



**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**

Cellular agents capable of causing infection of body cells include

- A. prions.
- B. toxins.
- C. DNA viruses.
- D. Gram-negative bacteria.

**Question 2**

In lymph nodes

- A. white blood cells mature into T cells.
- B. lymph drains back into the circulatory system.
- C. old and damaged red blood cells are destroyed.
- D. B and T cells gather and attach to foreign antigens.

**Question 3**







One of the similarities between the defence mechanisms of a plant and an animal includes the

- A. production of memory cells.
- B. release of immune cells through a circulatory system.
- C. use of an epidermal layer to inhibit the invasion of pathogens.
- D. production of salicylic acid to warn cells of an invading pathogen.

**Question 4**

William has an allergy that causes problems. Eight skin-prick tests were carried out to find the source of the problem. A portion of skin was divided into eight squares and a skin-prick made with an extract from each of the possible causes. An inflamed area indicates a positive reaction.

William's skin-prick test results are shown below.

horse 	house dust mite 	mould	histamine 	 indicates positive reaction
cat	guinea pig 	dog 	saline	

From the results it is reasonable to assume that

- A. William is allergic to saline.
- B. histamine is a negative control.
- C. William is allowed to keep his cat.
- D. the same allergen is found in a horse and a house dust mite.

**Question 5**

An inflammation reaction involves the

- A. release of histamines.
- B. agglutination of bacteria.
- C. production of immunoglobulin.
- D. vasoconstriction of blood vessels.

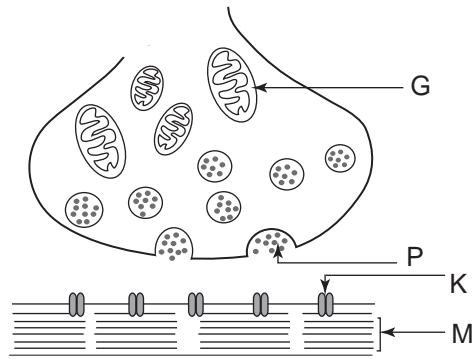
**Question 6**

White blood cells that are involved in the third line of defence of the immune system include

- A. mast cells.
- B. eosinophils.
- C. lymphocytes.
- D. macrophages.

**Question 7**

A bite from a krait snake injects toxins into the body of a victim. These toxins bind to acetylcholine receptors. Examine the following diagram.



The letter that best represents where the acetylcholine receptor is located is

- A. M.
- B. K.
- C. P.
- D. G.

**Question 8**

Congenital hypotrichosis is a disease of the immune system in cats. Cats with the disease fail to develop a functional thymus.

It is reasonable to assume that such cats have a deficiency of

- A. leucocytes that kill virus-infected cells.
- B. helper cells for cellular immunity.
- C. complement proteins.
- D. red blood cells.

**Question 9**

The coating of mouse eggs contains a protein, ZP3. Sperm must bind to ZP3 to be able to move through the coating to fertilise the egg.

A drug that is designed to bind to ZP3 would

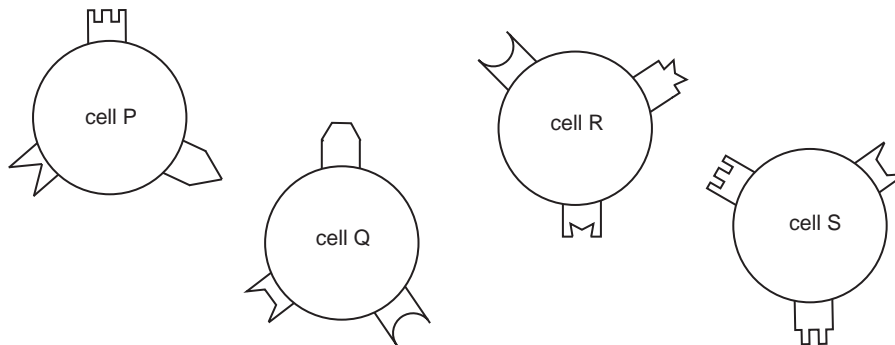
- A. be a type of enzyme.
- B. have the same shape as ZP3.
- C. inhibit fertilisation of the egg.
- D. disrupt hormone production throughout the body.

**Question 10**





Cells of the immune system have different kinds of structures on their surfaces. Three of the structure types that exist are

- the cell's own antigens, called self antigens
- receptors that enable a cell to identify its own antigens on any other cell
- receptors that identify foreign antigens on foreign cells.

Examine the following cells and the various structures on their surfaces.



From the information provided you are able to conclude that

- A. structure  is a self antigen for cell P.
- B. structure  is a self antigen for cell R.
- C. structure  is a self antigen for cell Q.
- D. structure  is a self antigen for cell S.

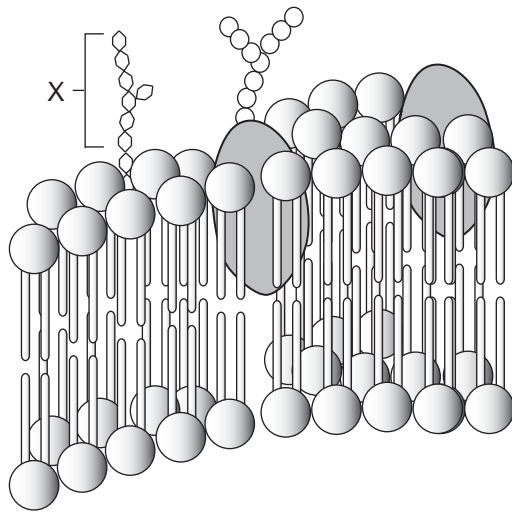
**Question 11**

An example of passive movement across a plasma membrane is

- A. a macrophage engulfing a bacterium.
- B. goblet cells of the small intestine secreting mucus into the gut lumen.
- C. a freshwater unicellular organism gaining water from its natural surroundings.
- D. the axon of a neurone exchanging sodium and potassium ions when the cell is stimulated.

