Insight Publications

INSIGHT

Trial Exam Paper

2006

BIOLOGY

Written examination 1

STUDENT NAME:

QUESTION AND ANSWER BOOK

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

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*	*Suggested times (minutes)*
A	25	25	25	30
B	8	8	50	60
			Total 75	90

- 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 23 pages, with an answer sheet for the multiple-choice questions.

Instructions

- Write your **name** in the box provided and on the multiple-choice answer sheet.
- 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.

SECTION A – Multiple-choice questions

Instructions for Section A

Section A consists of 25 multiple-choice questions, each worth one mark.
You should spend approximately 30 minutes answering this section of the paper.
Answer **all** questions using pencil on the answer sheet provided.
A correct answer scores 1 mark and an incorrect answer scores 0 marks.
Marks are **not** deducted for incorrect answers.
No marks will be awarded if more than one response is completed for any question.

Question 1

Macromolecules are grouped into four classes on the basis of their chemical composition and structure.

The four classes of macromolecules are

A. complex carbohydrates, disaccharides, lipids and nucleic acids.

B. complex carbohydrates, lipids, nucleic acids and proteins.

C. complex carbohydrates, triglycerides, fatty acids and proteins.

D. complex carbohydrates, monosaccharides, lipids and nucleic acids.

Question 2

Proteins are linear polymers that have been folded, twisted or coiled to arrive at their final structure known as a functional shape.

Which of the following is **unlikely** to result in a permanent change to the functional shape of a protein?

A. exposure to strong salty solutions

B. exposure to high temperatures

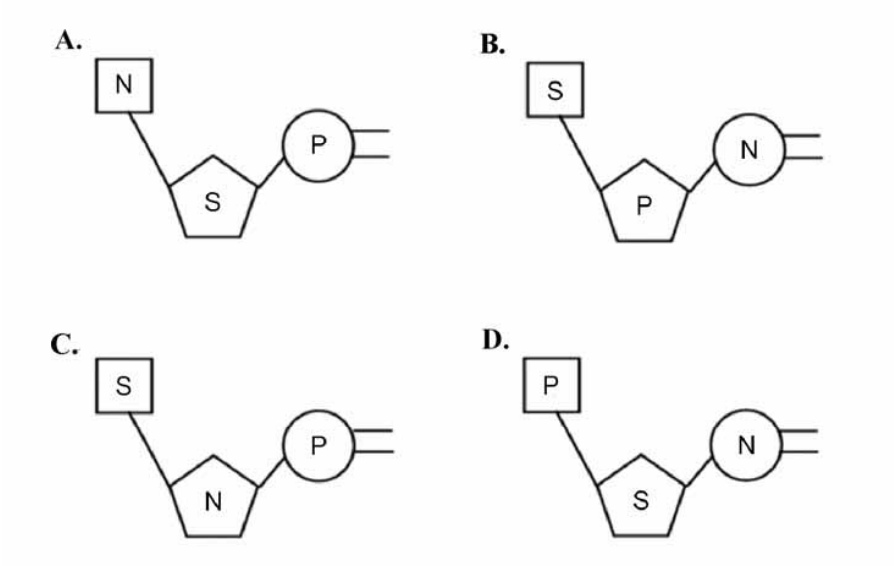
C. exposure to low temperatures

D. exposure to highly acidic or alkaline conditions

Question 3

Deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) are nucleic acids comprised of subunits known as nucleotides. A nucleotide unit always consists of three essential components.

A nucleotide is best represented by



Question 4

A typical prokaryote cell is likely to have

A. a distinct membrane-bound nucleus.

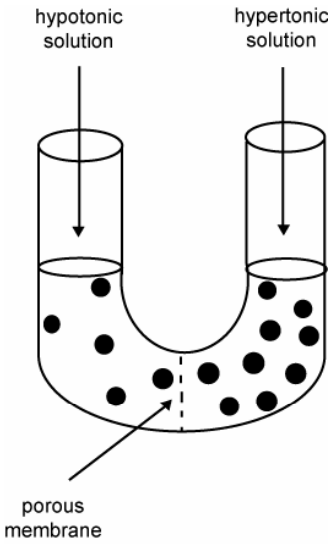
B. plasmids.

C. a single-stranded DNA molecule.

D. membrane-bound organelles.

Question 5

Two sugar solutions of differing concentrations are separated by a porous membrane which is permeable to the solvent but not the solute.



Over time

A. the water will diffuse from the hypotonic solution to the hypertonic solution.

B. the water will diffuse from the hypertonic solution to the hypotonic solution.

C. the sugar will diffuse from the hypotonic solution to the hypertonic solution.

D. the sugar will diffuse from the hypertonic solution to the hypotonic solution.

Question 6

Cells produce many large molecular substances, including hormones and enzymes, which need to be relocated within, or exported from, the cell. In addition, cells are required to import large molecules. In these circumstances the cell membrane forms small sacs known as vesicles, which are used to contain and transport the molecular substances.

Which of the following processes is associated with the cellular transport of macromolecules by the fusion of vesicles with the plasma membrane?

A. endocytosis

B. pinocytosis

C. exocytosis

D. phagocytosis

Question 7

The sum of chemical processes within a living cell is known as metabolism. All these processes occur through complex pathways that are capable of altering molecules in a series of steps.

Photosynthesis is an example of a metabolic reaction that occurs in plants. Photosynthesis is both

A. an anabolic and endogonic reaction.

B. an anabolic and endergonic reaction.

C. an anabolic and exergonic reaction.

D. a catabolic and an endergonic reaction.

Question 8

Most living cells are unlikely to harness heat as a source of energy because

A. heat denatures enzymes.

B. cells produce as much heat as they require.

C. heat is not a form of energy.

D. heat is not a requirement for metabolism to occur.

Question 9

Most human enzymes have optimal temperatures of about 35°C to 40°C.

There are bacteria that live in hot springs where temperatures are 70°C or higher. These bacteria are able to remain metabolically active because

A. their enzymes are insensitive to temperature.

B. their enzymes have high optimal temperatures.

C. the high temperatures facilitate active metabolism.

D. they use molecules other than proteins as their main catalysts.

Question 10

Cellular respiration is a metabolic process that breaks the chemical bonds in glucose molecules to release free energy in the form of ATP. When oxygen is the final electron acceptor in the process, it is known as aerobic cellular respiration. Anaerobic cellular respiration (or fermentation) uses other molecules as the final electron acceptor.

Which of the following statements about cellular respiration is true?

A. The end-products of anaerobic cellular respiration may include pyruvate, lactic acid or ethanol.

B. In anaerobic cellular respiration, the products of fermentation are found in the mitochondria.

C. Both aerobic and anaerobic cellular respiration produce the same net yield of 36 ATP molecules.

D. Both aerobic and anaerobic cellular respiration use glycolysis to oxidise glucose and other organic fuels to pyruvate.

Question 11

Krebs cycle is a stage in the process of cellular respiration. Pyruvate is converted to a compound called acetyl-CoA which then feeds into the Krebs cycle for further oxidation.

Likely products of this oxidation process are

A. NADH, $FADH_2$, ATP and O_2.

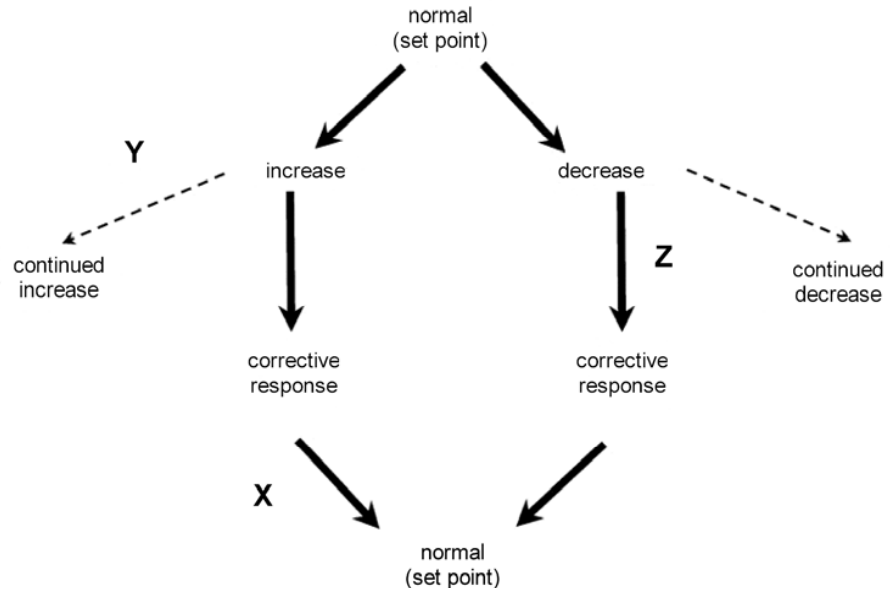
B. NADH, $FADH_2$, ATP and CO_2.

C. NAD, $FADH_2$, ATP and CO_2.

D. NAD, FAD, ATP and CO_2.

The following information is required for Questions 12 to 16.

All living organisms respond to signals from their external and internal environments. Responding to such signals is essential in order to maintain homeostasis. The diagram below represents a schematic summary of any homeostatic control process.



Question 12

Which of the following statements is **not** true of homeostasis?

A. Homeostasis is a dynamic state.

B. Homeostasis is the maintenance of a relatively constant internal environment.

C. Homeostasis maintains internal conditions within narrow limits of tolerance, despite changes in the external environment.

