



Trial Examination 2015

VCE Biology Unit 3

Written Examination

Question and Answer Booklet

Reading time: 15 minutes
Writing: 1 hour 30 minutes

Student's Name: _____

Teacher's Name: _____

Structure of Booklet

Section	Number of questions	Number of questions to be answered	Marks	Suggested time (minutes)
A Multiple-choice	25	25	25	30
B Short-answer	8	8	50	60
			Total 75	Total 90

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 booklet of 23 pages.

Answer sheet for multiple-choice questions.

Instructions

Please ensure that you write **your name** and your **teacher's name** in the space provided on this booklet and in the space provided on the answer sheet for multiple-choice questions.

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 booklet and hand them in.

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

Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2015 VCE Biology Units 3 & 4 Written Examination.

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SECTION A: MULTIPLE-CHOICE QUESTIONS**Instructions for Section A**

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

Choose the response that is **correct** 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.

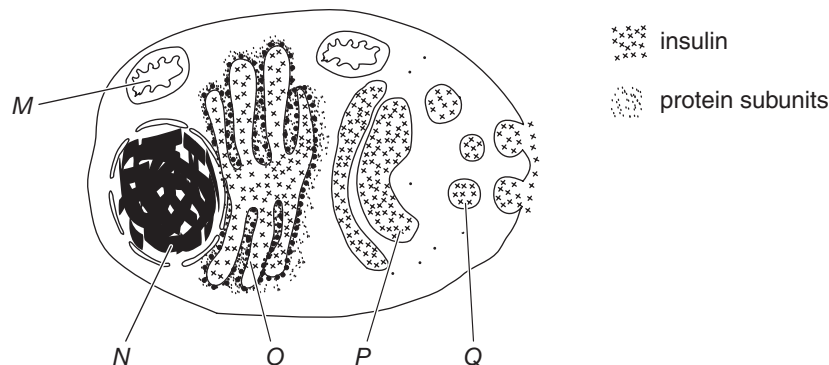
Question 1

Which of the following groups of molecules only includes polysaccharides?

- A. ribose, lactose, fructose and sucrose
- B. cellulose, maltose, glycogen and chitin
- C. starch, cellulose, glycogen and chitin
- D. sucrose, cellulose, glucose and starch

Question 2

The following diagram shows a cell that is producing and secreting insulin (a protein hormone). Organelles *M* to *Q* are involved in the process.



The sequence of organelles directly involved in the manufacture, packaging, modification and secretion of the insulin would be

- A. *M, N, O*
- B. *N, O, P*
- C. *O, P, Q*
- D. *M, N, O, P, Q*

Question 3

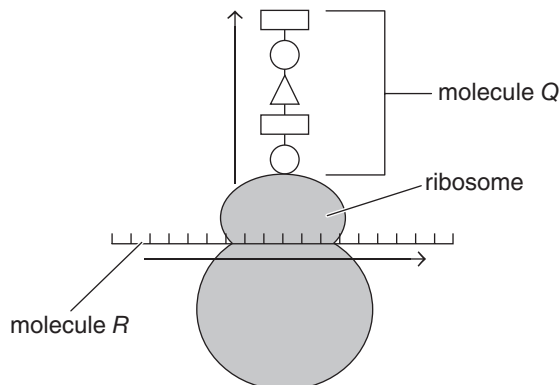
An organic molecule is shown to have carbon, hydrogen, oxygen, phosphorus and nitrogen as the main elements in it.

The molecule would probably be

- A. phenylalanine hydroxylase.
- B. a triglyceride.
- C. a steroid.
- D. DNA.

Question 4

The following diagram shows a cellular process occurring at a ribosome. *Q* and *R* are biomacromolecules that are an important part of the process.



A statement which is true of molecules *Q* and *R* respectively is

- A. *Q* is a protein formed by a hydrolysis reaction and *R* is the product of DNA replication.
- B. *Q* is a protein comprised of nucleotides and *R* is the product of translation.
- C. *Q* is a protein formed through a condensation reaction and *R* is the product of transcription.
- D. *Q* is a carbohydrate comprised of amino acid subunits and *R* is only found in the cytosol of the cell.

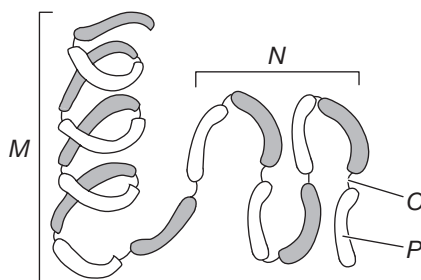
Question 5

The properties of water that make it an important biomolecule are that it

- A. is transparent and viscous.
- B. is polar and not viscous.
- C. has excellent heat retention and is non-polar.
- D. is cohesive and a solid at room temperature.

