SSABSA
SENIOR SECONDARY ASSESSMENT BOARD OF SOUTH AUSTRALIA
EXTERNAL EXAMINATION 2005

2005 BIOLOGY

FOR OFFICE USE ONLY

SUPERVISOR CHECK

ATTACH SACE REGISTRATION NUMBER LABEL TO THIS BOX

QUESTION BOOKLET 1

26 pages, 31 questions

RE-MARKED

Monday 14 November: 9 a.m.

Time: 3 hours

Section A and Part 1 of Section B

Examination material: Question Booklet 1 (26 pages)
Question Booklet 2 (15 pages)
one 8-page script book
one multiple-choice answer sheet
one SACE registration number label

Approved dictionaries and calculators may be used.

Instructions to Candidates

1. You will have 10 minutes to read the paper. You must not write in your question booklets or script book, or on your multiple-choice answer sheet, or use a calculator during this reading time but you may make notes on the scribbling paper provided.

2. This paper is in four sections: Section A and Part 1 of Section B are in Question Booklet 1; Part 2 of Section B and Sections C and D are in Question Booklet 2.

   Section A: Multiple-choice Questions (Questions 1 to 25)
   Answer Section A on the separate multiple-choice answer sheet, using black or blue pen.
   Answer ***all*** questions in Section A.

   Section B: Short-answer Questions (Questions 26 to 37)
   Answer Part 1 of Section B (Questions 26 to 31) in the spaces provided in Question Booklet 1.
   Write on page 26 of Question Booklet 1 if you need more space.

   Answer Part 2 of Section B (Questions 32 to 37) in the spaces provided in Question Booklet 2.
   Write on page 14 of Question Booklet 2 if you need more space.

   Section C: Practical Question (Question 38)
   Answer ***all*** parts of the question in Section C in the spaces provided in Question Booklet 2.
   Write on page 14 of Question Booklet 2 if you need more space.

   Section D: Extended-response Questions (Questions 39 and 40)
   Answer ***both*** questions in Section D in the separate script book.

3. In Sections B and C there is no need to fill all the space provided; clear, well-expressed answers are required. If you delete part or all of an answer you should clearly indicate your final answer and label it with the appropriate question number.

4. The allocation of marks and suggested allotment of time are as follows:

Section A	50 marks	40 minutes
Section B	100 marks	90 minutes
Section C	20 marks	20 minutes
Section D	30 marks	30 minutes
Total	200 marks	3 hours

5. Attach your SACE registration number label to the box at the top of this page. Copy the information from your SACE registration number label into the boxes on your multiple-choice answer sheet and on the front covers of Question Booklet 2 and your script book.

6. At the end of the examination, place Question Booklet 2, your script book, and your multiple-choice answer sheet inside the back cover of this question booklet.

STUDENT'S DECLARATION ON THE USE OF CALCULATORS

By signing the examination attendance roll I declare that:

- my calculators have been cleared of all memory;
- no external storage media are in use on these calculators.

I understand that if I do not comply with the above conditions for the use of calculators I will:

- be in breach of the rules;
- receive zero marks for the examination;
- be liable to such further penalty, whether by exclusion from future examinations or otherwise, as SSABSA determines.

SECTION A: MULTIPLE-CHOICE QUESTIONS (Questions 1 to 25)

(50 marks)

*Answer **all** questions in this section.*

*Each of the twenty-five multiple-choice questions in Section A involves choosing from four alternative answers. Read each question carefully. Then indicate the **one** alternative that you consider best answers the question by shading the bubble by the appropriate letter alongside the question number on the multiple-choice answer sheet. Use black or blue pen. It is in your interest to give an answer to every question in this section of the paper, as no marks are deducted for incorrect answers. Each question is worth 2 marks. You should spend about 40 minutes on this section.*

1. *Refer to the following table, which shows the mRNA codons for six amino acids:*

Amino acid	mRNA codon
glutamine	GAU
phenylalanine	UUC
lysine	AAG
proline	CCU
threonine	ACC
valine	GAA

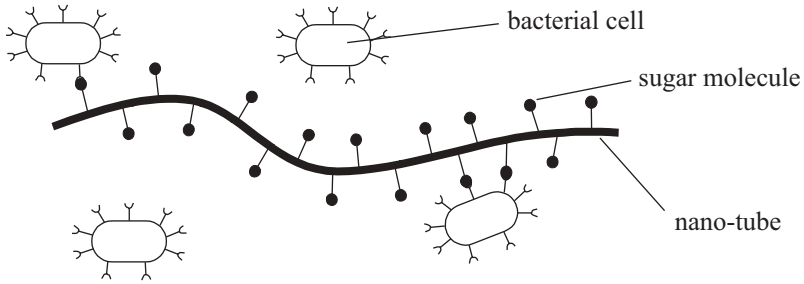
A small section of a protein has the following amino acid sequence:

glutamine–lysine–proline–valine–threonine.

The DNA base sequence that could be transcribed to produce this section of protein is

J. GAT AAG CCT GAA ACC.
K. CUA UUC GGA CUU UGG.
L. CTA TTC GGA CTT TGG.
M. GAU AAG CCU GAA ACC.

2. *Refer to the following diagram, which shows a nano-tube and some bacterial cells:*



Nano-tubes are complex molecular structures made of carbon compounds.

Researchers have recently developed a form of nano-tube that is coated with sugar molecules. These sugar molecules are able to bind to proteins on the surface of bacterial cells, causing the bacterial cells to clump.

Which one of the following statements is true?

J. Mutations in the bacterial DNA that codes for the receptor may reduce clumping of bacterial cells.
K. The sugar molecules on the nano-tubes must be the same shape as the receptors on the bacterial cells.
L. Chitin, a protein found in the walls of bacterial cells, could act as a receptor for sugar molecules.
M. The nano-tubes bring the bacteria together, enabling the bacteria to attach to each other at the receptor.

3. When body tissue is damaged the surrounding cells release the enzyme cyclo-oxygenase 2 (COX-2). COX-2 catalyses a reaction that manufactures prostaglandins, hormone-like substances that trigger pain and swelling.

Aspirin is a COX-2 inhibitor designed to relieve pain.

Aspirin is able to

J. bind to the active site on the substrate molecules that form prostaglandins.
K. have the same molecular shape as the active site on the COX-2 enzyme.
L. have a molecular shape complementary to that of the active site on the COX-2 enzyme.
M. have a molecular shape complementary to that of prostaglandins.

4. Which one of the following statements correctly describes a process that occurs during protein synthesis?

J. tRNA directs the assembling of nucleotide bases in the transcription of mRNA.
K. The sequence of mRNA codons directs the assembling of a polypeptide chain during translation.
L. mRNA is synthesised from free nucleotides in the nucleus during translation.
M. Transcription is a process in which tRNA molecules are synthesised from mRNA codons.

5. DNA–DNA hybridisation is a technique used to determine the similarity of DNA from different species.

In this technique:

- DNA is extracted from different species and cut into pieces using special enzymes;
- the DNA is heated to separate the double strands into single strands;
- single strands of DNA from different species are mixed together and cooled so that double strands of hybrid DNA form. Hybrid DNA consists of one strand from each of two different species.

Heat is then used to test how well the strands in the hybrid DNA have joined. The DNA nucleotides must match more closely in hybrid DNA strands that separate at a higher temperature than in hybrid DNA strands that separate at a lower temperature.

The following table shows the temperature (°C) needed to separate the hybrid DNA strands of four different species, **Q**, **R**, **S**, and **T**:

	Q	**R**	**S**	**T**
Q	86	85	81	82
R		87	82	81
S			86	85
T				87

Which one of the following statements is supported by the data provided?

J. **Q** is more closely related to **S** than it is to **R** or **T**.
K. **S** is more closely related to **R** than **Q** is to **T**.
L. **Q** is more closely related to **R** than **S** is to **T**.
M. **S** is more closely related to **T** than it is to **R** or **Q**.

6. On a strand of mRNA, 30% of the bases are uracil (U), 10% of the bases are cytosine (C), and 20% of the bases are adenine (A).

The mRNA strand was transcribed from a strand of DNA.

What percentage of the bases on this strand of DNA would be cytosine?

J. 10%.
K. 20%.
L. 30%.
M. 40%.

7. Which one of the following sequences of cell structures correctly describes the pathway that leads to the production, transport, and secretion of the protein thyroxine by thyroid gland cells?

