



## 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

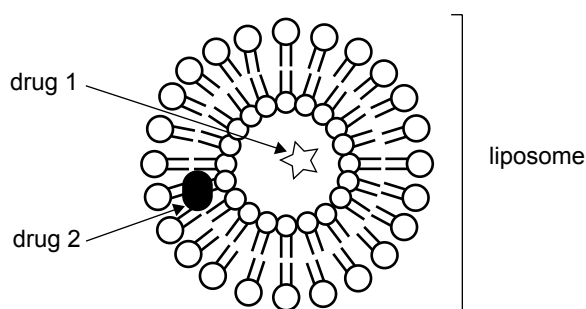
A polysaccharide that can be made in some animal cells is

- A. starch.
- B. pectin.
- C. glycogen.
- D. cellulose.

### Question 2

Liposomes are found in the cytosol and are formed from a double layer of phospholipid molecules identical to those found in plasma membranes. Liposomes can also be manufactured and used to carry medicinal drugs into cells.

Examine the following diagram.



It is reasonable to expect that

- A. drug 1 is lipophilic.
- B. drug 2 is water soluble.
- C. the interior of the liposome is aqueous.
- D. liposome-based membranes have a rigid structure.

### Question 3

Recent research has demonstrated that members of some families are unable to feel pain. They respond normally to touch, temperature and pressure and have no signs of nerve disease.

From this information it is reasonable to conclude that in the affected people

- A. neurons in the skin are unable to respond to external stimuli.
- B. ion channels are blocked in one group of specialised neurons.
- C. neurons are unable to produce neurotransmitters.
- D. brain cells fail to respond to electrical signals.

**Question 4**

A protein-based fibre could be constructed from repeated monomers of

- A.  $C_5H_{13}N_4COOH$
- B.  $CH_3(CH_2)_nCOOH$
- C.  $C_x(H_2O)_y$
- D.  $C_6H_5COCl$

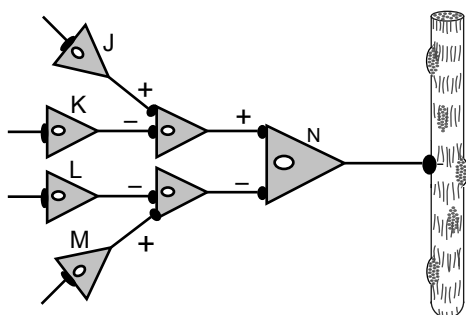
**Question 5**

Networks of neurons interact to support the complex functioning of an organism. Some signals from neurons activate processes. Other signals inhibit processes. Activation signals are indicated by a + sign, inhibitory signals by a – sign. A single activation signal is cancelled out by a single inhibition signal if they are given at the same time to the same neuron.

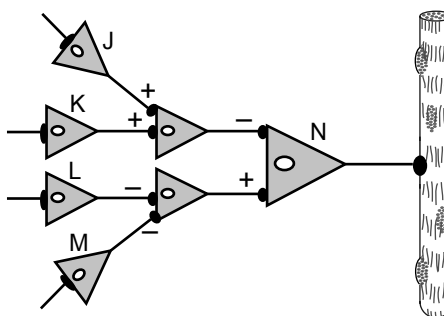
Several neuron networks, each associated with a muscle fibre, were investigated.

If neurons J, K, L and M were activated at the same time, you would expect neuron N to activate the muscle fibre in network

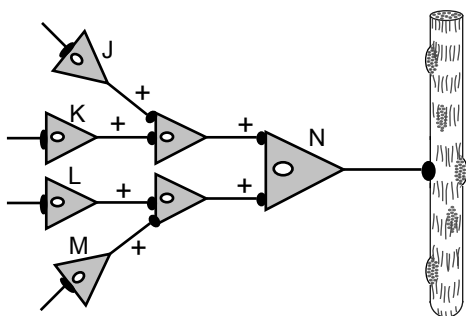
A.



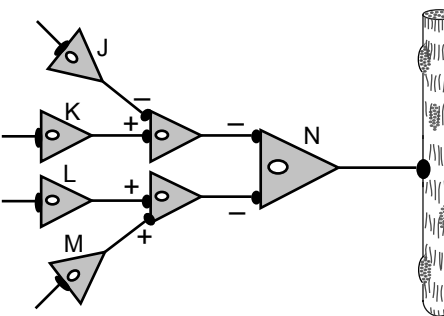
B.



C.



D.

**Question 6**

Rheumatoid arthritis (RA) is a chronic autoimmune disease that affects the joints. RA typically appears between the ages of 30 and 40 years.

Autoimmune diseases such as RA occur when

- A. B and T cell lymphocytes mistakenly attack ‘self’ tissue.
- B. B and T cell lymphocytes fail to recognise ‘non-self’ material.
- C. the immune system is unable to produce sufficient numbers of T lymphocytes.
- D. the immune system is unable to produce sufficient numbers of B lymphocytes.

**Question 7**

A student was asked to identify differences between the overall processes of photosynthesis and aerobic respiration in eukaryotic cells. The student prepared the table below to outline the differences.

