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INSIGHT
Trial Exam Paper

2010

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>	<i>Suggested times (minutes)</i>
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.
- An answer sheet for multiple-choice questions.

Instructions

- Write your **name** in the box provided and on the answer sheet for multiple-choice questions.
- You must answer the questions in English.

At the end of the examination

- Place the answer sheet for multiple-choice questions in the front cover of the question and answer 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** or that **best answers** the question.

1 mark will be awarded for a correct answer; no marks will be awarded for an incorrect answer.

Marks are **not** deducted for incorrect answers.

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

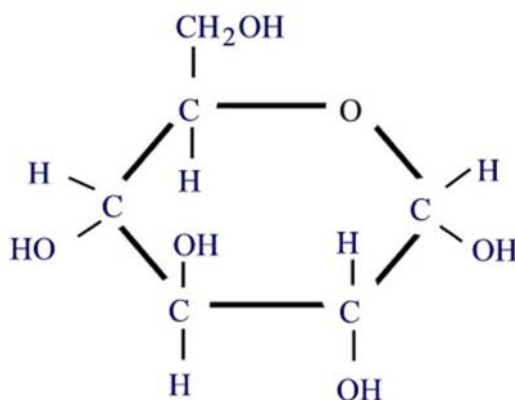
Question 1

Organic molecules are comprised of many elements. Three of the six elements most commonly found in organic molecules are carbon, hydrogen and oxygen. Three more elements commonly found in organic molecules include

- A. nitrogen, phosphorus, zinc.
- B. nitrogen, sulfur and phosphorus.
- C. nitrogen, phosphorus, calcium.
- D. nitrogen, sulfur, magnesium.

The following information relates to Questions 2, 3 and 4.

Glucose is the most common monosaccharide. The structural formula for glucose is



Question 2

Glucose molecules can be joined to make macromolecules known as polysaccharides. A polysaccharide commonly found in plants is

- A. cellobiose.
- B. cellulose.
- C. chitin.
- D. sucrose.

SECTION A – continued
TURN OVER

Question 3

The name given to the chemical reaction in which glucose molecules are joined together is

- A. condensation.
- B. hydrolysis.
- C. polymerisation.
- D. glycolysis.

Question 4

If five glucose molecules were added together, the molecular formula for the resulting polymer would be

- A. $C_{30}H_{60}O_{30}$
- B. $C_{30}H_{55}O_{30}$
- C. $C_{30}H_{55}O_{25}$
- D. $C_{30}H_{52}O_{26}$

Question 5

In living organisms, proteins

- A. are an essential source of energy.
- B. store hereditary information.
- C. receive signals from outside a cell.
- D. form steroid hormones.

Question 6

Which of the following is **not** found in a prokaryote cell?

- A. mitochondria
- B. plasma membrane
- C. ribosome
- D. double-stranded DNA

Question 7

In plant cells, plasmodesmata have a similar function to

- A. desmosomes.
- B. tight junctions.
- C. gap junctions.
- D. the extracellular matrix.