**Question 12**

The diagram shows a portion of a plasma membrane.



Molecule X is

- A. glycolipid.
- B. cholesterol.
- C. phospholipid.
- D. globular protein.

**Question 13**

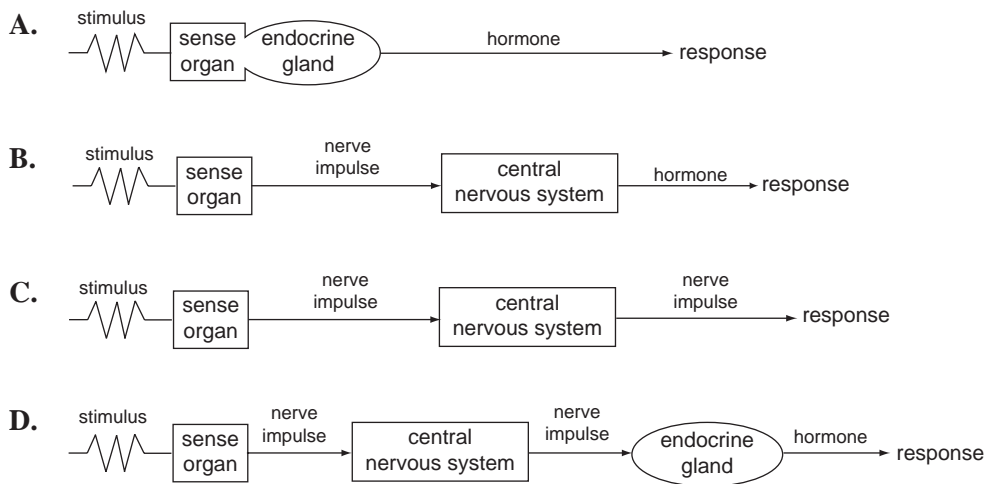
A known relationship between a plant growth hormone (regulator) and its effect includes

	<b>Plant growth hormone</b>	<b>Effect of hormone</b>
<b>A.</b>	auxin	cell elongation
<b>B.</b>	gibberellin	stomatal closure
<b>C.</b>	abscisic acid	promotes flowering
<b>D.</b>	cytokinin	promotes fruit ripening

**Question 14**

A woman accidentally touched a hot object. She withdrew her hand quickly in a reflex action.

A model of the event is best represented by

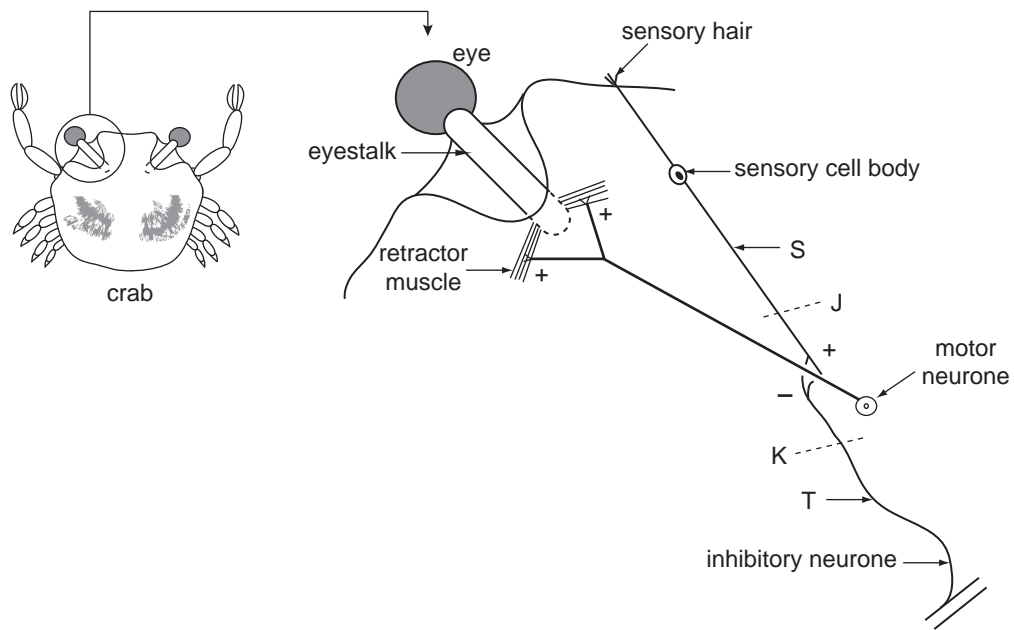
**Question 15**

The starting compounds and end products of a chemical reaction that results in an overall production of ATP is

	Starting compounds	End products
<b>A.</b>	nucleotides	DNA
<b>B.</b>	peptides	amino acids
<b>C.</b>	glucose	cellulose, water
<b>D.</b>	fatty acids, glycerol	triglycerides

**Question 16**

Eyestalk retraction in a crab is under the control of a sensory-motor reflex as shown in the diagram below.



Note that the sensory and inhibitory neurones both form synapses at the axon of the motor neurone.

