



# Victorian Certificate of Education 2011

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

## STUDENT NUMBER

Letter

Figures

Words


# BIOLOGY

## Written examination 1

Tuesday 14 June 2011

Reading time: 9.00 am to 9.15 am (15 minutes)

Writing time: 9.15 am to 10.45 am (1 hour 30 minutes)

## QUESTION AND ANSWER BOOK

### Structure of book

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
A	25	25	25
B	7	7	50
			Total 75

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.
- No calculator is allowed in this examination.

### Materials supplied

- Question and answer book of 23 pages.
- Answer sheet for multiple-choice questions.

### Instructions

- Write your **student number** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- All written responses must be in English.

### At the end of the examination

- Place the answer sheet for multiple-choice questions inside the front cover of this book.

**Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.**

**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 term used to indicate all proteins in an organism is

- A. protozoa.
- B. protease.
- C. proteome.
- D. proterozoic.

**Question 2**

Triglycerides

- A. dissolve readily in water.
- B. are a rich source of energy.
- C. can only be found in animal cells.
- D. are the building blocks of polysaccharides.

**Question 3**

It is accurate to claim that

- A. lipids are packaged in mitochondria.
- B. carbohydrates increase the rate of reactions.
- C. nucleic acids are made up of chains of amino acids.
- D. polysaccharides can be found as starch in plant cells.

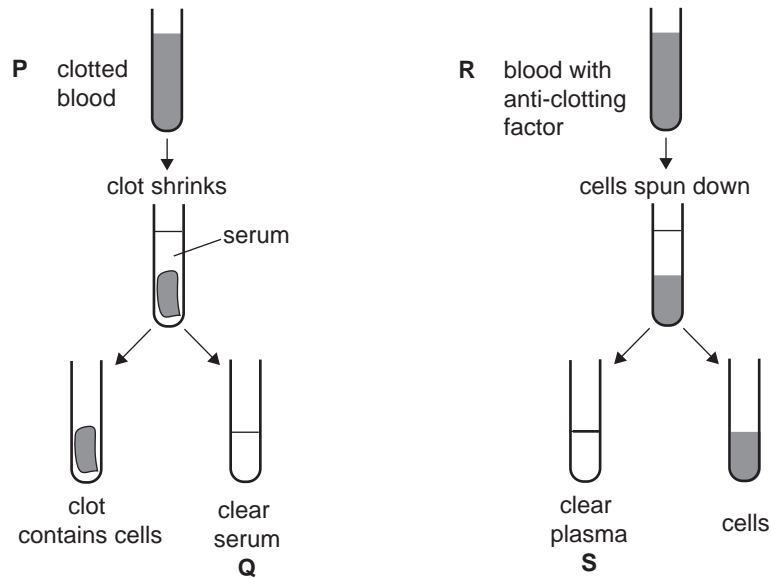
**Question 4**

A molecule of transfer RNA could include the nucleotide sequence

- A. CTCGAUTAC
- B. GGCUUUAAA
- C. CCUUTUGAG
- D. AAAATACCG

**Question 5**

A late step in the clotting of blood is the conversion of soluble fibrinogen to insoluble fibrin. Examine the following diagram.



It is reasonable to conclude that fibrin is present in

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

**Question 6**

It is reasonable to infer that an infection has occurred if

- A. histamine is released by cells.
- B. a scab has formed on a cut in the skin.
- C. bacteria are found in the large intestine.
- D. pathogens are found in leg muscle tissue.

**Question 7**

The lymphatic system contains

- A. B cells only.
- B. T cells only.
- C. B cells and T cells.
- D. neither B cells nor T cells.

**Question 8**

Nonspecific defences of the immune system that act against bacteria include

- A. antibodies.
- B. phagocytes.
- C. interferons.
- D. plasma cells.