D. Due to its self-regulating nature, homeostasis cannot fail.

Question 13

In the diagram

A. X represents positive feedback, Y represents negative feedback.

B. X represents negative feedback, Y represents positive feedback.

C. X represents positive feedback.

D. Y represents negative feedback.

Question 14

Control of blood glucose in a non-diabetic person follows a negative-feedback response. Using the model in the diagram, if a deficiency of blood glucose is detected, the most likely response at Z would be that

A. the pancreas secretes more insulin, which enhances the conversion of glucose to glycogen and fat.

B. the pancreas secretes less insulin, which enhances the conversion of glucose to glycogen and fat.

C. the pancreas secretes more insulin, which inhibits the conversion of glucose to glycogen and fat.

D. the pancreas secretes less insulin, which inhibits the conversion of glucose to glycogen and fat.

Question 15

In the case of control of blood glucose, the corrective response resulting from Z would be

A. a rise in blood glucose level.

B. a fall in blood glucose level.

C. a decrease in glucagon level.

D. an increase in glycogen level.

Question 16

Control of blood glucose is maintained

A. principally by the nervous system.

B. principally by the endocrine system.

C. through homeostasis whether an individual has diabetes or not.

D. by the hypothalamus and the pituitary gland.

Question 17

The ability of an organism to defend itself against pathogens depends on whether its immune system is capable of recognising and distinguishing 'self' from 'non-self'. 'Self' refers to materials or markers that are produced within an organism. If 'non-self' material enters an organism, B-cells and T-cells recognise them as foreign and an immune response is initiated.

Which of the following materials or markers would **not** stimulate an immune response from a B-cell or a T-cell in an organism?

A. an antibody

B. an antigen

C. pollen

D. a virus

Question 18

An epitope is the region on the surface of an antigen that is recognised by an antibody.

An epitope binds specifically with the

A. antibody-binding site.

B. constant heavy-chain regions in an antibody only.

C. constant light-chain regions in an antibody only.

D. variable regions of the combined heavy chain and light chain.

Question 19

Plants are susceptible to attack from pathogens which can cause disease. Viruses commonly infect plants and can be transmitted between plants by organisms such as insects, fungi and nematode worms. Plants have physical mechanisms for defence against pathogenic infections; however, these are not always effective.

A second line of defence could involve

A. leaves with a thick cuticle or waxy surface.

B. growth of hairs and thorns to deter vectors.

C. sunken stomata.

D. secretion of chemicals known as phytoalexins.

Question 20

Transmissible spongiform encephalopathies (TSEs) have been documented since the 18th century. TSEs are caused by infectious proteins known as prions and are difficult to treat. Prions occur in two forms, PrPc (normal) and PrPsc (disease causing).

Prions

A. possess genetic material in the form of DNA and sometimes RNA.

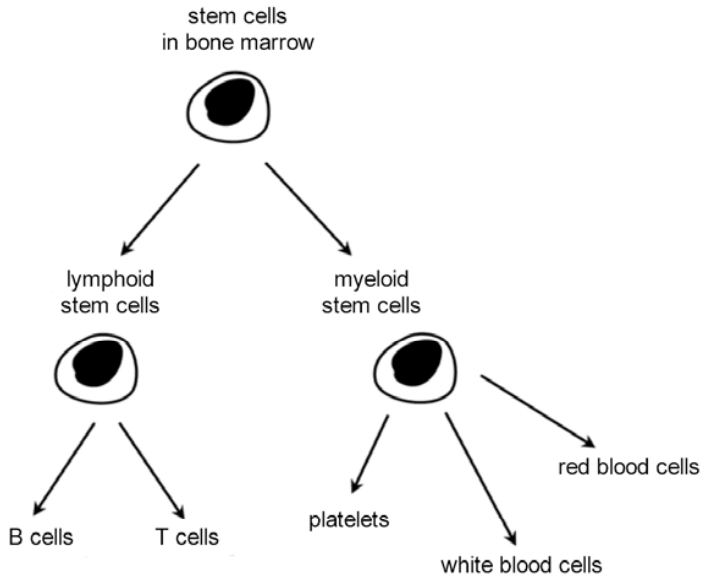
B. are resistant to high temperatures, some enzymes and ultraviolet radiation.

C. cause degenerative diseases including BSE, CJD and SARS.

D. only infect humans and cattle.

Question 21

Human blood cells develop from stem cells in the bone marrow. Stem cells reproduce by mitosis and then differentiate into B-cells and T-cells, white blood cells, red blood cells and platelets.



White blood cells are known as leucocytes and

A. include monocytes, lymphocytes and erythrocytes.

B. are associated specifically with the first line of defence.

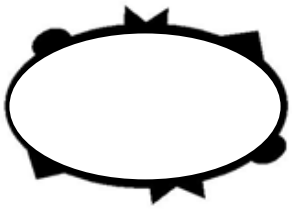
C. are found only in the lymphatic system.

D. some are capable of producing antibodies.

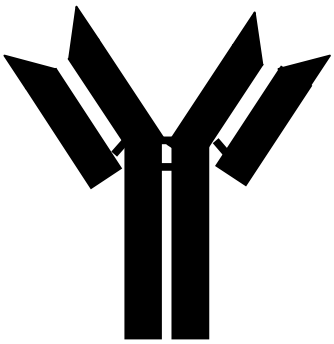
Question 22

The pathogen below entered an organism. After 48 hours, which one of the following might be found circulating through the body of the organism in much higher numbers?

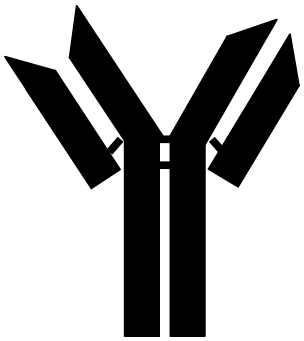
Pathogen W



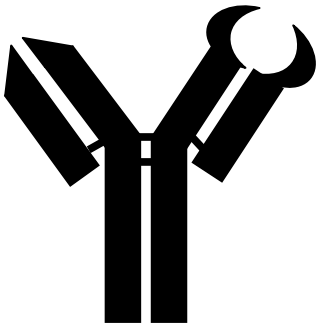
A.



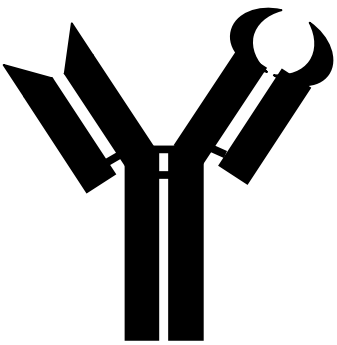
B.



C.

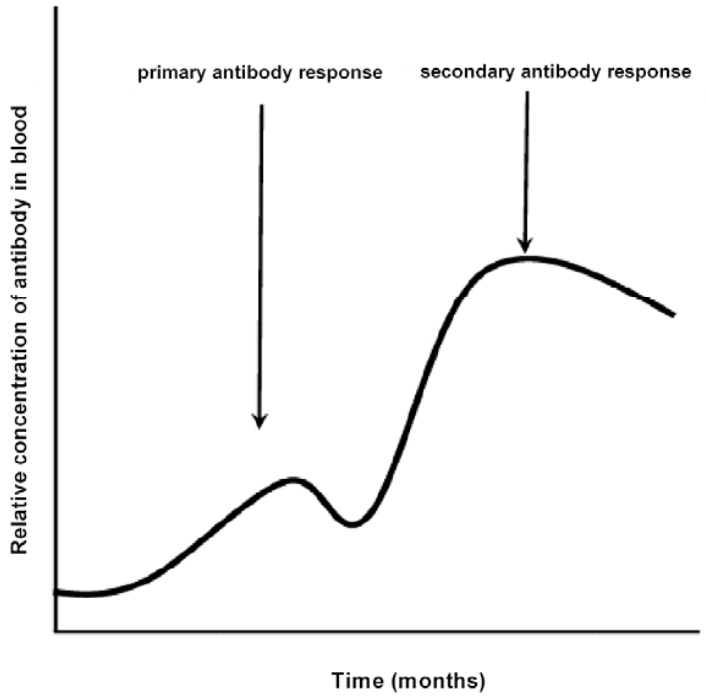


D.



Question 23

The graph shows the relative concentration of antibodies in the blood following an initial infection by a pathogen.



The secondary response occurs more rapidly and is greater in magnitude because

A. antibodies produced to fight the initial infection still remain.

B. there is a low concentration of B-plasma cells.

C. there is a high concentration of B-plasma cells.

D. B-memory cells are present in lymph nodes.

Question 24

Vaccines, which contain dead or attenuated disease-causing micro-organisms, activate the immune system to produce antibodies and prevent development of the disease.

This form of immunity is known as

A. acquired active immunity.

B. acquired passive immunity.

C. natural active immunity.

D. natural passive immunity.

Question 25

An allergic response is an exaggerated immune response to normally harmless substances found on the surfaces of foods, animals, drugs or cosmetics.

The cells most directly associated with an allergic response are

A. mast cells.

B. mast cells and basophils.

C. basophils.

D. lysosomes.

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

As part of a research project, four samples of organic material were scientifically analysed to det ermine the percentage composition of different elements. The results of the analysis are shown in the table.

Percentage	Sample A	Sample B	Sample C	Sample D
Carbon	32	22	20	23
Hydrogen	45	46	35	48
Oxygen	21	20	21	26
Nitrogen	15	12	31	0
Sulphur	2	0	0	0
Phosphorus	0	0	14	0

a. State which elements are found in proteins.

_____

1 mark

b. **i.** State which one of the samples is most likely to be a nucleic acid.

_____

ii. Explain the reason for your choice.

_____

_____

1 + 1 = 2 marks

Nucleic acids serve as a blueprint in the production of proteins. There are two types of nucleic acids: DNA and RNA.

c. Explain the fundamental difference between the chemical structures of DNA and RNA.

