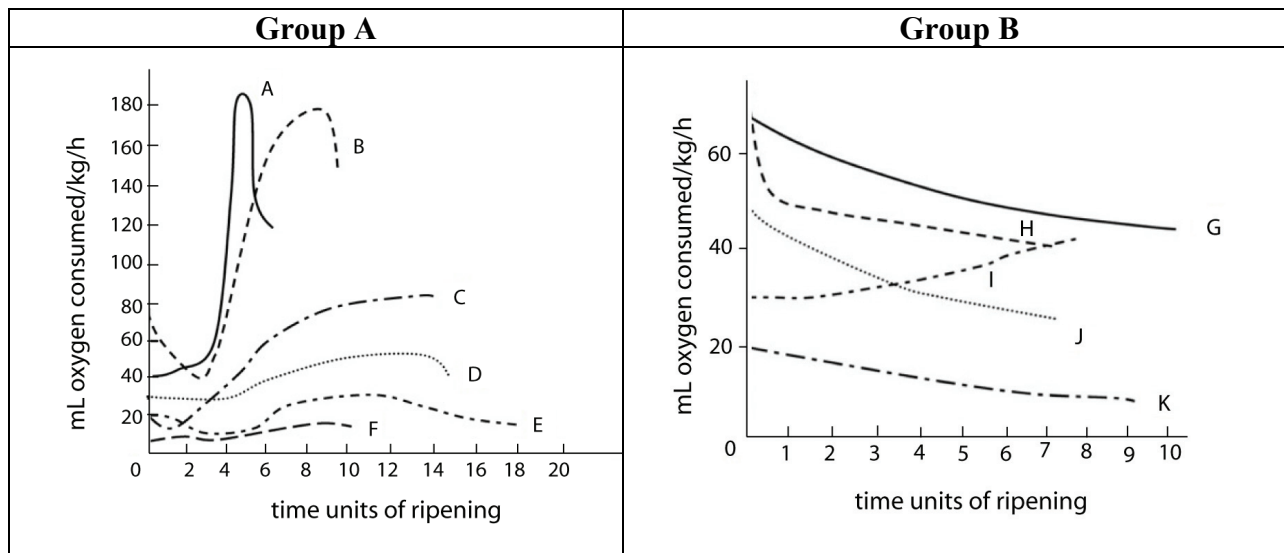
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1 mark  
Total 8 marks

**SECTION B** – continued  
**TURN OVER**

### Question 4

The ripening of many different types of fruit is associated with the production of a chemical, the gas ethylene. Ethylene acts to increase the levels of certain enzymes, including amylase and pectinase, within plant tissue. A researcher made a series of observations of a group of fruiting plants. In particular, the volume of oxygen consumed per kilogram per hour during the ripening process was recorded. The results were divided into two distinct groups and are shown in the following table.



- a. Why has the researcher made a distinction between Group A and Group B when presenting the results of the observations?

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2 marks

- b i. The consumption of oxygen is associated with a specific biochemical process in plants that occurs whether fruit is ripening or not. What is the name given to this biochemical process?

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- ii. What is the balanced chemical equation for this biochemical process?

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1 + 2 = 3 marks

- c. Identify the specific role that oxygen plays in the biochemical process referred to in Question 4bii. What happens to it?

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2 marks  
Total 7 marks



**Question 5**

The ripening of many different types of fruit is associated with the production of a chemical, the gas ethylene. Certain other aspects of plant growth and development are also controlled by chemical substances.

- a. What is the name given to the chemical substances that control plant growth and development?

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1 mark

Auxins such as indoleacetic acid (IAA) is a group of hormones which are produced by the growing tips of plants and are associated with a number of different processes, depending on their location and concentration. A synthetic auxin 2,4-dichlorophenoxyacetic acid (2,4-D) is a known selective herbicide to which dicotyledon weeds are generally susceptible. It is sprayed over crops and pastures in which the weeds grow, killing the dicotyledons but not the monocotyledons.

- b i. What is a selective herbicide?

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- ii. Suggest **one** way that 2,4-D is effective in controlling growth of weeds.

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1 + 1 = 2 marks

Despite previous success with controlling weeds, 2,4-D has become less effective at killing weeds over time. Funding for further research on the commercial use of the herbicide has been made available.

- c i. What is the most likely reason for the re-emergence of weeds in crops after spraying with 2,4-D?

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- ii. Identify **one** other reason that agricultural scientists might want to investigate 2,4-D.

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1 + 1 = 2 mark

Total 5 marks

**SECTION B – continued**  
**TURN OVER**

**Question 6**

Neurons are an essential means of communication within multicellular organisms. They form part of a complex system which also includes the brain and spinal cord. The brain and spinal cord form the central nervous system (CNS) while the nerve cells that lie outside the brain and spinal cord form the peripheral nervous system (PNS) which has both sensory and motor divisions.