   J. Nucleus → ribosomes → endoplasmic reticulum → Golgi body → cell membrane.
   K. Nucleus → ribosomes → vesicle → endoplasmic reticulum → cell membrane.
   L. Ribosomes → mitochondria → Golgi body → vesicle → cell membrane.
   M. Ribosomes → endoplasmic reticulum → nucleus → Golgi body → cell membrane.

8. Animals that cannot physiologically control their body temperature cannot survive in very cold environments. As the water in the animal's extracellular fluid begins to freeze, the extracellular fluid becomes more concentrated than the fluid in the cytoplasm of the cells. Water moves out of the cells, resulting in dehydration and death.

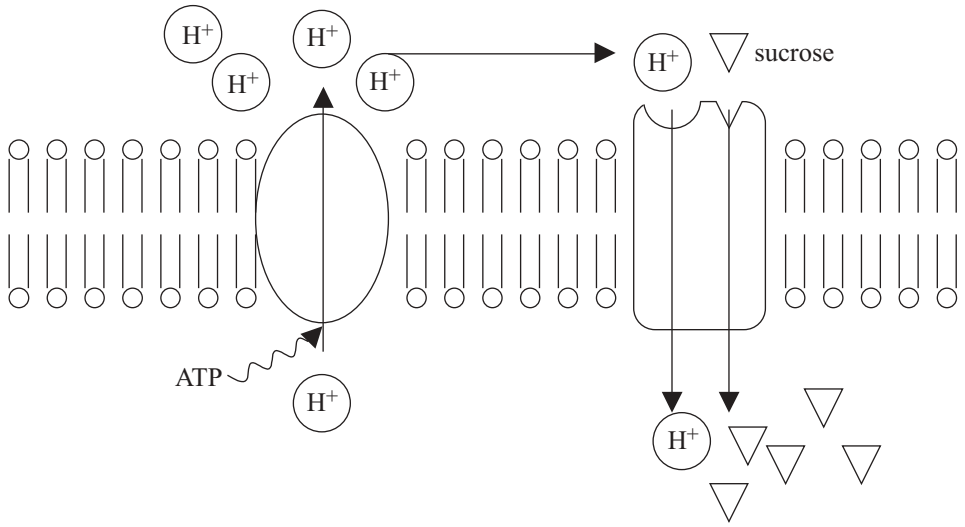
   This does not occur in the wood frog *(Rana sylvanica*). As the environment gets colder, the concentration of glucose in the frog's cells increases dramatically. Even when the water in the extracellular fluid has frozen and the frog's heart and breathing have stopped, the frog will revive unharmed as the environment gets warmer.

   The ability of the wood frog to survive while frozen depends on the presence of glucose in the cytoplasm.

   The presence of glucose in the cytoplasm ensures that the solute concentration of the cytoplasm is

   J. lower than that of the extracellular fluid, and thus cells will dehydrate.
   K. higher than that of the extracellular fluid, and thus cells will dehydrate.
   L. lower than that of the extracellular fluid, and thus cells will not dehydrate.
   M. higher than that of the extracellular fluid, and thus cells will not dehydrate.

9. *Refer to the following diagram, which represents part of a cell membrane:*



An ATP-driven pump concentrates H^+ ions on the outside of the cell membrane.

The H^+ ions then diffuse back into the cell, bringing sucrose molecules with them through special protein molecules in the membrane. The intracellular concentration of sucrose then increases.

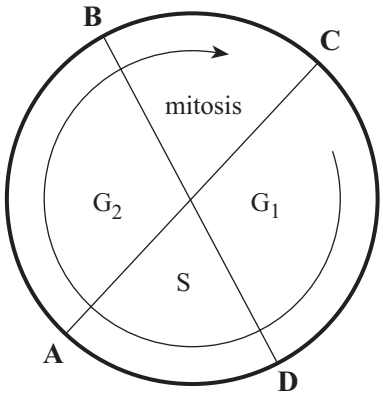
Which one of the following changes would increase the rate of transport of sucrose into the cell?

J. An increased extracellular concentration of H^+.
K. A decreased intracellular concentration of ATP.
L. An increased intracellular concentration of sucrose.
M. A decreased extracellular concentration of sucrose.

10. Which one of the following statements best describes one difference between prokaryotic cells and eukaryotic cells?

J. Prokaryotic cells do not have the cellular components for autotrophic nutrition.
K. Prokaryotic cells do not have a nuclear membrane.
L. Prokaryotic cells have membrane-bound organelle structures different from those of eukaryotic cells.
M. Prokaryotic cells have a higher degree of specialisation than eukaryotic cells have.

11. *Refer to the following diagram, which represents stages in the cell cycle:*



Which one of the following statements is correct?

J. To prevent mitosis from taking place, a block would occur in a chemical reaction in a stage from **C** to **B**.
K. DNA synthesis would occur in the stage from **A** to **B**.
L. Ribosomes will be particularly active in the stage from **B** to **C**.
M. All cells resulting from mitosis will continue to pass through the stages from **C** to **D**, **D** to **A**, **A** to **B**, and **B** to **C** again.

12. The concentration of carbon dioxide in a sample of air was found to be 280 ppm (parts per million). A controlled experiment was designed to measure the concentration of carbon dioxide in the air after it had flowed over the leaves of a green plant. Measurements were taken at a range of light intensities.

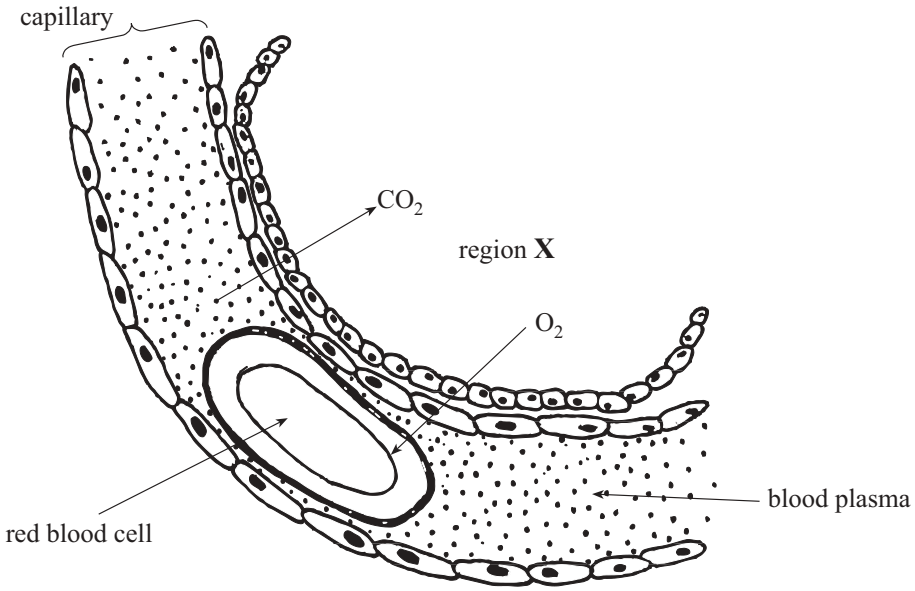
The following results were obtained:

Light intensity (% of full sunlight)	**Concentration of carbon dioxide in air after flowing over leaves (ppm)**
75	253
50	252
25	254
10	280

Which one of the following statements is ***not*** consistent with these results?

J. At the lower light intensities tested, the rate of photosynthesis is limited by light intensity.
K. In the dark, the concentration of carbon dioxide in the air after it had flowed over leaves would be at least 280 ppm.
L. At the higher light intensities tested, the rate of photosynthesis is affected by factors other than light.
M. At a light intensity of 10% of full sunlight, photosynthesis does not occur.

13. *Refer to the following diagram, which shows a capillary in the human body:*



This diagram is not drawn to scale.