Question 6

The diagram below shows a globular protein.

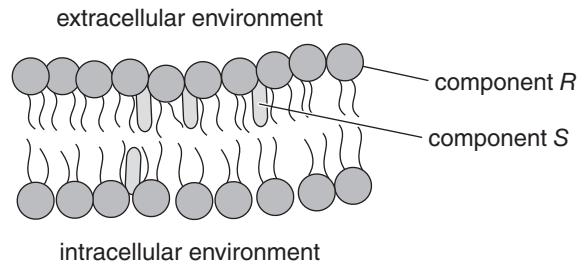


Which of the following correctly identifies structures *M* to *P*?

	<i>M</i>	<i>N</i>	<i>O</i>	<i>P</i>
A.	α -helix	β sheet	peptide bond	amino acid
B.	β sheet	α -helix	hydrogen bond	nucleotide
C.	β sheet	α -helix	amino acid	peptide bond
D.	α -helix	β sheet	peptide bond	nucleotide

Question 7

The diagram below shows a plasma membrane.

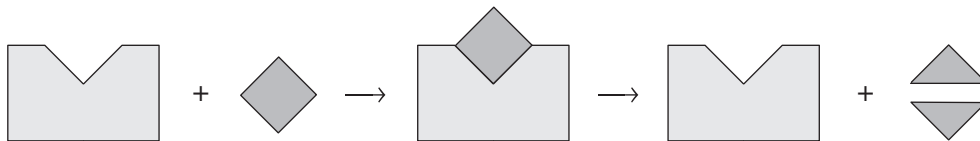


Which of the following statements is correct?

- A. Component *R* is comprised of hydrophilic fatty acid 'tails' and a hydrophobic phosphate 'head', and component *S* is a type of nucleic acid.
- B. Component *R* is comprised of hydrophilic fatty acid 'heads' and a hydrophobic phosphate 'tail', and component *S* helps to maintain fluidity of the membrane.
- C. Component *R* is called a phospholipid, and component *S* would be at higher levels in Arctic fish compared to tropical fish.
- D. Component *R* separates the intracellular environment from the extracellular environment, and component *S* will mix well with water.

Question 8

The following diagram shows the interaction between an enzyme and a substrate.

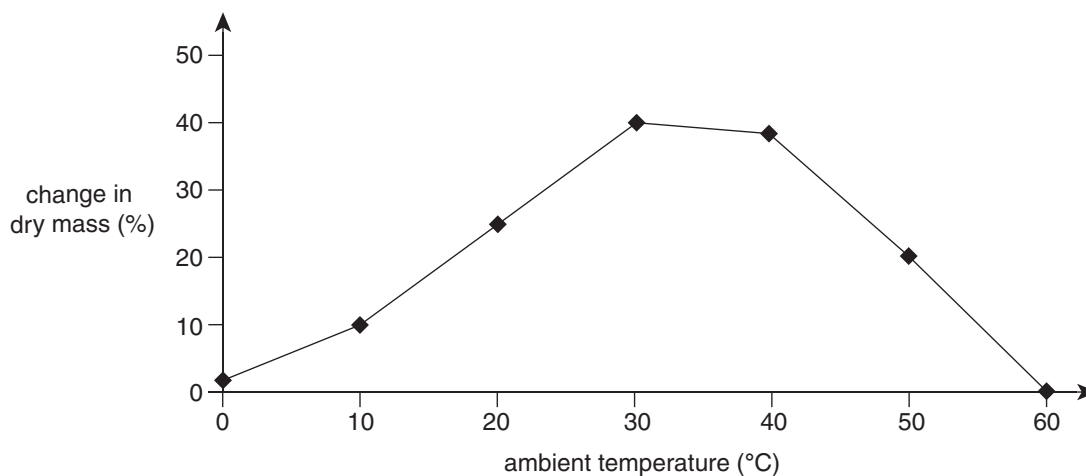


The diagram above illustrates

- A. the reusable nature of enzymes.
- B. end-product inhibition.
- C. an anabolic reaction.
- D. that the optimum conditions for the enzyme are 37°C and pH 7.

Use the following information to answer Questions 9–11.

The following graph shows the relationship between ambient temperature and the rate of photosynthesis for a group of geranium plants (*Pelargonium hortorum*). This was measured by calculating the percentage change in the dry mass of the plants over a six-week period.



