



## 2007 BIOLOGY

**FOR OFFICE  
USE ONLY**

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**ATTACH SACE REGISTRATION NUMBER LABEL  
TO THIS BOX**

**QUESTION  
BOOKLET****1**

21 pages, 30 questions

**Monday 12 November: 9 a.m.**

Time: 3 hours

**Section A and Part 1 of Section B**

Examination material: Question Booklet 1 (21 pages)  
Question Booklet 2 (13 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 Students**

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 three sections: Section A and Part 1 of Section B are in Question Booklet 1; Part 2 of Section B and Section C 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 36)  
Answer Part 1 of Section B (Questions 26 to 30) in the spaces provided in Question Booklet 1.  
Write on page 21 of Question Booklet 1 if you need more space.  
Answer Part 2 of Section B (Questions 31 to 36) in the spaces provided in Question Booklet 2.  
Write on page 12 of Question Booklet 2 if you need more space.  
**Section C: Extended-response Questions** (Questions 37 and 38)  
Answer *both* questions in Section C in the separate script book.
3. In Section B 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	120 marks	110 minutes
Section C	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 Question Booklet 1.

**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;
- have my marks for the examination cancelled or amended;
- 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. Which one of the following alternatives correctly identifies the type of sugar, the structure, and the bases found in a DNA molecule?

	Type of sugar	Structure	Bases
J.	deoxyribose	double stranded	A, T, C, G
K.	deoxyribose	single stranded	A, U, C, G
L.	ribose	double stranded	A, T, C, G
M.	ribose	single stranded	A, U, C, G

2. The enzyme cellulase is sometimes added to washing powders. Cellulase helps remove grass stains by breaking down cellulose into glucose. It has an optimum pH of 5.0 and an optimum temperature of 55°C.

Which one of the following conditions would result in faster removal of grass stains from clothes being washed with a powder that contains cellulase?

- J. Increasing the wash temperature from 55°C to 60°C.  
K. Adding less than the optimum amount of washing powder to the wash.  
L. Decreasing the pH from 7.0 to 6.0.  
M. Adding more than the recommended amount of water to the wash.
3. Which one of the following alternatives correctly identifies a chemical, one of its locations in a cell, and its function in that location?

	Chemical	Location	Function in that location
J.	phospholipid	cell membrane	energy reserve
K.	chitin	cell wall	structural
L.	protein	cell wall	energy reserve
M.	cellulose	cell membrane	structural

4. A length of mRNA attached to a ribosome codes for the production of a polypeptide that is 120 amino acids long.

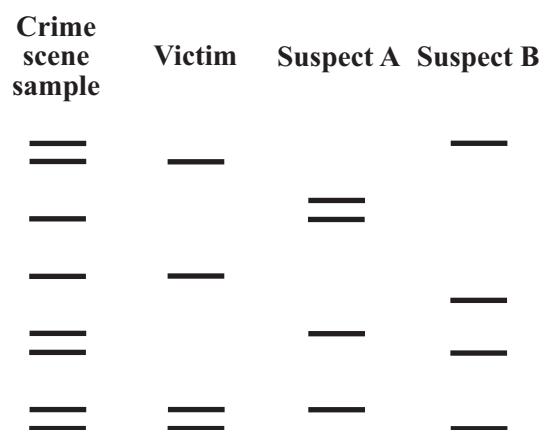
How many mRNA nucleotides code for the amino acids in this polypeptide?

- J. 40.
- K. 120.
- L. 360.
- M. 720.

5. Enzymes

- J. lower the activation energy in both synthesis reactions and breakdown reactions.
- K. lower the activation energy in breakdown reactions but not in synthesis reactions.
- L. raise the activation energy in synthesis reactions but not in breakdown reactions.
- M. raise the activation energy in both synthesis reactions and breakdown reactions.

6. Refer to the following diagram, which shows DNA fingerprints from four sources:

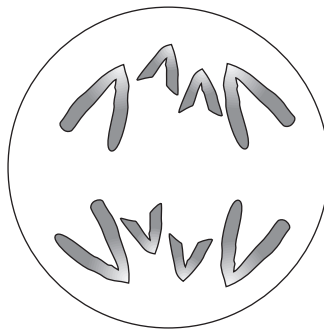


The sample taken from the crime scene contains DNA from

- J. the victim and suspect A.
- K. the victim and suspect B.
- L. the victim, suspect A, and suspect B.
- M. the victim and an unknown individual.