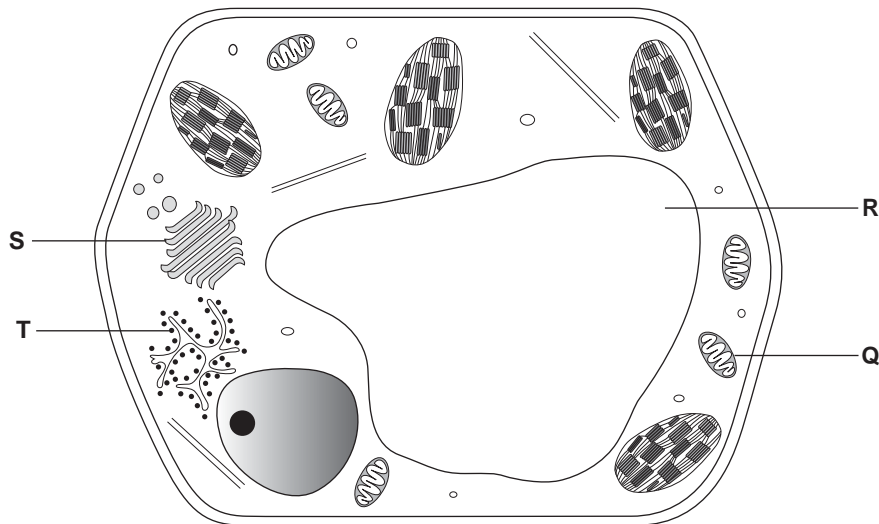
**Question 9**

Antibodies passed from a mother to her baby during breast-feeding would be best described as

- A. naturally acquired, passive immunity.
- B. naturally acquired, active immunity.
- C. artificially acquired, passive immunity.
- D. artificially acquired, active immunity.

**Question 10**

Consider the following cell.



The synthesis of

- A. glucose occurs in structure Q.
- B. DNA occurs in structure R.
- C. RNA occurs at structure S.
- D. protein occurs at structure T.

**Question 11**

Histoplasmosis is an infectious disease of the lungs caused by the soil-based fungus *Histoplasma capsulatum*.

The *H. capsulatum* fungus is most likely to be

- A. killed by antibiotics.
- B. a prokaryotic organism.
- C. only able to grow in a dry, cool environment.
- D. made of thread-like filaments known as hyphae.

**Question 12**

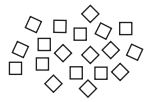
*Vibrio cholerae* produces a toxin that binds to a plasma membrane receptor on intestinal cells of the host. The toxin permanently activates the G protein in target cells, causing them to lose water rapidly. When a person is infected with cholera they suffer severe dehydration.

*V. cholerae* toxin

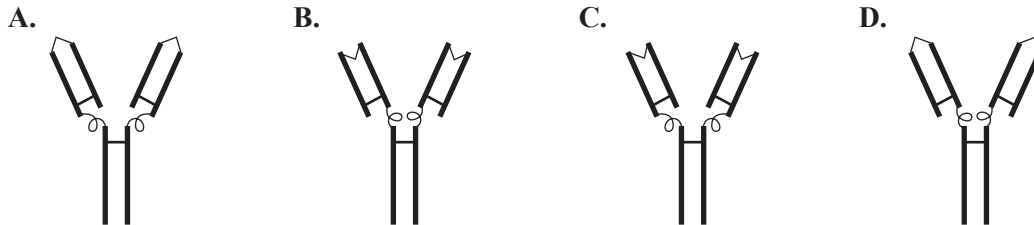
- A. disrupts normal signal transduction in the cell.
- B. is an example of a second messenger molecule.
- C. is a lipid-soluble molecule.
- D. acts as a neurohormone.

**Question 13**

This diagram shows a group of antigens.



An appropriate antibody to use against these antigens would be type

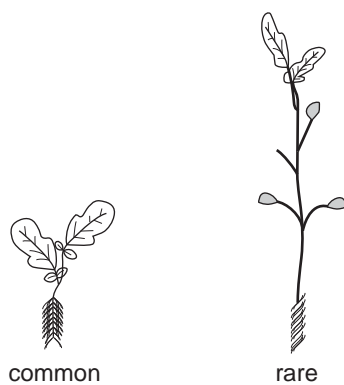
**Question 14**

The Golgi apparatus is responsible for the

- A. manufacture of lipids.
- B. production of energy for the cell.
- C. destruction of unwanted cellular molecules.
- D. modification and packaging of protein molecules.

**Question 15**

There are two different forms of *Brassica rapa*. When both forms are grown for 11 days, the following growth pattern is seen.