Question 9

When conducting an experiment such as this, a controlled condition is the

- A. ambient temperature that *Pelargonium hortorum* was exposed to.
- B. initial mass of *Pelargonium hortorum*.
- C. percentage change in dry mass of *Pelargonium hortorum*.
- D. intensity of light that *Pelargonium hortorum* was exposed to.

Question 10

What approximate ambient temperature(s) would a *Pelargonium hortorum* need to be exposed to for a change in dry mass of 20%?

- A. 17°C
- B. 17°C and 50°C
- C. 50°C
- D. 50°C and 25°C

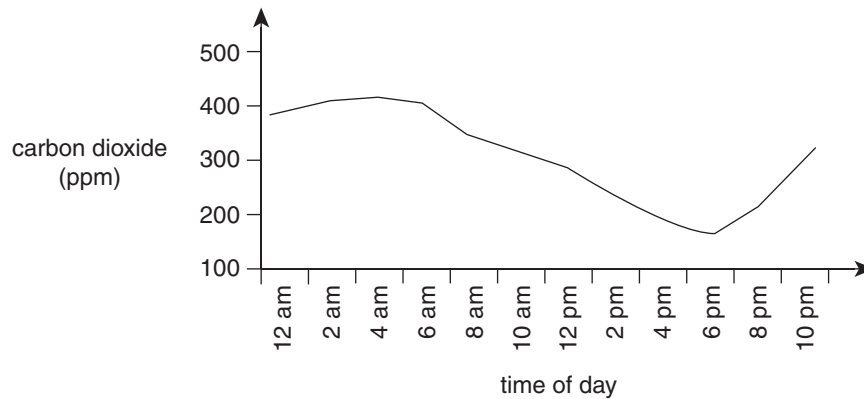
Question 11

A valid conclusion to be made from the experiment could be that

- A. at temperatures above 30°C, the three-dimensional shape of photosynthetic enzymes in *Pelargonium hortorum* starts to change.
- B. enzymes relating to photosynthesis are denatured at temperatures lower than 30°C.
- C. the optimum range for photosynthetic enzymes in *Pelargonium hortorum* is 25°C to 35°C.
- D. the percentage change in dry mass would be higher if the CO₂ level surrounding *Pelargonium hortorum* was doubled.

Question 12

The graph below represents the level of carbon dioxide around a plant over a 24-hour period.



The statement that is most accurate with regards to this data is that at

- A. 2 am the rate of photosynthesis is at a maximum.
- B. 10 am the rate of photosynthesis is equal to the rate of respiration.
- C. 6 pm the rate of photosynthesis is at a maximum and the rate of respiration is zero.
- D. 10 pm the rate of photosynthesis is 350 ppm.

Question 13

The main difference between the Krebs's cycle and the electron transport chain (ETC) is

- A. the Krebs's cycle produces 34ATP, while the ETC produces 2ATP.
- B. a product of the Krebs's cycle is H₂O, while a product of the ETC is CO₂.
- C. the Krebs's cycle occurs in the matrix of the mitochondria, while the ETC occurs along the cristae of the mitochondria.
- D. the Krebs's cycle makes NAD from NADH, while the ETC makes NADH from NAD.

Question 14

The Brazilian red ant (*Solenopsis saevissima*) secretes a chemical from its venom gland that leads members of its own species towards a food source, while also representing a territorial mark for organisms outside of their species.

The term that most accurately describes this chemical is

- A. pheromone.
- B. signalling molecule.
- C. hormone.
- D. enzyme.

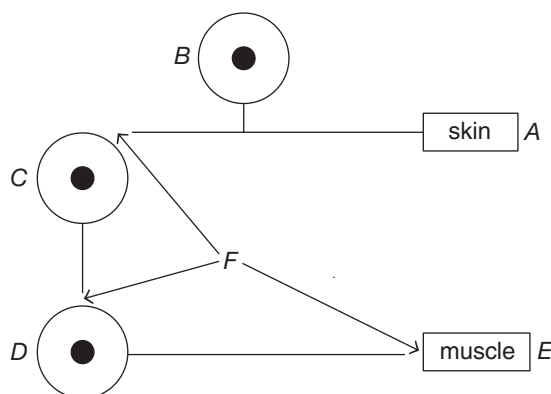
Question 15

Signal amplification could be best described as

- A. testosterone binding to an intracellular receptor in a muscle cell, which leads to the activation of a muscle protein gene.
- B. insulin binding to a surface receptor, which leads to the activation of glycogen synthase as well as the opening of a glucose channel on the cell membrane.
- C. acetyl choline binding to a receptor on the surface of a neuron, leading to the opening of a gated sodium channel.
- D. gibberellic acid binding to a surface receptor of an aleurone cell, which mobilises 5 G-proteins; each G-protein then activates 10 protein kinase enzymes.