The table presents a summary of the peripheral nervous system.

**a.** Complete the table.

sensory nervous system		conveys information to CNS from the external environment
	visceral sensory neurons	
motor nervous system	somatic nervous system	
		conveys signals that regulate internal environment

4 marks

Neurons act by transmitting information in the form of an electrical impulse. In order for this to occur, the cell membrane of a nerve cell must be polarised.

**b i.** Explain what is meant by 'polarised'.

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**ii.** How is a polarised state achieved in nerve cells?

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1 + 1 = 2 marks  
Total 6 marks

**Question 7**

Until recently, all infective agents were thought to contain some form of nucleic acid.

**a i.** Identify **two** basic forms of nucleic acid commonly found in infective agents.

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**ii.** Draw a labelled diagram of a monomer of **one** of the nucleic acids.

1 + 3 = 4 marks

Transmissible spongiform encephalopathies (TSEs) are a group of degenerative nervous diseases which affect mammals. They are caused by infective agents lacking nucleic acid and are comprised entirely of protein. These agents are capable of replication and causing infection in previously uninfected tissue.

**b.** What is the name given to these infective agents?

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1 mark

Total 5 marks

**SECTION B – continued**  
**TURN OVER**

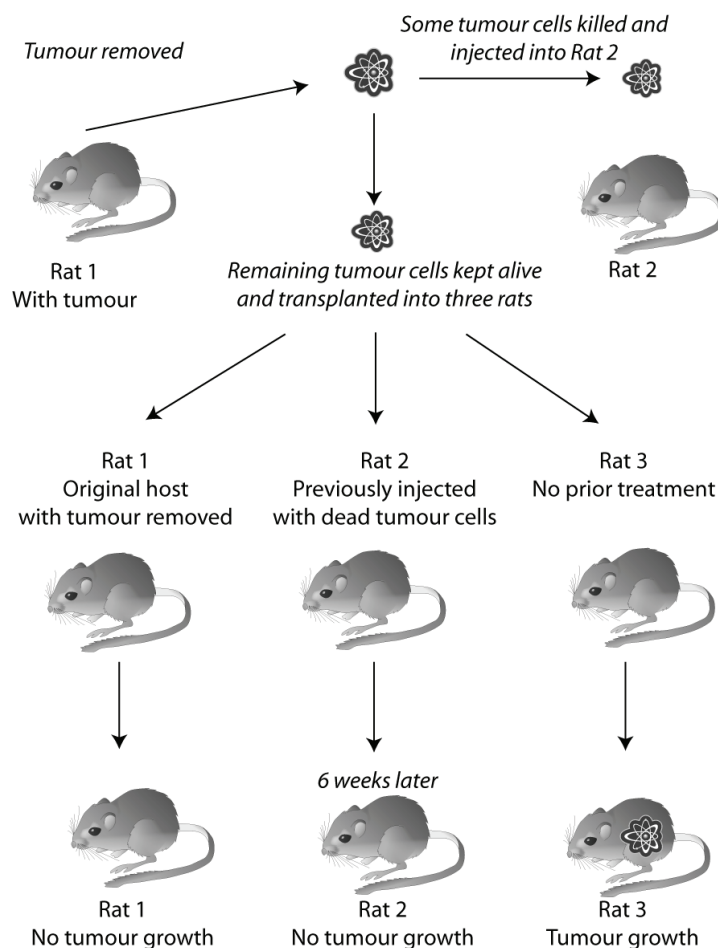
### Question 8

In healthy living tissue, cell death and cell production are regulated. Sometimes when regulation is interrupted, tumours or cancers can form in living tissue and can present life-threatening conditions.

- a. What is the name given to the group of molecules that controls whether a cell lives or dies?

1 mark

Using laboratory rats bred from the same parents, research was carried out to determine if the development of tumours could be prevented by vaccination. Growth of a tumour was induced in a single laboratory rat (Rat 1). The tumour was then removed and some of the cells were killed and the rest were kept alive in tissue fluid for four weeks. Some of the dead cells were injected into another rat (Rat 2). After four weeks the living tumour cells were divided into three groups and administered to Rat 1, Rat 2 and a new rat (Rat 3). Observations were made of the rats over 6 weeks. The process is described in the following diagram.



- b. What was the purpose of injecting dead tumour cells into Rat 2?

1 mark

- c. What events occur in the immune system of Rat 2 after the injection of dead tumour cells?

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2 marks

- d. In the experiment, Rat 1 and Rat 3 are both injected with live tumour cells; however, after 6 weeks only Rat 3 shows tumour growth. Explain why this occurs.

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2 marks

Before the results of the research were ready to be published it was necessary to make some modifications to the experimental design.

- e. Explain clearly **one** modification that would need to be made to the experimental design and why it is required.

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2 marks

Total 8 marks