The only correct comparison listed by the student is

	<b>Photosynthesis</b>	<b>Aerobic respiration</b>
A.	Exergonic	Endergonic
B.	All stages occur within chloroplasts	All stages occur within mitochondria
C.	Electron transport not involved	Electron transport involved
D.	Uses water as a reactant in the first stage	Forms water as a product in the final stage

**Question 8**

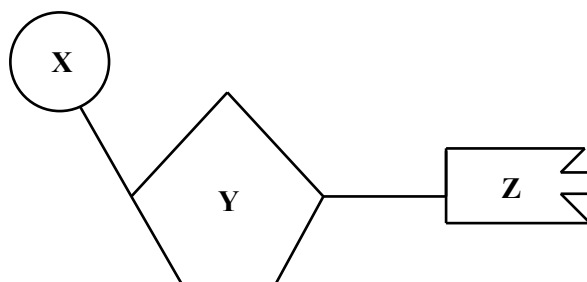
During periods of strenuous exercise or prolonged fasting, glycogen stored in liver and muscle cells is depleted. All glucose in the blood and cells may be completely depleted as well.

If this occurs, the compound that is next most accessible for use in glycolysis is

- A. lipid.
- B. DNA.
- C. starch.
- D. protein.

**Question 9**

The following diagram represents a nucleotide with subunits X, Y and Z.



This nucleotide could be identified as a monomer of DNA but not RNA if

- A. X is ribose.
- B. Z is thymine.
- C. Y is phosphate.
- D. Z paired with cytosine.

**Question 10**

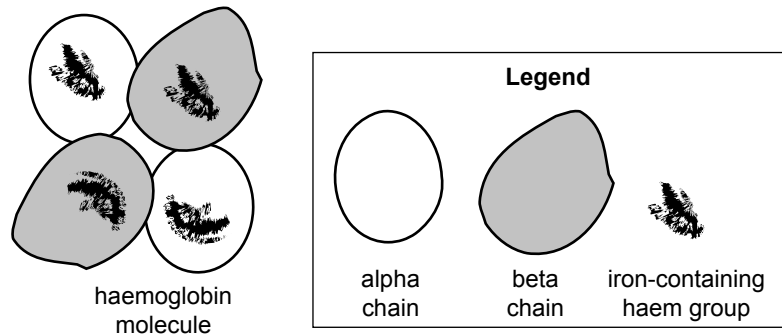
During surgery, some breast cancer patients have lymph nodes removed from the armpit areas. This may result in swelling of the arm.

It could be expected that the

- A. lymphocytes would no longer be able to act with antigens in the patient.
- B. lymphatic flow in the arm has reversed direction.
- C. build up of tissue fluid in the arm would contain leucocytes.
- D. patient can no longer fight infections on that side of the body from which the nodes were removed.

**Question 11**

A haemoglobin molecule is composed of four protein (globin) chains each attached to an iron-containing haem group. Two are identical alpha chains and two are identical beta chains. The following diagram is a stylised representation of a haemoglobin molecule.



A haemoglobin molecule would be classified as having a

- A. primary protein structure.
- B. secondary protein structure.
- C. tertiary protein structure.
- D. quaternary protein structure.

**Question 12**

A swimmer cut his foot on a sharp piece of coral. Microscopic fragments of the living coral remained in the wound and the swimmer suffered itching, redness and pain for several days afterwards.

The nonspecific responses made by his immune system as a result of this injury could include

- A. reaction of antibodies with the living coral fragments.
- B. decreased blood vessel permeability in the foot.
- C. removal of foreign material by neutrophils.
- D. a decrease in body temperature.

**Question 13**

In Australia, it is recommended that children receive immunisation against chicken pox at 18 months and again at 7 years of age.

The following table gives information with regard to chicken pox about an Australian family.

Family member	Age	Immunological history	Immunisation history regarding chicken pox
mother	30 years	Contracted chicken pox aged 5 years	No immunisation
father	35 years	No information available	No immunisation
first child	4 years	Has not had chicken pox	Immunised at 18 months
second child	15 months	Has not had chicken pox	No immunisation
third child	2 weeks fully breast fed	Has not had chicken pox	No immunisation

The family described above were all exposed to the chicken pox virus. Two weeks later, the second child, of 15 months, developed the disease. No other family member showed any symptoms of the disease, even after one month.

Given the information above, it would be reasonable to claim that the

- A. 15-month-old child has a defective immune system.
- B. father already had infective chicken pox virus in his body.
- C. 2-week-old baby had naturally acquired chicken pox antibodies.
- D. 4-year-old child had previously received an injection of chicken pox antibodies.

**Question 14**

*Nitrosomonas europa* is a species of bacteria that obtains its energy by oxidising ammonium ions to nitrite ions.