Use the following information to answer Questions 16 and 17.

The following diagram refers to a typical reflex arc of the skin located on the palm of a hand. *A* to *F* refer to different components of the reflex arc. In this situation, the palm of the hand has inadvertently touched a very hot surface.

**Question 16**

The receptor and effector in the situation above would be

- A. A and E.
- B. B, C and D.
- C. A and F.
- D. D and E.

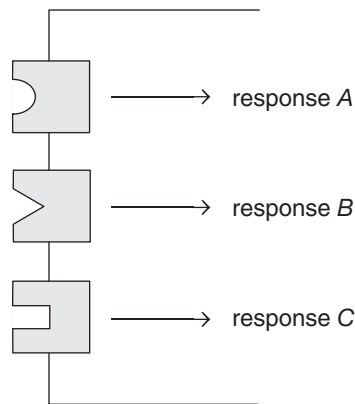
Question 17

The three arrows pointing from *F* to different locations of the reflex arc refer to

- A. the axons conveying an electrical signal at 10 m s^{-1} .
- B. neurotransmitters transferring a message across a synapse.
- C. the axons collecting a message from the dendrites.
- D. neurotransmitters passing an electrical signal across the synapse.

Question 18









The diagram below illustrates how three receptors on the surface of a stem cell, if activated, can bring about three responses (*A*, *B* and *C*). If more than one receptor is activated, the responses triggered are different to either response *A*, *B* or *C*.



The table below illustrates the potential responses which are possible.

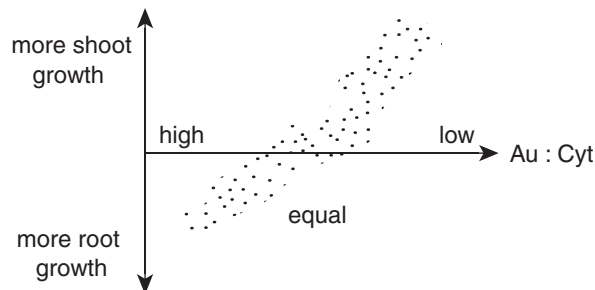
Receptor(s) activated	Type of response
<i>A</i>	increased growth of cell
<i>B</i>	activation of carrier proteins
<i>C</i>	opening of protein channels
<i>A</i> and <i>B</i>	differentiation into skin cells
<i>A</i> and <i>C</i>	apoptosis of the cell
<i>B</i> and <i>C</i>	differentiation into nerve cells
<i>A</i> , <i>B</i> and <i>C</i>	differentiation into muscle cells

For a stem cell to differentiate into nerve cells, it would need to be exposed to the signalling molecules

- A. ,  and 
- B.  only
- C.  and  only
- D.  and  only

Question 19

A plant callus is an undifferentiated mass of plant cells that can be used to measure the effect of plant growth regulators on cell growth and differentiation. A series of experiments were set up to measure the effect of varying the amount of auxin (Au) and cytokinin (Cyt) on the development of root and shoot tissue within a callus. A graph of the results is below.



A horticulturist removes a cutting from a plant he wants to propagate. He puts the cutting in the soil and places a hormone mix that will promote root growth in that region of the plant.

Based on the graph, the hormone mix is most likely to contain

- A. equal amounts of auxin and cytokinin.
- B. more cytokinin than auxin.
- C. more auxin than cytokinin.
- D. only auxin.

Question 20

Malaria is a mosquito-borne infectious disease caused by a single-celled protist belonging to the genus *Plasmodium*. Each year, over 200 million people currently contract the disease, which makes the development of a vaccine a priority. The life cycle of the plasmodium includes both a sexual and an asexual phase. It is the sexual phase that makes the development of a vaccine difficult.

This is due to the

- A. asexual phase producing so many malarial plasmodia that the vaccine would be ineffective.
- B. sexual phase resulting in the presence of different antigens on the surface of the malarial plasmodia, making a vaccine ineffective against them.
- C. necessity of the vaccine to target both the mosquito and the plasmodia.
- D. mass of vaccine required being too huge to manufacture for so many infected people.

Question 21

It is sometimes very difficult to correctly diagnose certain diseases. For example, the symptoms of pneumonia and influenza both include fever, a sore throat and body aches.

A doctor is sure a patient has pneumonia (caused by the bacteria *Streptococcus pneumonia*) rather than swine flu (caused by the H1N1 virus).

The best course of action to take would be to

- A. vaccinate the patient immediately.
- B. prescribe a course of antibiotics.
- C. encourage bedrest until the fever subsides.
- D. prescribe anti-inflammatory medication for the sore throat.