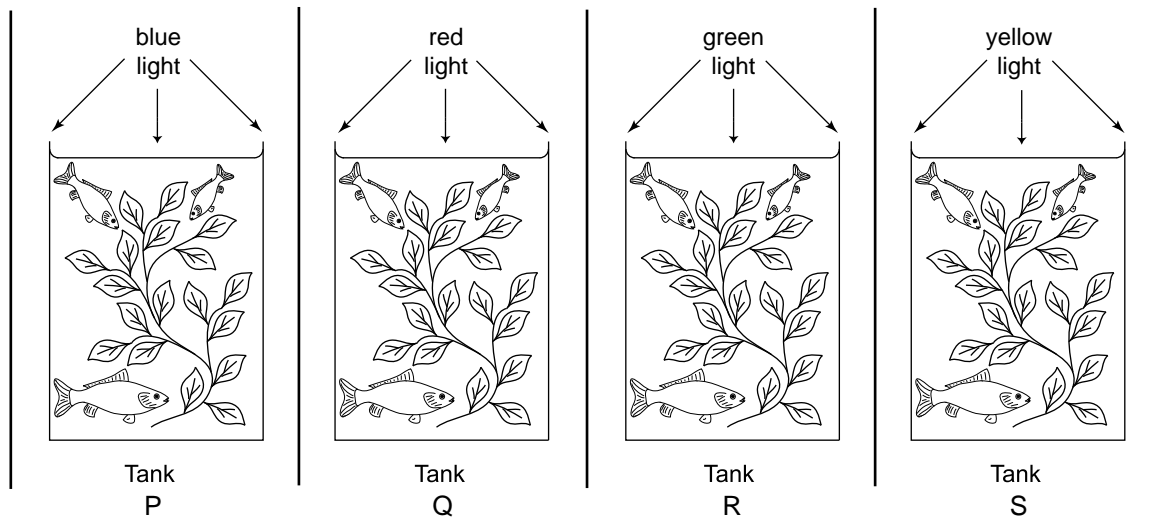
You would expect

- A. retraction of the eyestalk if the sensory hair is stimulated.
- B. retraction of the eyestalk if the inhibitory neurone is stimulated after cutting the sensory neurones at site **J**.
- C. no retraction of the eyestalk if the sensory and inhibitory neurones are stimulated after cutting the inhibitory nerve at site **K**.
- D. retraction of the eyestalk if the sensory and inhibitory neurones are stimulated at the same time at locations **S** and **T** respectively.



The following information relates to Questions 17 and 18.

Samples of a particular water plant and fish were placed in four identical glass tanks. The fish were provided with food pellets. The tanks were isolated from each other, and each was illuminated by a different coloured light source.



### Question 17

The plant that is expected to produce the most oxygen is the plant in tank

- A. P.
- B. Q.
- C. R.
- D. S.

### Question 18

During cellular respiration, the fish in the tanks use oxygen

- A. in the glycolysis stage.
- B. to break down ATP molecules to ADP molecules.
- C. to combine with carbon dioxide to produce glucose.
- D. as the final acceptor of electrons and hydrogen ions.

**Question 19**

At extremely low oxygen levels, important cellular proteins unravel. Another intracellular protein, Hsp60, has been discovered in a wide range of prokaryotic and eukaryotic cells. This protein may bind to other proteins and prevent their unravelling.

It would be reasonable to infer that Hsp60

- A. is manufactured at free ribosomes.
- B. has a structure which is secondary.
- C. is produced continuously by a cell.
- D. is produced in equal amounts by living cells in a multicellular organism.

**Question 20**

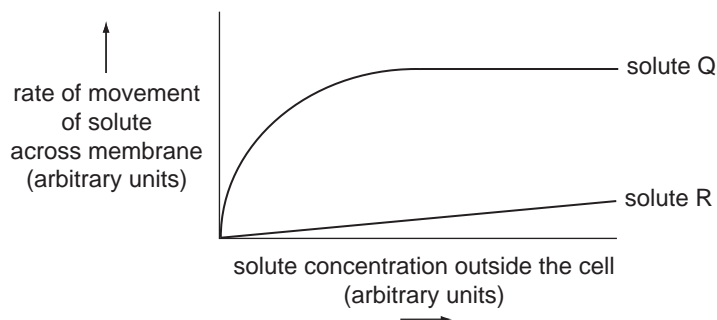
One function of lipids in plant cells is to

- A. capture sunlight.
- B. act as a solvent of glucose.
- C. provide structural support.
- D. protect cells from dehydration.

**Question 21**

Solute Q moves across the plasma membrane via protein channels. Solute R moves across the plasma membrane by simple diffusion. The rate of movement of each solute into a cell is recorded and graphed.

The results are shown in the following graph.



It would be reasonable to conclude that

- A. solute Q is lipid soluble.
- B. solute Q saturates the protein channels.
- C. the gradient of the graph for solute R will increase as the temperature decreases.
- D. as solute R is metabolised within a cell, its rate of movement across the membrane decreases.

**Question 22**

Particular biological molecules react with chemicals called reagents to give distinct colour changes. The colour depends on the kind of biological molecule and the type of reagent used, as shown in the following table.

Chemical reagent	Biological molecule	Colour change observed
K	starch	dark blue
L	protein	violet
M	lipid	red
N	nucleic acid	green

A researcher added different reagents to some isolated ribosomes.

The colours she would observe are

- A. red and green.
- B. green and violet.
- C. dark blue and red.
- D. violet and dark blue.

**Question 23**

Laundry powder is sometimes advertised as containing powerful enzymes that break down dirt. These enzymes are called extremozymes. They come from some species of bacteria and archaea. The following table gives the optimal functioning of enzymes from some of these species.