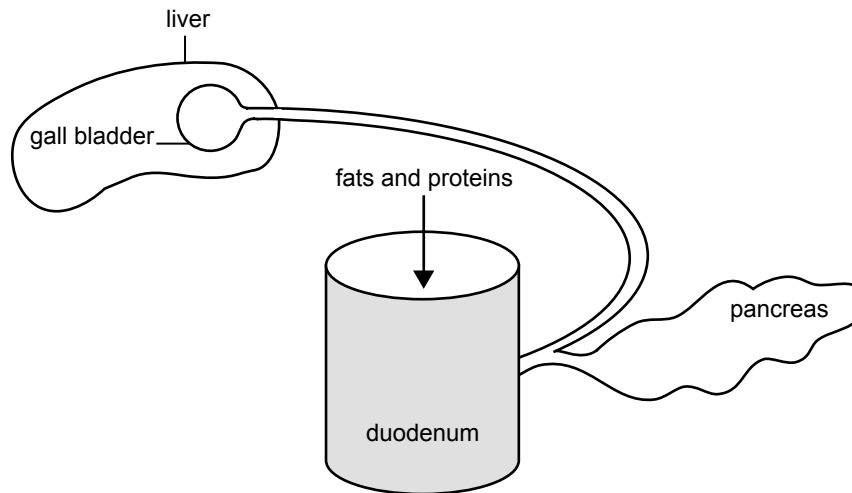
ammonium ions + oxygen → nitrite ions + hydrogen ions + water

It is reasonable to argue that

- A. the reaction is anaerobic.
- B. the reaction is endergonic.
- C. no heat is produced in this reaction.
- D. ATP is produced as a result of this reaction.

**Question 15**

When fats and proteins are present in the duodenum, events occur that result in digestive enzymes being released into the duodenum from the pancreas. In addition, the gall bladder contracts and releases bile into the duodenum.



It is reasonable to conclude that

- A. signalling molecules carry messages from the duodenum to both the gall bladder and the pancreas.
- B. signalling molecules would diffuse through tissue fluid that fills the spaces between the different organs.
- C. an increase in digestive enzymes from the pancreas results in an increase of fats and proteins in the duodenum.
- D. an increase in bile from the gall bladder reduces the break down of fats and proteins.

**Question 16**

Homeostatic systems comprise components such as sensors, effectors and variables.

In such systems, the component being kept relatively constant is

- A. the variable.
- B. input to the sensor.
- C. input to the effectors.
- D. output from the effectors.

**Question 17**

Canavanine is an amino acid that is part of the defence system of some plants. Some insects that eat seeds containing canavanine incorporate it into their own proteins in the place of the amino acid arginine. This causes the insect to produce proteins with a modified tertiary and/or quaternary structure. The proteins containing canavanine can affect the nervous system of the insect.

This information suggests that canavanine

- A. is a plant hormone that affects insects.
- B. is a pheromone that attracts insects.
- C. makes seeds containing it distasteful to insects.
- D. in insect proteins reduces the ability of an insect to feed.

**Question 18**

A specific immune response involves

- A. helper T lymphocytes releasing cytotoxins.
- B. T lymphocytes recognising antigens presented by macrophages.
- C. suppression of the response by memory B cells after the infection.
- D. B lymphocytes, each with a number of different surface antibodies.

**Question 19**

Myosin is a protein consisting of six chains and is the main component of some muscle filaments.

It would be reasonable to classify myosin as a

- A. contractile protein.
- B. hormonal protein.
- C. globular protein.
- D. storage protein.

**Question 20**

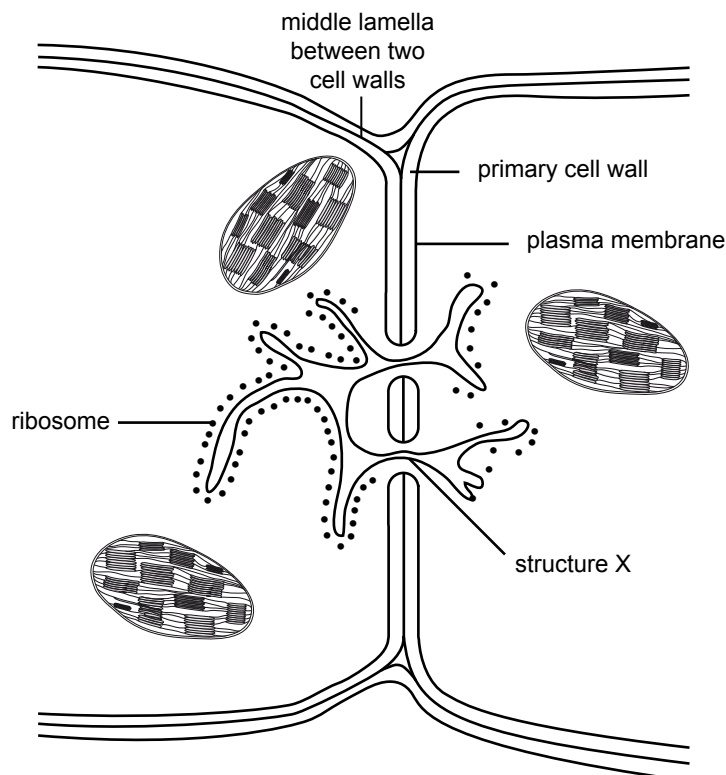
Cell organelles and membranes that are involved in the transport of biomolecules from inside a cell to outside a cell include

- A. ribosomes.
- B. microtubules.
- C. membranes that form vesicles during endocytosis.
- D. secretory vesicles that bud off from the Golgi complex.



**Question 21**

Some plant cells have connections through their cell walls through which they can communicate. The following diagram includes a section of the cell walls of two plant cells that are next to each other and includes two of these areas of connection.