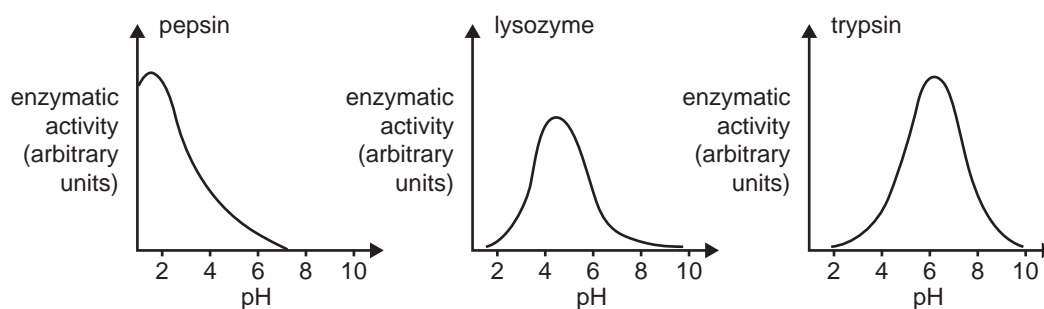


The rare form of *B. rapa* is most likely to

- A. produce excess gibberellin.
- B. be unable to bend towards the light.
- C. have an increased production of ethylene.
- D. have a reduced production of cytokinin.

**Question 16**

Examine the following graphs.



From these graphs it is reasonable to infer that at a pH of 4

- A. trypsin would be inactive.
- B. all the pepsin would be denatured.
- C. all three enzymes would lack a functional active site.
- D. lysozyme has the highest activity of the three enzymes.

**Question 17**

Amino acids in the body are broken down in the liver during times of starvation. The products of this breakdown are used to manufacture glucose that can be stored as glycogen or released into the blood.

It is reasonable to infer that

- A. manufacture of glucose is an exergonic reaction.
- B. heat is a by-product of the breakdown of glycogen.
- C. amino acid breakdown is an endergonic reaction.
- D. activation energy is not required to start biological reactions.

**Question 18**

A common neurotransmitter is acetylcholine (ACh), which excites the post-synaptic neuron. Lack of ACh in brain synapses has been linked to Alzheimer's disease. A number of other chemicals also act at synapses. The table below outlines some of these chemicals and their actions.

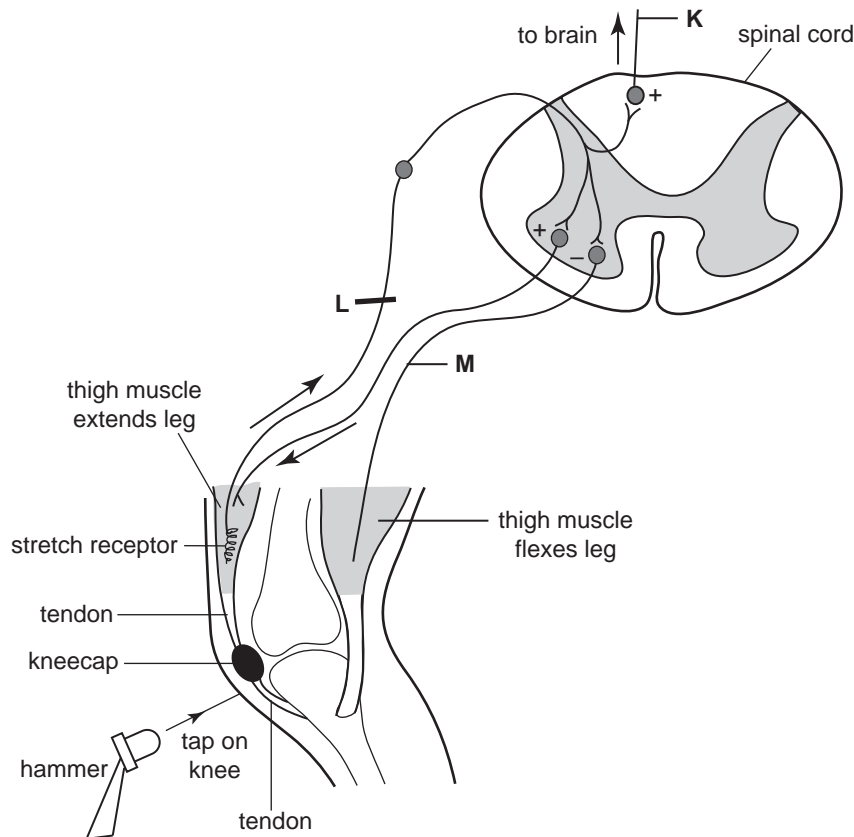
Chemical	Source in nature	Effect at synapse
Botulinum	<i>Clostridium</i> bacteria	Prevents release of ACh from the pre-synaptic membrane
Eserine	African calabar bean	Inhibits acetylcholinesterase, the enzyme which breaks down ACh after post-synaptic stimulation
Curare	South American plant <i>Chondrodendron</i> sp.	Blocks post-synaptic receptors
Nicotine	Tobacco plant	Stimulates in the same way as ACh

Based on this information, a possible treatment for Alzheimer's disease is to

- A. administer eserine as a drug.
- B. inject curare into the patient's CNS.
- C. recommend that the patient stop smoking.
- D. purposely infect the patient with *Clostridium*.