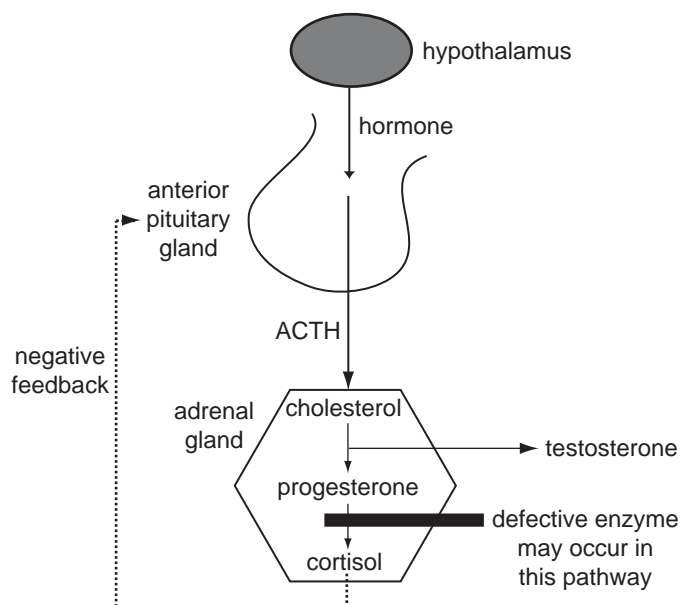
Species	Enzyme	Optimal temperature °C	Optimal pH
<i>Psychrobacter</i> sp.	J	10–30	7.0–9.0
<i>Pseudomonas</i> sp.	K	40	10.0
<i>Methanococcus</i> sp.	L	120	5.0–8.0
<i>Cystofilobasidium</i> sp.	M	40–42	5.0

Given this information and your knowledge of enzyme function, the best enzyme to add to the laundry powder would be

- A. enzyme J.
- B. enzyme K.
- C. enzyme L.
- D. enzyme M.

*The following information relates to Questions 24 and 25.*

Cholesterol is usually converted to progesterone and testosterone. Progesterone is then converted to cortisol due to the action of an enzyme 21-hydroxylase. If the enzyme is defective, the synthesis of cortisol is reduced and an excess of testosterone is produced. This results in a disorder called congenital adrenal hyperplasia (CAH). ACTH is the hormone that stimulates this pathway. To diagnose the CAH disorder, an ACTH stimulation test is performed. Blood is measured for starting levels of testosterone. ACTH is then injected and another blood sample is taken and analysed after 60 minutes.

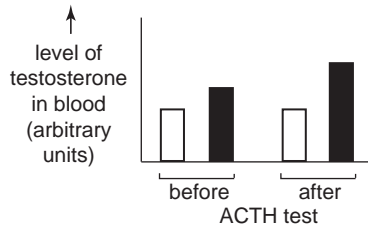
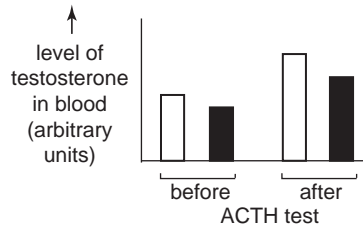
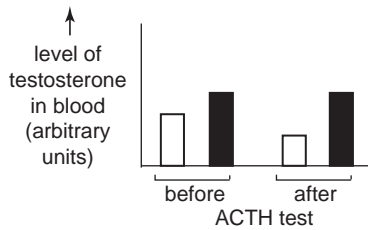
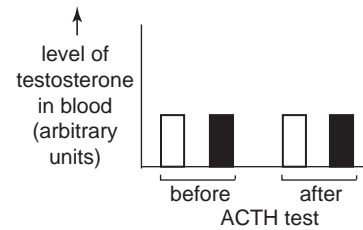


**Question 24**

Given the key



the graph that best represents the changes in the level of testosterone in an ACTH stimulation test is

**A.****B.****C.****D.****Question 25**

An appropriate treatment to give an individual with CAH would be

- A. cholesterol.
- B. progesterone.
- C. regular ACTH tests.
- D. testosterone inhibitors.

**SECTION B – Short answer questions**

**Instructions for Section B**

Answer this section in **pen**.

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

**Question 1**

a. What is the general function of a hormone?

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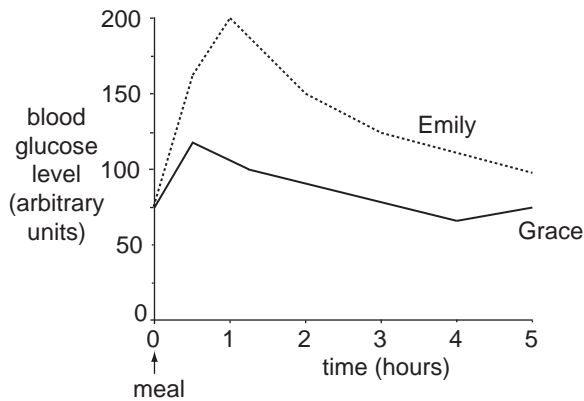


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1 mark

Blood glucose levels are controlled by a homeostatic mechanism.

Two females of the same age and similar body structure were each given an identical meal. The following graph shows the level of blood glucose in each female for the five-hour period after eating the meal.



b. i. Explain whether Emily or Grace had a defect in the blood-glucose homeostatic mechanism. Refer to at least two parts of the graph to support your answer.

