



**SECTION A – Multiple-choice questions****Instructions for Section A**

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

Choose the response that is **correct** for the question.

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

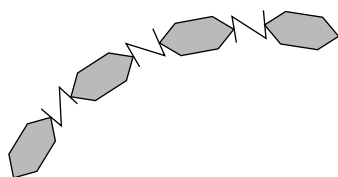
Marks will **not** be deducted for incorrect answers.

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

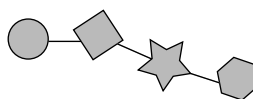
**Question 1**

The most appropriate representation of a triglyceride is

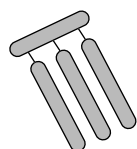
A.



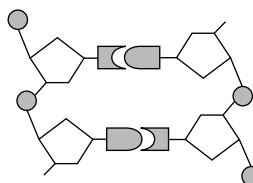
B.



C.



D.

**Question 2**

The activity of an enzyme is

- A. decreased by the presence of an inhibitor.
- B. unaffected by the pH of the cytosol of a cell.
- C. reduced at very low temperatures due to denaturation.
- D. increased as the temperature rises above the enzyme's optimum temperature.

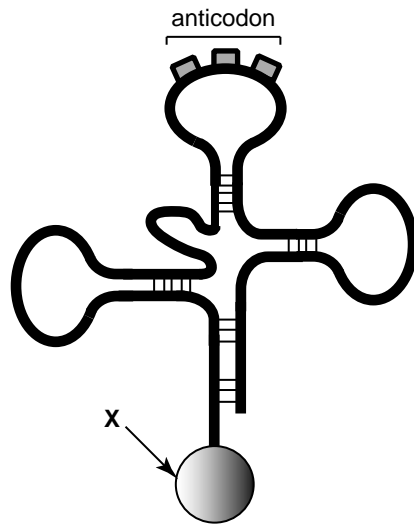
**Question 3**

Synthesis of sucrose from glucose is

- A. a catabolic reaction that joins molecules together.
- B. an exergonic reaction involving the breaking of chemical bonds.
- C. an anabolic reaction that releases energy for cellular metabolism.
- D. an endergonic reaction that requires an input of energy to proceed.

**Question 4**

Examine the following diagram.



Structure X represents

- A. DNA.
- B. a vesicle.
- C. an amino acid.
- D. three nucleotides.

**Question 5**

A particular DNA double helix is 100 nucleotide pairs long and contains 25 adenine bases.

The number of guanine bases in this DNA double helix would be

- A. 25
- B. 50
- C. 75
- D. 100

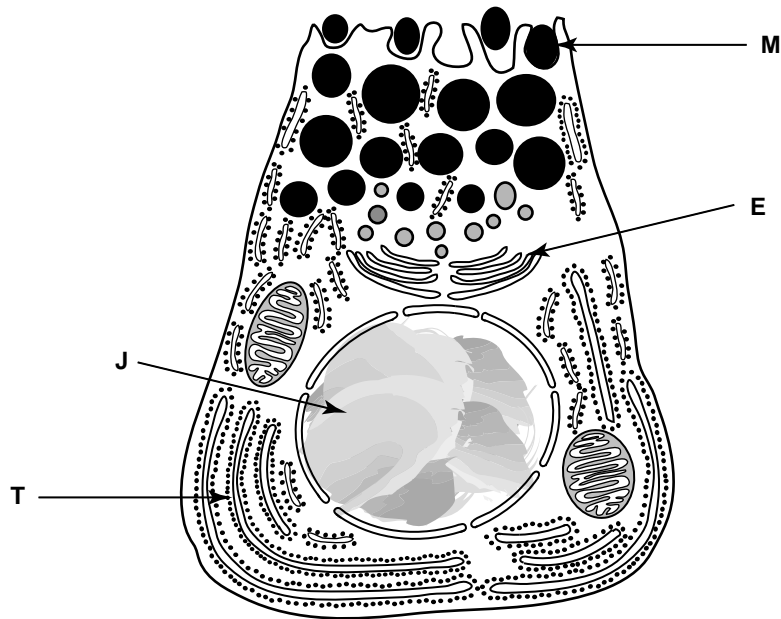
**Question 6**

Plants growing in soil with low levels of nitrogen may be unable to produce sufficient molecules of

- A. ribonucleic acids.
- B. triglycerides.
- C. cellulose.
- D. sucrose.

**Question 7**

Examine the following diagram of a pancreatic cell.