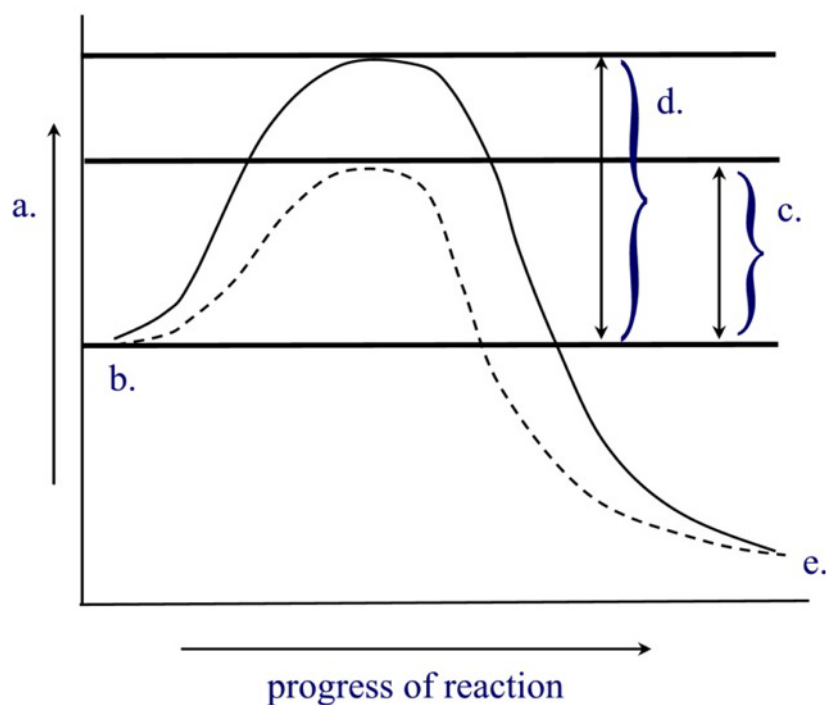
Question 8

The fluid mosaic model describes plasma membranes as consisting of

- A. a phospholipid bilayer with proteins embedded in and attached to it.
- B. a lipid bilayer with proteins coating the outside of the hydrophobic structure.
- C. a cholesterol bilayer with proteins embedded in the hydrophobic centre.
- D. a phospholipid bilayer with proteins sandwiched between the layers.

The following information relates to Questions 9 and 10.

The graph shows the progress of an endergonic reaction with and without an enzyme.



Question 9

An endergonic reaction

- A. involves the net release of free energy into the surrounding environment.
- B. involves the absorption of free energy from the surrounding environment.
- C. occurs in cellular respiration.
- D. follows a catabolic pathway.

Question 10

On the graph, the correct labels for the parts **a** to **e** are

	a.	b.	c.	d.	e.
A.	reactants	products	activation energy with enzyme	activation energy without enzyme	free energy
B.	products	free energy	activation energy without enzyme	activation energy with enzyme	reactants
C.	reactants	products	activation energy with enzyme	activation energy without enzyme	free energy
D.	free energy	reactants	activation energy without enzyme	activation energy with enzyme	products

Question 11

At the conclusion of glycolysis, the net products will be

- A. 2 ATP, 2 CO₂, 2 ethanol.
- B. 2 ATP, 2 NADH, 2 pyruvate, 2 H₂O.
- C. 38 ATP, 2 CO₂, 2 ethanol.
- D. 38 ATP, 6 CO₂, 2 pyruvate.

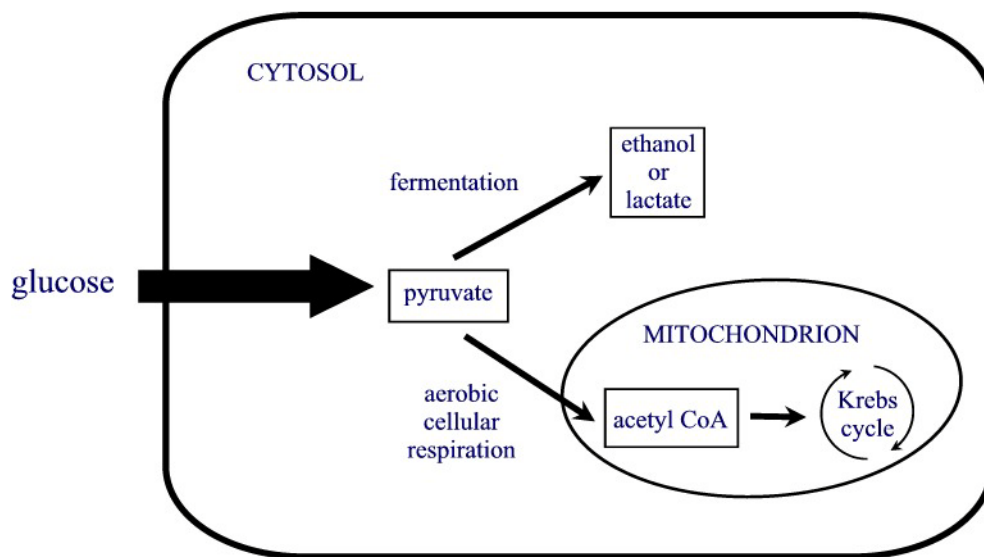
Question 12

Which of the following reactions is correctly paired with the location in which it occurs?