_____

_____

1 mark

Chitin, a structural polysaccharide, is a major component of the arthropod exoskeleton. It is similar to cellulose except for the addition of nitrogen in the glucose monomer.

d. i. Define the term monomer.

_____

ii. What is the name given to the process where monomers join to become macromolecules?

_____

iii. Which sample is most likely to contain chitin?

_____

1 + 1 + 1 = 3 marks
Total 7 marks

Question 2

Living organisms are comprised of one or more cells. All cells have distinctive structures and these structures are directly related to the specific function of the cell.

The table below shows information about cells found in a typical eukaryotic organism.

a. Complete the table below.

Cell type	**Cellular structure**	**Function of structure**
epithelial cell	microtubule	
muscle cell		site of ATP production
	flagellum	produces motion to allow transport
liver cell	endoplasmic reticulum	

4 marks

In addition to their complex internal structure, body cells of some eukaryotes are supported by connective tissue such as bone and cartilage.

b. i. What is the name of the network that surrounds cells in body tissues?

_____

ii. What cells produce and secrete the macromolecules that contribute to this network?

_____

1 + 1 = 2 marks
Total 6 marks

Question 3

Vicia faba is a species of broad bean commonly used in investigations of plant growth. Like all plants, the broad bean is reliant on the biochemical processes of photosynthesis and cellular respiration for survival. Photosynthesis occurs in structures known as chloroplasts.

There are two phases in photosynthesis – a light-dependent phase and a light-independent phase.

a. Where in the chloroplast does the light-dependent phase occur?

_____

1 mark

b. What is produced as a result of the light-independent phase?

_____

1 mark

Plants are dependent on photosynthesis because it produces essential materials for the process of cellular respiration.

Cellular respiration proceeds over three stages – glycolysis, Krebs cycle and electron transport.

c. **i.** Where in a plant cell does glycolysis occur?

_____

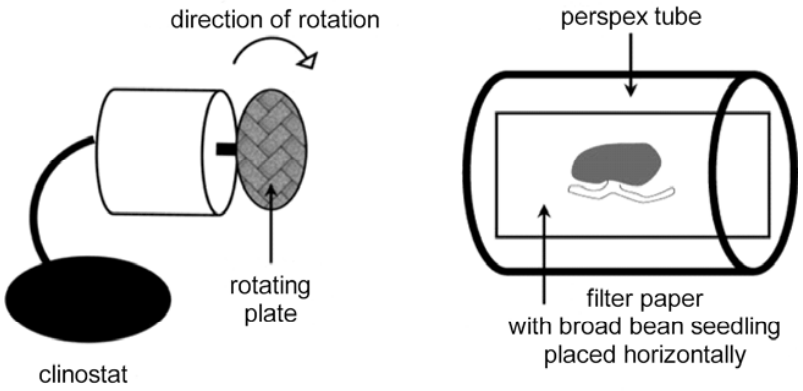
ii. Where in a plant cell does electron transport occur?

_____

1 + 1 = 2 marks
Total 4 marks

Question 4

An experiment was carried out to investigate the control of growth of roots and shoots in the broad bean *Vicia faba*. Young broad bean seedlings (approximately 2 cm) were placed securely against water soaked filter paper in clear perspex tubes that also contained a hydrating gel. The tubes were uncapped during the day, capped loosely at night and experienced the same light conditions. A clinostat (a device consisting of a rotating plate which can revolve at various speeds) was used in the experiment.



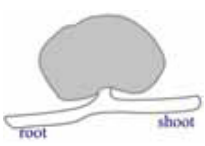
Group 1: seedling placed horizontally and grown in the light (no clinostat)

Group 2: seedling placed horizontally on a clinostat (not switched on)

Group 3: seedling placed horizontally on a clinostat (switched on slow)

Group 4: seedling placed horizontally on a clinostat (switched on fast)

The results are shown in the following table.

Group 1	**Group 2**	**Group 3**	**Group 4**
seedling placed horizontally seedling not placed on clinostat	seedling placed horizontally on a clinostat clinostat not switched on	seedling placed horizontally on a clinostat clinostat switched on (slow rotation)	seedling placed horizontally on a clinostat clinostat switched on (fast rotation)
			

a. What is the name given to the plant response investigated in this experiment?

_____

1 mark

b. Why was a clinostat used in this experiment?

_____

_____

1 mark

c. Using the information from the experiments, what conclusion can you make about the growth of roots and shoots? Explain how you reached your conclusion.

Conclusion

_____

_____

Explanation

_____

_____

_____

_____

1 + 2 = 3 marks

Roots and shoots of broad beans have cells which contain starch grains known as starch statoliths. It has been hypothesised that the position of statoliths has a direct impact on the distribution of the plant hormone associated with growth in the root and shoot.

d. What is the name of the plant hormone associated with growth in the root and shoot?

_____

1 mark

e. Using the information from the experiments and your knowledge of plant hormones, explain the directional growth of roots and shoots in broad beans.

_____

_____

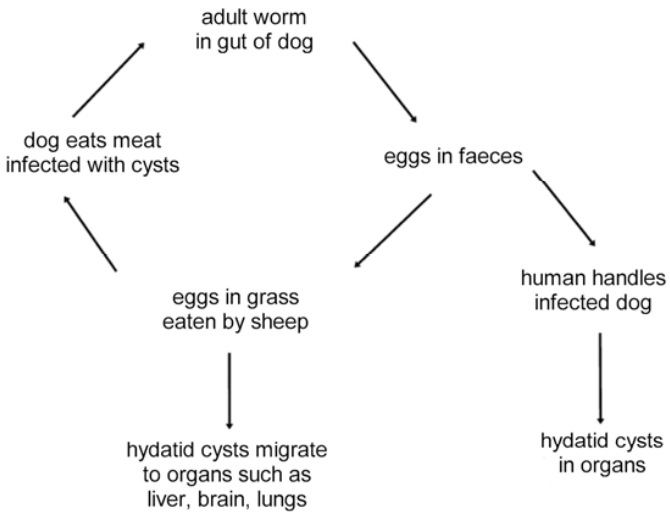
_____

_____

2 marks
Total 8 marks

Question 5

The hydatid tapeworm *Echinococcus granulosis* normally inhabits the intestines of dogs. The mature adult produces eggs that are passed in the dog faeces. The eggs contaminate grass and, in rural areas, are ingested by livestock, usually sheep. In the sheep, the eggs develop into hydatid cysts that contain many tapeworm heads. Individual cysts can generate more cysts that are suspended in the fluid of the mother cyst. Hydatid cysts move into the bloodstream and migrate to body tissue, in particular, the liver, brain and lungs. Dogs can ingest the hydatid cysts if they eat raw tissue from infected dead livestock.



a. What is the role of the sheep in the life cycle of *Echinococcus granulosis*?

_____

1 mark

b. Identify one structural feature you would expect to find in the mature adult and explain how it helps it to survive in the dog.

_____

_____

2 marks

Humans can become infected by *Echinococcus granulosis* after handling infected dogs. In some circumstances, growing cysts can block blood vessels leading to vital organs. With care, the cysts can be removed surgically.

c. Why is it necessary to ensure that cysts are removed intact from an infected person?

_____

1 mark

d. What is one method that can be used to prevent domestic pets from being infected by this parasitic worm?

_____

1 mark
Total 5 marks

Question 6

Bombyx mori is a silkworm moth. The female silkworm moths attract males by emitting chemical signals that diffuse through the air. A male hundreds of metres away is capable of detecting these molecules and will fly toward their source.

a. What is the name given to the chemical used by the female silkworm moth?

_____

1 mark

In some circumstances, other organisms will release the same chemical signals used by certain species. This enables them to trap their prey more effectively.

b. **i.** What term is used to describe the simulation of this chemical signal?

_____

ii. For what other purpose is an organism likely to copy a characteristic of another species?

_____

_____

1 + 1 = 2 marks

The male silkworm moth has large comb-like antennae which act as sensory organs for the chemicals the female emits. Each filament of an antenna possesses thousands of structures that detect the chemical signal.

c. What is the general name given to the detecting structures found on the antennae?

_____

1 mark
Total 4 marks

Question 7

Multiple sclerosis (MS) is the most common chronic disease of the central nervous system in developed countries. It affects one in 1000 people of northern European origin and is considered an autoimmune disease.

a. What are the characteristics of an autoimmune disease?

_____

_____

1 mark

In MS, there is a breakdown of the myelin sheath. Damage to the myelin sheath can interfere with communication between parts of the central and the peripheral nervous systems.

b. **i.** What is the myelin sheath?

_____

ii. What is its function?

_____

_____

1 + 1 = 2 marks

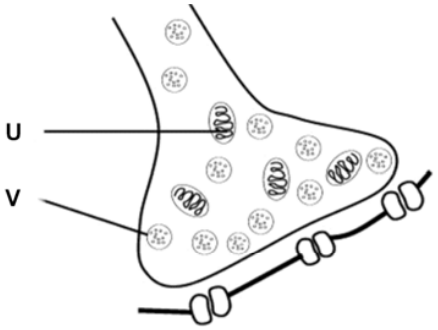
For a person who does not have MS, communication signals between the central and the peripheral nervous systems are unimpaired.

c. By what method are communication signals principally transmitted in the nervous system?

_____

1 mark

The diagram shows the junction between two neurons.



d. **i.** Identify structure U.

_____

What is its function?

_____

_____

ii. Identify structure V.

_____

What is its function?

_____

_____

1 + 1 = 2 marks

Between the two neurons there is a gap known as a synaptic cleft.

e. How does the communication signal travel across this gap?

_____

_____

_____

_____

_____

3 marks
Total 9 marks

Question 8

The human body acts in many ways to guard against infection and disease. Sometimes these lines of defence are not always effective and a person may become infected with a pathogen. *Clostridium tetani* is a bacterial micro-organism that causes a disease called tetanus.

a. What is the difference between an infection and a disease?