The order in which the parts of the cell play a role in the production and secretion of proteins is

- A. M, E, J, T
- B. T, J, M, E
- C. J, T, E, M
- D. E, M, T, J

**Question 8**

Protein forms part of the structure of

- A. polysaccharides.
- B. transfer RNA.
- C. phospholipids.
- D. haemoglobin.

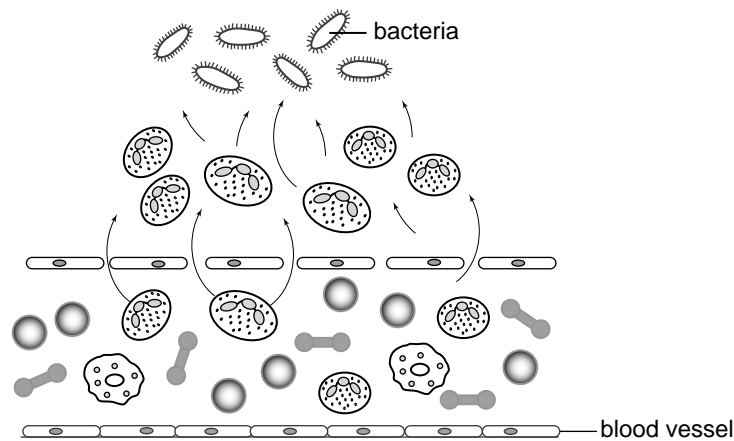
**Question 9**

Major Histocompatibility Complex (MHC) class 1 molecules

- A. release complement proteins.
- B. are found only on B and T cells.
- C. present foreign antigens to B and T cells.
- D. produce antibodies that are specific to each antigen.

**Question 10**

Consider the following diagram showing a bacterial infection within a human.



Cells moving from the blood vessel towards the bacteria

- A. are natural killer cells.
- B. would act as phagocytes.
- C. cause vasodilation of the blood vessel.
- D. release histamine in response to tissue damage.

*Use the following information to answer Questions 11 and 12.*

Ripening of fruit, for example figs, is caused by ethylene gas, a lipid-soluble compound that diffuses easily from cell to cell as well as to neighbouring plants. Plant tissues produce ethylene at certain developmental stages and in response to stressful conditions, such as heat or injury.

Plant cells have special ethylene-binding receptors. When ethylene is detected, a series of reactions follows inside the cell. This results in the production of pectinases to break down cell walls and amylases to convert carbohydrates into simple sugars.

**Question 11**

The production of enzymes following the binding of ethylene to a receptor is a result of

- A. endocytosis.
- B. an action potential.
- C. signal transduction.
- D. facilitated diffusion.

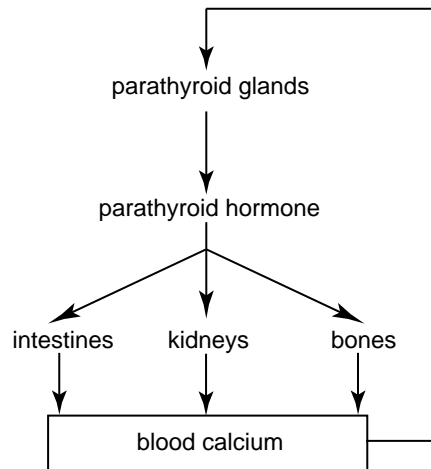
**Question 12**

A statement consistent with the information above is that

- A. ethylene stimulates cell elongation which enables fruit to grow.
- B. the scratching of the surfaces of harvested figs speeds up ripening.
- C. changes triggered by ethylene would discourage animals from consuming fruit.
- D. ethylene receptors are located on the external surfaces of the plasma membrane.

**Question 13**

The following flow chart shows a feedback mechanism related to parathyroid hormone. Parathyroid hormone acts on various parts of the body and stimulates an increase in the concentration of blood calcium.