- A. glycolysis – cristae of mitochondrion only.
- B. citric acid cycle – cytosol.
- C. ATP synthesis – matrix of the mitochondrion only.
- D. electron transport – cristae of the mitochondrion.

Question 13

A process known as alcoholic fermentation has been observed in yeasts and roots cells of certain plants. The diagram shows the possible pathways that can follow glycolysis in a metabolising cell.



The principle outcome of alcoholic fermentation is the

- A. regeneration of the oxidising agent NAD⁺, enabling glycolysis to continue in the absence of oxygen.
- B. production of beer.
- C. production of lactic acid during exercise.
- D. significant increase in the amount of ATP produced in cellular respiration.

Question 14

During paracrine signalling, chemical signals are

- A. released from a cell and act upon other cells within the immediate vicinity of their origin.
- B. produced within a cell, diffuse locally and trigger a response in the cells that have released them.
- C. diffused into the bloodstream and trigger responses in target cells all around the body.
- D. released into the external environment where they can have an effect on the physiology or behaviour of other animals.

Question 15

The most accurate description of the difference between hormones and pheromones is

- A. pheromones are small, volatile molecules whereas hormones are not.
- B. pheromones are signals that function between organisms, whereas hormones communicate within an organism.
- C. pheromones use neurons as their means of transmission, whereas hormones use chemicals as their means of transmission.
- D. pheromones are involved in reproduction, whereas hormones are not.

Question 16

Epinephrine is a hormone produced in humans. When it binds to the muscle cells of the small intestine, contraction of the muscles is inhibited. In contrast, when it binds to heart muscle, it speeds up the contraction. Epinephrine can have different effects on muscle cells because

- A. small intestine muscle is not as strong as heart muscle and has a weaker response to epinephrine.
- B. the cells in small intestine muscle and heart muscle have different signal transduction pathways for epinephrine, producing different cellular responses.
- C. there are more receptors for epinephrine in heart muscle cells than there are in small intestine muscle cells.
- D. epinephrine circulates to the heart first and the higher concentration around heart muscle cells results in a stronger response.

Question 17

A signal molecule that binds to a plasma membrane protein functions as a

- A. protein kinase.
- B. receptor protein.
- C. second messenger.
- D. ligand.

Question 18

The bracken *Pteridium aquilinum* is an herbaceous plant which produces hormones that are capable of disrupting the development of insect predators as part of its passive defence mechanism.

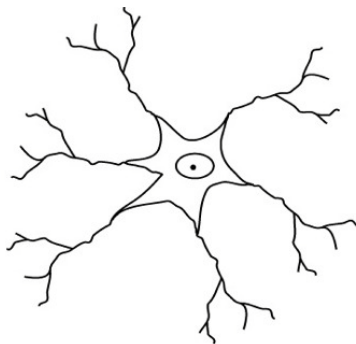


Another example of passive defence in *Pteridium aquilinum* could be the

- A. production of a carcinogen that is toxic to rodents and livestock.
- B. secretion of antibiotic-like substances to kill pathogens.
- C. sealing off infected areas with cork cells.
- D. increasing of reactive oxygen levels to kill microorganisms.

Question 19

The diagram below shows a representation of an interneuron.



In the nervous system, interneurons

- A. do not have cell bodies.
- B. are found only in the peripheral nervous system.
- C. have electrical synapses between neurons.
- D. may connect afferent and effector neurons.

Question 20

Sexually transmissible infections (STIs) are usually spread between humans when sexual contact is made between an individual who is infected with a disease and one who is not. An STI usually occurs in organs associated with the reproductive system but can also involve other systems of the body. Which of the following agents would **not** cause an STI?

- A. prion
- B. virus
- C. bacteria
- D. fungus

Question 21

There are three known classes of interferons. Interferons are proteins and can be released by

- A. helper T cells that bind to antigen presenting cells.
- B. macrophages that have become antigen-presenting cells.
- C. cells infected by viruses.
- D. mast cells that bind to antigens.