It is reasonable to conclude that

- A. such cells lack a nucleus.
- B. structure X is made of cellulose.
- C. the cytosols of the two cells are isolated from each other.
- D. material is able to pass from cell to cell without having to travel through a plasma membrane.

**Question 22**

Signal molecules that pass from one cell to another in plants include

- A. gibberellins that inhibit seed germination.
- B. ethylene that gives the instruction for fruits to ripen.
- C. abscisic acid that gives the instruction for leaves to grow.
- D. auxin that gives the instruction for stems to stop growing.

**Question 23**

In plants, bacterial infection sometimes leads to the production of an oil, methyl salicylate. This oil can travel through the air and reaches neighbouring plants that have not yet been infected. Although uninfected, the recipient plants produce a defensive response.

It is reasonable to suggest that

- A. methyl salicylate is a pheromone.
- B. the infecting bacteria produce methyl salicylate.
- C. methyl salicylate lacks a specific message for recipient cells.
- D. the recipient plants produce a substance that kills pathogens.

**Question 24**

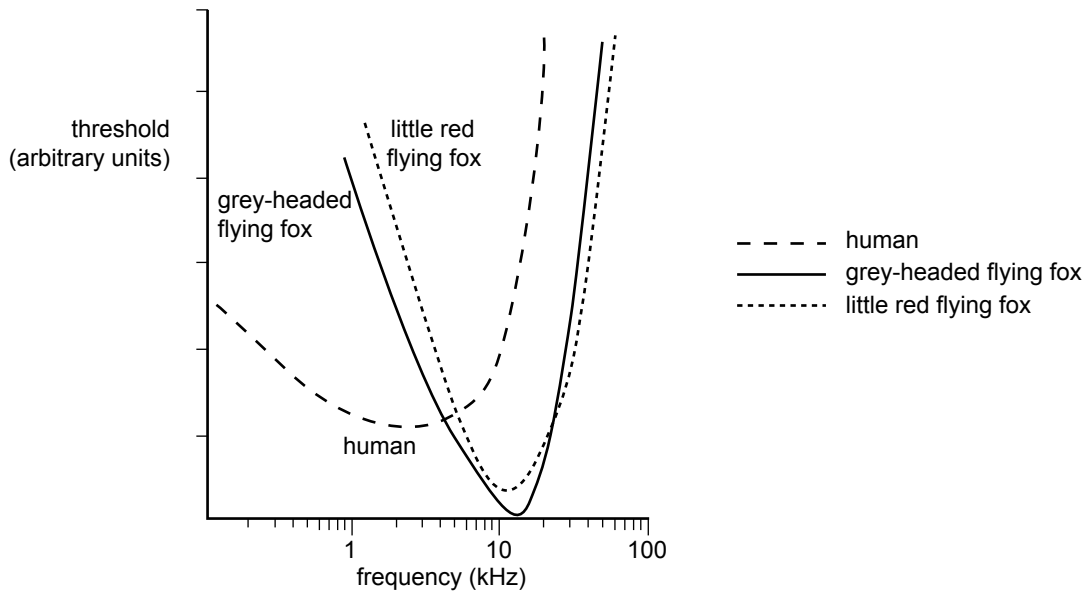
The olfactory part of a brain is responsible for an animal's ability to smell. The brain of a black flying fox has a relatively large olfactory lobe, indicating that these flying foxes rely heavily on smell to find their food.

Signals between neurons in the olfactory lobe would occur by means of

- A. enzymes.
- B. hormones.
- C. neurohormones.
- D. neurotransmitters.

**Question 25**

The following graph compares the hearing of humans with the hearing of two flying foxes.



The threshold is a measure of sensitivity where the higher the value, the louder is the volume of sound required to hear a particular frequency.

Assume that the human, the grey-headed flying fox and the little red flying fox were exposed to a range of sounds. Although the sounds were at different frequencies, they were all at the same volume.

From the data provided on the graph, one can conclude that

- A. it is more difficult for a human to hear the sound if it has a frequency of 1 kHz than if it has a frequency of 10 kHz.
- B. a grey-headed flying fox can hear the sound at 10 kHz better than can the little red flying fox.
- C. a grey-headed flying fox hears all sounds better than the little red flying fox whatever the frequency of the sound.
- D. at frequencies below 1 kHz, humans have more difficulty hearing the sound than both flying foxes.

## SECTION B – Extended response questions

### Instructions for Section B

Answer this section in **pen**.

Answer all questions in the spaces provided.

#### Question 1

- a. What is the general name for the chemicals that act as sex attractants in many insects?

\_\_\_\_\_

1 mark

A hormone was produced in one cell, entered the blood stream and travelled to two groups of cells adjacent to each other. One group of cells responded to the hormone but the neighbouring group did not.

- b. What is the most likely reason for this difference in response by cells to the same hormone?

\_\_\_\_\_

\_\_\_\_\_

1 mark

Consider one hormone you have studied this year that is transported through the blood to one or more types of cells.

- c. i. Name the hormone.

\_\_\_\_\_

- ii. Name the tissue or gland that produces the hormone.