The region labelled **X** represents part of

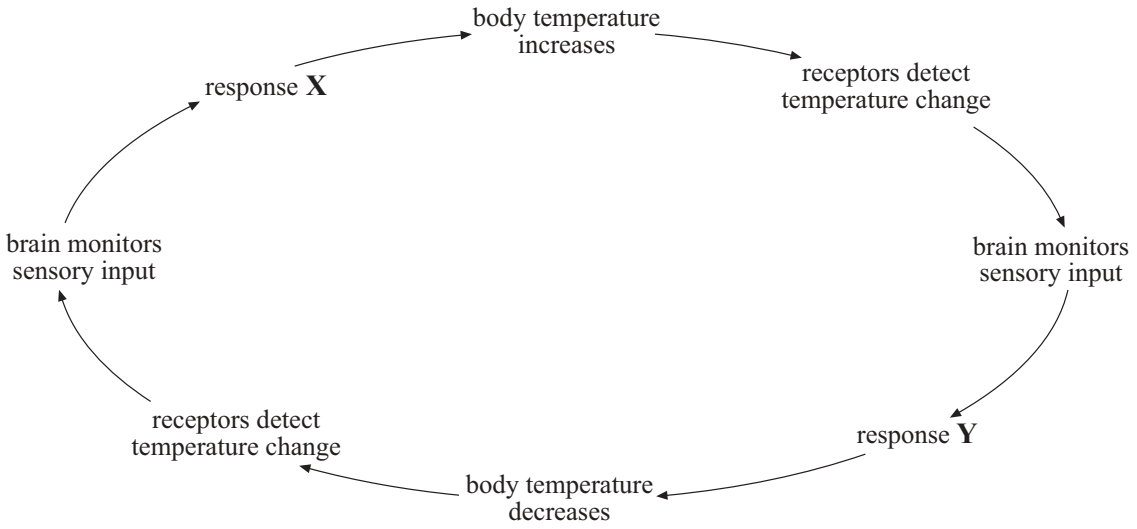
J. a glomerulus.
K. an alveolus.
L. a villus.
M. a body cell.

14. During meiosis, chromatids in homologous pairs of chromosomes often twist around each other, break, exchange segments, and rejoin.

This process is known as

J. crossing over, and results in genetically variable daughter cells.
K. independent assortment, and results in genetically identical daughter cells.
L. independent assortment, and results in haploid daughter cells.
M. crossing over, and results in diploid daughter cells.

15. *Refer to the following diagram, which represents the mechanism for temperature control in a normal healthy human being:*



Which one of the following combinations correctly describes response **X** and response **Y**?

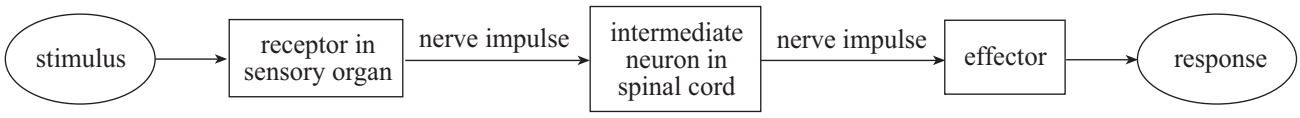
	Response X	**Response Y**
J.	vasodilation	decreased sweat production
K.	decreased sweat production	vasoconstriction
L.	increased shivering	increased sweat production
M.	increased metabolic rate	increased shivering

16. Hybrid animals that result from mating between two different species are usually infertile. However, sometimes female hybrids are able to produce viable offspring.

Female hybrids that are able to produce viable offspring produce

J. genetically identical haploid cells by meiosis.
K. viable diploid cells by meiosis which can be fertilised to retain the diploid number.
L. viable haploid cells by meiosis which can be fertilised to restore the diploid number.
M. genetically different diploid cells by meiosis.

17. *Refer to the following diagram, which shows a stimulus–response model in a normal healthy human being:*



Which one of the following statements best fits the model shown above?

J. An endocrine gland responds to a low level of calcium in the blood by releasing a hormone that produces an increase in the level of calcium in the blood.
K. A person touches a hot object and immediately pulls the hand away in a reflex action.
L. The adrenal gland of a cold person is stimulated by a message from the brain to release a hormone that increases metabolic rate.
M. An athlete's leg muscles respond when the athlete decides to increase running speed.

18. *Refer to the following table, which shows short-term and long-term changes to the body that are triggered by stress:*

Short-term changes triggered by stress	Long-term changes triggered by stress
• Release of glucose into the bloodstream • Increase in breathing rate • Increase in blood pressure • Increase in metabolic rate	• Increase in breakdown of fats • Suppression of immune system

Stress triggers both short-term and long-term changes to the body through the action of hormones.

In a stressful situation a mammal's brain will send an immediate nerve signal to the adrenal gland, triggering the release of adrenalin and producing short-term effects. The brain will also begin to release adrenocorticotrophic hormone (ACTH). This hormone travels through the blood to the adrenal gland, triggering the production and release of glucocorticoid hormone, which has long-term effects.

Which one of the following statements is consistent with the information above?

J. The sight of a dangerous animal will immediately increase the heart rate of a mammal through the action of glucocorticoid hormones.
K. Nerve damage may affect adrenalin levels.
L. The long-term suppression of the immune system is due to the effect of adrenalin.
M. The injection of ACTH will increase blood pressure.

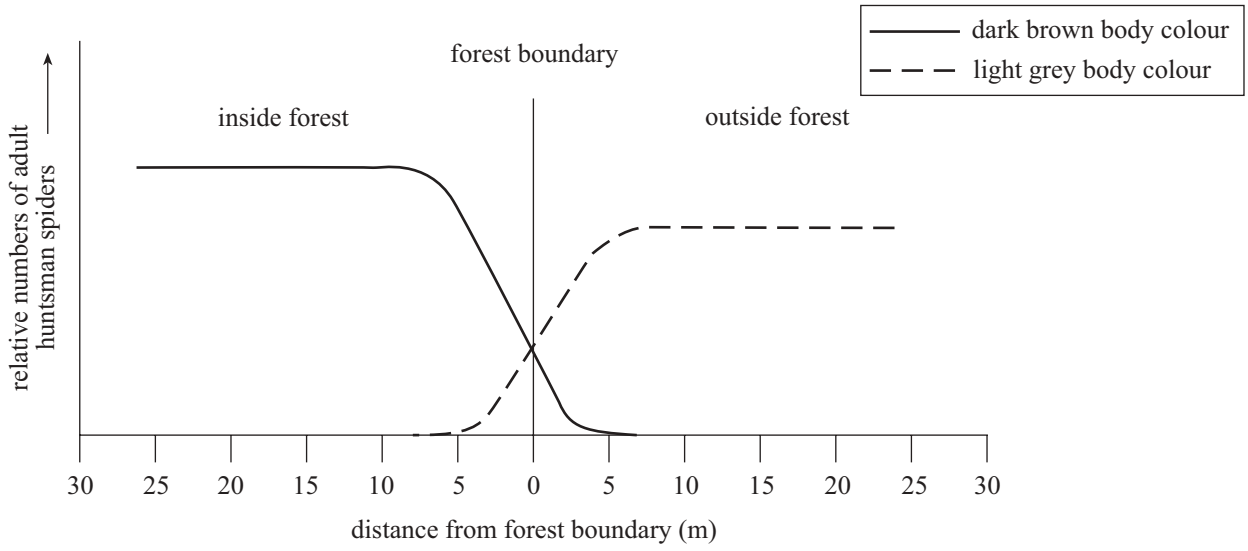
19. The FATP-4 protein is involved in actively transporting fatty acids into epithelial cells of the villi.

Biologists have modified the FATP-4 gene in some mice so that the amount of FATP-4 protein produced is lowered by 60% in epithelial cells of the villi.

These genetically modified mice would be expected to have lower levels of

J. lipids in the capillaries of the villi.
K. lipids in the lymph vessels of the villi.
L. amino acids in the capillaries of the villi.
M. amino acids in the lymph vessels of the villi.

20. *Refer to the following graph, which shows the distribution of huntsman spiders at a forest boundary:*

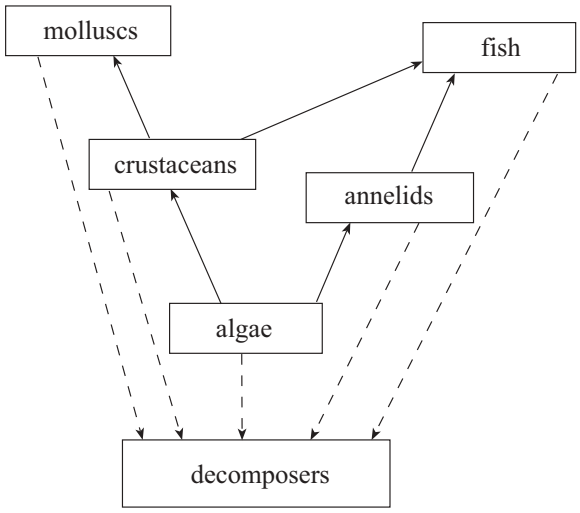


One species of huntsman spider (*Isopeda isopedella*) varies in body colour from dark brown to light grey. In one community at the forest boundary, two populations of this species were found. Some were found living in the leaf litter inside the forest and others were found living in the grass just outside the forest. The relative numbers of dark brown adult spiders and light grey adult spiders found at certain distances from the forest boundary are shown in the graph above.