Question 22

The ability of the immune system to distinguish self from non-self limits the success of blood transfusion. As shown in the table below, in the ABO blood group system, there are four groups A, B, AB and O. People are classified into one of these groups on the basis of the antigen found on their red blood cells and the antibodies present in their blood plasma.

Blood group	Antigen on plasma membrane	Antibody in plasma
A	A	anti-B
B	B	anti-A
AB	A and B	neither anti-A nor anti-B
O	neither A nor B	anti-A and anti-B

A transfusion of Type B blood was given to a person who has Type A blood. As a result of the transfusion

- A. there would be no reaction because Type B is a universal donor blood type.
- B. the recipient's anti-B antibodies reacted with the donated red blood cells.
- C. the recipient formed anti-A and anti-B antibodies.
- D. the recipient's B antigens reacted with the donated anti-B antibodies.

Question 23

Phagocytosis is the process in which large substances are taken up by a cell. A target cell is most likely phagocytosed by a

- A. plasma cell.
- B. neutrophil.
- C. natural killer cell.
- D. cytotoxic T cell.

Question 24

In 1955 Sir Macfarlane Burnet first proposed the clonal selection theory. Clonal selection is responsible for

- A. rearrangement of antibody genes.
- B. recognition of Class I MHC markers by cytotoxic T cells.
- C. formation of cell cultures in the commercial production of monoclonal antibodies.
- D. proliferation of clones of plasma and memory cells specific for an antigen that has been encountered.

Question 25

In some individuals, when there is an interruption of the normal ability to distinguish self from non-self, an autoimmune disease occurs. Which of the following would **not** be considered an autoimmune condition?

- A. insulin-dependent diabetes (Type 1).
- B. non-insulin dependent diabetes (Type 2).
- C. multiple sclerosis.
- D. rheumatoid arthritis.

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

Answer this section in **pen**.

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

Question 1

In humans, sickle cell disease is an inherited blood disorder caused by a mutation in the sixth DNA triplet of the HBB gene (the gene that codes for the beta haemoglobin chain). The mutation, where an A is replaced by a T, occurs at nucleotide 17, producing the triplet GTG. The normal DNA triplet in the sequence is GAG.

1a. In GAG, what does the letter A represent?

1 mark

		SECOND BASE					
		T	C	A	G		
FIRST BASE	T	phe	ser	tyr	cys	T	THIRD BASE
		leu		stop	stop	A	
				stop	trp	G	
	C	leu	pro	his	arg	T	
				gln		A	
		ile		thr	asn	ser	
	met/stop	lys	arg		A		
	G	val	ala	asp	gly	T	
				glu		C	
				A			
				G			

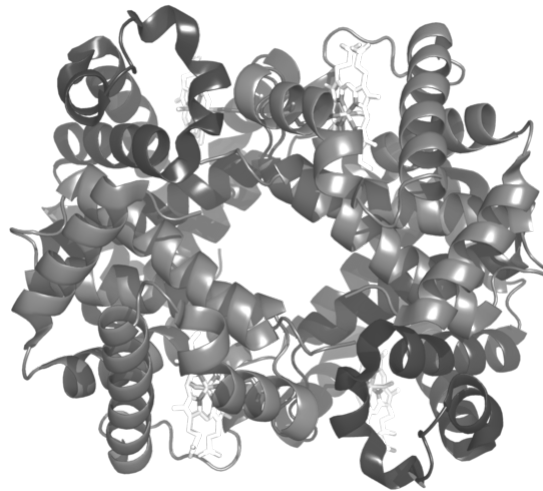
1b. Use the information in the table above to indicate how the normal beta haemoglobin chain differs from the sickle cell haemoglobin chain.

1 mark

- 1c.** Apart from DNA, identify one other molecule that plays a significant role in the production of a polypeptide and briefly outline its function.
-

1 mark

Haemoglobin is a protein that carries oxygen in red blood cells. It is a molecule made up of four haemoglobin chains, two alpha chains and two beta chains, and four haem (iron containing) groups attached at the centre of each chain. A representation of a molecule of adult haemoglobin is shown below.