\_\_\_\_\_

- iii. Explain what the term signal transduction refers to.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

- iv. What is the outcome as a result of signal transduction in the cells that were targets for the hormone you chose in **part c.i.** of this question?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

1 + 1 + 1 + 1 = 4 marks

Total 6 marks

**Question 2**

**a.** Briefly explain the role that each of the following have in the immune response to infection.

**i.** Phagocytes

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**ii.** Complement proteins

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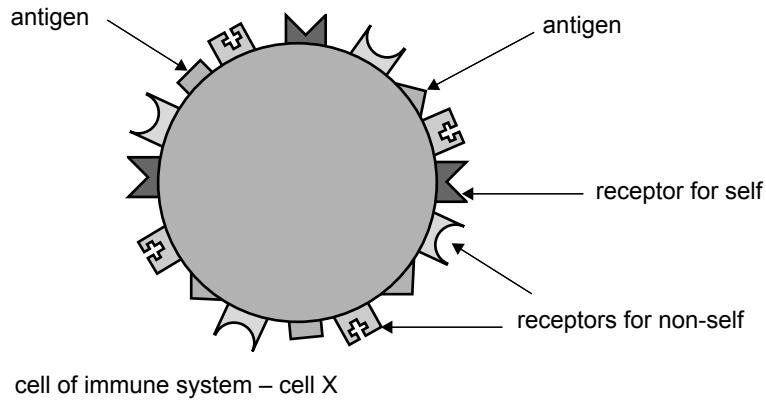
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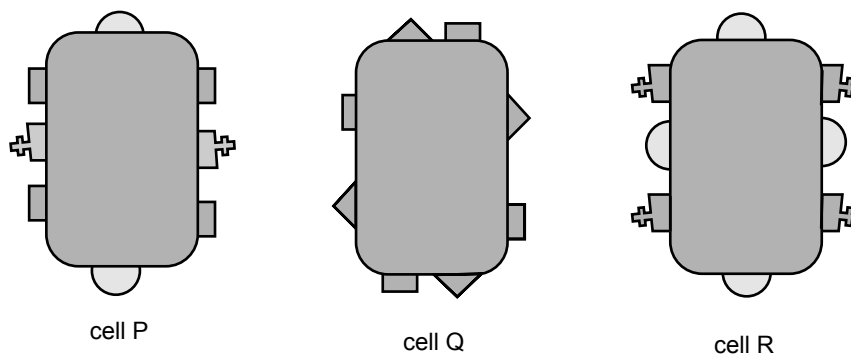
1 + 1 = 2 marks

Immune cells have many different kinds of receptors on their plasma membranes as well as different kinds of self antigens. Some of the receptors are for self antigens and some are for non-self antigens. By examining other cells for the presence of self and non-self antigens, immune cells can determine the kind of threat those other cells might be for the organism. The more non-self antigens an immune cell detects, the greater will be its reaction against a cell it comes into contact with.

Examine the following immune cell. Note the kinds of antigens and receptors it has.



This immune cell X encounters the following three cells.



- b. i. Which of these cells, P, Q or R, will cause the greatest response from cell X?

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- ii. Explain the choice you made in **part b.i.**

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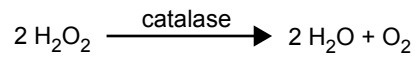
1 + 1 = 2 marks

Total 4 marks

**Question 3**

Many living cells produce hydrogen peroxide as a by-product of some metabolic reactions. Hydrogen peroxide is a poisonous substance for these cells and is immediately decomposed into water and oxygen by an enzyme called catalase.

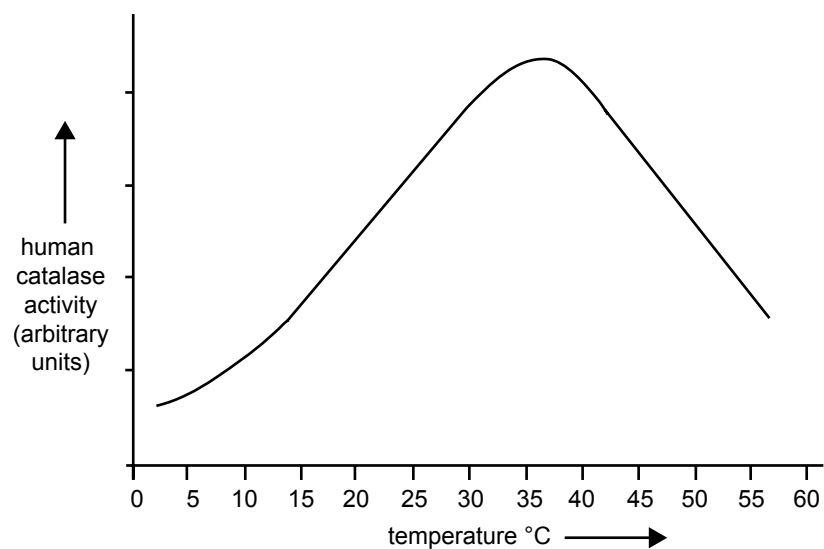
The reaction is represented by the equation



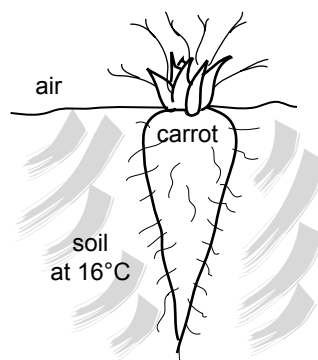
- a. Which is the substrate in this chemical reaction?