The best explanation for this distribution is that

J. the two populations of spiders were once different species.
K. the two populations of spiders were unable to interbreed and individuals were adapting to suit their habitats.
L. the differences in the two habitats had changed the physical appearance of individual spiders.
M. a particular body colour provided a selective advantage to spiders in a particular habitat.

21. *Refer to the following food web, in which arrows indicate energy flow through a community:*



In this community, energy

J. is lost only through molluscs and fish.
K. enters the community only through decomposers.
L. is lost at all trophic levels.
M. enters the community only through consumers.

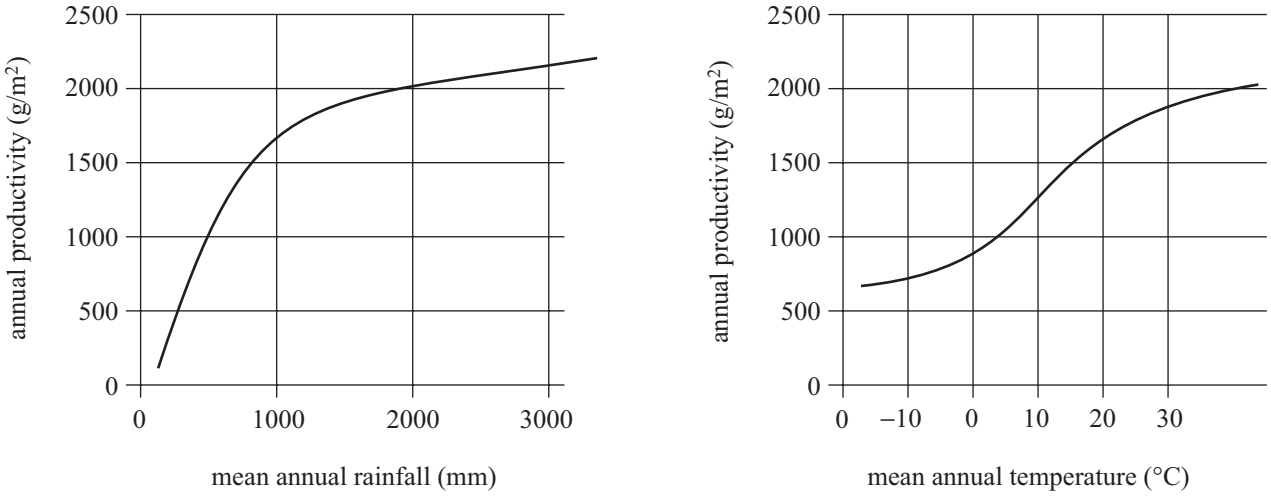
22. Which one of the following combinations correctly matches a reproductive strategy with the relative length of time to reach sexual maturity, conditions that favour population increase, and the number of offspring produced in a lifetime?

	Reproductive strategy	**Relative length of time to reach sexual maturity**	**Conditions that favour population increase**	**Number of offspring produced in a lifetime**
J.	*r*-selected	short	abundant resources	many
K.	*K*-selected	long	limited resources	many
L.	*r*-selected	long	limited resources	few
M.	*K*-selected	short	abundant resources	few

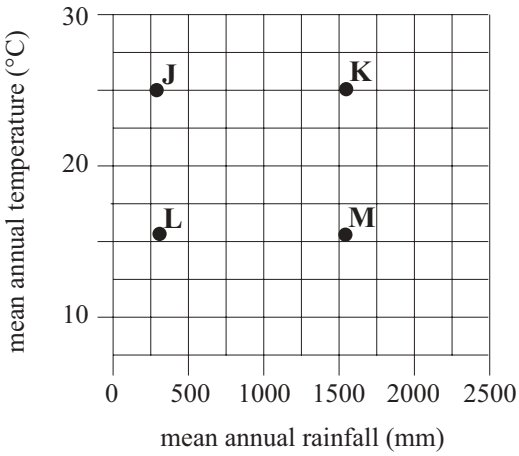
23. The most likely reason for an increase in resistance to penicillin in a population of bacteria is that

J. variation increases as a result of asexual reproduction of bacteria.
K. penicillin causes mutations in the bacteria, allowing them to become resistant to penicillin.
L. bacteria adapt to the presence of penicillin by altering their metabolism.
M. penicillin kills susceptible bacteria.

24. *Refer to the following graphs, which show the effects of mean annual rainfall and mean annual temperature on annual productivity:*



Which one of the ecosystems shown in the graph below, **J**, **K**, **L**, or **M**, would be likely to have the highest annual productivity?



25. *Refer to the following table, which shows the results from two sets of measurements, set* **1** *and set* **2***:*

Measurements	**Set 1** **(arbitrary units)**	**Set 2** **(arbitrary units)**
1	10.11	11.85
2	10.09	11.01
3	10.10	11.21
4	10.06	11.32
5	10.11	11.72
	Average 10.10	Average 11.55

If the true value for the result from the sets of measurements is 11.50, then the results from set **1** are

J. more accurate but less precise than the results from set **2**.
K. more accurate and more precise than the results from set **2**.
L. less accurate but more precise than the results from set **2**.
M. less accurate and less precise than the results from set **2**.

SECTION B: SHORT-ANSWER QUESTIONS (Questions 26 to 37)

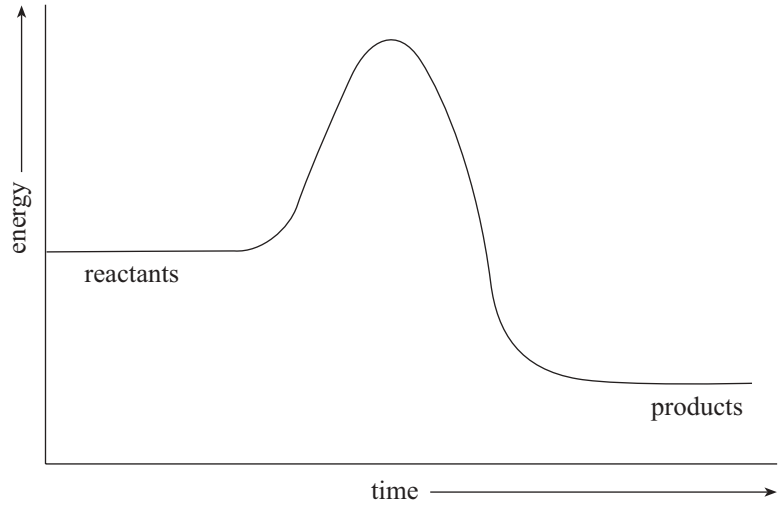
(100 marks)

*You should spend about 90 minutes on this section. Answers may be in note form. The allocation of marks is shown in brackets at the end of each part of each question. Answer **all** questions in the spaces provided.*

Part 1 (Questions 26 to 31)

(60 marks)

26. *Refer to the following graph, which shows the change in energy during a biological reaction:*



The graph shows the change in energy during a biological reaction that has ***not*** been catalysed by an enzyme.

(a) Draw a line on the graph above to show the change in energy that would occur if an enzyme were present. (2 marks)

(b) State what is meant by the activation energy of a biological reaction.

_____

_____ (2 marks)

(c) Describe one way in which the active site of an enzyme is involved in increasing the rate of a biological reaction.

_____

_____

_____ (2 marks)

(d) Biological reactions involve many regulated steps to control the rate of heat release.