Name of female \_\_\_\_\_

Explanation \_\_\_\_\_

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Consider Grace.

ii. Explain the small rise in her level of glucose between four and five hours after the meal.

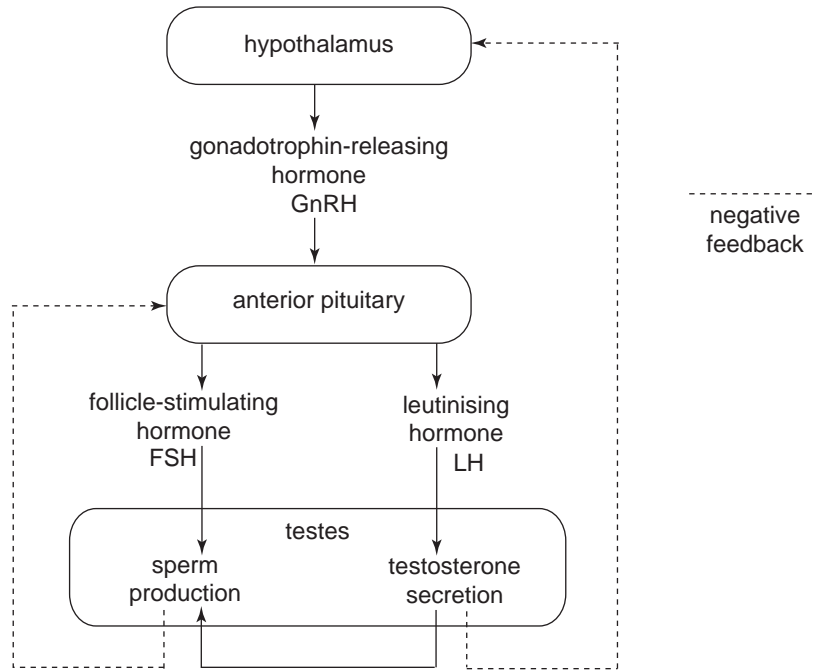
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2 + 1 = 3 marks

The following diagram outlines the hormonal control of the testes.



If a tumour develops in the anterior pituitary of a male, normal production of follicle-stimulating hormone (FSH) and leutinising hormone (LH) is inhibited.

c. i. What effect would this have on the fertility of the person concerned?

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ii. Explain what effect the presence of the tumour in the anterior pituitary would have on the production of gonadotrophin-releasing hormone (GnRH) by the hypothalamus.

Circle your choice and explain your answer.

**fall in production**

**rise in production**

Explanation

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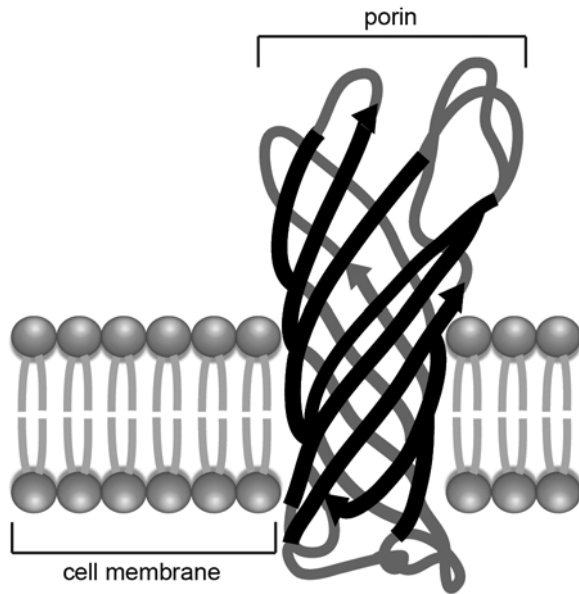
1 + 2 = 3 marks

Total 7 marks

**Question 2**

Some bacterial cell membranes contain proteins called porins. A porin is a pipe-like structure made of a single amino acid chain that embeds itself into the membrane.

The image below shows a portion of a cell membrane containing a porin.



In the diagram above, two structures are labelled.

- a. Outline one function of each structure.

Cell membrane \_\_\_\_\_  
\_\_\_\_\_

Porin \_\_\_\_\_  
\_\_\_\_\_

2 marks





**Question 3**

*Elysia chlorotica* is a bright green sea slug, with a soft leaf-shaped body. It has a life span of 9 to 10 months. This sea slug is unique among sea slugs as it is able to survive on solar power.

*E. chlorotica* acquires chloroplasts from the algae it eats, and stores them in the cells that line its digestive tract.

Young *E. chlorotica* fed with algae for two weeks can survive for the rest of their lives without eating.

- a. What is the product of photosynthesis that provides the energy that enables *E. chlorotica* to survive for so long without eating?

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1 mark

The product of photosynthesis must undergo a three-stage process for the slug to access the energy in the product.

- b. Name and give a brief description of each of these stages.

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3 marks

A watery environment can have a low concentration of dissolved gases.

- c. Explain how having chloroplasts allows *E. chlorotica* to overcome this disadvantage.