1 mark

The activity of catalase in humans was tested across a number of different temperatures and the results graphed. The results are shown below.



Catalase is found in many plants, including carrots.



A student predicted that if a temperature graph was prepared for carrot catalase activity, the optimal temperature would be expected to be much lower than that shown by catalase from humans.

- b. Do you agree or disagree with the student's prediction? Explain the reason for your choice.

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1 mark

- c. Describe (or outline) an experiment you would carry out with pieces of carrot to test the accuracy of the student's prediction. Hydrogen peroxide is available as a 3% in water solution.

Explain fully what results would support or negate the student's prediction.

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3 marks

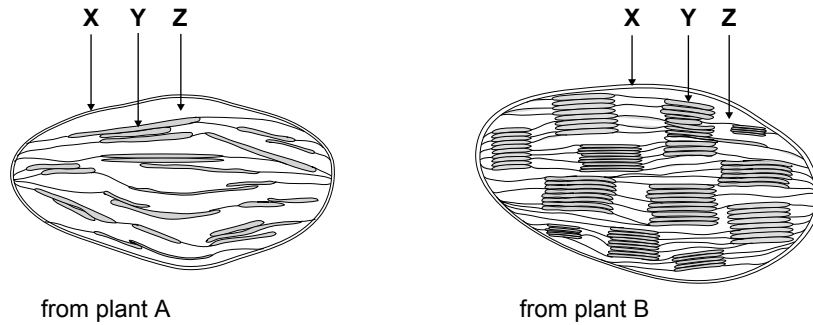
Total 5 marks

**Question 4**

The bird’s-nest fern, *Alocasia macrorrhiza*, usually grows in deeply shaded rainforests and has dark green fronds. Sometimes it is found in open, sunny locations by roadsides where it tends to have lighter coloured fronds.

Two bird’s-nest ferns, one from each of the two habitats described above, were examined. A sample of cells from a frond of each of the ferns was collected.

These cells were examined under an electron microscope and a typical chloroplast from each habitat (deeply shaded rainforest and sunny location) was drawn. These drawings are shown below.



a. Which of the labelled parts, X, Y or Z, absorb light energy? Name the part.

\_\_\_\_\_

1 mark

b. Which drawing, A or B, shows a chloroplast from the rainforest habitat? Explain the reason for your choice in terms of the relationship between structure and function.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2 marks

c. Name the process by which the chemical reactants for the light-dependent reactions of photosynthesis enter a chloroplast.

\_\_\_\_\_

1 mark

Chloroplasts contain large numbers of ribosomes.

d. Explain the importance of the presence of these ribosomes.

\_\_\_\_\_

\_\_\_\_\_

1 mark



It is now widely accepted by biologists that chloroplasts and mitochondria were once independent prokaryotic organisms which came to live symbiotically inside larger eukaryotic cells. This idea is known as the endosymbiotic theory.

- e. Name one structural feature of chloroplasts or mitochondria and outline how it supports the endosymbiotic theory for the origin of these organelles.

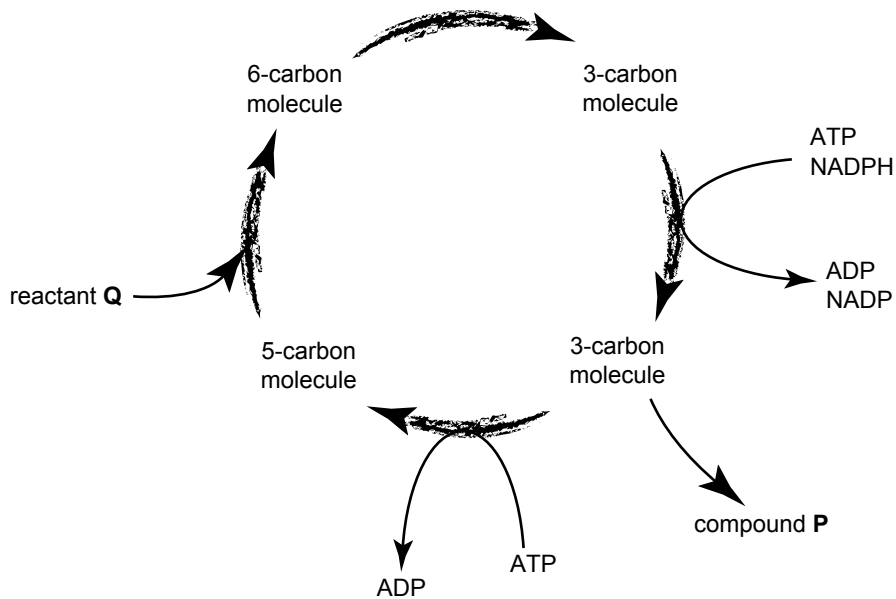
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1 mark

The simplified diagram below summarises the light-independent reactions (Calvin cycle) of photosynthesis.



- f. Name reactant Q.

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1 mark

You will note that during the light-independent reactions many energy-carrier molecules of NADPH and ATP are used.

- g. What is the source of these energy carriers?

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1 mark

- h. What is compound P?