**Question 19**

When muscle fibres are stimulated, the muscle contracts. The gentle tapping of a tendon stimulates stretch receptors. The response to this stimulation is a 'knee jerk' reflex action. That is, the leg suddenly straightens. The pathway involved is shown in the diagram below.



Examination of this pathway reveals that

- A. inhibition of neuron **M** will allow the leg to flex (or bend).
- B. injury to neuron **K** is unlikely to affect the knee jerk response.
- C. cutting the neuron at point **L** has no effect on the knee jerk response.
- D. stretching of the tendon in one knee initiates the response in the other knee.

**Question 20**

The reaction  $\text{ADP} + \text{P}_i \longrightarrow \text{ATP}$

- A. is irreversible.
- B. occurs without the presence of enzymes.
- C. occurs in yeast cells during fermentation.
- D. only occurs in cells containing mitochondria.

**Question 21**

An example of homeostasis is when

- A. root hairs of a pumpkin plant grow towards a source of water.
- B. evaporation of water from the body surface after swimming has a cooling effect.
- C. cabbage plants grown in a phosphorus-deficient soil mobilise phosphorus from tissues and release it into the phloem.
- D. the body surface colour of the chameleon lizard changes to match the colour of the foliage on which it is resting.

**Question 22**

The following image is of a Siamese cat.



The colour produced in the fur of a Siamese cat is under the control of a tyrosinase enzyme that is sensitive to particular temperatures. A summary of the enzyme action is

pigment precursor  $\xrightarrow{\text{body temperature at or above } 37^{\circ}\text{C}}$  no pigment produced

pigment precursor  $\xrightarrow{\text{body temperature below } 37^{\circ}\text{C}}$  pigment produced

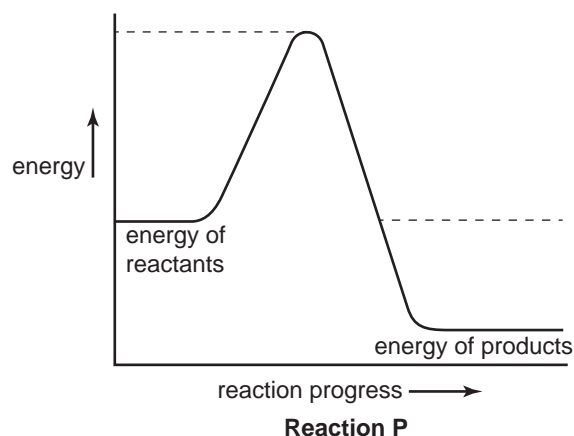
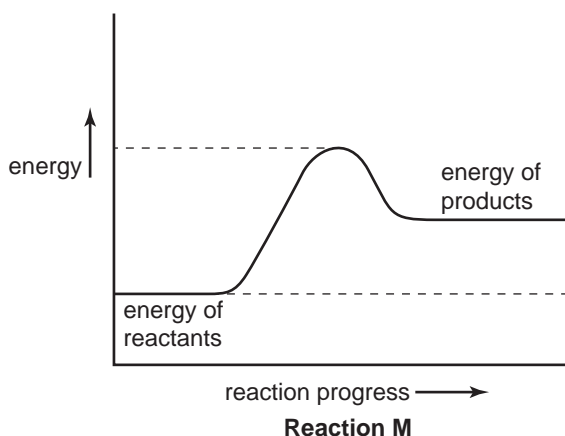
The core body temperature of a cat ranges from about  $38^{\circ}\text{C}$  to  $39.2^{\circ}\text{C}$ .

It is likely that in Melbourne

- A. Siamese kittens have dark fur over their bodies when they are born.
- B. Siamese cats that live outside a house show an increase in pigment during summer.
- C. Siamese cats that live inside a house in winter have darker fur than those that live outside.
- D. Siamese cats that live outside in winter have darker fur than Siamese cats in tropical regions.

**Question 23**

The following graphs depict two different reactions.



From the two graphs, it is reasonable to conclude that

- A. in reaction **P**, the energy level of the products is greater than that of the reactants.
- B. activation energy of reaction **M** is greater than that of reaction **P**.
- C. both graphs **M** and **P** represent endothermic reactions.
- D. energy is released in reaction **P** only.



*The following information is required for Questions 24 and 25.*

People that have been infected with one or more different respiratory viruses develop antibodies in response to each kind of virus in their blood.