_____

_____

1 mark

If the first line of defence fails and *Clostridium tetani* enters the body, a series of responses occurs. Cells known as phagocytes play a significant role in the second line of defence.

b. How does a macrophage contribute to second-line defence?

_____

_____

1 mark

Complement proteins are blood proteins that assist phagocytes in recognising pathogenic micro-organisms. There are around 20 known complement proteins.

c. Outline one way that complement proteins can assist phagocytes in recognising pathogenic micro-organisms.

_____

_____

1 mark

If *Clostridium tetani* has entered the body through the skin, there may be some inflammation at the site of entry.

d. Explain what causes the inflammation in the area.

_____

_____

1 mark

e. What chemical is associated with the inflammatory response?

_____

1 mark

f. State whether this response is an example of non-specific or specific immunity.

_____

_____

1 mark

The current program against vaccine-preventable diseases in Australia recommends that infants, children and adults be immunised against tetanus at the age of 2 months, 4 months, 6 months, 4 years and around 15 years, with a booster every 5 years afterwards.

g. Why is it necessary to have so many immunisations in the first 6 months of life?

_____

_____

1 mark
Total 7 marks

END OF QUESTION AND ANSWER BOOK

Insight Publications

INSIGHT

Trial Exam Paper

2006

BIOLOGY

Written examination 1

Solutions book

This book presents:

- correct sample answers
- tips showing you how to work through the questions
- summaries of key knowledge tested for each question in Section B.

SECTION A – Multiple-choice questions

Question 1

Macromolecules are grouped into four classes on the basis of their chemical composition and structure.

The four classes of macromolecules are

A. complex carbohydrates, disaccharides, lipids and nucleic acids.

B. **complex carbohydrates, lipids, nucleic acids and proteins.**

C. complex carbohydrates, triglycerides, fatty acids and proteins.

D. complex carbohydrates, monosaccharides, lipids and nucleic acids.

Answer is B

Tips

- *B is correct because it identifies the four classes of biomacromolecules.*
- *A and D do not identify proteins.*
- *C does not identify nucleic acids.*

Question 2

Proteins are linear polymers that have been folded, twisted or coiled to arrive at their final structure known as a functional shape.

Which of the following is **unlikely** to result in a permanent change to the functional shape of a protein?

A. exposure to strong salty solutions

B. exposure to high temperatures

C. **exposure to low temperatures**

D. exposure to highly acidic or alkaline conditions

Answer is C

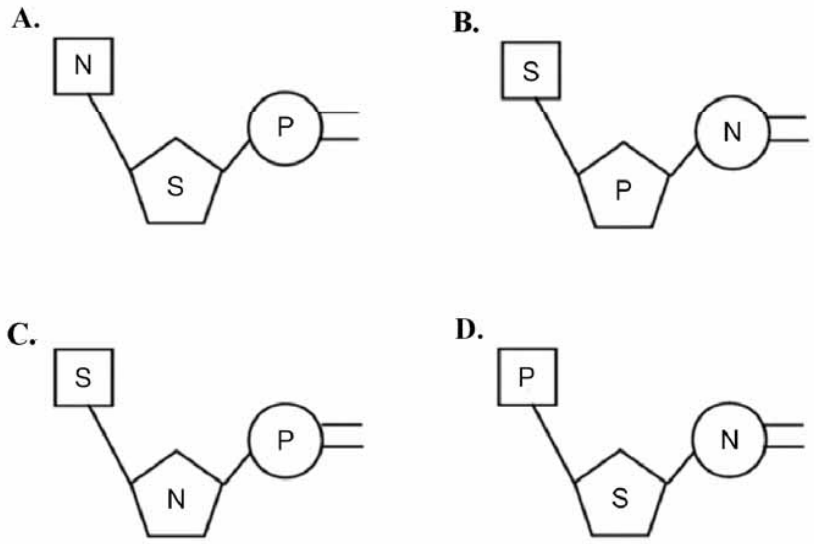
Tips

- *A and D are incorrect. Exposure to low temperatures is least likely to result in a permanent change to the functional shape of a protein. Unlike high temperatures, low temperatures do not provide enough energy to alter or break the chemical bonds in the complex structure of the protein molecule. Due to their chemical properties and resultant interaction with proteins, strong salty solutions and/or highly acidic or alkaline solutions can lead to changes in bonding arrangements which are then likely to result in changes in functional shape.*
- *B is incorrect. High temperatures can alter or break chemical bonds in the protein molecule thereby changing the functional shape.*

Question 3

Deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) are nucleic acids comprised of subunits known as nucleotides. A nucleotide unit always consists of three essential components.

A nucleotide is best represented by



Answer is D

Question 4

A typical prokaryote cell is likely to have

A. a distinct membrane-bound nucleus.

B. **plasmids.**

C. a single-stranded DNA molecule.

D. membrane-bound organelles.

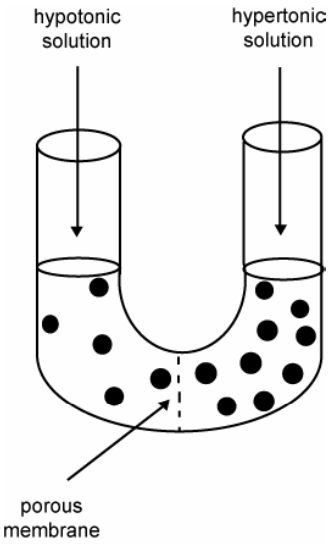
Answer is B

Tips

- *Typical prokaryotes have plasmids.*
- *A is incorrect. They do not have membrane-bound nuclei.*
- *C is incorrect. They have a single, **double**-stranded DNA molecule.*
- *D is incorrect. They do not have membrane-bound organelles.*

Question 5

Two sugar solutions of differing concentrations are separated by a porous membrane which is permeable to the solvent but not the solute.



Over time

A. **the water will diffuse from the hypotonic solution to the hypertonic solution.**

B. the water will diffuse from the hypertonic solution to the hypotonic solution.

C. the sugar will diffuse from the hypotonic solution to the hypertonic solution.

D. the sugar will diffuse from the hypertonic solution to the hypotonic solution.

Answer is A

Tip

- *The water will diffuse from the hypotonic solution to the hypertonic solution through the porous membrane. The porous membrane prevents the solute (sugar) from diffusing down the concentration gradient (from a region of relatively high solute concentration to one of relatively low solute concentration). Only the water molecules can diffuse from a region of relatively high solvent (water) concentration to one of relatively low solvent concentration.*

Question 6

Cells produce many large molecular substances, including hormones and enzymes, which need to be relocated within, or exported from, the cell. In addition, cells are required to import large molecules. In these circumstances the cell membrane forms small sacs known as vesicles, which are used to contain and transport the molecular substances.

Which of the following processes is associated with the cellular transport of macromolecules by the fusion of vesicles with the plasma membrane?

A. endocytosis

B. pinocytosis

C. **exocytosis**

D. phagocytosis

Answer is C

Tip

- *A, B and D are incorrect. The process of exocytosis involves the secretion or expulsion of material from within a cell. In order to cross the plasma membrane, the material is packaged in a vesicle which fuses with the membrane so its contents can be exported. Endocytosis, pinocytosis and phagocytosis are all forms of bulk transport of material into a cell. There is no fusion of vesicles to plasma membranes associated with these three processes.*

Question 7

The sum of chemical processes within a living cell is known as metabolism. All these processes occur through complex pathways that are capable of altering molecules in a series of steps.

Photosynthesis is an example of a metabolic reaction that occurs in plants. Photosynthesis is both

A. an anabolic and endogonic reaction.

B. **an anabolic and endergonic reaction.**

C. an anabolic and exergonic reaction.

D. a catabolic and an endergonic reaction.

Answer is B

Tip

- *The only correct combination is B. Photosynthesis is a chemical process which requires energy (endergonic) and constructs complex molecules, i.e. carbohydrates from more simple ones (anabolic). It does not release energy (exergonic) nor does it break down complex molecules to simple ones (catabolic).*

Question 8

Most living cells are unlikely to harness heat as a source of energy because

A. **heat denatures enzymes.**
B. cells produce as much heat as they require.
C. heat is not a form of energy.
D. heat is not a requirement for metabolism to occur.

Answer is A

Tip

- *B, C and D are incorrect. Harnessing heat as a source of energy would be detrimental to the cell. Heat has the effect of denaturing enzymes, which are proteins, because it changes the functional shape of the molecule. If cells produce heat, it is harnessed in a form of energy in chemical bonds.*

Question 9

Most human enzymes have optimal temperatures of about 35°C to 40°C.

There are bacteria that live in hot springs where temperatures are 70°C or higher. These bacteria are able to remain metabolically active because

A. their enzymes are insensitive to temperature.
B. **their enzymes have high optimal temperatures.**
C. the high temperatures facilitate active metabolism.
D. they use molecules other than proteins as their main catalysts.

Answer is B

Tips

- *A is incorrect. The bacteria can remain metabolically active because their enzymes have high optimal temperatures relative to human enzymes. The optimal temperature and pH ranges for enzymes vary between species. Enzymes are always sensitive to temperature.*
- *C is incorrect. Active metabolism will not be facilitated if the temperature denatures the enzymes in the organism.*
- *D is incorrect. Cells use enzymes (proteins) as biological or organic catalysts. They do not and cannot use any other molecules for this purpose.*

Question 10

Cellular respiration is a metabolic process that breaks the chemical bonds in glucose molecules to release free energy in the form of ATP. When oxygen is the final electron acceptor in the process, it is known as aerobic cellular respiration. Anaerobic cellular respiration (or fermentation) uses other molecules as the final electron acceptor.