- 1d.** What type of protein is haemoglobin?
-

1 mark

- 1e.** What level of structure is found in the haemoglobin molecule?
-

1 mark

- 1f. i.** What is the function of the haem group associated with each of the polypeptide chains in the molecule?
-

1 mark

- 1f. ii.** What is the name given to the non-protein component of haemoglobin?
-

1 mark

Total 1+1+1+1+1+1+1=7 marks

SECTION B – continued

Question 2

The principle source of energy for all living organisms comes from the sun. Radiant energy is transformed into chemical energy which is then incorporated into energy available in food chains.

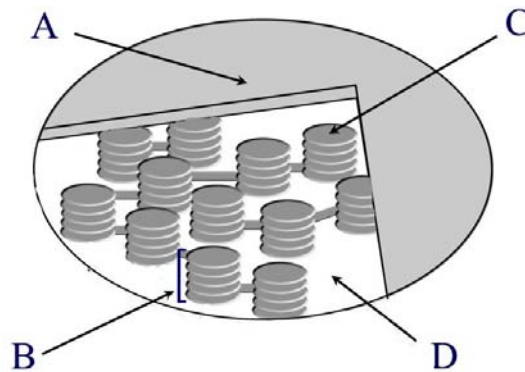
2a. i. What is the name of the process that transforms radiant energy into chemical energy?

1 mark

2a. ii. Write the balanced chemical equation for this process.

2 marks

The diagram below shows an organelle typically associated with the process described in part **2ai**.



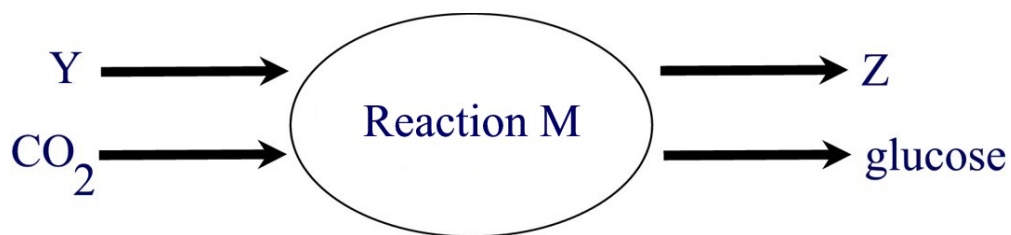
2b. Identify the structures and their associated function by completing the following table.

	Structure	Function
A		
B		
C		
D		

4 marks

SECTION B – Question 2 – continued
TURN OVER

The diagram below shows a symbolic representation of Reaction M which occurs as part of the process described in part **2ai**.



2c. i. Suggest what input Y might represent.

1 mark

2c. ii. Suggest what output Z might represent.

1 mark

Total 1+2+4+1+1=9 marks

Question 3

There are more than 100 different types of naturally occurring gibberellins in plants. The major events in the discovery of gibberellins are summarised in the table.

Time	Event
Early-20th century	Farmers in Asia noticed that some rice seedlings in their rice paddies were hyperelongated causing them to fall over before they could reach maturation and flowering.
1926	Ewiti Kurosawa (plant pathologist) discovers that a fungus of the genus <i>Gibberella</i> causes hyperelongation in plants.
1930s	A fungus causes hyperelongation by secreting a chemical; the chemical is subsequently named gibberellin.

Gibberellins belong to a group of chemicals known as hormones or plant growth regulators. Hormones are produced by plants and animals.

- 3a.** Identify one similarity and one difference shown by hormones produced in plants and hormones produced in animals.