7. As a cell grows, its
- J. efficiency in exchanging materials across the cell membrane increases.
  - K. surface area increases.
  - L. surface area to volume ratio increases.
  - M. volume decreases.
8. One consequence of having many small regulated steps in an energy pathway is
- J. an increase in the activation energy for the pathway.
  - K. a decrease in the amount of heat lost from the pathway.
  - L. a decrease in the amount of ATP released from the pathway.
  - M. an increase in the total energy released from the pathway.

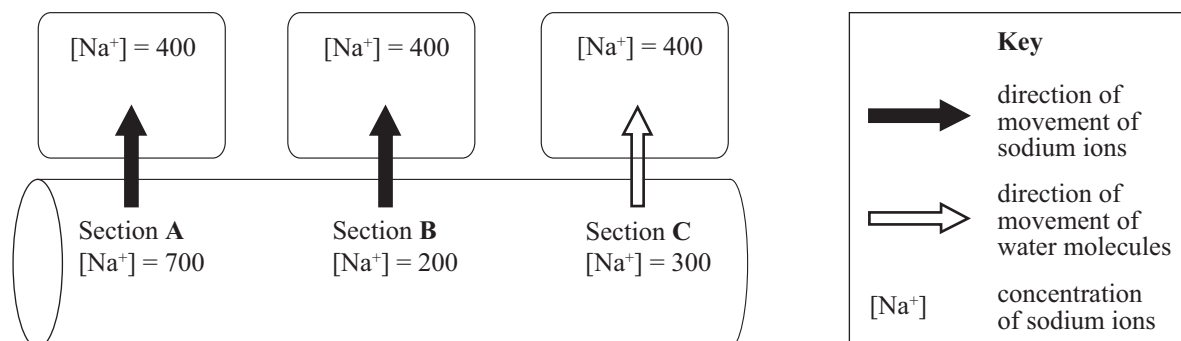
9. Refer to the following diagram, which represents a diploid cell in the process of cell division:



Which one of the following combinations correctly matches the type of cell division shown with the diploid number of the dividing cell?

	Type of cell division	Diploid number of cell
J.	mitosis	8
K.	meiosis	8
L.	mitosis	4
M.	meiosis	4

10. Refer to the following diagram, which shows the concentration of sodium ions inside three sections along a kidney tubule and in a cell next to each section of the tubule:



Note: the diagram is not drawn to scale.

Which one of the following combinations correctly matches the processes that result in the net movement of

- sodium ions out of section A;
- sodium ions out of section B;
- water molecules out of section C?

Process that results in the net movement of:			
	Sodium ions out of section A	Sodium ions out of section B	Water molecules out of section C
J.	diffusion	active transport	osmosis
K.	active transport	diffusion	osmosis
L.	diffusion	active transport	active transport
M.	active transport	diffusion	active transport

11. Which one of the following statements about cell culture is *incorrect*?

- J. The temperature of the culture is critical because it affects the rate of chemical reactions in the cells.
- K. A cell culture can be used to produce genetically identical human cancer cells.
- L. A gene of interest can be transferred into a bacterium by cell culture.
- M. Sterile conditions are needed in a cell culture to prevent the growth of unwanted microorganisms.

12. The bacterium *Salmonella enterica* causes typhoid fever in human beings. Although this bacterium is a single cell, its genome consists of about 4500 genes.

Even a simple cell such as *Salmonella enterica* has many genes because these genes control the manufacture of many different

- J. polypeptides that code for amino acids.
- K. nucleotides that code for RNA.
- L. DNA molecules that code for proteins.
- M. RNA molecules that code for polypeptides.

13. Which one of the following statements about the structure of an organism is correct?

- J. Nerve cells and muscle cells have different functions because they contain different DNA.
- K. Organs consist of one type of tissue that has one specific function.
- L. The respiratory system consists of different tissues containing cells with identical DNA.
- M. Tissues consist of two or more different types of cells that have similar functions.