The blood of four patients was tested to diagnose which viruses each patient had previously been infected with. The results are shown in the following table.

Key: ++ agglutination  
0 no agglutination

Blood from	Antibody to			
	Rhinovirus	Influenza A	Influenza B	RSV
Becky	++	++	0	0
Emily	0	++	++	++
Mary	++	++	0	0
Stella	0	0	++	0

#### Question 24

From the information in the table it is reasonable to infer that

- A. Stella has been infected with RSV.
- B. Mary has been infected with three kinds of virus.
- C. Emily has been infected with the greatest number of different viruses.
- D. Becky and Stella have each been infected with the same set of viruses.

Once the antibody distribution was known, doctors vaccinated the four patients against viruses for which each patient had no immunity.

#### Question 25

From the information given in the table it is reasonable to infer that Becky would be given

- A. vaccines for Rhinovirus and influenza A.
- B. vaccines for influenza B and RSV.
- C. the same vaccines as Emily.
- D. vaccines for influenza A.

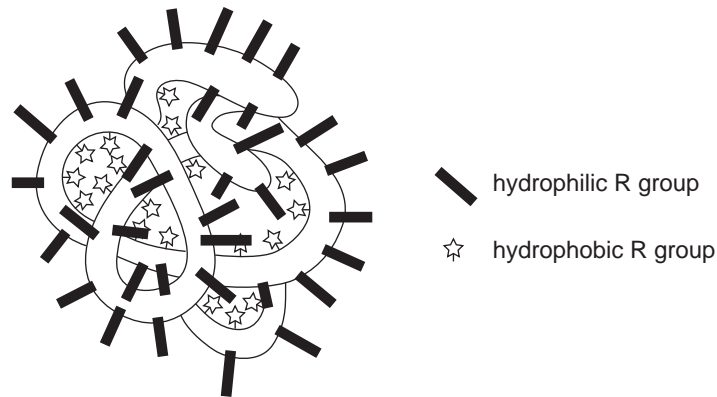
**SECTION B – Short answer questions****Instructions for Section B**

Answer this section in **pen**.

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

**Question 1**

The following figure represents a globular protein.



This molecule is likely to be highly soluble in water.

a. Outline why such a conclusion can be made about this molecule.

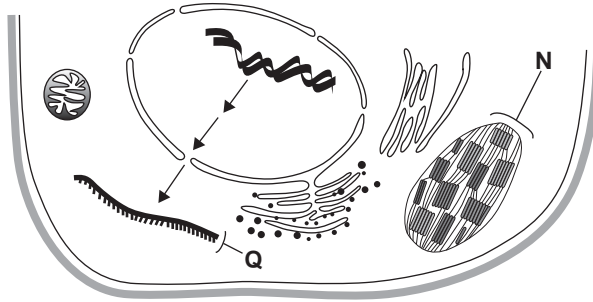
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2 marks

The following figure represents a portion of a plant cell.

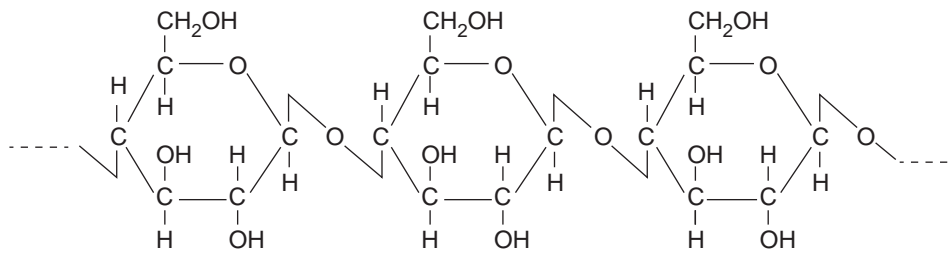


b. Examine the figure above and complete the following table.

	Type of nucleic acid found in structure	Specific function of the nucleic acid
Structure N		
Structure Q		

4 marks

The following diagram shows a portion of an unknown macromolecule found in cells. The remaining portion of the molecule contained the same repeating unit.



Two students were discussing this diagram. Sally suggested it represents cellulose. Toby disagreed. He suggested that the diagram represents the enzyme cellulase.

c. Name the student who is correct and explain why.

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2 marks

Total 8 marks

**SECTION B – continued  
TURN OVER**

**Question 2**

The thymus is an important organ in the immune system. As humans grow older, there is a change in the weight of the thymus and an increase in the proportion of fat it contains.

Examine the following table.