Similarity:

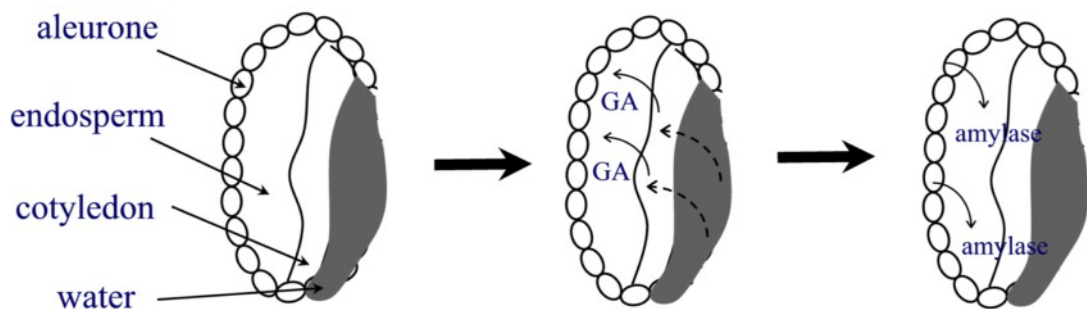
Difference:

2 marks

- 3b.** What other plant hormone is capable of stimulating cell elongation in plants?

1 mark

The seeds of the barley plant *Hordeum vulgare* store nutrients in the endosperm, tissue which provides nourishment to the developing embryo (cotyledon). After planting and watering, a seed absorbs water, which causes the cotyledon to release gibberellins (GA). This signals the seed to break dormancy and commence germination. In addition, gibberellin triggers the release of amylase from the aleurone. Amylase hydrolyses starch in the endosperm to sugar. This process is described in the diagram.

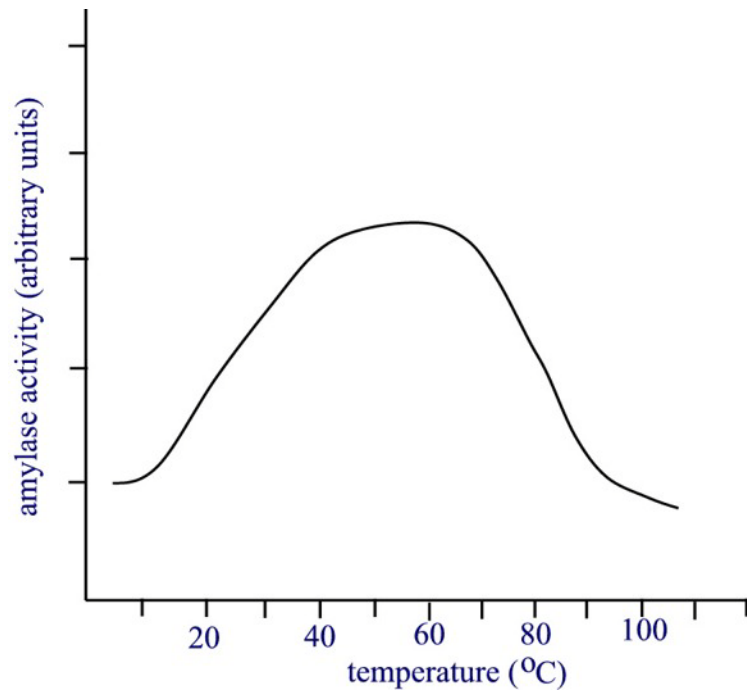


- 3c.** What is amylase and what is the relationship between amylase and starch?

2 marks

SECTION B – Question 3 - continued
TURN OVER

Amylase is also produced by the salivary glands in humans and begins the process of carbohydrate digestion in the mouth. The graph shows the activity of amylase across a range of temperatures.



3d. Explain the effect on amylase activity as the temperature approaches 100°C.

2 marks
Total 2+1+2+2=7 marks

Question 4

- 4a.** Select a homeostatic system you have studied in Unit 3 Biology and use **all** the components in the box below to present a labelled diagram explaining how the specific system operates. You can also include your own components to explain the model.

response	stimulus	receptor	effector	processing centre
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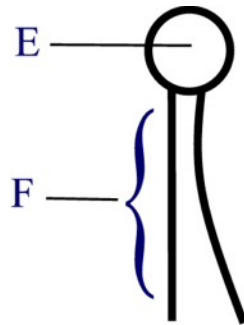
2 marks

- 4b.** Explain whether this is an example of a positive or negative feedback mechanism.

1 mark

Question 5

Cell membranes are found in all organisms. The primary constituent of a cell membrane is a phospholipid, the structure of which is shown in the diagram below.