14. The action of a person removing his or her hand from a hot surface is a reflex response. In this reflex response

- J. sensory neurons carry nerve impulses directly from receptor cells in the skin to muscle cells.
- K. nerve impulses are transmitted to effector cells via motor neurons.
- L. motor neurons carry nerve impulses directly from receptor cells in the skin to muscle cells.
- M. nerve impulses are transmitted to receptor cells in the muscle via sensory neurons.

15. A person's core body temperature increases as a result of exercise. To restore the core temperature to normal, the body responds by

- J. increasing sweat production as a result of hormonal control.
- K. increasing blood flow to surface capillaries as a result of nervous control.
- L. increasing metabolic rate as a result of hormonal control by the thyroid gland.
- M. rapidly relaxing and contracting muscles as a result of nervous control.

16. Which one of the following processes, which occur in a normal healthy human nephron, requires the process of active transport?

- J. Transportation of sodium ions from the blood into the filtrate.
- K. Reabsorption of protein from the filtrate into the blood.
- L. Transportation of urea from the filtrate into the urine.
- M. Reabsorption of glucose from the filtrate into the blood.

17. In an experiment, yeast cells were placed in a glucose solution in a closed container and grown under anaerobic conditions.

Which one of the following would **not** have been released by the respiring yeast cells?

- J. Lactic acid.
- K. Ethanol.
- L. Heat.
- M. Carbon dioxide.

18. Which one of the following combinations of processes results in increased genetic variation?

- J. The crossing over of homologous chromosomes in mitosis followed by the joining of haploid cells during fertilisation.
- K. The independent assortment of chromosomes in meiosis followed by the joining of diploid cells during fertilisation.
- L. The crossing over of homologous chromosomes in mitosis followed by the joining of diploid cells during fertilisation.
- M. The independent assortment of chromosomes in meiosis followed by the joining of haploid cells during fertilisation.

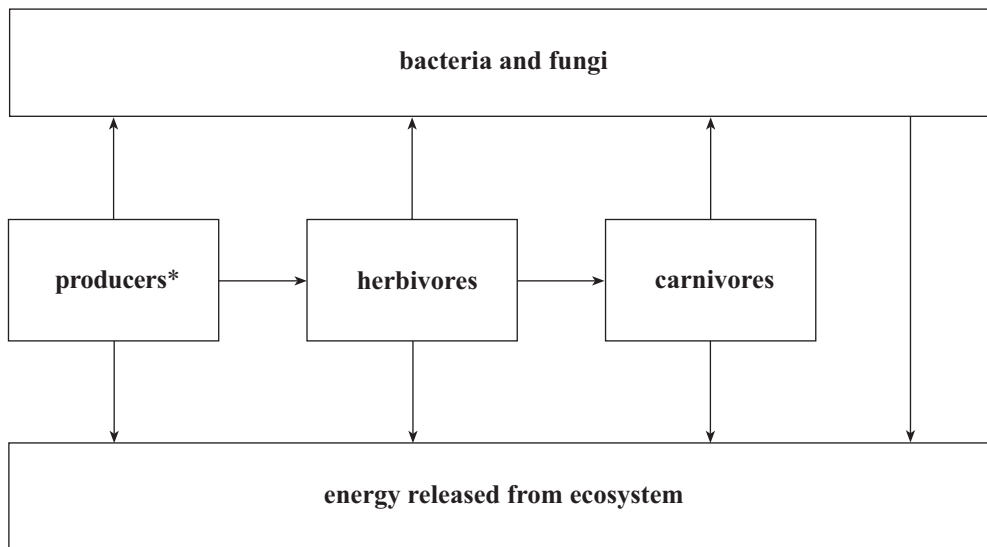
19. Fluid that moves out of blood capillaries forms the tissue fluid that surrounds cells.

Which one of the following statements is correct?

- J. Tissue fluid is formed from fluid that moves out of blood capillaries only by diffusion.
- K. Red blood cells move out of blood capillaries in order to transport oxygen to cells.
- L. The presence of proteins in the blood in the capillaries causes water to move from tissue fluid back into the capillaries.
- M. The main function of lymph vessels is to collect and remove urea from tissue fluid.