Which of the following statements about cellular respiration is true?

A. The end-products of anaerobic cellular respiration may include pyruvate, lactic acid or ethanol.

B. In anaerobic cellular respiration, the products of fermentation are found in the mitochondria.

C. Both aerobic and anaerobic cellular respiration produce the same net yield of 36 ATP molecules.

D. **Both aerobic and anaerobic cellular respiration use glycolysis to oxidise glucose and other organic fuels to pyruvate.**

Answer is D

Tips

- *A is not the best answer, because although pyruvate is produced by anaerobic cellular respiration, it is then converted to other compounds in the process. Pyruvate is not an end-product of anaerobic cellular respiration.*
- *B is incorrect. Products of fermentation are found in the cytosol, not the mitochondria.*
- *C is incorrect. The first stage of both aerobic and anaerobic cellular respiration results in the production of pyruvate by oxidising glucose (and sometimes other organic fuels such as glycerol or amino acids) in a process known as glycolysis. Aerobic cellular respiration produces a net yield of 36 (38) mole ATP per mole of glucose used whereas anaerobic cellular respiration produces a net yield of 2 mole ATP per mole of glucose used.*

Question 11

Krebs cycle is a stage in the process of cellular respiration. Pyruvate is converted to a compound called acetyl-CoA which then feeds into the Krebs cycle for further oxidation.

Likely products of this oxidation process are

A. NADH, $FADH_2$, ATP and O_2.

B. **NADH, FADH2, ATP and CO2.**

C. NAD, $FADH_2$, ATP and CO_2.

D. NAD, FAD, ATP and CO_2.

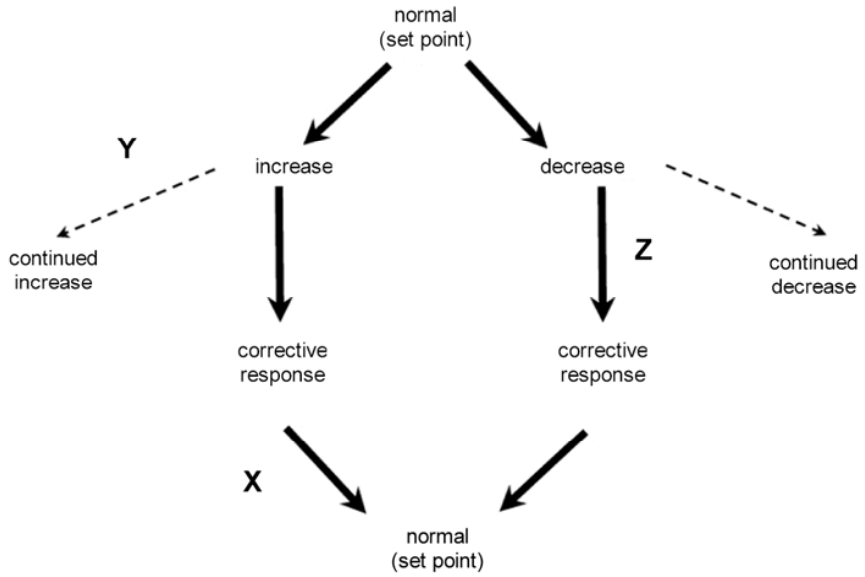
Answer is B

Tips

- *A is incorrect. Krebs cycle produces NADH, $FADH_2$, ATP and CO_2. O_2 is not released.*
- *C is incorrect. NAD becomes a 'loaded' acceptor molecule.*
- *D is incorrect. FAD becomes a 'loaded' acceptor molecule in this stage of aerobic cellular respiration.*

The following information is required for Questions 12 to 16.

All living organisms respond to signals from their external and internal environments. Responding to such signals is essential in order to maintain homeostasis. The diagram below represents a schematic summary of any homeostatic control process.



Question 12

Which of the following statements is **not** true of homeostasis?

A. Homeostasis is a dynamic state.

B. Homeostasis is the maintenance of a relatively constant internal environment.

C. Homeostasis maintains internal conditions within narrow limits of tolerance, despite changes in the external environment.

D. **Due to its self-regulating nature, homeostasis cannot fail.**

Answer is D

Tip

- *A, B and C are all true of homeostasis. Homeostasis 'fails' when certain factors produce effects beyond the range of the normal homeostatic response to change.*

Question 13

In the diagram

A. X represents positive feedback, Y represents negative feedback.

B. **X represents negative feedback, Y represents positive feedback.**

C. X represents positive feedback.

D. Y represents negative feedback.

Answer is B

Tips

- *A and C are incorrect. In the diagram, X represents negative feedback and Y represents positive feedback. X cannot represent positive feedback because a corrective response returns the system to its 'normal (set point)' after the 'increase' in the 'normal (set point)' which indicates a negative feedback response.*
- *D is incorrect. Y cannot represent negative feedback because there is no corrective response to return the system to its 'normal (set point)' after the 'increase' in the 'normal (set point)'. There is, in fact, a continued increase which indicates a positive feedback mechanism in place.*

Question 14

Control of blood glucose in a non-diabetic person follows a negative-feedback response. Using the model in the diagram, if a deficiency of blood glucose is detected, the most likely response at Z would be that

A. the pancreas secretes more insulin, which enhances the conversion of glucose to glycogen and fat.

B. the pancreas secretes less insulin, which enhances the conversion of glucose to glycogen and fat.

C. the pancreas secretes more insulin, which inhibits the conversion of glucose to glycogen and fat.

D. **the pancreas secretes less insulin, which inhibits the conversion of glucose to glycogen and fat.**

Answer is D

Tip

- *The most likely homeostatic response at Z if a deficiency of blood glucose is detected would be a decrease in the secretion of insulin from the beta cells (in the islets of Langerhans) in the pancreas. This would inhibit the conversion of glucose to glycogen and fat, thus restoring levels of glucose in the blood to within the normal range. (B is therefore incorrect – it does not enhance conversion.) The pancreas would not secrete more insulin as this would lead to increased uptake of blood glucose into cells and a further drop in blood glucose (A and C are incorrect).*

Question 15

In the case of control of blood glucose, the corrective response resulting from Z would be

A. **a rise in blood glucose level.**
B. a fall in blood glucose level.
C. a decrease in glucagon level.
D. an increase in glycogen level.

Answer is A

Tips

- *B and C are incorrect. The corrective response at Z would lead to a rise in blood glucose level because in addition to the decrease in insulin production (which inhibits conversion of glucose to glycogen and fat) there is also an increase in the release of glucagon (a hormone released from the alpha cells in the islets of Langerhans) in the pancreas.*
- *D is incorrect. Glucagon triggers the conversion of stored glycogen and fats to glucose, thus the level of glycogen would* ***decrease****.*

Question 16

Control of blood glucose is maintained

A. principally by the nervous system.
B. **principally by the endocrine system.**
C. through homeostasis whether an individual has diabetes or not.
D. by the hypothalamus and the pituitary gland.

Answer is B

Tips

- *A is incorrect. There are no electrical impulses associated with this mechanism.*
- *C is incorrect. Control of blood glucose is principally maintained by the endocrine system in an individual who is free of diabetes.*
- *D is incorrect. The hypothalamus and pituitary gland are involved in many homeostatic mechanisms, but not, however, in the control of blood glucose. Control of blood glucose is principally maintained by cells in the pancreas.*

Question 17

The ability of an organism to defend itself against pathogens depends on whether its immune system is capable of recognising and distinguishing 'self' from 'non-self'. 'Self' refers to materials or markers that are produced within an organism. If 'non-self' material enters an organism, B-cells and T-cells recognise them as foreign and an immune response is initiated.

Which of the following materials or markers would **not** stimulate an immune response from a B-cell or a T-cell in an organism?

A. **an antibody**

B. an antigen

C. pollen

D. a virus

Answer is A

Tip

- *B, C and D are incorrect. In normal circumstances (absence of autoimmune disease), an antibody would not normally stimulate an immune response from a B-cell or T-cell in an organism because it is recognised as 'self'. Antigens, pollen and viruses are all recognised as 'non-self' due to their antigenic state and would therefore stimulate an immune response.*

Question 18

An epitope is the region on the surface of an antigen that is recognised by an antibody.

An epitope binds specifically with the

A. antibody-binding site.

B. constant heavy-chain regions in an antibody only.

C. constant light-chain regions in an antibody only.

D. **variable regions of the combined heavy chain and light chain.**

Answer is D

Tips

- *A is incorrect – not specific enough. The structure of an antibody is such that the epitope binding site is comprised of the variable regions of the combined light chain and heavy chain.*
- *B and C are incorrect. It is not physically possible to bind with only the light chain regions or only the heavy chain regions of an antibody.*

Question 19

Plants are susceptible to attack from pathogens which can cause disease. Viruses commonly infect plants and can be transmitted between plants by organisms such as insects, fungi and nematode worms. Plants have physical mechanisms for defence against pathogenic infections; however, these are not always effective.

A second line of defence could involve

A. leaves with a thick cuticle or waxy surface.

B. growth of hairs and thorns to deter vectors.

C. sunken stomata.

D. **secretion of chemicals known as phytoalexins.**

Answer is D

Tips

- *D is correct because second-line defence in plants involves the use of chemicals. Phytoalexins are plant chemicals that act in a similar way to antibiotics to protect a plant against pathogens. The first line of defence in plants is associated with a physical barrier against pathogens.*
- *A, B and C are incorrect. They all provide a structural (physical) barrier and therefore provide **first-line** defence, not second-line defence.*

Question 20

Transmissible spongiform encephalopathies (TSEs) have been documented since the 18th century. TSEs are caused by infectious proteins known as prions and are difficult to treat. Prions occur in two forms, PrPc (normal) and PrPsc (disease causing).