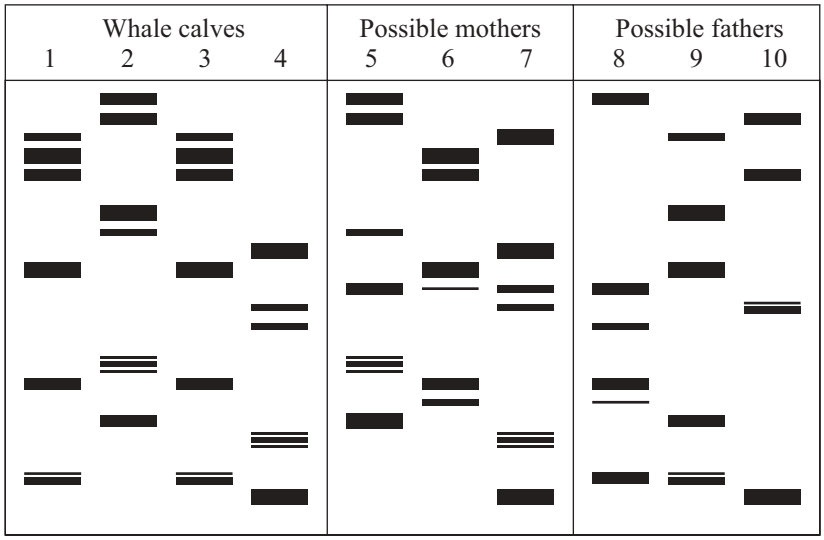
Describe one effect that an uncontrolled rate of heat release would have on protein molecules.

_____

_____

_____ (2 marks)

27. (a) *Refer to the following diagram, which shows the DNA fingerprints of four whale calves (1, 2, 3, and 4) and their possible mothers (5, 6, and 7) and possible fathers (8, 9, and 10):*



The diagram above can be used to determine the parents of the whale calves.

(i) State how the information in this diagram can be used to determine the parents of the whale calves.

_____

_____ (2 marks)

(ii) Use the diagram to identify the individual that is the father of most of the offspring.

_____ (2 marks)

(b) The polymerase chain reaction (PCR) is used to increase the amount of DNA for DNA fingerprinting.

(i) State why the DNA polymerase enzyme needed for the PCR is derived from bacterial cells that naturally live in hot springs, where the temperature may exceed 90°C.

_____

_____ (2 marks)

(ii) State why the DNA polymerase enzyme derived from bacterial cells is able to increase the amount of DNA from any species of organism.

_____

_____ (2 marks)

(iii) A primer is a small piece of synthetically manufactured single-stranded DNA of a specific nucleotide sequence.

State why the primer's nucleotide sequence is critical to its function in the PCR.

_____

_____ (2 marks)

28. A biologist was examining a single-celled organism found on the bottom of a shallow sea. The biologist carried out a number of tests when studying the organism and found that it:

- reproduced by splitting into two equal halves;
- contained no chlorophyll;
- could survive in water without oxygen but reproduced much more rapidly when oxygen was present;
- could not survive in water without carbon dioxide unless glucose was present.

The biologist observed that when the organism was subjected to greater light intensity its rate of reproduction increased. The biologist concluded that this organism was able to photosynthesise but used a chemical other than chlorophyll to capture light energy.

(a) Explain the evidence that supports the conclusion that this organism was able to photosynthesise.

(4 marks)

(b) Explain why greater light intensity could lead to an increased rate of reproduction of this organism.

(4 marks)

(c) Further study of the organism enabled the biologist to identify a chemical that was thought to have the same function as chlorophyll. The biologist carried out an experiment in which cells with different concentrations of this chemical were exposed to identical conditions.

State the results that would indicate that this chemical was involved in photosynthesis.

(2 marks)

29. Lymphocytes are white blood cells that make disease-fighting chemicals called antibodies. These cells can be grown in the laboratory if they are fused to cancer cells. Lymphocytes that are fused to cancer cells are called hybridoma cells. Hybridoma cells can be cultured in a flask. Culturing hybridoma cells in a flask involves mitotic cell division.

(a) State one important consequence of mitotic cell division in tissue culture.

_____

_____ (2 marks)

(b) List four factors that must be present for the culture of hybridoma cells to be successful.

(i) _____

(ii) _____

(iii) _____

(iv) _____ (4 marks)

(c) State one reason why cancer cells are used to stimulate lymphocytes to divide.

_____

_____ (2 marks)

(d) Tissue culture can be used to reproduce large numbers of individual plants.

Explain one disadvantage of reproducing plants by tissue culture.

_____

_____

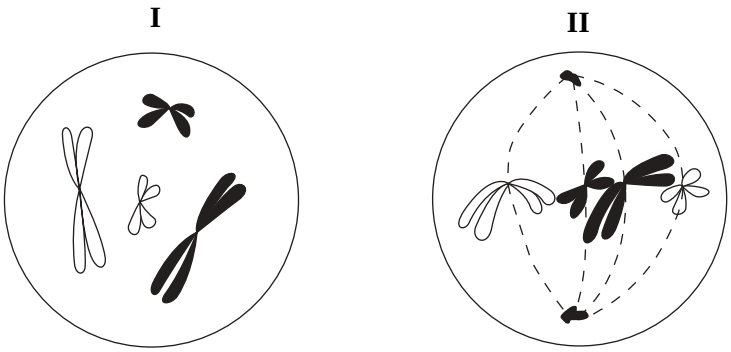
_____

_____

_____

_____ (4 marks)

30. *Refer to the following diagrams, which show two successive stages,* **I** *and* **II**, *in the division of a cell:*



(a) In the space below, draw the chromosomes as they would appear next (in stage **III** of the division of this cell).

III

(2 marks)

(b) State one piece of evidence from the diagrams above to indicate that this is a eukaryotic cell.

_____

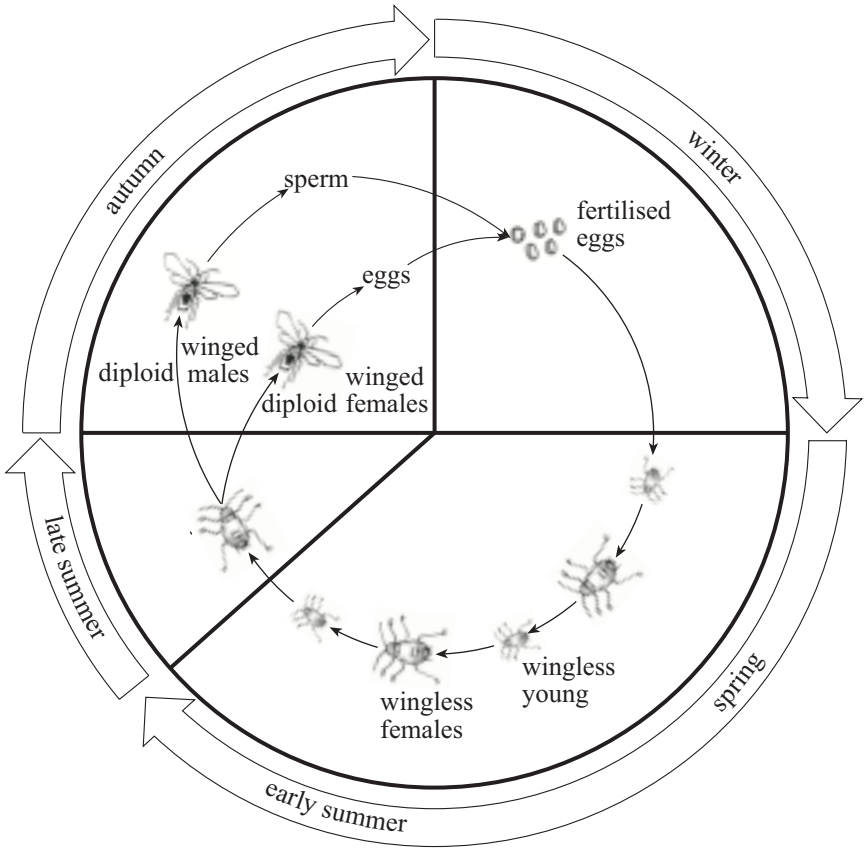
_____ (2 marks)

(c) Name the cell structure that moves the organelles and the cell membrane during cell division.

_____

_____ (2 marks)

(d) *Aphids are small sap-sucking diploid insects. Refer to the following diagram, which shows the life cycle of aphids:*



(i) Using the information in the diagram above, name the season during which meiosis occurs in aphids.

_____ (2 marks)

(ii) During the seasons of spring and early summer female aphids reproduce asexually. This process results in offspring that are genetically identical to the parent.

Explain why the offspring produced by one female are genetically different from the offspring produced by other females.