Age	At birth	10 years	20 years	30 years	60 years
Average weight of thymus (gram)	20	35	20	15	5

- a. Explain the likely consequence of this change in thymus weight in an individual.

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2 marks

After two days at a school camp, seven-year-old Paul developed large, itchy red patches and blisters on his right arm. Within two days it had spread to many parts of his body. Paul was diagnosed with a sensitivity reaction to a plant called poison ivy.

- b. Describe the sequence of events that would result in the red patches and blisters on Paul.

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3 marks

Paul was given skin cream to apply to his itchy red blisters. He was also asked to shampoo his hair, wash his body thoroughly with soap and water and cut his nails short.

- c. Explain why these instructions were given to Paul.

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1 mark

Paul was also advised to wear long pants and long-sleeved shirts on any future hikes.

- d. Explain why it is important for Paul to follow these instructions.

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2 marks

Total 8 marks

**Question 3**

Herbivores can cause damage to the leaves, flowers and fruits of plants. In response, a plant may drop the affected part. This process of ‘dropping off’ parts by a plant is called abscission.

- a. Name the plant hormone responsible for plant abscission.

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1 mark

Some *Physalis* plants abscise fruit containing larvae of a moth predator, *Heliothis subflexa*. To complete development, *H. subflexa* larvae need to feed off more than one fruit. For this to occur, larvae from dropped fruit must relocate and climb onto a new host plant.

An experiment was performed to determine the effectiveness of the abscission strategy for plants.

Two different species of *Physalis* were used.

Species 1: *P. pubescens* – a low shrub with drooping, spreading branches

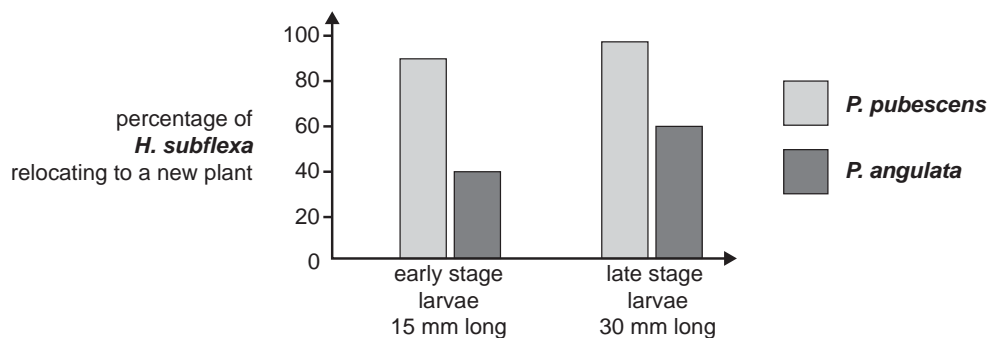
Species 2: *P. angulata* – a tall shrub with upright stem and branches

Different sized larvae were used.

- larvae at early stage development – 15 mm long
- larvae at late stage development – 30 mm long

Each species of plant was tested with two different sized larvae.

The results obtained are summarised in the following graph.



- b. i. Which species of *Physalis* is more susceptible to relocation by *H. subflexa* larvae?

- ii. From the information given suggest a reason why.

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1 + 1 = 2 marks

A farmer decided she would reduce the number of *H. subflexa* in her cotton crop by installing a pheromone trap in the corner of the field.

c. i. What is a pheromone?

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ii. How would the presence of the trap reduce the *H. subflexa* infestation in the crop?

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1 + 1 = 2 marks

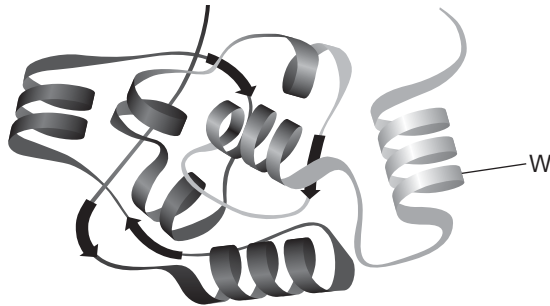
Total 5 marks

**Question 4**

- a. Draw a labelled diagram of the arrangement of the phospholipids in a plasma membrane.

2 marks

The membrane of human plasma cells contains Toll-like receptors (TLR). A portion of one type of TLR is shown below.



- b. What is the name given to the type of secondary protein structure labelled W?

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1 mark



Autoimmune diseases such as asthma and eczema are increasing in the Australian population. It is hypothesised that the TLRs in human cell membranes are not being stimulated enough, due to our strict hygiene practices including the overuse of antibacterial hand washes. As a result, in some individuals, the absence of a range of antigens leads to a situation in which TLRs stimulate T cells to attack self cells. This results in an autoimmune disease.