Prions

A. possess genetic material in the form of DNA and sometimes RNA.

B. **are resistant to high temperatures, some enzymes and ultraviolet radiation.**

C. cause degenerative diseases including BSE, CJD and SARS.

D. only infect humans and cattle.

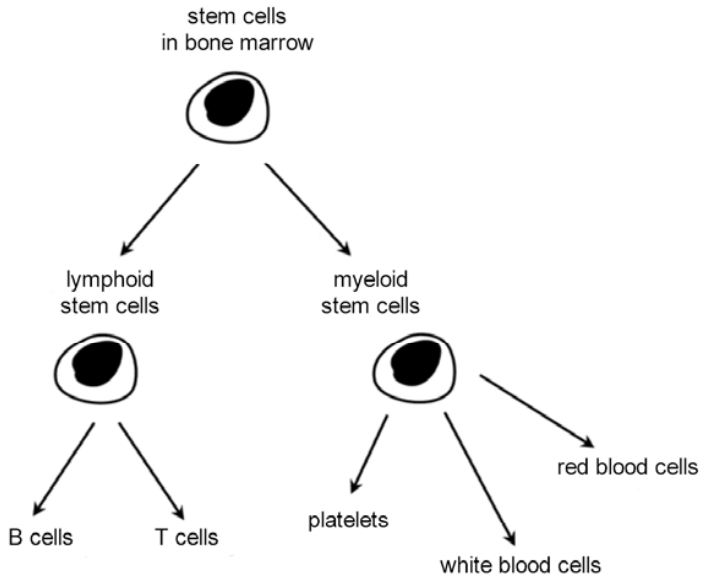
Answer is B

Tips

- *Prions are infectious proteins which are resistant to high temperatures, some enzymes and ultraviolet radiation.*
- *A is incorrect. They do not possess any genetic material.*
- *C is incorrect. They **do** cause BSE, CJD but **not** SARS, which is viral.*
- *D is incorrect. They do not just infect humans and cattle; they can infect sheep and cats too.*

Question 21

Human blood cells develop from stem cells in the bone marrow. Stem cells reproduce by mitosis and then differentiate into B-cells and T-cells, white blood cells, red blood cells and platelets.



White blood cells are known as leucocytes and

A. include monocytes, lymphocytes and erythrocytes.

B. are associated specifically with the first line of defence.

C. are found only in the lymphatic system.

D. **some are capable of producing antibodies.**

Answer is D

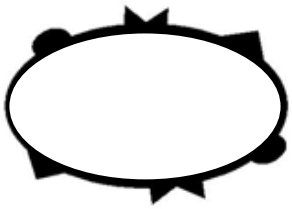
Tips

- *A is incorrect. They do not include erythrocytes – red blood cells.*
- *B is incorrect. They are associated with the second and third lines of defence.*
- *C is incorrect. They are found in the blood, lymph and tissue fluid.*
- *White blood cells are capable of producing antibodies.*

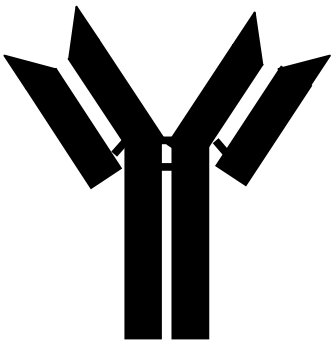
Question 22

The pathogen below entered an organism. After 48 hours, which one of the following might be found circulating through the body of the organism in much higher numbers?

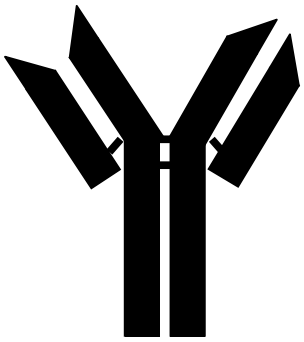
Pathogen W



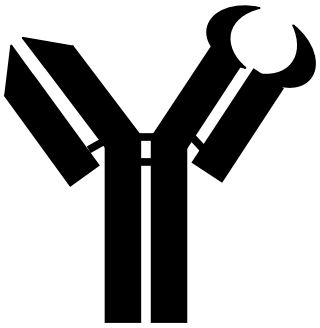
A.



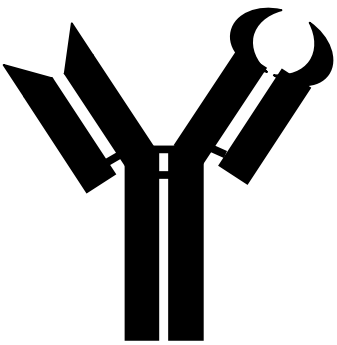
B.



C.



D.



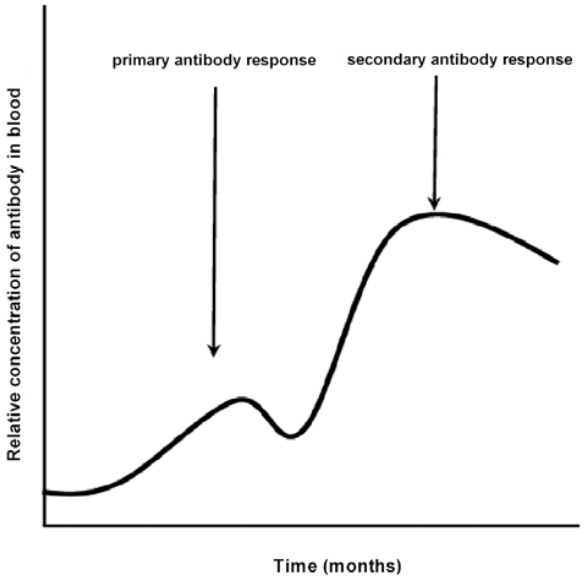
Answer is A

Tips

- *The only correct answer is A. Antibodies are proteins with a Y-shaped structure that bind specifically with antigens. The antigen-binding sites are located on the arms of the Y. The antigen-binding sites on an antibody are identical.*
- *B, C and D do not depict antibodies with identical antigen-binding sites.*

Question 23

The graph shows the relative concentration of antibodies in the blood following an initial infection by a pathogen.



The secondary response occurs more rapidly and is greater in magnitude because

A. antibodies produced to fight the initial infection still remain.

B. there is a low concentration of B-plasma cells.

C. there is a high concentration of B-plasma cells.

D. **B-memory cells are present in lymph nodes.**

Answer is D

Tips

- *A is incorrect. Antibodies could not survive for the length of time (months) suggested.*
- *B is incorrect. A low concentration of B-plasma cells is more likely to produce an effect similar to the primary response and the immune system will need to undergo clonal selection to produce antibodies and B-memory cells. It cannot produce a secondary response such as that depicted.*
- *C is incorrect. The concentration of B-plasma cells at the time of the secondary response is very unlikely to be high given the time elapsed since the primary antibody response, as they only survive for a few days.*
- *Following an encounter with a specific antigen, B-memory cells (and B-plasma cells) have been produced through the process of clonal selection. After some time the B-memory cells migrate to the lymph nodes where they remain until activated by antigens. The B-plasma cells produce large amounts of antibodies which circulate in the body for only around a month.*

Question 24

Vaccines, which contain dead or attenuated disease-causing micro-organisms, activate the immune system to produce antibodies and prevent development of the disease.
This form of immunity is known as

A. **acquired active immunity.**
B. acquired passive immunity.
C. natural active immunity.
D. natural passive immunity.

Answer is A

Tips

- *A is correct. Acquired active immunity involves introducing a dead or attenuated form of a pathogen (through a vaccine) to an organism to stimulate the immune system to make memory cells so that it is ready for rapid activation in the event of an infection of that same (or closely related) pathogen.*
- *B is incorrect. Immunity can also be acquired passively through inoculation with antibodies produced by other organisms.*
- *C and D are incorrect. Immunity can also be developed naturally either when antibodies pass from mother to foetus through the placenta (D) or when an individual naturally comes into direct contact with a live form of the pathogen (not through a vaccine) and the immune system produces antibodies and continues to do so (C).*

Question 25

An allergic response is an exaggerated immune response to normally harmless substances found on the surfaces of foods, animals, drugs or cosmetics.

The cells most directly associated with an allergic response are

A. mast cells.
B. **mast cells and basophils.**
C. basophils.
D. lysosomes.

Answer is B

Tips

- *A and C are incorrect – not specific enough. Cells most directly associated with an allergic response are mast cells and basophils. Both cell types are associated with the response – not one or the other.*
- *D is incorrect. Lysosomes are associated with the breakdown and recycling of molecules within cells, not immunity.*

END OF SECTION A

SECTION B – Short-answer questions

Question 1

AREA OF STUDY 1 – Molecules of life
Key Knowledge – The chemical nature of the cell; the synthesis of macromolecules
Knowledge of the chemical composition (the constituent elements) of the biological molecules is expected in this question. Students should be able to review the composition of these samples and, based on the elements present (and their relative amounts), deduce what macromolecules they are most likely to be and why. Students should be able to identify the subunits which make up a nucleotide unit.

As part of a research project, four samples of organic material were scientifically analysed to determine the percentage composition of different elements. The results of the analysis are shown in the table.

Percentage	Sample A	Sample B	Sample C	Sample D
Carbon	32	22	20	23
Hydrogen	45	46	35	48
Oxygen	21	20	21	26
Nitrogen	15	12	31	0
Sulphur	2	0	0	0
Phosphorus	0	0	14	0

1a. State which elements are found in proteins.

Answer

Carbon, hydrogen, oxygen, nitrogen and sulphur

1 mark

Tip

- *All five elements must be given in the answer to be awarded 1 mark for this question.*

1b. i. State which one of the samples is most likely to be a nucleic acid.