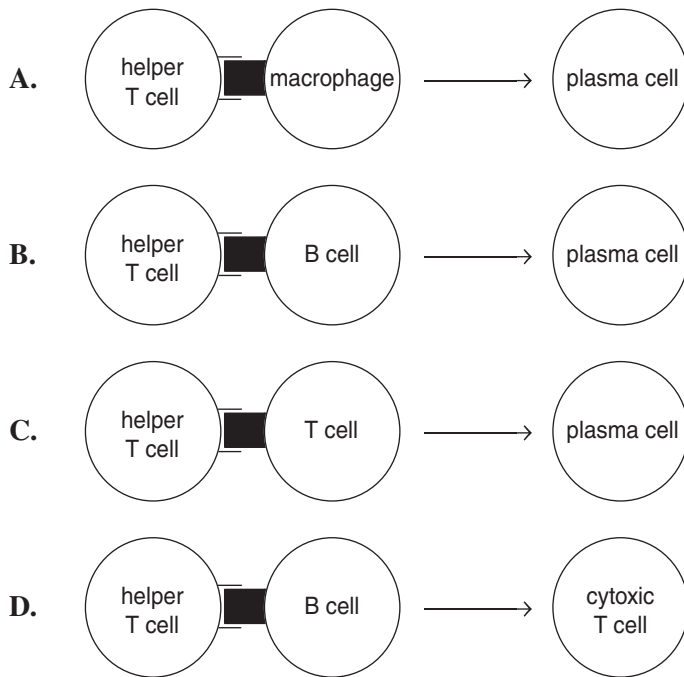
Question 22

The cell-mediated immune response acts against

- A. prions in the brain.
- B. the neurotoxin released by pathogens such as *Clostridium tetani* at the site of infection.
- C. antibodies in the bloodstream that have been acquired artificially.
- D. the non-self markers on the surface of transplanted cells.

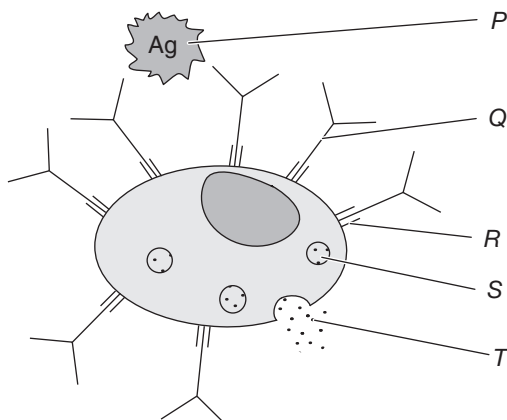
Question 23

The diagram that best portrays the interaction between a helper T cell and other cells of the immune system is



Use the following information to answer Questions 24 and 25.

The diagram below shows a mast cell involved in an allergic response. Structures *P* to *T* refer to various aspects of the response.



Question 24

Based on the diagram, as well as your understanding of an allergic response, it is reasonable to conclude that

- A. structure *Q* is regarded as non-self.
- B. if structure *R* was shaped differently, the allergen would not bind to it.
- C. chemical *T* would lead to constriction of blood vessels.
- D. structure *P* would normally not initiate an allergic response in most people.

Question 25

Upon repeat exposure to the allergen, it would be reasonable to observe

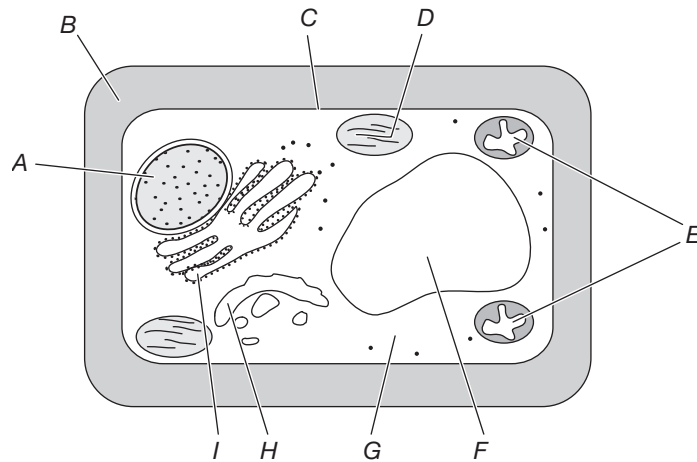
- A. more mast cells of this kind at the likely site of an allergen invasion.
- B. more structure *Q*s bound to structure *R* per mast cell.
- C. more chemical *T* moving by exocytosis into the extracellular environment.
- D. all of the above

SECTION B: SHORT-ANSWER QUESTIONS

Instructions for Section B
 Answer **all** questions in the spaces provided. Write using black or blue pen.