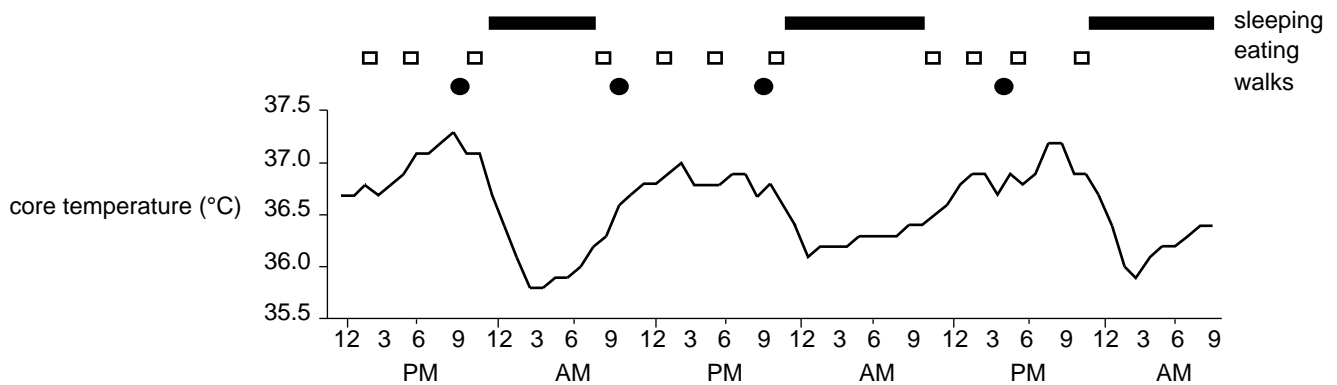
At any fall in the level of calcium in the blood, action by the parathyroid hormone would result in

- A. a rise in the level of calcium in urine.
- B. an increase in absorption of calcium by bones.
- C. a reduction in the activity of the parathyroid glands.
- D. increased absorption of calcium from the intestines.

Use the following information to answer Questions 14 and 15.

An experiment on the control of body temperature recorded the core temperature of one human subject, Jonah, living in one room for three days. The room temperature was kept constant at 20 °C.

The results of the experiment are shown on the graph below.



#### Question 14

It is reasonable to state that Jonah's core body temperature is

- A. normally 36.5 °C.
- B. highest after eating.
- C. lowest when sleeping.
- D. similar to that of the environment.

#### Question 15

The independent variable in this experiment was

- A. Jonah.
- B. the activity of Jonah.
- C. the room temperature.
- D. the core body temperature of Jonah.

**Question 16**

The ABO blood group system has four main groups. Consider the following table.

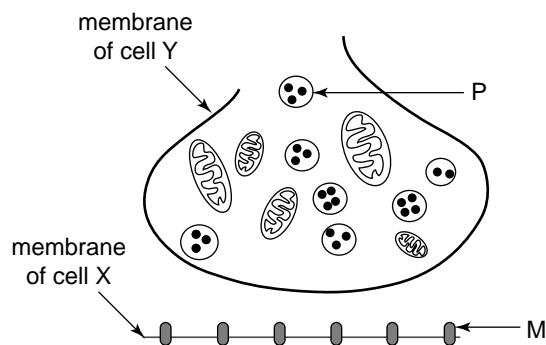
	Blood group samples			
	O	A	B	AB
Antigens on red blood cells	neither A nor B	A	B	both A and B

Agglutination of blood cells would occur if

- A. antibodies of type A were added to a sample of group O blood.
- B. antibodies of type A were added to a sample of group B blood.
- C. antibodies of type B were added to a sample of group A blood.
- D. antibodies of type B were added to a sample of group AB blood.

**Question 17**

The diagram below represents a synapse.



It is reasonable to suggest that

- A. structure M secretes neurotransmitter molecules.
- B. an electrical message travels from cell X to cell Y.
- C. structure P supplies energy to transmit a nerve impulse.
- D. neurotransmitter molecules diffuse from cell Y to cell X.



**Question 18**

Rubella is a virus that causes a highly contagious infection. When infected with rubella, humans initially produce IgM antibodies and then IgG antibodies. IgM antibodies do not cross the placenta.

Tests for the presence of IgM and IgG antibodies are carried out on a newborn baby if its mother has been diagnosed with a rubella infection during pregnancy.

The results from tests carried out on four newborn babies before they had been fed are shown in the table below.

	<b>Antibodies for the rubella virus found in the baby's blood</b>
<b>Baby 1</b>	none
<b>Baby 2</b>	IgG
<b>Baby 3</b>	IgM
<b>Baby 4</b>	IgM

Using your knowledge and the information given, it would be correct to conclude that

- A. the mother of baby 1 has immunity to the rubella virus.
- B. baby 2 will have about two years of passive immunity to the rubella virus.
- C. baby 3 received IgM antibodies to the rubella virus from its mother.
- D. baby 4 was exposed to the rubella virus during fetal development.

**Question 19**

At about 12 months of age a baby is immunised against measles, mumps and rubella.