_____

_____

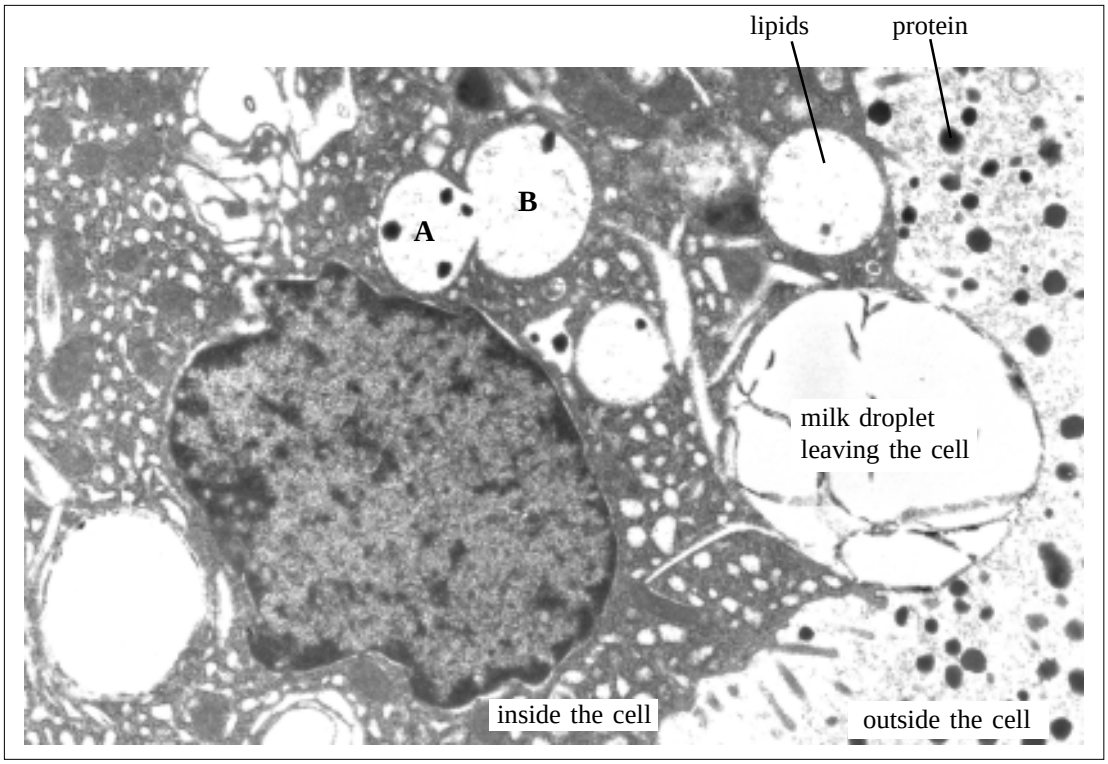
_____

_____

_____

_____ (4 marks)

31. *Refer to the following electron photomicrograph, which shows part of a lactating (milk-producing) cell from a mammary gland. The white structures contain lipids and the black spots are protein:*



Source: Department of Anatomical Sciences, University of Adelaide

(a) Name the process by which the milk is leaving the cell.

_____ (2 marks)

(b) State one feature of membrane structure that enables structures **A** and **B** to join together.

_____

_____ (2 marks)

(c) Some cows have been genetically engineered so that they produce milk proteins similar to the milk proteins produced by human beings.

Explain how a change in DNA can cause a change in the milk proteins produced.

(4 marks)

You may write on this page if you need more space to finish your answers to Part 1 of Section B. Make sure to label each answer carefully (e.g. 29(d) continued).

SSABSA
SENIOR SECONDARY ASSESSMENT BOARD OF SOUTH AUSTRALIA
EXTERNAL EXAMINATION 2005

2005 BIOLOGY

SACE REGISTRATION NUMBER

SEQ | FIGURES | CHECK LETTER | BIN

BIOLOGY

QUESTION BOOKLET

2

15 pages, 9 questions

Monday 14 November: 9 a.m.

Part 2 of Section B, Section C, and Section D

Write your answers to Part 2 of Section B and to Section C in this question booklet.
Write your answers to Section D in the separate script book.

SECTION B: SHORT-ANSWER QUESTIONS

Part 2 (Questions 32 to 37)

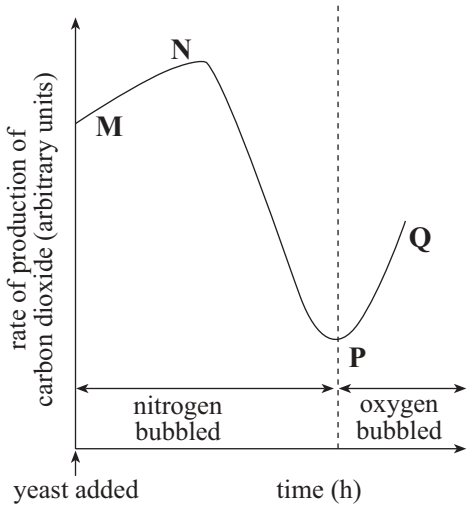
(40 marks)

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

32. An experiment was carried out to investigate the rate of production of carbon dioxide by yeast cells.

    Nitrogen gas was bubbled through a glucose solution overnight to remove any dissolved oxygen. A suspension of yeast cells was then added to the glucose solution. Nitrogen continued to be bubbled through the glucose and yeast mixture. The nitrogen supply was then ceased and oxygen was bubbled through the mixture.

    Throughout the experiment, the rate of production of carbon dioxide was measured. The results obtained are shown in the following graph:



(a) Using chemical formulae, write the equation for the process that occurred between point **M** and point **N**.

_____ (2 marks)

(b) Explain why the yeast cells released energy more efficiently between points **P** and **Q** than between points **M** and **N**.

(4 marks)

(c) Describe how ATP was produced using the energy released between point **P** and point **Q**.

(2 marks)

33. One way of determining the metabolic rate of an animal is to measure the amount of oxygen it uses over time. Larger animals use more oxygen than smaller animals use, and so the metabolic rate is usually expressed as the volume of oxygen consumed per unit of body mass.

The table below shows the metabolic rates of some mammals:

Mammal	**Body mass (kg)**	**Metabolic rate measured as oxygen consumption per hour (mL/kg)**
mouse	0.025	1600
rat	0.23	870
rabbit	2.20	470
dog	12	320
human being	70	200
horse	700	110
elephant	3800	67

(a) State the relationship between body mass and metabolic rate for the mammals listed in the table above.

_____

_____

_____ (2 marks)

(b) Explain why heat loss can account for the fact that the mouse has the highest metabolic rate of the mammals listed in the table.

_____

_____

_____

_____

_____

_____ (4 marks)

34. The tubules of the nephron are long and have thin walls.

(a) State how each of these features assists the function of the nephron.

(i) Long tubules: _____

_____ (2 marks)

(ii) Thin walls: _____

_____ (2 marks)

(b) State one effect that a sudden decrease in blood pressure would have on the function of the nephron.