5a. Identify the structures and describe their behavioural properties in water by completing the following table.

	Structure	Behaviour in water
E		
F		

3 marks

Two students were having a discussion about biological molecules. Student A was insistent that lipids should be grouped with carbohydrates, proteins and nucleic acids, whilst Student B disagreed vehemently, stating instead that lipids were the ‘odd group out’ and should be grouped independently.

5b. State which student is correct and clearly explain your reasoning.

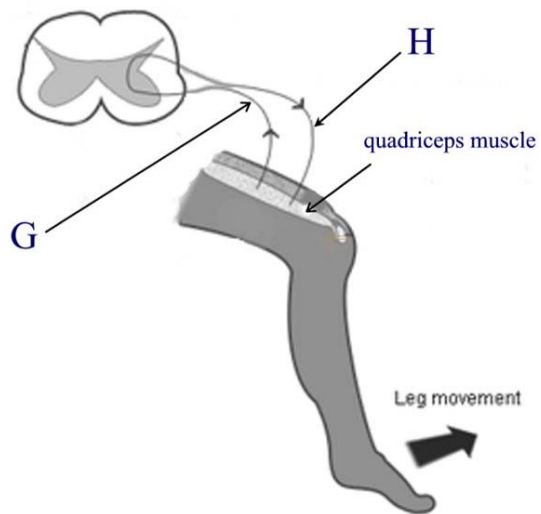
2 marks

Total 3+2=5 marks

SECTION B – continued
TURN OVER

Question 6

The diagram below shows a nerve pathway in humans which becomes activated automatically if the tendon connected to the quadriceps muscle in the leg is stimulated.



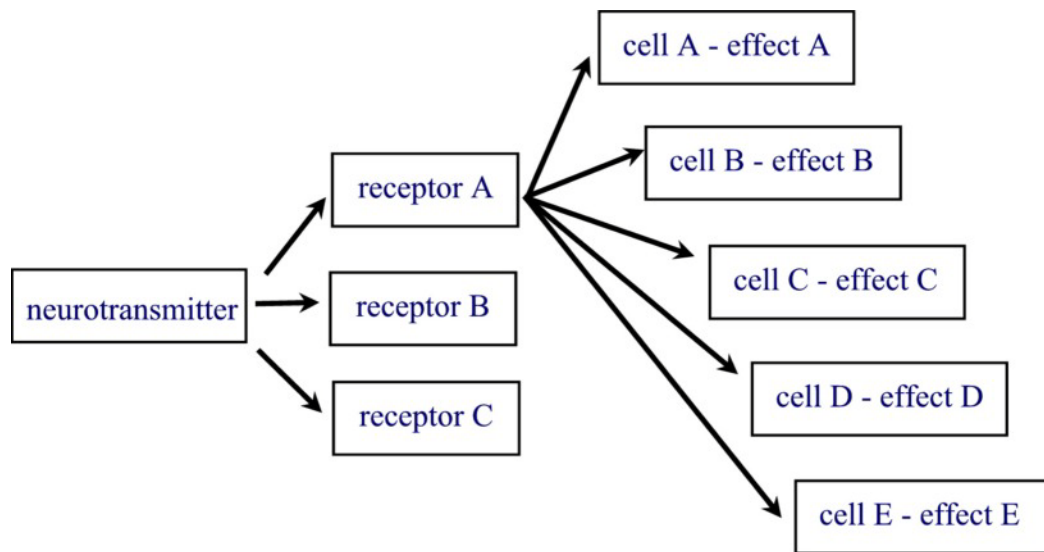
- 6a.** Name and explain the characteristics associated with this particular type of nerve pathway.

1 mark

- 6b.** Using the letters shown, indicate which part of the diagram represents a sensory neuron.

1 mark

There are over 100 known neurotransmitters which are classified into five groups based on chemical structure. The diagram models a potential neurotransmitter–receptor–effect interaction in a human nervous system.



6c. i. What is a neurotransmitter?

1 mark

6c. ii. Explain why this model of neurotransmitter-receptor-effect interaction could have implications in the development of drugs that are used to manage brain function or treat nervous system diseases.