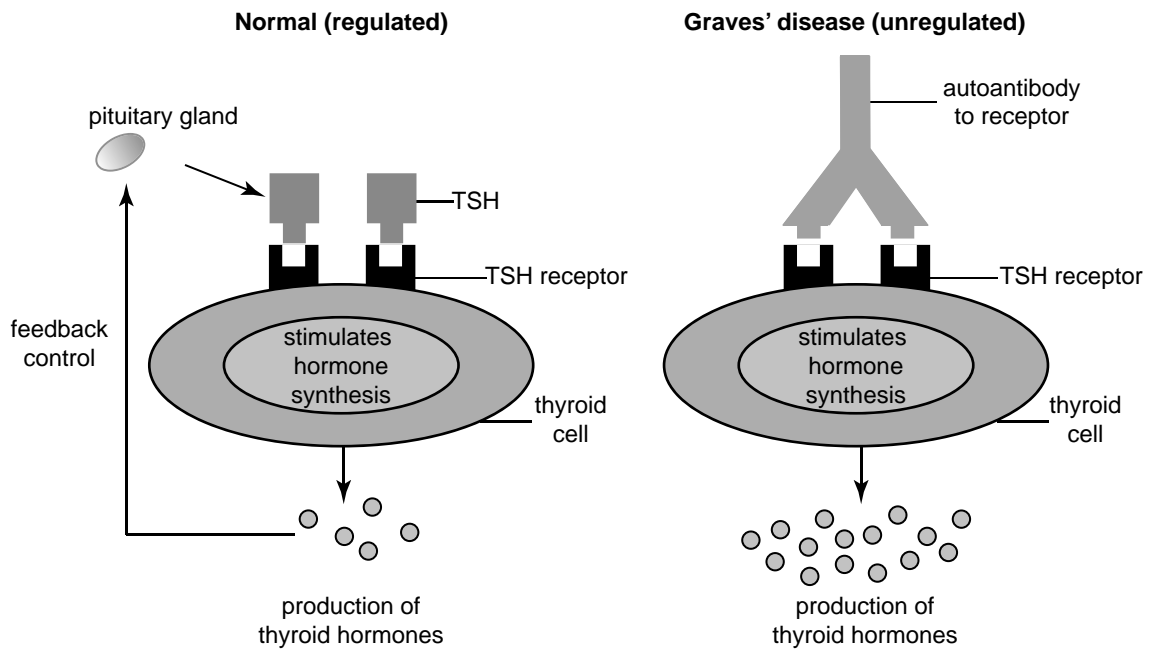
The immunity the baby acquires as a result of this vaccination is called

- A. active and natural.
- B. active and induced (artificial).
- C. passive and natural.
- D. passive and induced (artificial).

**Question 20**

Graves' disease is an autoimmune disease in which the production of thyroid hormones by thyroid cells is unregulated. The following diagrams outline what occurs in regulated and unregulated thyroid cells.

TSH stands for thyroid stimulating hormone.

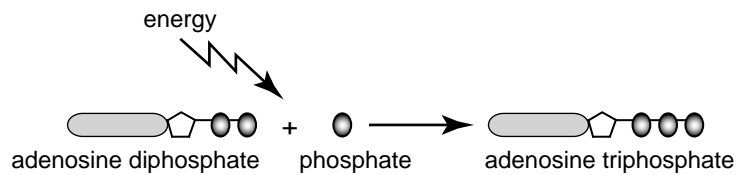


From the information given in the diagrams it is reasonable to claim that

- A. TSH inhibits the production of thyroid hormones.
- B. positive feedback control occurs with regulated cells.
- C. the presence of autoantibodies overstimulates the thyroid.
- D. individuals with Graves' disease lack appropriate receptors on thyroid cells.

Use the following information to answer Questions 21 and 22.

Adenosine diphosphate (ADP) is an organic molecule found in large quantities in most cells. ADP is converted to adenosine triphosphate (ATP) by phosphorylation, as shown in the diagram below.



### Question 21

The original source of energy for this reaction is

- A. ADP.
- B. glucose.
- C. sunlight.
- D. phosphate.

### Question 22

The process that produces the largest number of ATP molecules is

- A. synthesis of polypeptide molecules.
- B. breakdown of glucose during glycolysis.
- C. the light-independent reactions of photosynthesis.
- D. the electron transport chain in cellular respiration.