A group of scientists recruited 120 women who already had a child or close family member with asthma or eczema. These women took part in a research experiment as outlined in the following table.

	<b>Group A 60 women</b>	<b>Group B 60 women</b>
<b>Experimental method</b>	<ul style="list-style-type: none"> <li>• Pregnant women given probiotics for 2 months prior to baby's birth.</li> <li>• Baby is given probiotics every day for the first 18 months of life.</li> </ul>	<ul style="list-style-type: none"> <li>• Pregnant women given placebo for 2 months prior to baby's birth.</li> <li>• Baby is given placebo every day for the first 18 months of life.</li> </ul>
<b>Results</b>	<ul style="list-style-type: none"> <li>• 25% of the babies developed symptoms of asthma or eczema.</li> </ul>	<ul style="list-style-type: none"> <li>• 90% of the babies developed symptoms of asthma or eczema.</li> </ul>

**Note:** Probiotics are cultures of beneficial bacteria normally found in the human intestine. During pregnancy, the probiotics pass through the umbilical cord from mother to baby.

c. What is meant by a placebo?

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1 mark

d. Explain why the babies from Group A were less likely to develop asthma or eczema. Include reference to the immune system in your answer.

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2 marks

Mice can also develop autoimmune diseases such as asthma and eczema. Scientists wished to repeat the experiment using mice susceptible to developing asthma and eczema.

e. What are two factors in the experimental design that scientists would have to control?

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2 marks

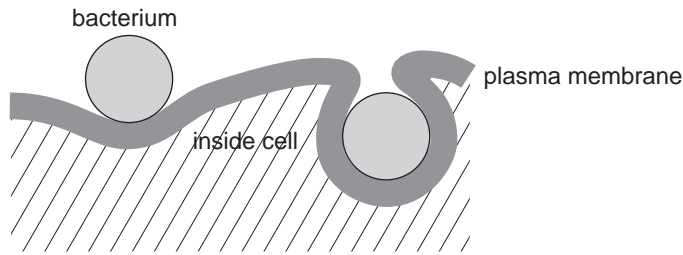
Total 8 marks

**SECTION B – continued  
TURN OVER**

**Question 5**

*Neisseria meningitidis* is a bacterium that causes meningitis. This disease causes inflammation of tissue surrounding the brain and spinal cord in humans.

Bacteria enter through plasma membranes as shown in the figure below.



a. Name the process shown in the figure.

\_\_\_\_\_

1 mark

In an attempt to prevent the spread of the bacteria the immune system releases antibodies and macrophages to an area of infection.

b. Describe how antibodies and macrophages inhibit the spread of *N. meningitidis*.

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2 marks

*N. meningitidis* can protect itself from the immune system by releasing a protease that breaks the subunits of the antibody.

c. Why is this enzyme named a protease?

\_\_\_\_\_

\_\_\_\_\_

1 mark

A patient infected with *N. meningitidis* can be given a drug that acts as an inhibitor to the protease enzyme.

d. Explain why the drug needs to have a shape complementary to the protease enzyme.

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\_\_\_\_\_

1 mark

Total 5 marks

**CONTINUES OVER PAGE**

**SECTION B – continued**  
**TURN OVER**

**Question 6**

The hypothalamus, located within the brain, consists of neurons that produce hormones. The hormones are transported along the neural axon eventually being emptied into blood vessels at the far end of the neural axon.

a. Explain how this form of transport compares with that shown by a typical neuron.