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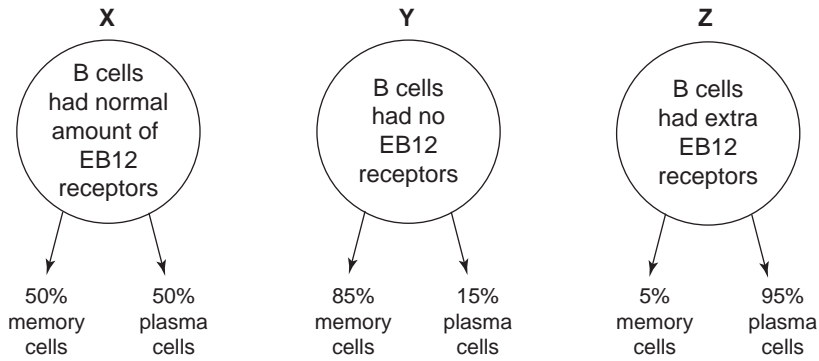
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1 mark

Total 5 marks

**Question 4**

EB12 is a receptor on the B cells of mice that helps determine if a cell becomes a plasma or a memory cell. Scientists used three different strains of mice to investigate B cell immunity. None of the strains had been exposed to the influenza virus. The strains were as follows.



The three mice strains were infected with the influenza virus.

a. Explain which strain, X, Y or Z, would be best at destroying the fast-acting influenza virus.

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2 marks

b. Explain how blocking the action of EB12 receptors could result in the production of a more efficient vaccine.

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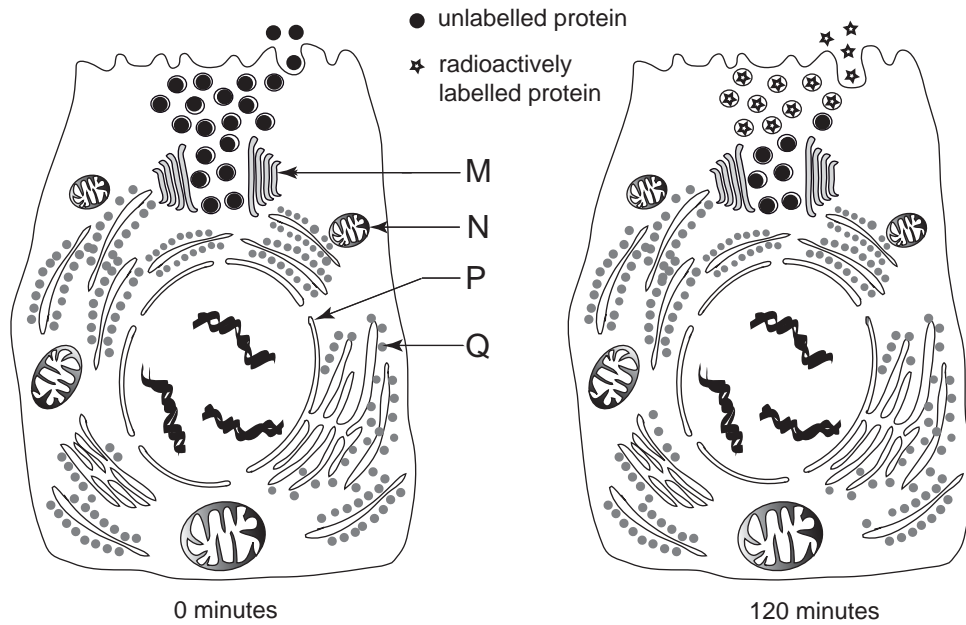
2 marks

Total 4 marks

**Question 5**

Human pancreatic cells produce proteases that act on the contents of the small intestine. An experiment was performed to track the pathway of protease synthesis and release. This involved feeding pancreatic cells for a brief period with amino acids that had been radioactively labelled. These amino acids can be tracked over time. Images were taken immediately (0 minutes) after feeding the cells, then 3, 20 and 120 minutes later.

The results at 0 and 120 minutes are shown below.



At the 3 and 20 minute intervals the radioactive amino acids were observed to be at organelles.

a. Name and describe the functions of organelles M and N.

i. Organelle M \_\_\_\_\_

Function \_\_\_\_\_  
\_\_\_\_\_

ii. Organelle N \_\_\_\_\_

Function \_\_\_\_\_  
\_\_\_\_\_

2 + 2 = 4 marks

- b. Which of the letters, **M**, **N**, **P** and **Q**, indicates an organelle where the radioactive amino acids would be expected to be detected after three minutes?

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1 mark

A hormone (hormone Y) travels from its site of production to a cell (cell X) elsewhere in the body.

- c. Explain how the characteristics of hormone Y will influence the way in which it initiates signal transduction with cell X.

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2 marks

Total 7 marks

**Question 6**

- a. List the three components of a DNA nucleotide.

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1 mark

In Tay Sachs disease (TSD), the enzyme that breaks down glycolipid is faulty due to a genetic mutation. Examine the following two tables.

**Table X** – Portion of the genetic code

	Second letter				
First letter	A	G	T	C	Third letter
A	phe	ser	tyr	cys	A
G	leu	pro	his	arg	A
C	val	ala	glu	gly	T

**Table Y** – Portion of DNA sequences

	DNA nucleotide sequence	Amino acid sequence
Normal individual	-- CTT GCA AAA --	glu - arg - phe
TSD individual	-- CTT GTA AAA --	

The amino acid sequence shown in Table Y for a normal individual forms part of the enzyme hexosaminidase A (Hex A).

- b. What is the amino acid sequence for the TSD individual in Table Y? Use the information in Table Y to explain how changing one amino acid in a polypeptide may adversely affect the function of a protein of which the amino acid is part.