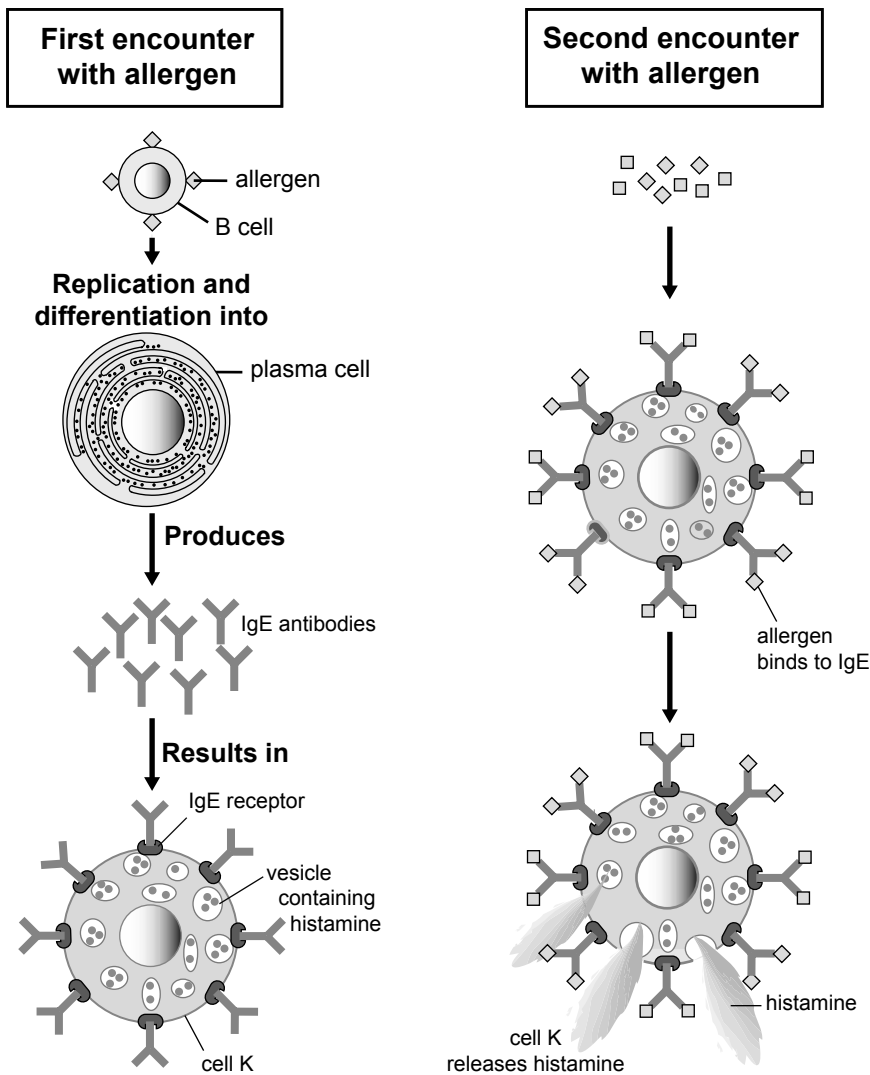
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1 mark

Total 9 marks

**Question 5**

The diagrams below outline the sequence of events involved in an allergic response.



a. Name one well-recognised allergen.

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1 mark

Examine the plasma cell shown in the above diagram.

b. i. Identify the organelle that is abundant in the cytosol of the plasma cell.

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ii. Explain the specific role of this organelle in the plasma cell.

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1 + 1 = 2 marks

- c. i. Name the type of cell represented by cell K.

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Cells of type K can produce localised allergic responses in particular regions of the body.

- ii. Name one such region of the body.

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- iii. Describe one effect of the release of histamine by cell K into the surrounding extracellular fluid or bloodstream.

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- iv. Name the process by which histamine is released by cell K.

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1 + 1 + 1 + 1 = 4 marks

Total 7 marks

**Question 6**

During digestion, large molecules are broken down into their constituent monomers (subunits).

a. Complete the table below.

Large molecules	Monomers (subunits)
	Amino acids
Lipid	
	Monosaccharide
DNA	

2 marks

b. Explain how a monosaccharide enters an epithelial cell.

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1 mark

c. For what purpose would a cell use a lipid monomer?

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1 mark

d. Part of the sequence of a DNA strand responsible for the production of an amino-acid chain is shown. Below it, write the complementary DNA base sequence.

<b>ATG</b>	<b>AAC</b>	<b>AGC</b>	<b>GGC</b>

1 mark

e. What does G in AGC stand for?

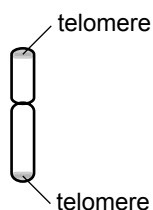
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1 mark

Total 6 marks

**Question 7**

Chromosomes are DNA structures in the nucleus of a cell. The ends of chromosomes are called telomeres.



Some changes in the DNA of these telomeres can trigger the development of cancer.

Scientists are working to detect these changes in telomeres at an early stage of their development.

- a. Outline one advantage of being able to detect early changes in telomere DNA.

1 mark

One normal sequence of DNA in a particular telomere was AATCGTCCAGGG. On examination of the telomeres of one patient this sequence was found to have changed to AACCGTCCTGGG.

The doctor examined the relationship between a DNA sequence and amino acids that could be expected. He used the following table to obtain information.