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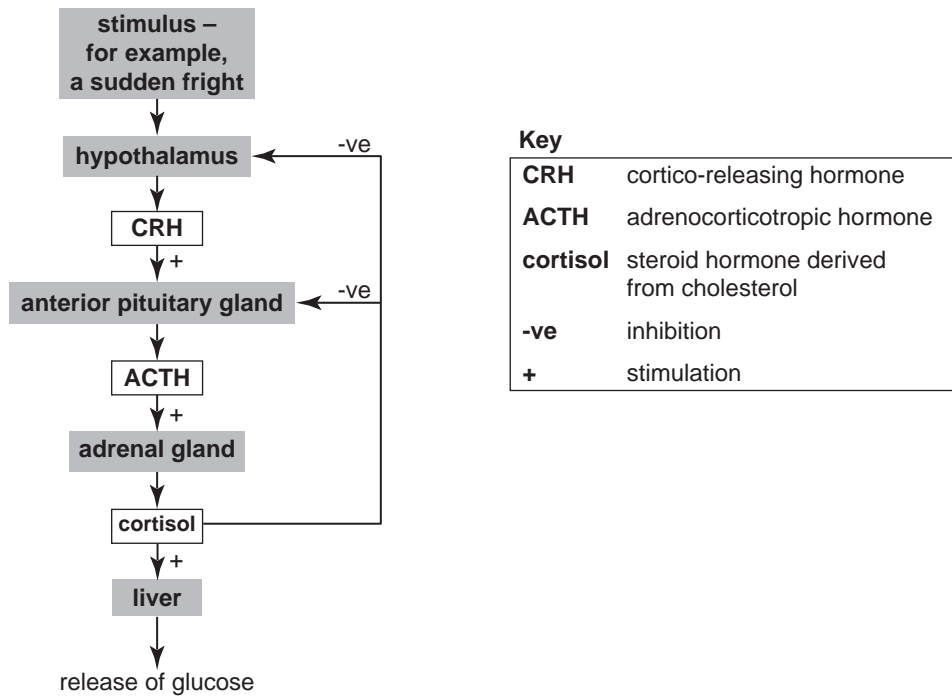
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2 marks

The anterior pituitary gland, also located in the brain, absorbs the hormones delivered by these blood vessels. The anterior pituitary gland itself secretes a hormone that targets the adrenal glands that are located on top of the kidneys. A pathway is shown below.



Key	
<b>CRH</b>	cortico-releasing hormone
<b>ACTH</b>	adrenocorticotrophic hormone
<b>cortisol</b>	steroid hormone derived from cholesterol
<b>-ve</b>	inhibition
<b>+</b>	stimulation

b. Explain in what ways the anterior pituitary gland acts as both receptor and effector in this pathway.

Receptor \_\_\_\_\_

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Effector \_\_\_\_\_

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2 marks

The adrenal glands produce the 'stress' hormone, cortisol. Short periods of stress lead to a burst of cortisol production. Elevated levels of cortisol are detected by the hypothalamus and anterior pituitary gland.

- c. Explain how the actions of cortisol regulate levels of blood glucose.

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3 marks

Total 7 marks

**Question 7**

a. Write the word or chemical equation for aerobic cellular respiration.

1 mark

b. Cyanide inactivates metabolic reactions at the cristae of mitochondria. Cyanide poisoning often results in death. Explain why.

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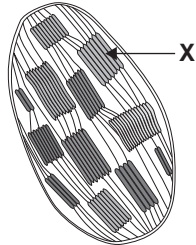
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2 marks

The diagram below shows a chloroplast.



c. Describe the chemical changes that occur at location X when light is present.

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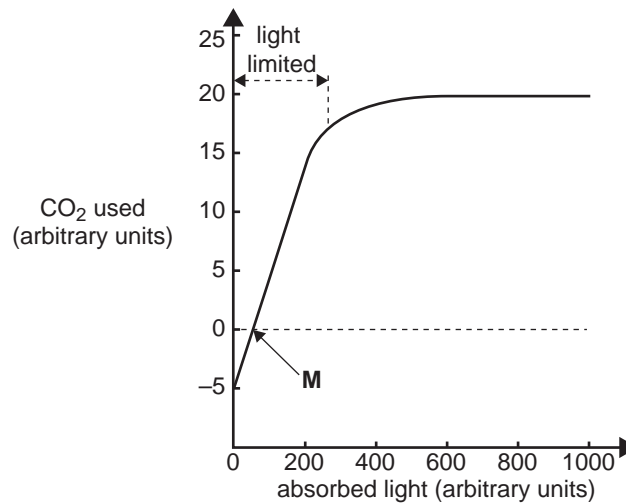
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2 marks

The graph below shows the rate of carbon dioxide exchange between a leaf and its external environment as light intensity is altered. All other variables are kept constant throughout the experiment.



- d. i. Outline what is occurring at point M in terms of chemical reactions.

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- ii. Explain why the graph line becomes nearly horizontal from about 600 units of absorbed light.

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1 + 1 = 2 marks

RuBisCo is an enzyme found in chloroplasts. Its normal function is to catalyse the reaction in which carbon dioxide is a substrate. In certain plants, when the level of carbon dioxide is low in the leaf, RuBisCo uses oxygen as the substrate and releases hydrogen peroxide and ammonia.

- e. Explain why it is beneficial for a plant to have a high level of carbon dioxide in its leaves.

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2 marks

Total 9 marks