Answer

Sample C

1 mark

1b. ii. Explain the reason for your choice.

Answer

Nucleic acid is composed of carbon, hydrogen, oxygen phosphorus and nitrogen. Each of these elements (and no others) is present in Sample C.

1 mark

AREA OF STUDY 1 – Molecules of life
Key Knowledge – The chemical nature of the cell; the structure of DNA and RNA
Knowledge of the similarities and differences between DNA and RNA are required here. Students should have confident knowledge of the distinction between a ribose and deoxyribose sugar.

Nucleic acids serve as a blueprint in the production of proteins. There are two types of nucleic acids: DNA and RNA.

1c. Explain the fundamental difference between the chemical structures of DNA and RNA.

Answer

The existence of a ribose sugar in RNA (ribonucleic acid) and a deoxyribose sugar in DNA. The deoxyribose sugar lacks an oxygen atom on its carbon.

1 mark

AREA OF STUDY 1 – Molecules of life
Key Knowledge – The chemical nature of the cell; the synthesis of macromolecules
Knowledge of the relationship between monomers and polymers, an awareness of the process involved in the formation of polymers (macromolecules), and an ability to apply understanding of macromolecule composition to specific examples. Chitin is a structural polysaccharide, and a saccharide is a carbohydrate which is comprised of carbon, hydrogen and oxygen. Therefore, the sample most likely to contain chitin will contain those three elements.

Chitin, a structural polysaccharide, is a major component of the arthropod exoskeleton. It is similar to cellulose except for the addition of nitrogen in the glucose monomer.

1d. i. Define the term monomer.

Answer

A single subunit/building block of a polymer

1 mark

1d. ii. What is the name given to the process where monomers join to become macromolecules?

Answer

Polymerisation

1 mark

1d. iii. Which sample is most likely to contain chitin?

Answer

Sample B

1 mark

Tip

- *Not Sample A (chitin, a carbohydrate like cellulose, does not contain sulphur) or Sample C (chitin, a carbohydrate like cellulose, does not contain phosphorus). Not Sample D because chitin contains nitrogen.*

Question 2

AREA OF STUDY 1 – Molecules of life
Key Knowledge – The role of the organelles and plasma membranes in the packaging and transport of biomolecules
It is expected that students will have a clear knowledge and understanding of the relationship between structure and function in cells of living organisms. They should be able to explain the function of a structure and, if given the function, name the structure. It is also expected that they can make a prediction about cell type based on a description of structure and function. In addition, an understanding of how body cells are physically supported at an intracellular and extracellular level and knowledge of the cells that contribute to this support network is essential.

Living organisms are comprised of one or more cells. All cells have distinctive structures and these structures are directly related to the specific function of the cell.

The table below shows information about cells found in a typical eukaryotic organism.

2a. Complete the table below.

Answers (in *italics*)

Cell type	**Cellular structure**	**Function of structure**
epithelial cell	microtubule	*maintaining cell shape* **OR** *enabling the elongation of cells* **OR** *facilitating movement of organelles and/or chromosomes* **OR** *involved in spindle formation during eukaryote cell division* 1 mark
muscle cell	*mitochondrion* 1 mark	site of ATP production
sperm cell **OR** *unicellular eukaryote* 1 mark	flagellum	produces motion to allow transport
liver cell	endoplasmic reticulum	*transport channels for newly made proteins in cell, smooth ER* **OR** *site of protein synthesis, rough ER* **OR** *site of membrane production* 1 mark

4 marks

In addition to their complex internal structure, body cells of some eukaryotes are supported by connective tissue such as bone and cartilage.

2b. i. What is the name of the network that surrounds cells in body tissues?

Answer

Extracellular matrix (ECM)

1 mark

2b. ii. What cells produce and secrete the macromolecules that contribute to this network?

Answer

Fibroblasts

1 mark

Question 3

AREA OF STUDY 1 – Molecules of life
Key Knowledge – The nature of biochemical processes; energy transformations, including main stages in and sites of photosynthesis and cellular respiration

Students are required to demonstrate a clear knowledge of the different stages of photosynthesis, and specifically where they occur in the photosynthesising cell. Also required is knowledge of the products of both stages of photosynthesis. Students should be able to demonstrate a similarly thorough knowledge of the three stages of cellular respiration and where they occur in plants.

Vicia faba is a species of broad bean commonly used in investigations of plant growth. Like all plants, the broad bean is reliant on the biochemical processes of photosynthesis and cellular respiration for survival. Photosynthesis occurs in structures known as chloroplasts.

There are two phases in photosynthesis – a light-dependent phase and a light-independent phase.

3a. Where in the chloroplast does the light-dependent phase occur?

Answer

Thylakoid membranes

1 mark

3b. What is produced as a result of the light-independent phase?

Answer

Sugar

OR

Carbohydrate

1 mark

Plants are dependent on photosynthesis because it produces essential materials for the process of cellular respiration.

Cellular respiration proceeds over three stages – glycolysis, Krebs cycle and electron transport.

3c. i. Where in a plant cell does glycolysis occur?

Answer

Cytosol

1 mark

3c. ii. Where in a plant cell does electron transport occur?

Answer

Inner mitochondrial membranes

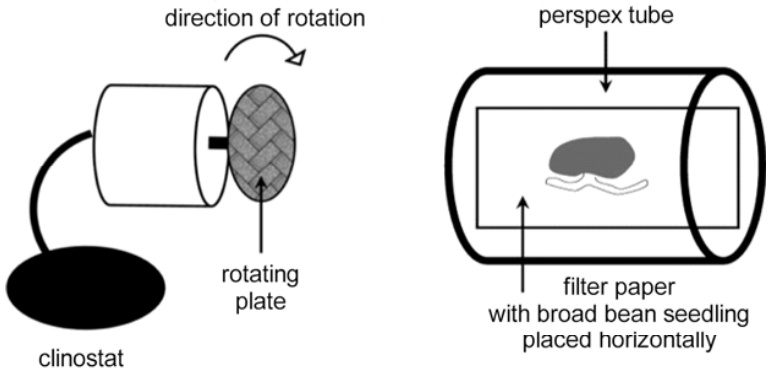
1 mark

Question 4

AREA OF STUDY 2 – Detecting and responding
Key Knowledge – Co-ordination and regulation; signalling molecules; plant growth regulators

Question 4 expects that students will have a clear knowledge and understanding of communication and regulation of growth in plants, and in particular, how environmental factors can impact on these responses. In addition, students are required to read and process information about experimental design, procedure and results, and draw logical and accurately supported conclusions from the evidence they are given. While students may not have knowledge of starch statoliths, they should be able to apply their knowledge about plant hormones (auxins and their variable effects on different types of cells in a plant) to draw inferences and explain the directional growth of roots and shoots.

An experiment was carried out to investigate the control of growth of roots and shoots in the broad bean *Vicia faba*. Young broad bean seedlings (approximately 2 cm) were placed securely against water soaked filter paper in clear perspex tubes that also contained a hydrating gel. The tubes were uncapped during the day, capped loosely at night and experienced the same light conditions. A clinostat (a device consisting of a rotating plate which can revolve at various speeds) was used in the experiment.



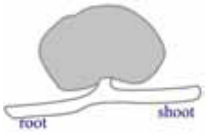
Group 1: seedling placed horizontally and grown in the light (no clinostat)

Group 2: seedling placed horizontally on a clinostat (not switched on)

Group 3: seedling placed horizontally on a clinostat (switched on slow)

Group 4: seedling placed horizontally on a clinostat (switched on fast)

The results are shown in the following table.

Group 1	**Group 2**	**Group 3**	**Group 4**
seedling placed horizontally seedling not placed on clinostat	seedling placed horizontally on a clinostat clinostat not switched on	seedling placed horizontally on a clinostat clinostat switched on (slow rotation)	seedling placed horizontally on a clinostat clinostat switched on (fast rotation)
			

4a. What is the name given to the plant response investigated in this experiment?

Answer

Geotropism

OR

Gravitropism

1 mark

4b. Why was a clinostat used in this experiment?

Answer

To investigate the effect of rotation on geotropic responses

1 mark

4c. Using the information from the experiments, what conclusion can you make about the growth of roots and shoots? Explain how you reached your conclusion.

Answer

Conclusion
That speed of rotation has an effect on the geotropic response of roots and shoots of bean seedlings.

1 mark

Explanation
Under normal conditions (Group 1 and Group 2) roots and shoots demonstrate positive and negative geotropism. In Group 3 the slow rotation results in a clearly observable response to gravity. In Group 4 the rotation is fast, preventing the plant from responding to the gravitational stimulus.

2 marks

Roots and shoots of broad beans have cells which contain starch grains known as starch statoliths. It has been hypothesised that the position of statoliths has a direct impact on the distribution of the plant hormone associated with growth in the root and shoot.

4d. What is the name of the plant hormone associated with growth in the root and shoot?

Answer

Auxin

1 mark

4e. Using the information from the experiments and your knowledge of plant hormones, explain the directional growth of roots and shoots in broad beans.

Answer

Statoliths have an impact on the distribution of auxin. Auxins accumulate on the lower side of the roots and shoots (1 mark).
In the shoot, auxin enhances cell elongation on the lower side, leading to upward curvature. In the root, auxin inhibits cell growth on the lower side, leading to a downward curvature (1 mark).