TSD amino acid sequence \_\_\_\_\_

Explanation \_\_\_\_\_

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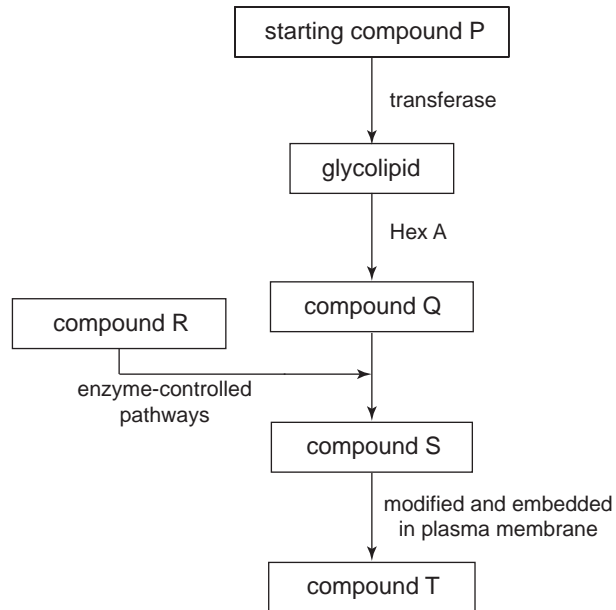
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3 marks

Part of the metabolic pathway for the breakdown of glycolipid is shown below.



- c. Explain which enzyme-substrate complex fails to form correctly in sufferers of TSD.

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2 marks

A promising form of treatment for TSD is the addition of N-mycin, a chemical which inhibits the action of transferase.

- d. Describe how this treatment may reduce the excessive build-up of brain cell glycolipids without compromising the health of the individual.

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2 marks

Total 8 marks

**Question 7**

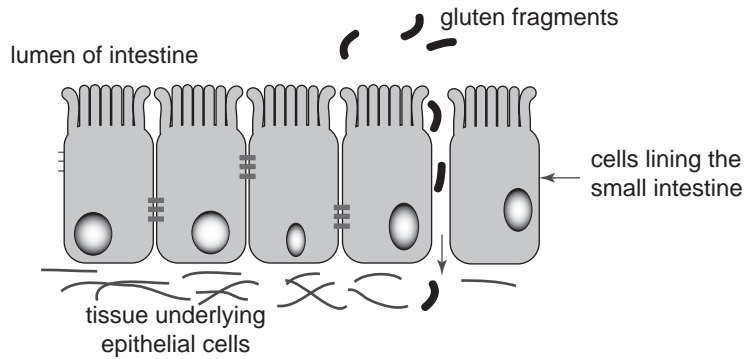
Coeliac disease in humans is caused when cells of the immune system attack the epithelial cells that line the small intestine.

- a. What is the general name given to this type of disorder?

\_\_\_\_\_

1 mark

Coeliac sufferers are unable to break down the gluten found in grains such as wheat. One of the features of coeliac disease is ‘leaky gut syndrome’. A small gap appears between the epithelial cells that line the small intestine. Gluten fragments enter the gap and accumulate under the epithelial cells. Macrophages are stimulated to remove the fragments.



- b. Explain how a macrophage is able to remove and destroy a gluten fragment. You may use a written answer or labelled diagrams or both.

\_\_\_\_\_

\_\_\_\_\_

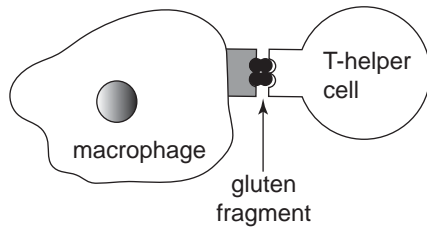
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2 marks



Once a macrophage has destroyed a gluten fragment, it displays a piece of the fragment on its membrane using a special major histocompatibility complex (MHC) marker. A T-helper cell then attaches to the MHC marker-antigen complex.

The macrophage T-helper cell complex is shown below.



The macrophage T-helper cell complex stimulates other cells and chemicals to target and damage epithelial cells that line the intestine.

c. Name one cell or chemical that would be stimulated by the macrophage T-helper cell complex and state its function.

Name \_\_\_\_\_

Function \_\_\_\_\_

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

2 marks

Assume that a drug has been shown to be safe for human use and is about to be trialled. Assume that you suffer from coeliac disease and have been invited to take this drug as part of the trial.

d. What are two different questions about the drug trial that you would ask your doctor?