DNA sequence	Amino acid
AAT or AAC	leucine
CGT or CGG	alanine
CCA or CCT	glycine
GGG or GGT	proline

- b. Is the doctor likely to be concerned or not concerned about the change in the telomere DNA of this patient? Explain your answer.

1 mark

- c. Name one application of molecular biology in medicine that you have studied this year and outline the significance of its use.

Name of application \_\_\_\_\_

Significance

2 marks

Total 4 marks

**Question 8**

Viruses are responsible for many diseases.

- a. Name one natural feature of the body that acts as a first line of defence when a person comes in contact with a pathogen.

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1 mark

After infection with a virus, some cells secrete interferons.

- b. Describe the role of interferons.

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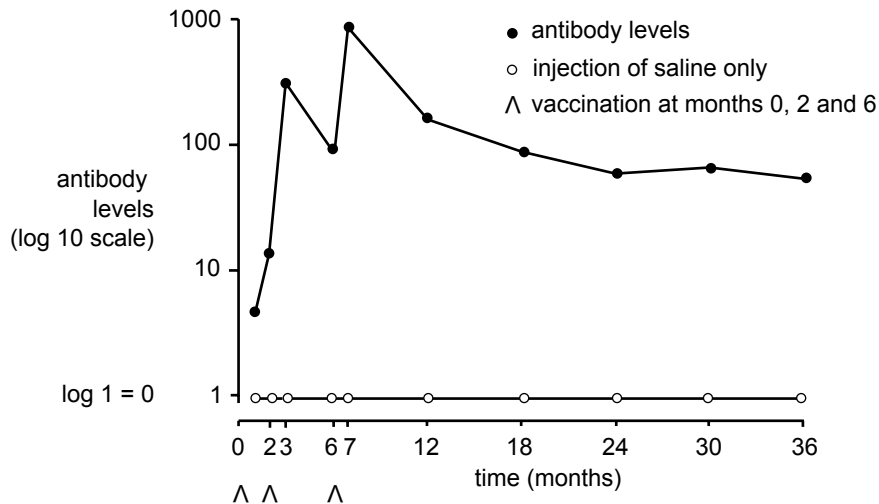


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1 mark

Cervical cancer is a rare consequence of persistent infection by the Human Papilloma Virus (HPV) in some women. The virus is transmitted sexually and may cause genital warts in both males and females. The natural immune response to this virus is not very effective.

Recently a vaccine has been produced to prevent this viral infection and therefore reduce the incidence of cervical cancer. The vaccine contains virus-like particles from the protein coat of the virus in a saline solution. The graph below shows the antibody response to a trial vaccination program in 16–23-year-old women, to whom three doses were given. Another group of women received injections of saline only.



- c. In the design of the vaccine, what feature prevents the virus-like particles infecting cells and causing disease?

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1 mark

- d. What is the purpose of injecting some women with a saline solution?

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1 mark

e. Why does the antibody response increase with each vaccination?

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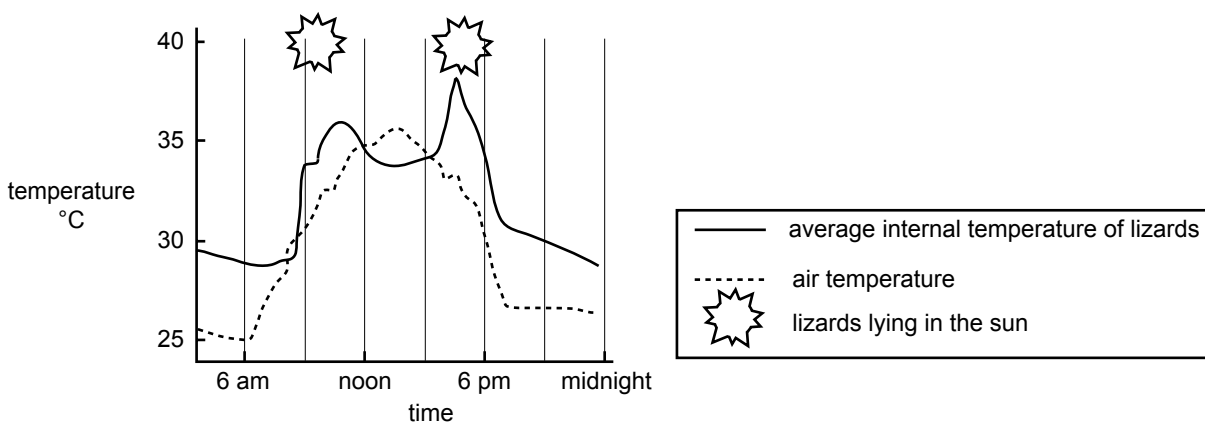
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2 marks

Total 6 marks

**Question 9**

Researchers measured the internal body temperatures of a number of perentie lizards, *Varanus giganteus*, on a day in March 1983. The following graph shows the average body and air temperature for that day.



a. i. On this day, at what time did the lizards reach their highest internal body temperature?

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ii. Does the answer you gave in **part i.** coincide with the highest air temperature for the day? Explain.

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1 + 1 = 2 marks

b. Is a lizard likely to detect skin temperature by the nervous system or the hormonal system? Explain.

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1 mark

Total 3 marks