2 marks

Total 1+1+1+2=5 marks

SECTION B – continued
TURN OVER

Question 7

In the middle of 2009, a new influenza A (H1N1) virus circulated amongst humans around the globe. The human population demonstrated little or no immunity to the virus and due to its highly contagious nature it spread rapidly, particularly among people between the ages of 10 to 45. Typical symptoms of the disease include fever, cough, headache, muscle and joint pain, sore throat and runny nose, and sometimes vomiting and diarrhoea.

7a. Identify one mode of transmission for influenza A (H1N1) virus.

1 mark

During the early stages of the pandemic, the only treatment available for influenza A (H1N1) was an antiviral medication (oseltamivir or zanamivir); there were no vaccinations. In a desperate effort to control and contain the spread of the virus, antiviral medication was administered, in many cases only on the basis of symptoms. Serious concerns were expressed over this approach to the management of the disease.

7b. Identify a problem that could occur from the widespread use of antiviral medication.

1 mark

In September 2009, the Therapeutic Goods Administration (TGA) approved an influenza A (H1N1) vaccine for use in Australia. With many immunisation programs it is necessary to administer the vaccination at intervals over several months. With influenza A (H1N1) vaccine only a single dose is required and is recommended for all individuals who are ‘most at risk of exposure’.

7c. Why is the vaccination for influenza A (H1N1) recommended for those at ‘most risk of exposure’ to the virus, even if they have taken a course of the influenza A (H1N1) antiviral treatment?

2 marks

Total 1+1+2=4 marks

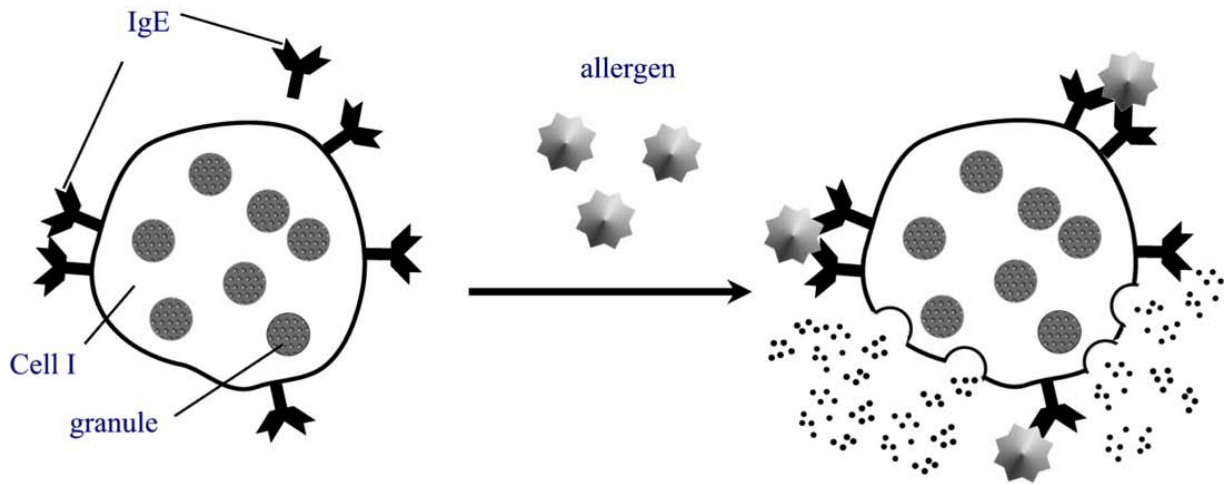
Question 8

In humans, acquired immunity can provide significant protection against a vast array of pathogens; however, if a disruption occurs within the immune system, disease can occur or become exacerbated.

8a. What is acquired immunity?

2 marks

Allergies are considered disruptions to the immune system and are described as hypersensitive responses to particular antigens known as allergens. The most common allergies are associated with antibodies of the IgE class. The diagram describes the events that take place in an allergic response.



8b. What is the name given to Cell I?

1 mark

8c. Outline the sequence of events which lead to the binding of IgE molecules to Cell I.

3 marks

Total 2+1+3=6 marks