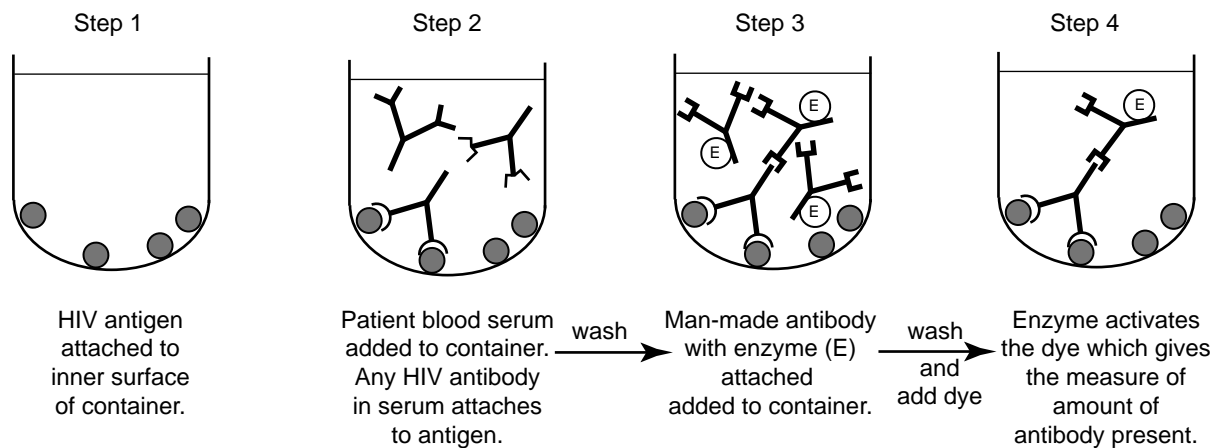
### Question 23

Interferon is a chemical that

- A. kills bacteria by producing holes in the bacterial wall.
- B. protects uninfected cells from viral attack.
- C. suppresses the immune response.
- D. is produced by T cells.

Use the following information to answer Questions 24 and 25.

A diagnostic test for HIV infection includes the following steps.



### Question 24

This test for HIV is reliable because the

- A. dye reacts with the patient's blood serum.
- B. enzyme has an active site for the HIV antigen.
- C. man-made antibody has the same shape as the HIV antigen.
- D. HIV antigen has a complementary shape specific to the HIV antibody.

### Question 25

The results of the tests of three patients are given in the following table.

Positive control	Negative control	Patient R	Patient S	Patient T
1.689	0.153	0.155	0.675	1.999

Numbers are expressed as optical density at 450 nm. The more intense the dye is, the higher the optical density. The cut-off value indicating a positive result is 0.500. Values below 0.300 are considered to be negative.

The results of these tests suggest that

- A. patient T has not been exposed to HIV.
- B. patient R has been exposed to the HIV antigen.
- C. patient S has responded to exposure to HIV by developing antibodies.
- D. the positive control contained fewer HIV antibodies than the negative control.

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**SECTION B – Short answer questions**

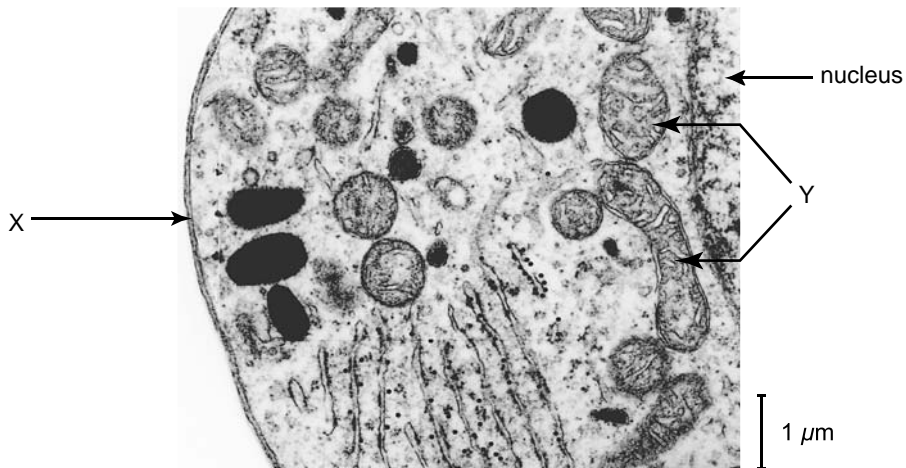
**Instructions for Section B**

Answer this section in **pen**.

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

**Question 1**

The electromicrograph below shows a portion of a cell.



a. Name and describe the structure of X.

Name \_\_\_\_\_

Description \_\_\_\_\_

2 marks

b. What would you look for to determine whether a cell is from an animal or a plant?