Question 1 (5 marks)

The following diagram is of a photosynthetic plant cell. Labels *A* to *I* represent structures or areas that are important to the functioning of the cell.



In completing the parts below, state which of the labels (*A* to *I*) are consistent with the following structures/processes. Note that there may be more than one answer.

- a. Which structures contain DNA? 1 mark

- b. Which structure contains thylakoid membranes? 1 mark

- c. In which area is the electron transport chain located? 1 mark

- d. If the cell was placed in a hypertonic environment, which structure(s) would dramatically change appearance? 1 mark

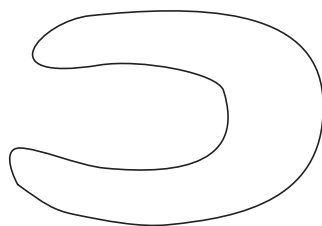
- e. On which structure would receptors to external signals be located? 1 mark

Question 2 (6 marks)

DNA polymerase is an enzyme that catalyses the synthesis of DNA. The enzyme is comprised of several polypeptide chains which form the functional protein. This protein looks like a hand clasping a rod (see diagram below). The protein reaction occurs on the 'palm' of the hand.

- a.** At what level of structure is functional DNA polymerase operating? 1 mark

A diagrammatic representation of DNA polymerase is shown below.

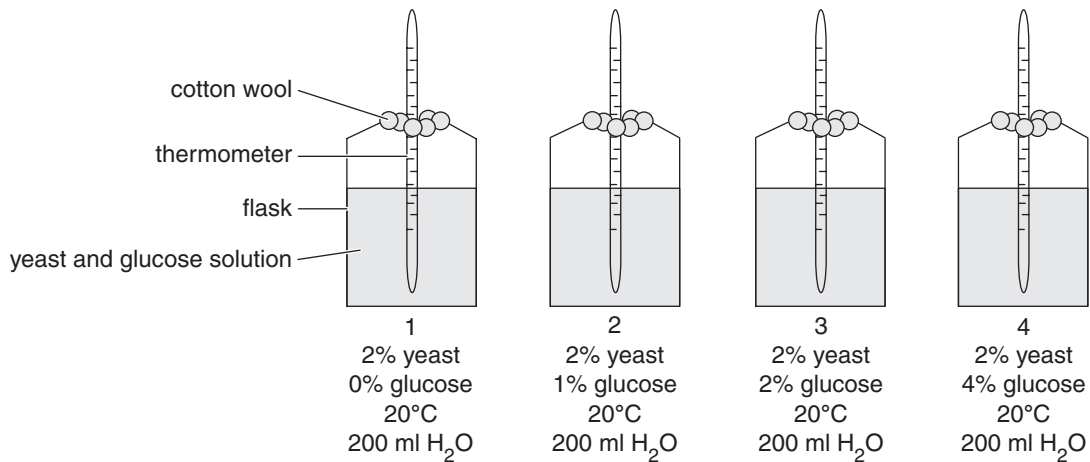


- b. i.** On the diagram above, mark the location of the active site. 1 mark
- ii.** What is occurring at the active site of this particular enzyme when it is synthesising DNA? 1 mark

- c.** Describe how carbohydrates, nucleic acids and proteins interact within a cell to form DNA polymerase. 3 marks

Question 3 (9 marks)

Four insulated flasks containing yeast (*Saccharomyces cerevisiae*), glucose and a variety of other conditions were set up during a Biology class. The set-up is illustrated in the diagram below.



- a. What was the purpose of the cotton wool in this experiment? 1 mark

The temperature of each flask was recorded every 30 minutes for 24 hours. The maximum temperature increase of each flask was recorded in the table below.

Flask number	1	2	3	4
Maximum temperature increase (°C)	1	10	13	15

- b. i. Explain why there was an increase in temperature in flask 1. 2 marks

- ii. Predict the maximum temperature increase that would be observed if there was a fifth flask that contained 8% glucose (all other variables are the same as above). 1 mark

The water that was used throughout the series of experiments had been aerated. However, if the water had been boiled prior to the experiment, the yeast would have been exposed to anaerobic conditions.

- c. i.** Discuss the difference/s that would be apparent in flask 4 during the 24-hour experiment if the conditions were anaerobic compared to aerobic. 1 mark

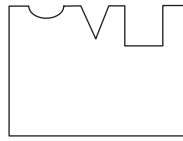
- ii.** Discuss the benefit to the yeast of aerobic conditions rather than anaerobic conditions. 1 mark

Respiration is a complex process that occurs in different cellular locations and involves three main stages.