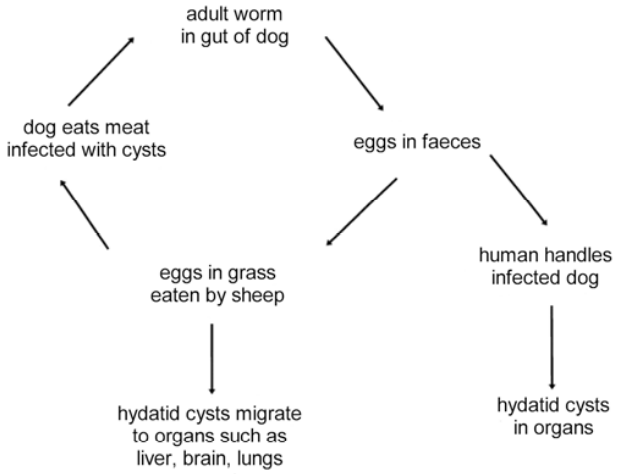
2 marks

Question 5

AREA OF STUDY 2 – Detecting and responding
Key Knowledge – Co-ordination and regulation; physical and chemical barriers to infection in plants and animals
Pathogens, cellular agents, strategies for the control of pathogenic agents

Students are expected to demonstrate their knowledge and understanding of the characteristics of organisms that cause disease, in particular parasites. Awareness of the various stages of a parasite life cycle (including hosts and vectors) and characteristics that enable it to survive in the host is essential. Ability to identify and discuss strategies for successful treatment and control is also necessary.

The hydatid tapeworm *Echinococcus granulosis* normally inhabits the intestines of dogs. The mature adult produces eggs that are passed in the dog faeces. The eggs contaminate grass and, in rural areas, are ingested by livestock, usually sheep. In the sheep, the eggs develop into hydatid cysts that contain many tapeworm heads. Individual cysts can generate more cysts that are suspended in the fluid of the mother cyst. Hydatid cysts move into the bloodstream and migrate to body tissue, in particular, the liver, brain and lungs. Dogs can ingest the hydatid cysts if they eat raw tissue from infected dead livestock.



5a. What is the role of the sheep in the life cycle of *Echinococcus granulosis*?

Answer

Intermediate host

1 mark

5b. Identify one structural feature you would expect to find in the mature adult and explain how it helps it to survive in the dog.

Answer

A scolex with suckers or a scolex with a ring of hooks (1 mark)
It maintains a strong attachment to the intestinal wall of the dog. (1 mark)

OR

The mature adult has a protective body coating (1 mark)
It makes it resistant to digestive enzymes found in the intestine of the dog (1 mark).

2 marks

Humans can become infected by *Echinococcus granulosis* after handling infected dogs. In some circumstances, growing cysts can block blood vessels leading to vital organs. With care, the cysts can be removed surgically.

5c. Why is it necessary to ensure that cysts are removed intact from an infected person?

Answer

If the cyst ruptures during removal, the worms in the cyst may be spread further.

1 mark

5d. What is one method that can be used to prevent domestic pets from being infected by this parasitic worm?

Answer

Worming tablets

1 mark

Question 6

AREA OF STUDY 2 – Detecting and responding
Key Knowledge – Signalling molecules: pheromones
Knowledge of the existence of chemical signalling between organisms is expected in this question. Specifically, students should be able to recognise and identify the behaviour demonstrated by the silkworm moths and be able to identify that a pheromone is involved in the signalling. More diverse and complex uses of chemical signals such as trapping prey through simulation of other species' pheromones (mimicry) should be familiar. Students should be able to apply knowledge about receptors to this question.

Bombyx mori is a silkworm moth. The female silkworm moths attract males by emitting chemical signals that diffuse through the air. A male hundreds of metres away is capable of detecting these molecules and will fly toward their source.

6a. What is the name given to the chemical used by the female silkworm moth?

Answer

Pheromone

1 mark

In some circumstances, other organisms will release the same chemical signals used by certain species. This enables them to trap their prey more effectively.

6b. i. What term is used to describe the simulation of this chemical signal?

Answer

Mimicry

1 mark

6b. ii. For what other purpose is an organism likely to copy a characteristic of another species?

Answer

As a defence against a predator

1 mark

The male silkworm moth has large comb-like antennae which act as sensory organs for the chemicals the female emits. Each filament of an antenna possesses thousands of structures that detect the chemical signal.

6c. What is the general name given to the detecting structures found on the antennae?

Answer

Receptors

1 mark

Question 7

AREA OF STUDY 2 – Detecting and responding
Key Knowledge – Co-ordination and regulation; disorders of the immune response
Students are expected to demonstrate recognition, understanding and knowledge of autoimmune disease and its characteristics in terms of the ability to recognise self and non-self cells and the role that B-cells and T-cells play in this process. It is also expected that students will be able to make links between autoimmune disease (as it relates to MS) and electrical communication. Knowledge and understanding of the structure and function of neurons and the mechanism by which electrical impulses are transmitted across a junction between two neurons is essential. Students should be able to discuss transmission of a nerve impulse across the synaptic cleft in terms of diffusion of neurotransmitter substance, protein receptor, the pre- and post-synaptic membrane.

Multiple sclerosis (MS) is the most common chronic disease of the central nervous system in developed countries. It affects one in 1000 people of northern European origin and is considered an autoimmune disease.

7a. What are the characteristics of an autoimmune disease?

Answer

The immune system loses the ability to distinguish self cells from non-self cells. B-cells and T-cells then attack and destroy self cells.

1 mark

7b. i. What is the myelin sheath?

Answer

The fatty layer surrounding the axons of many neurons

1 mark

7b. ii. What is its function?

Answer

It increases the speed at which electrical impulses travel along the nerve.

OR

It insulates nerve fibres from each other, enhancing the speed of impulse.

1 mark

For a person who does not have MS, communication signals between the central and peripheral nervous systems are unimpaired.

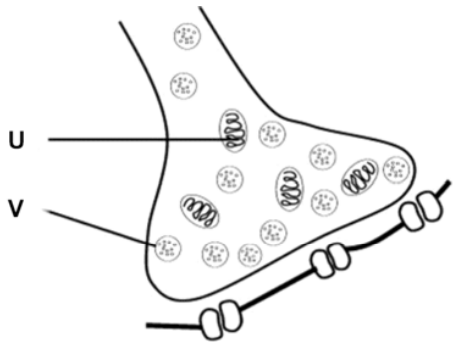
7c. By what method are communication signals principally transmitted in the nervous system?

Answer

By electrical impulses

1 mark

The diagram shows the junction between two neurons.



7d. **i.** Identify structure U. What is its function?

Answer

Mitochondrion
ATP production

1 mark

Tip

- *No mark is awarded for 'mitochondria' – only one is indicated on the diagram, therefore the singular form is correct.*

7d. **ii.** Identify structure V. What is its function?

Answer

Secretory vesicle
Storage of chemical neurotransmitter

1 mark

Between the two neurons there is a gap known as a synaptic cleft.

7e. How does the communication signal travel across this gap?

Answer

The electrical impulse arrives at the end of the axon/synaptic knob which triggers secretory vesicles to migrate towards the pre-synaptic membrane (1 mark).
The vesicles fuse with the membrane and release neurotransmitter into the synaptic cleft (1 mark).
Neurotransmitter diffuses across synaptic cleft and binds with protein receptors on the post-synaptic membrane (1 mark).

3 marks

Tip

- *The maximum score for this question is 3 marks; all information presented must be correct to gain full marks.*

Question 8

AREA OF STUDY 2 – Detecting and responding
Key Knowledge – Immune response, acquired immunity; physical and chemical barriers to infection in plants and animals
In this question, students are expected to be able to distinguish, at a biological level, between infection and disease. An understanding of the three lines of defence in immunity is vital, and students must be able to clearly distinguish between them. A clear knowledge of the different cells and non-cellular material that contribute to defence at each level must be demonstrated in this question. Knowledge of non-specific versus specific immunity is essential as is an understanding of the immunological principles behind vaccination.

The human body acts in many ways to guard against infection and disease. Sometimes these lines of defence are not always effective and a person may become infected with a pathogen. *Clostridium tetani* is a bacterial micro-organism that causes a disease called tetanus.

8a. What is the difference between an infection and a disease?

Answer

An infection occurs when a pathogen enters an organism; a disease is the state which results due to the harmful effects of a pathogen in its host.

1 mark

If the first line of defence fails and *Clostridium tetani* enters the body, a series of responses occurs. Cells known as phagocytes play a significant role in the second line of defence.

8b. How does a macrophage contribute to second-line defence?

Answer

It moves from blood vessels to tissues engulfing and digesting bacteria and dead cells by phagocytosis.

1 mark

Complement proteins are blood proteins that assist phagocytes in recognising pathogenic micro-organisms. There are around 20 known complement proteins.

8c. Outline one way that complement proteins can assist phagocytes in recognising pathogenic micro-organisms.

Answer

By coating the surface of fungi or bacteria and signalling to phagocytes to engulf them

OR

By promoting inflammation and attracting phagocytes and other leucocytes

1 mark

If *Clostridium tetani* has entered the body through the skin, there may be some inflammation at the site of entry.

8d. Explain what causes the inflammation in the area.

Answer

Arterioles in the injured area vasodilate, leading to an increased blood flow to the area.

1 mark

8e. What chemical is associated with the inflammatory response?

Answer

Serotonin

OR

Histamine

1 mark

8f. State whether this response is an example of non-specific or specific immunity.

Answer

Non-specific immunity

1 mark

The current program against vaccine-preventable diseases in Australia recommends that infants, children and adults be immunised against tetanus at the age of 2 months, 4 months, 6 months, 4 years and around 15 years, with a booster every 5 years afterwards.

8g. Why is it necessary to have so many immunisations in the first 6 months of life?

Answer

It can take an immature immune system longer to build up the necessary numbers of B-memory cells that recognise and destroy the *Clostridium tetani*.

1 mark

END OF SOLUTIONS BOOK