Question 1 \_\_\_\_\_

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

Question 2 \_\_\_\_\_

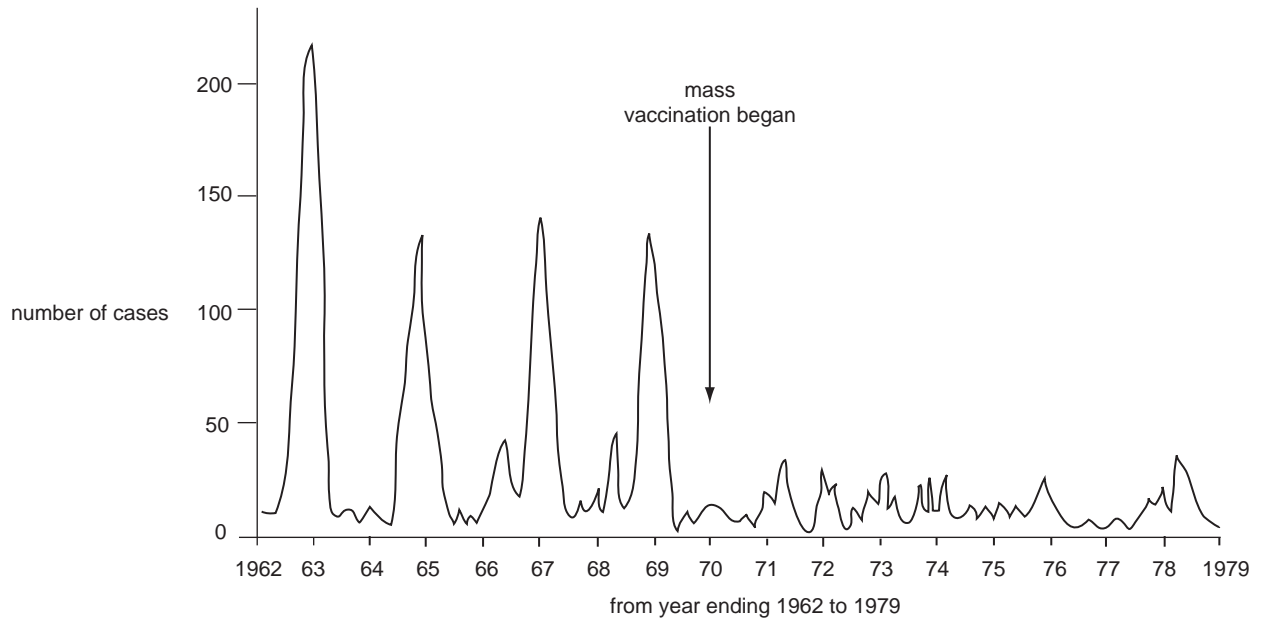
\_\_\_\_\_  
\_\_\_\_\_

2 marks

Total 7 marks

**Question 8**

Measles is a highly contagious, serious disease caused by an RNA virus. There were regular epidemics of the disease until the introduction of mass vaccination. The following graph indicates the incidence of measles in Victoria from 1962 to 1979.



a. What was the time period between successive epidemics?

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1 mark

An unaffected person without immunity has a 90 per cent chance of catching the disease if they live in the same house as a person with the disease.

If a child is suspected of having measles, a serum sample is taken and tested for measles-specific IgM and IgG antibodies.

b. What conclusion could be made if high levels of these antibodies were found and what action would be taken?

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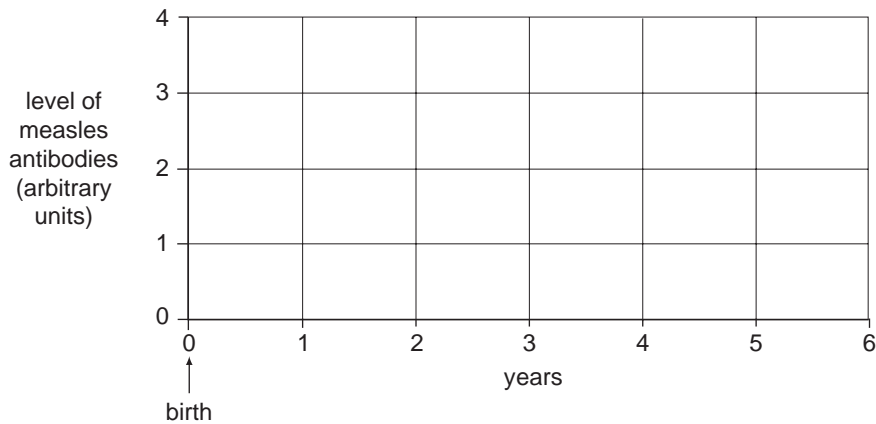


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2 marks

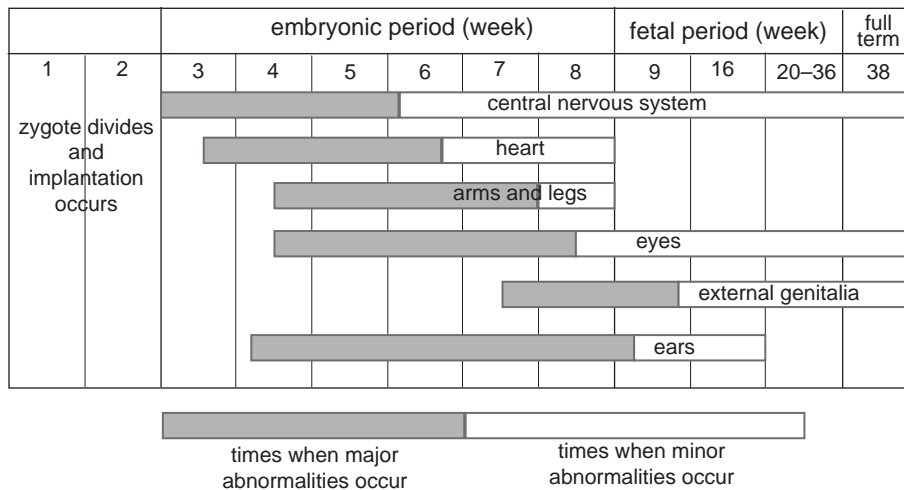
In Australia, vaccination against measles is a two-dose schedule. The first dose is generally given at age 12 months and the second dose at 4 years.

- c. On the grid below, graph the level of measles antibodies you would expect in a vaccinated child. The child's mother is known to have had measles as a child.



2 marks

*Rubella* is a contagious viral disease. An individual may have the disease for two or more weeks before it is diagnosed. If a pregnant woman is infected with *Rubella*, the developing baby may develop serious defects. The following diagram outlines the development of various organs of a baby in utero.



Each bar shows the time over which a particular organ develops.

Two pregnant women are diagnosed with *Rubella*. Mrs Smith is 6 weeks pregnant and Mrs Jones is 28 weeks pregnant.

- d. Which embryo or fetus is at greater risk of developing a major defect? Refer to at least two areas of development to support your answer.

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2 marks

Total 7 marks