\_\_\_\_\_  
\_\_\_\_\_

2 marks

It has been suggested that as humans age the structures labelled Y become less efficient.

c. Explain the consequence of this for an elderly person.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2 marks

d. What is the difference between the cytosol and the cytoplasm of a cell?

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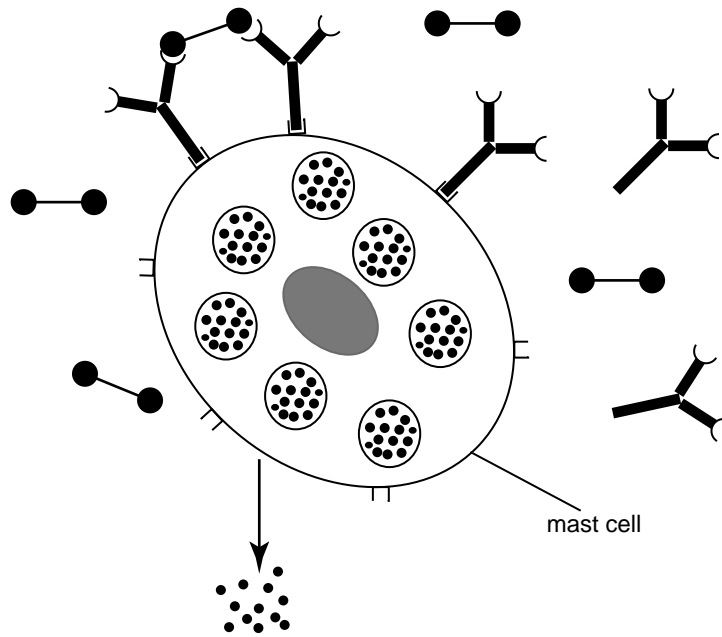
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2 marks

**Question 2**

Mast cells are found in a number of different tissues and play an important role in allergic reactions. Consider the following diagram.



Label **at least three** appropriate parts of the diagram related to the activation and action of a mast cell. Referring to the diagram and labels you have entered, outline the order of events that occur during allergic reactions.

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4 marks

**Question 3**

Human insulin is a macromolecule composed of two amino acid chains. The chains are connected by disulfide bonds.

- a. To what group of macromolecules does insulin belong?

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1 mark

Insulin found in other animals varies from human insulin.

The following table compares all the differences seen in the primary structure of human, cow, pig and sheep insulin.

	Amino acid position number within	
	Alpha chain	Beta chain
	-8 - 9 - 10-	-30-
<b>human</b>	-thr - ser - ile-	thr
<b>cow</b>	-ala - ser - val-	ala
<b>pig</b>	-thr - ser - ile-	ala
<b>sheep</b>	-ala - gly - val-	ala

- b. What is meant by the term 'primary structure' of the insulin macromolecule?

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1 mark

Humans with diabetes take insulin injections to maintain their health.

- c. If supplies of human insulin were not available, which one of the other three animals listed in the table would be the best source of insulin? Explain your reason for choosing this particular animal.

Animal \_\_\_\_\_

Explanation \_\_\_\_\_

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2 marks



The table below contains the genetic code for protein production.

		Second letter					
		A	G	T	C		
First letter	A	AAA } phe AAG } AAT } leu AAC }	AGA } AGG } ser AGT } AGC }	ATA } tyr ATG } ATT } Stop ATC } Stop	ACA } cys ACG } ACT } Stop ACC } trp	A G T C	
	G	GAA } GAG } leu GAT } GAC }	GGA } GGG } pro GGT } GGC }	GTA } GTG } his GTT } GTC } gln	GCA } GCG } arg GCT } GCC }	A G T C	
	T	TAA } TAG } ile TAT } TAC } met Start	TGA } TGG } thr TGT } TGC }	TTA } TTG } asn TTT } TTC } lys	TCA } ser TCG } TCT } arg TCC }	A G T C	
	C	CAA } CAG } val CAT } CAC }	CGA } CGG } ala CGT } CGC }	CTA } CTG } asp CTT } CTC } glu	CCA } CCG } gly CCT } CCC }	A G T C	

d. Use the information in the table **to explain**

- i. the different sequence of nucleotides in humans and cows with respect to the DNA coding for the amino acid at position 30.

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- ii. **whether** the sequence of nucleotides in DNA coding for the amino acid at position 30 will be identical in cows, pigs and sheep.