_____

_____ (2 marks)

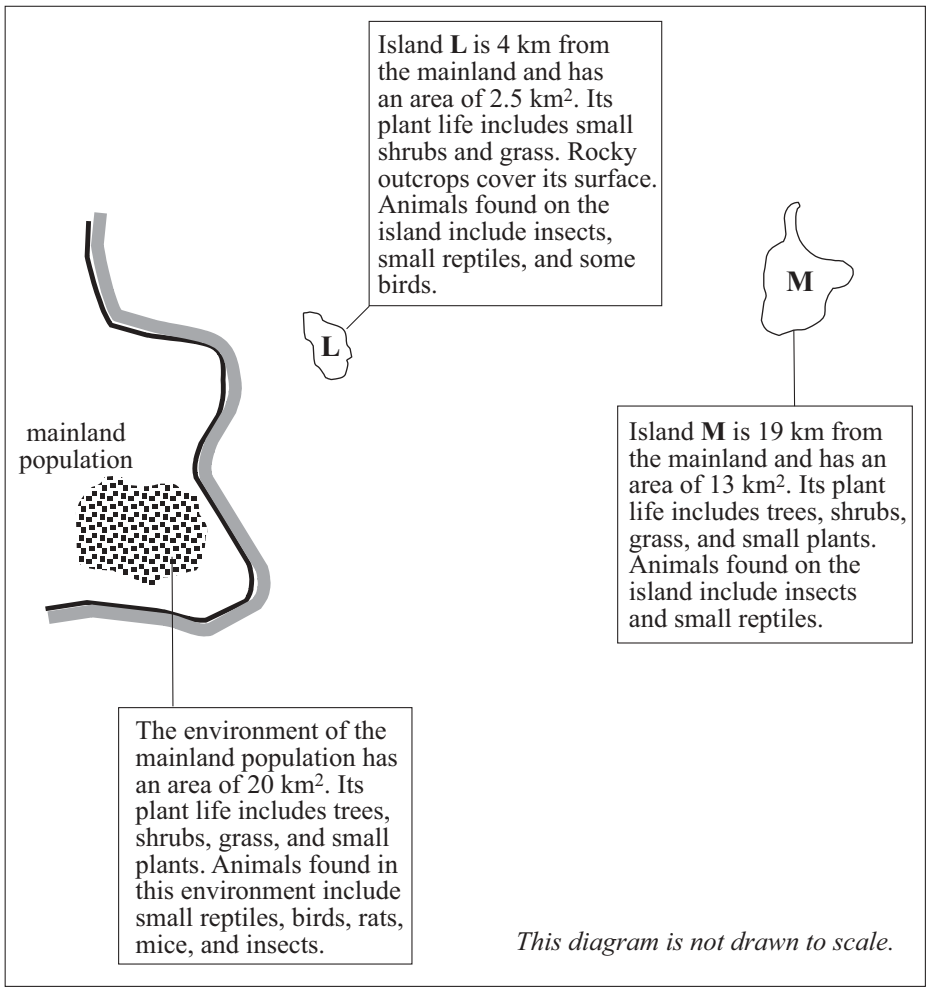
35. One method of conserving endangered bird species involves capturing mainland birds and establishing small populations of them on isolated offshore islands. These islands are chosen because they are free from introduced species that are found on the mainland.

(a) State one way in which *non-predatory* animals introduced to the mainland may contribute to the declining populations of these birds.

_____

_____ (2 marks)

Refer to the following diagram, which shows data about the environment of a mainland population of an endangered bird species, and data about the environment on two nearby offshore islands, **L** *and* **M***:*



(b) Using the information in the diagram on the page opposite, construct a table to compare the environment of the mainland population with the environment of islands **L** and **M**.

(4 marks)

(c) The birds in the mainland population are known to nest among the long grass and low shrubs in the shelter of the trees. They feed on seeds, insects, and small reptiles.

Scientists decide to move a number of endangered birds from the mainland population to one of the nearby offshore islands. They establish the new population on island **M** rather than on island **L** to minimise the risk of speciation.

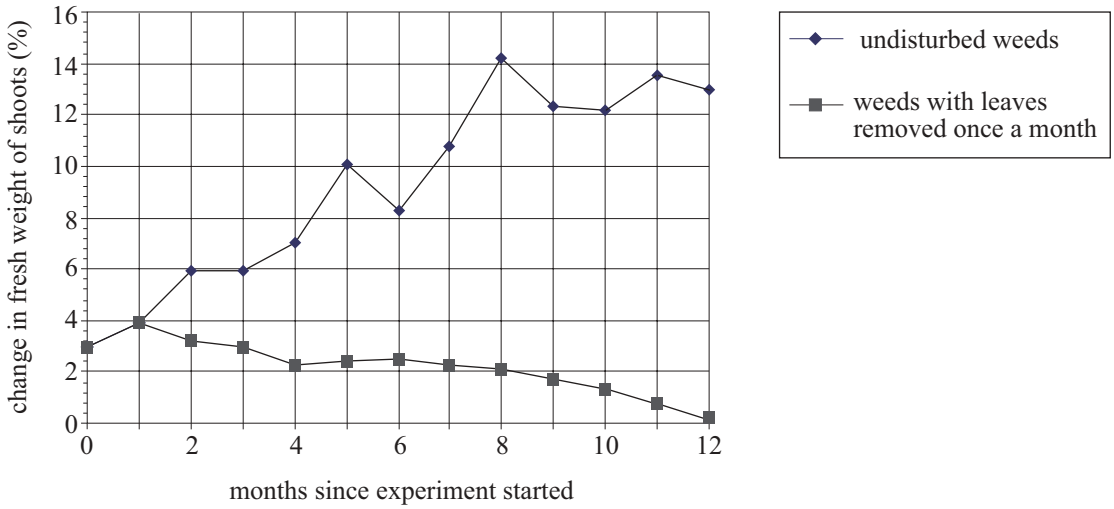
Explain why a population on island **M** is less likely than a population on island **L** to result in rapid speciation.

(4 marks)

36. When a plant does not use all the sugar it produces for growth, the sugar may be converted into starch and stored in the roots of the plant.

Many weeds store large quantities of starch in their roots. When their leaves are removed these weeds use the stored starch as a source of energy to send up new shoots.

The graph below shows the change in fresh weight of shoots of one population of weeds that has been left undisturbed and of another population of weeds that has had its leaves removed once a month for 12 months:



(a) State one abiotic factor that may have caused the variation in growth of the undisturbed weeds.

_____ (2 marks)

(b) Explain why removing their leaves once a month will eventually kill the weeds.

_____

_____

_____

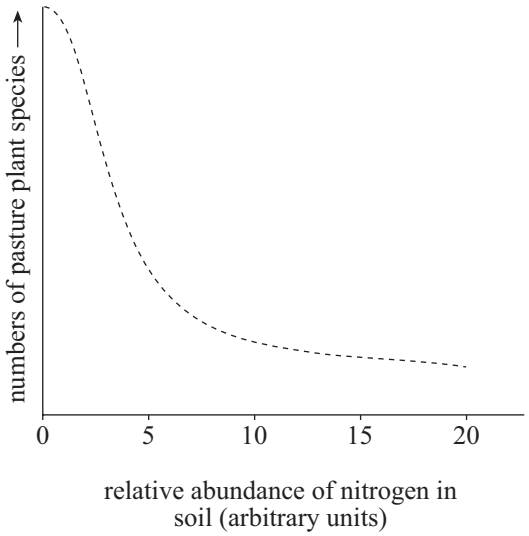
_____

_____

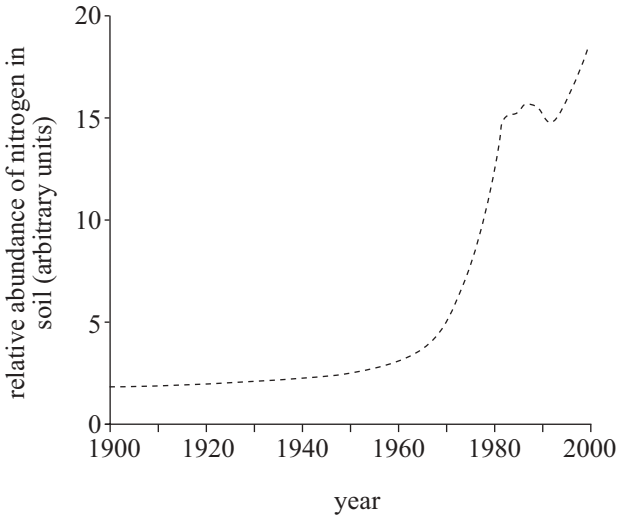
_____ (4 marks)

37. *Refer to the following graphs, which show trends in ecosystems:*

Graph **1**



Graph **2**



(a) State one conclusion that could be drawn from the information in graph **1**.

_____

_____

_____ (2 marks)

(b) Assuming the trends shown in both graphs continue, predict the change that would occur in the diversity of pasture plant species over the next 50 years.

_____

_____

_____ (2 marks)

SECTION C: PRACTICAL QUESTION (Question 38)

(20 marks)

Answer all parts of Question 38 in the spaces provided. You should spend about 20 minutes on this section.

The allocation of marks is shown in brackets at the end of each part of the question.

38. A series of experiments was conducted to investigate the effects of different factors on the rate of an enzyme-catalysed reaction. The enzyme had an optimum temperature of 35°C.

    (a) One experiment was carried out to investigate the effect of changing pH on this enzyme-catalysed reaction.

        (i) State one hypothesis for this experiment.

        _____

        _____ (2 marks)

        (ii) State why it was important to minimise the effect of random errors in this experiment.