- d.** Discuss the main events of glycolysis. Include in your answer the cellular location, the inputs and the outputs of the process. 3 marks

Question 4 (5 marks)

Designing drugs to inhibit particular enzymes is a financially lucrative industry for biochemists. The enzyme below catalyses a reaction that cuts a virus from the cell it was manufactured in. The survival advantage for the virus is that it can then proceed to infect other cells.



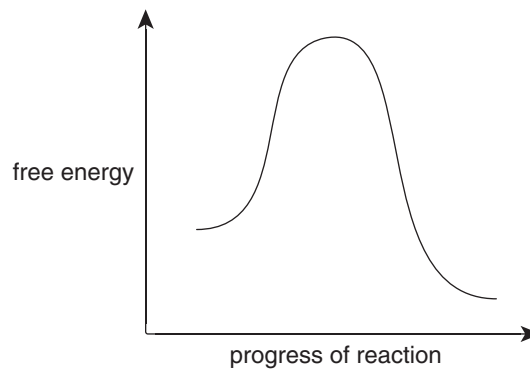
a. The enzyme represented above carries out a catabolic reaction.

i. Define the term 'catabolic'.

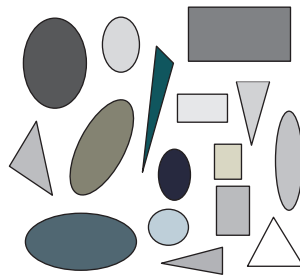
1 mark

ii. On the energy profile diagram below, show the effect that the enzyme has on the 'cutting' reaction.

1 mark



A database of chemicals is available that could provide good candidates as drugs either on their own or in combination. They are able to be easily joined with strong chemical bonds. Some of these chemicals are illustrated below.



b. i. Draw a diagram of the chemicals you would use to design a drug that would act as a competitive inhibitor of the enzyme shown above.

1 mark

ii. Justify your answer to part **b. i.**

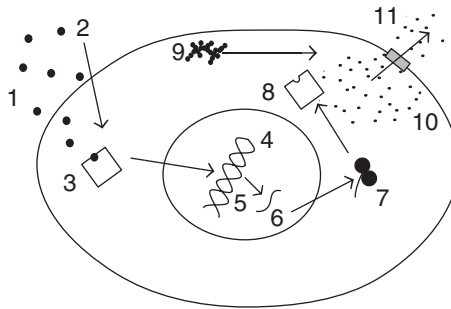
2 marks

Question 5 (7 marks)

The thyroid gland secretes a hormone called thyroxine, which is a small biomolecule comprised of tyrosine (an amino acid) as well as iodine. The primary function of thyroxine is to regulate metabolism. Thyroxine is transported in the bloodstream, enclosed in a protein carrier, and when it is at the target cell's extracellular environment it moves directly across the plasma membrane and binds to a receptor in the cytosol.

- a.** Explain how the action of thyroxine is different to most other hormones that are comprised of amino acids. 2 marks

The diagram below illustrates the action of thyroxine within a cell. Labels 1 to 11 represent different steps/components that are important for the action of thyroxine.



- b. i.** Complete the table below by filling in the blank sections. 2 marks

Number	Name of step/component represented
1	
3	thyroxine receptor
5	
6	mRNA
7	
9	glycogen
10	

- ii.** What is the difference between steps 2 and 11, with respect to the movement across the membrane? 1 mark

- iii.** State which of the steps/components of the diagram are part of signal transduction during the cell's response to thyroxine. 1 mark

The response triggered by thyroxine is a change in metabolism. For example, if the metabolic rate is too high, the level of thyroxine will fall.

- c.** In this particular negative feedback model, name the stimulus and response. 1 mark

stimulus

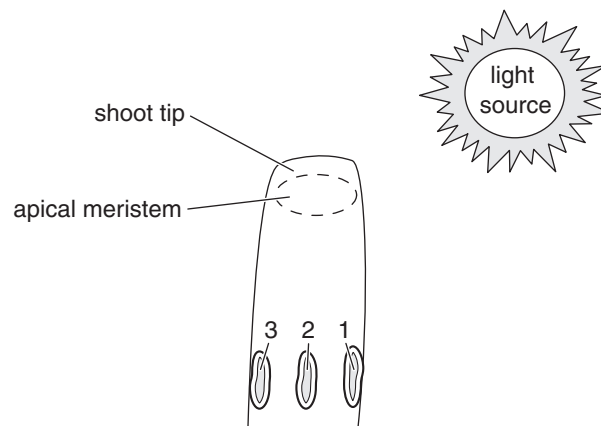
response

Question 6 (7 marks)

Auxin is a plant growth regulator that acts on the cells of the growing shoots of plants. It is generated within the apical meristem of growing shoots. High concentrations of auxin, via signal transduction, promote cell elongation and as a result, growing plant shoots tend to show phototropic responses. Several models have been proposed to explain the action of auxin and three cells were investigated depending on their position within the growing shoot.