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1 + 1 = 2 marks

**Question 4**

Australia is currently experiencing an epidemic of pertussis. Pertussis is a highly contagious respiratory infection caused by the bacteria *Bordetella pertussis* (whooping cough). Pertussis vaccine is offered as part of an immunisation program for children at two months, four months, six months, four years and in Year 10 of secondary school.

- a. i. Name the cells that are responsible for the production of antibodies.

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Two children have been immunised according to the schedule. One is two months old and the other is four months old.

- ii. What difference would there be in the children's levels of antibodies against *Bordetella pertussis*?

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1 + 1 = 2 marks

Consider a Year 10 student. Memory cells will have been produced during the periods of immunisation when the student was younger.

- b. What are **two** advantages of having these memory cells when the student receives their immunisation in Year 10?

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2 marks

In Victoria in the past two years the number of cases of pertussis has increased dramatically. In 2010 there were over 6500 reported cases of pertussis; 66 per cent of these cases were adults and most of these adults had been immunised in childhood.

- c. i. Outline a likely reason for the high percentage of adults with pertussis in 2010.

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- ii. Describe one process that could be introduced by the Department of Health, Victoria, to reduce the number of adults being infected with pertussis.

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1 + 1 = 2 marks

The human immune response to antigens of *Bordetella pertussis* can be measured by the level of antibodies in the blood.

- d. Is this test a measure of cell-mediated immunity? Explain your answer.

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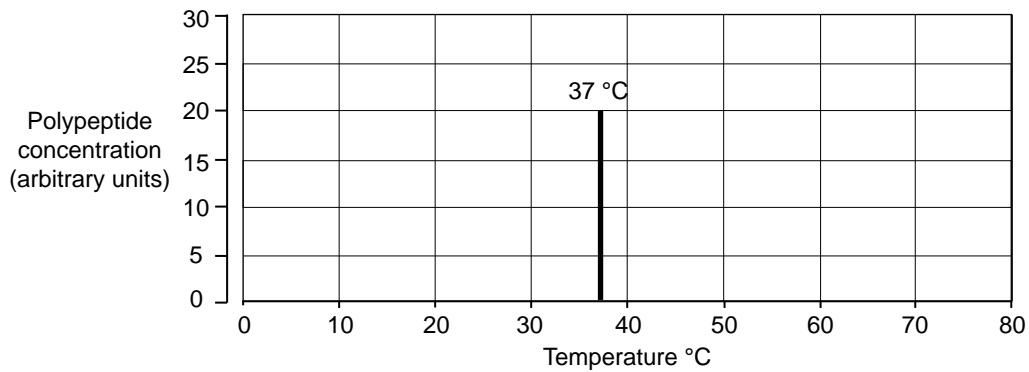


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1 mark

**Question 5**

Half an hour after an adult person completed eating a protein-rich meal, a sample was taken of the contents of their stomach. This sample was divided into three equal parts in separate tubes. Each tube was incubated at a different temperature for 10 hours. After that time, each tube's contents was tested to determine its polypeptide concentration. The result for the sample incubated at 37 °C is shown on the graph below.



- a. On the graph above, draw the results you would expect for the samples incubated at 10 °C and 80 °C. 2 marks
- b. Explain your predicted results for the polypeptide concentrations at temperatures of 10 °C and 80 °C.

10 °C \_\_\_\_\_

\_\_\_\_\_

80 °C \_\_\_\_\_

\_\_\_\_\_

2 marks

**Question 6**

Homeostasis is essential for the survival of any organism.

**a. i.** What is homeostasis?

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**ii.** State one variable, other than body temperature and blood calcium levels, that is under homeostatic control in a mammal. Explain why the homeostatic control of this variable is essential for survival.

Variable \_\_\_\_\_

Explanation \_\_\_\_\_

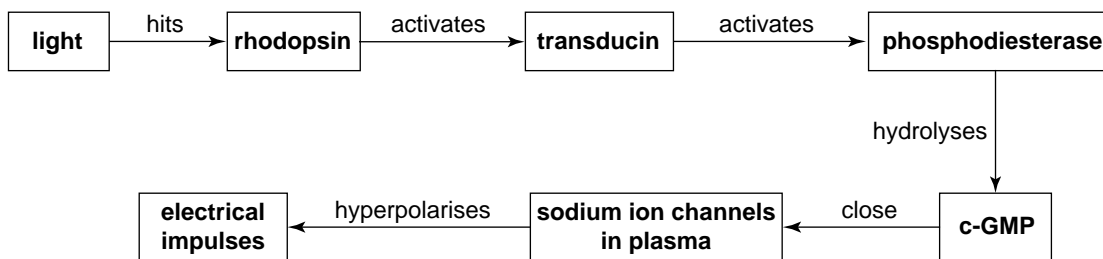
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1 + 2 = 3 marks

The flow chart below summarises a sequence of events occurring inside a rod cell in the retina of the human eye.