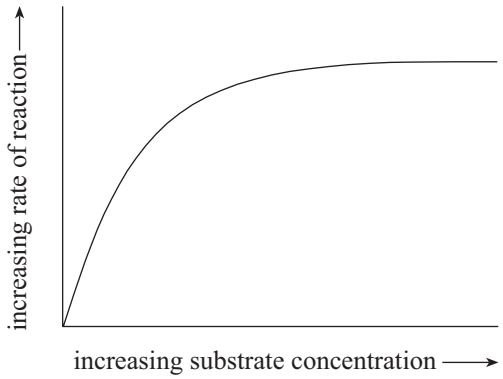
        _____

        _____ (2 marks)

(b) A second experiment was carried out to investigate the effect of increasing substrate concentration on the rate of the same enzyme-catalysed reaction.

This experiment was carried out at a temperature of 35°C, a pH of 7, and a constant enzyme concentration.

The graph below shows the pattern of results of this experiment:



(i) State why it was necessary to maintain a constant pH in this experiment.

_____

_____ (2 marks)

(ii) State the independent variable in this experiment.

_____ (2 marks)

(iii) Describe the *pattern* shown by the results of this experiment.

_____

_____

_____

_____

_____

_____ (4 marks)

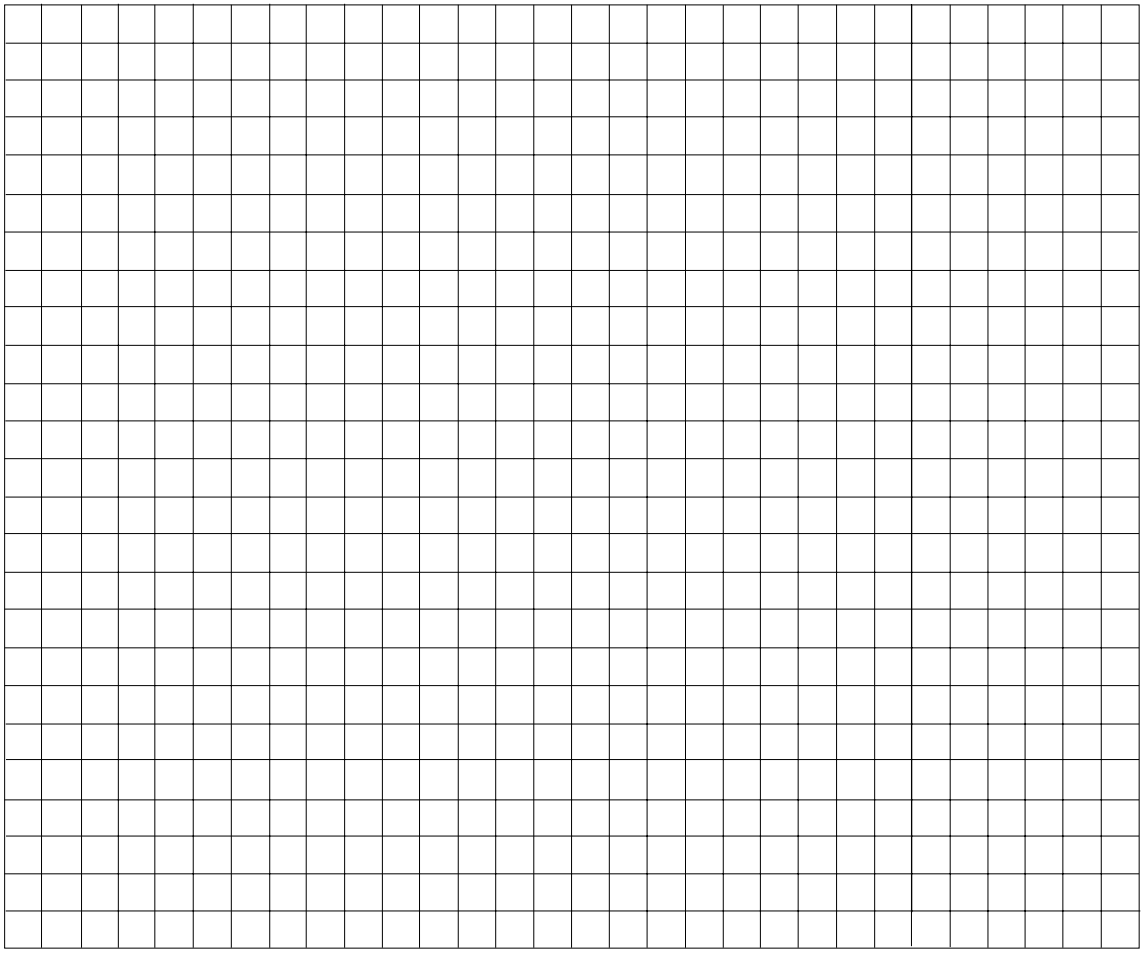
(iv) On the graph above, draw a line to show how you would expect the pattern of results to change if this experiment were repeated at 28°C. (2 marks)

(c) A third experiment was carried out to investigate the effect of temperature on the average rate of the same enzyme-catalysed reaction. The results are shown in the table below:

Temperature (°C)	Average rate of reaction (arbitrary units)
10	0.07
25	0.12
35	0.50
45	0.28
55	0.08
65	0.00

(i) On the grid below, draw a graph of these data.

The effect of temperature on the average rate of an enzyme-catalysed reaction



(4 marks)

(ii) The results shown in the table on the page opposite are considered to be true values.

If the experiment were repeated using alternative equipment and materials, state one *pattern* of results that would indicate a systematic error.

_____

_____

_____ (2 marks)

You may write on this page if you need more space to finish your answers to either Part 2 of Section B or Section C. Make sure to label each answer carefully (e.g. 35(c) continued).

SECTION D: EXTENDED-RESPONSE QUESTIONS (Questions 39 and 40)

(30 marks)

*Answer **both** questions in this section.*

*Write your answers in the separate script book provided. **Begin each answer on a new page.***

You should spend about 30 minutes on this section, 5 to 10 minutes planning and 20 to 25 minutes writing. Credit will be given for clear, well-expressed answers that are well organised and relevant to the questions.

39. Type I diabetes can be treated with human insulin made by genetically engineered bacteria. Type II diabetes and some other diseases can be controlled by lifestyle changes.

    - Describe how bacteria can be genetically engineered to produce human insulin.
    - Discuss the advantages of relying on:

      lifestyle changes to control lifestyle-related diseases;

      genetic engineering to control lifestyle-related diseases.

    (15 marks)

40. After a large bushfire there are significant changes in the number and type of plant species present in the area.

    In one study, sixty-three plant species were recorded in one area a year after a bushfire, compared with only ten plant species recorded in the area before the bushfire.

    - Explain why many *different* plant species were able to establish in the area in the first year after the fire.
    - Describe how succession occurred in this plant community after the first year.
    - Explain why biodiversity is considered to be a desirable feature of a biological community.

    (15 marks)

SECTION B: SHORT-ANSWER QUESTIONS

Part 2 (Questions 32 to 37)

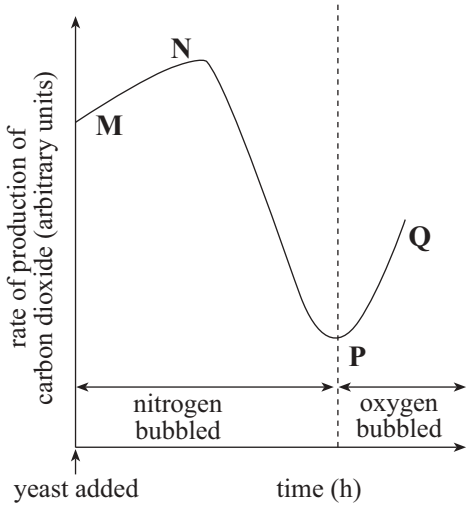
(40 marks)

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

32. An experiment was carried out to investigate the rate of production of carbon dioxide by yeast cells.

    Nitrogen gas was bubbled through a glucose solution overnight to remove any dissolved oxygen. A suspension of yeast cells was then added to the glucose solution. Nitrogen continued to be bubbled through the glucose and yeast mixture. The nitrogen supply was then ceased and oxygen was bubbled through the mixture.

    Throughout the experiment, the rate of production of carbon dioxide was measured. The results obtained are shown in the following graph:



(a) Using chemical formulae, write the equation for the process that occurred between point **M** and point **N**.

_____ (2 marks)

(b) Explain why the yeast cells release energy more efficiently between points **P** and **Q** than between points **M** and **N**.

(4 marks)

(c) Describe how ATP is produced using the energy released between point **P** and point **Q**.

(2 marks)