- Cell 1 was located on the side of the shoot exposed to a light source.
- Cell 2 was located in the middle of the shoot.
- Cell 3 was located on the shaded side.

The diagram below illustrates the location of the three cells in a shoot tip of wheat seedlings (*Triticum monococcum*).



Model 1 proposed that light from one side caused the closure of auxin-importing transport channels, reducing the flow of auxin into cells on the exposed side.

- a.** Explain how model 1 would lead to a phototropic response. 2 marks

Model 2 proposed that light only caused lateral auxin channels to open, redirecting the auxin towards the shaded side of the shoot.

A method used to determine whether the importing channels or the lateral channels are active involves the use of a specific fluorescent dye (green for the importing channels and red for the lateral channels) that targets those particular proteins when they are active. The dyes can be viewed using a fluorescent microscope.

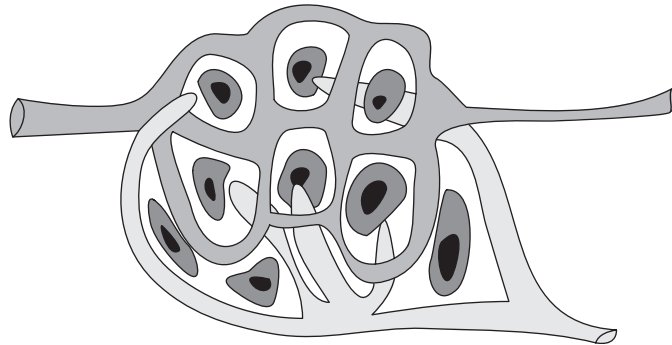
- b. i.** Write a hypothesis that would enable model 2 to be tested. 1 mark

- ii.** Design an experiment that would enable your hypothesis to be tested. **3 marks**

- iii.** What results would support your hypothesis? **1 mark**

Question 7 (5 marks)

The following diagram shows the position of the circulatory and lymphatic systems in a bed of cells.



a. On the diagram, label the areas/structures listed below. 2 marks

- interstitial fluid
- lymph duct
- cell
- capillary

The lymphatic ducts form long tubes that move lymph through them. The lymph moves into lymph nodes, where (amongst a range of other cells) ‘naive’ T cells are located in high concentrations.

b. State the main differences between the ‘naive’ T cells found in the lymph nodes. 1 mark

One type of cell that leaves the lymph nodes is a cytotoxic T cell.

c. Describe the role of a cytotoxic T cell in the cell-mediated immune response. 2 marks

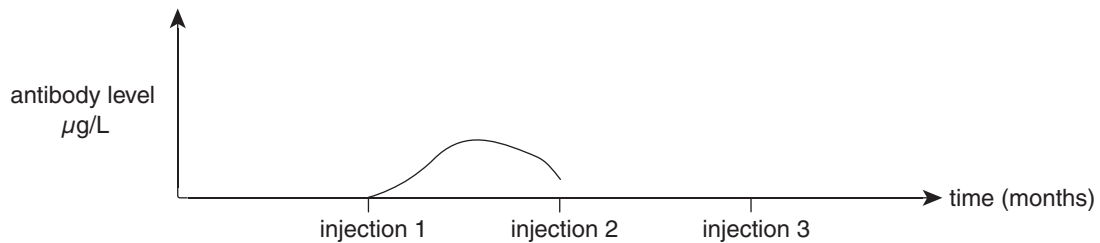
Question 8 (6 marks)

Funnel-web (*Atrax robustus*) spider bites are potentially lethal due to the effect of atracotoxin (ACTX), but thankfully there have been no deaths recorded since antivenom has been available for use. Biologists produce the antivenom by injecting small volumes of ACTX into rabbits. This is not lethal to the rabbits, but it activates their immune system.

- a. Describe how a rabbit's immune system will respond to ACTX after the first injection. 2 marks

Over time, the rabbits are injected on several occasions to hypersensitise their immune system against ACTX.

- b. On the axis below, show how the immune system would respond to injections 2 and 3. 2 marks



When the antivenom is administered to a victim of a funnel-web spider bite, their recovery is generally fairly rapid. It is said that the spider-bite victim has been given artificial passive immunity.

- c. Describe why the immunity is regarded as artificial as well as passive. 2 marks

END OF QUESTION AND ANSWER BOOKLET