This sequence of events is part of a stimulus-response system.

**b. i.** Explain why a rod cell is regarded as a receptor in this system.

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**ii.** Many of a human’s regulating systems are based on negative feedback. Does the series of events taking place in a rod cell form part of a negative feedback system? Explain your answer.

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1 + 1 = 2 marks

A rod cell is part of the nervous system. The nervous system and the endocrine system work together to maintain homeostasis.

- c. A comparison between one aspect of the nervous system and the endocrine system is given in the table below. Complete the table with reference to two other aspects of the nervous and endocrine systems.

Differences	Aspect	Nervous system	Endocrine system
1	Type of message	Electrical	Chemical
2			
3			

2 marks

### Question 7

Yellow fever is caused by a virus transmitted through the bite of a particular species of mosquito.

- a. Would you describe a virus as a cellular or non-cellular pathogen? Justify your answer.

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2 marks

- b. An unvaccinated person travelled to an area where yellow fever virus existed and became exposed to the virus. Describe **two** ways in which the first line of defence of their body would protect against an infection by this virus.

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2 marks

- c. As a requirement for re-entry, travellers returning to Australia from Africa and South America must have proof of vaccination against yellow fever.

Explain why this precaution is taken and what course of action Australian authorities may take for an unvaccinated person wanting to re-enter Australia.

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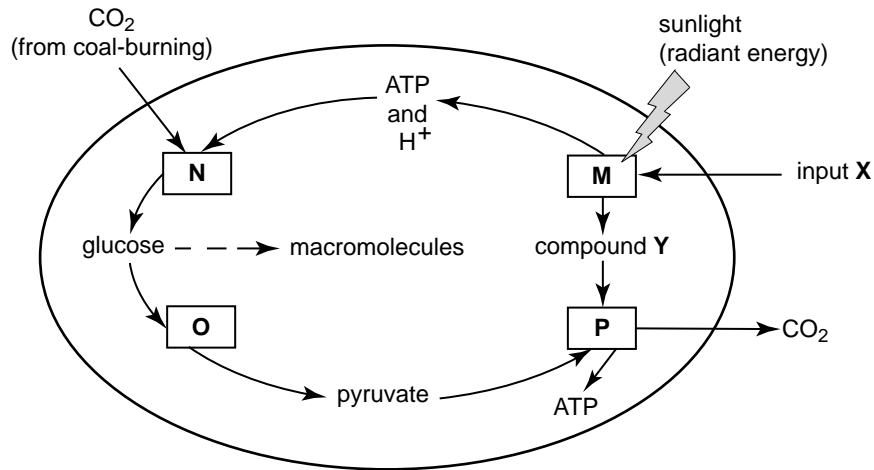
2 marks

**Question 8**

Climate change has been linked to an excess of carbon dioxide in the atmosphere. The burning of coal is a major contributor to this excess of carbon dioxide.

Microalgae such as *Chlorella* can use greater amounts of carbon dioxide than land plants and they do not require prime soil, reliable rainfall and a particular climate. *Chlorella* can be grown cheaply in existing or engineered ponds which are supplied with carbon dioxide from a coal-burning power station nearby.

The following diagram represents a summary of the processes (labelled M, N, O, P) occurring in a *Chlorella* cell.



a. Name

i. input X \_\_\_\_\_

ii. compound Y \_\_\_\_\_

2 marks

b. With reference to the diagram above, complete the following table.

Process	Name of process	Site of process
M		grana of chloroplast
O	glycolysis	
P	stages of cellular respiration	

3 marks

*Chlorella* pond farms could reduce 50% of the carbon dioxide that is produced by coal-burning power stations. Consider the summary of processes occurring in a *Chlorella* cell.

- c. Given that carbon dioxide is an output of process P, explain how *Chlorella* farming could prevent 50% of the carbon dioxide emitted by coal-burning power stations from entering the atmosphere.

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2 marks

- d. What are **two** conditions, other than carbon dioxide supply, that an engineer or biologist maintaining a *Chlorella* pond farm would need to control to keep the growing conditions at an optimum level?

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1 mark