20. Refer to the following diagram, which represents the average daily energy flow in a lawn ecosystem:



\*Energy captured by producers is 2000 kJ/m<sup>2</sup>/day.

The total amount of energy released from the ecosystem will be closest to

- J. 2000 kJ/m<sup>2</sup>/day.
  - K. 200 kJ/m<sup>2</sup>/day.
  - L. 20 kJ/m<sup>2</sup>/day.
  - M. 2 kJ/m<sup>2</sup>/day.
21. Methicillin-resistant *Staphylococcus aureus* (MRSA) is a strain of bacterium that has been detected in the intensive care units of hospitals in recent years. MRSA is not killed by the antibiotic methicillin.

Methicillin resistance probably occurred in *Staphylococcus aureus* as a result of

- J. individual bacteria slowly building up immunity to methicillin.
- K. methicillin becoming weaker over time.
- L. more patients being treated in intensive care units, so that infections spread more easily.
- M. random mutations in the bacterial population producing some bacteria that are methicillin-resistant.

22. Refer to the following table, which shows data relating to the ecological footprint of four nations:

Nation	Total ecological footprint (global hectares/person)	Total biocapacity (global hectares/person)
Australia	6.6	12.4
China	1.6	0.8
Indonesia	1.1	1.0
Malaysia	2.2	3.7

The total ecological footprint is a measure of how many global hectares an individual needs in order to sustain his or her lifestyle. This figure is based on the food, transport, and housing that a person requires.

Biocapacity is a measure of how many global hectares per person are available to generate these resources.

From this information it can be concluded that

- J. the Australian lifestyle uses almost twice as many global hectares as Australia's biocapacity can sustain.
- K. the population of China lives a lifestyle that China does not have the biocapacity to support.
- L. Indonesia has the biocapacity to support the lifestyle of its people if they live on smaller blocks of land.
- M. Malaysia does not have the biocapacity to sustain the current lifestyle of its population.

23. For around 10000 years the Pearson Island rock wallabies, *Petrogale lateralis pearsonii*, have been genetically isolated from similar rock wallabies on the mainland of South Australia.

Scientists have analysed blood samples taken from the wallabies and the results show that individuals in the Pearson Island rock wallaby population are genetically very similar.

One consequence of this low genetic diversity is that the Pearson Island rock wallabies

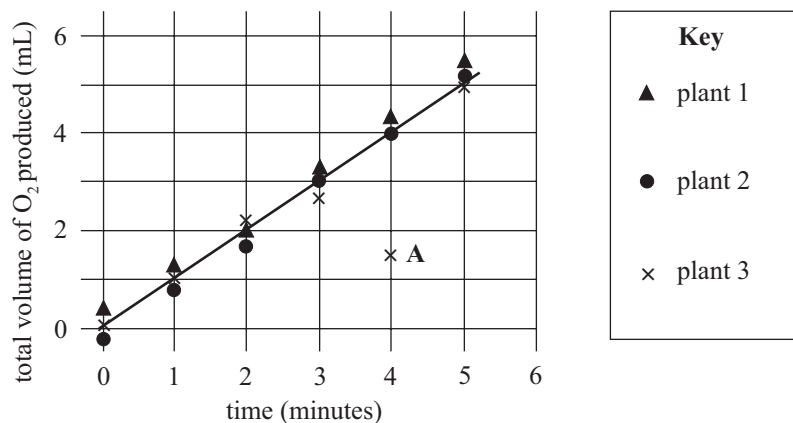
- J. are likely to be susceptible to the same selection pressures.
- K. are likely to evolve into a new species of wallaby.
- L. will become well adapted to their isolated environment.
- M. will become extinct.

24. Many forest ecosystems in Australia were destroyed when the land was cleared for agricultural use. Some landowners have recently fenced off selected patches of their property to allow these areas to revert to the kind of ecosystem that existed before the land was cleared.

The first new plant species to establish themselves in these fenced-off areas are most likely to produce

- J. few seeds, which will grow into large, long-lived plants.
- K. many seeds, which will grow into large, short-lived plants.
- L. few seeds, which will grow into small, long-lived plants.
- M. many seeds, which will grow into small, short-lived plants.

25. Refer to the graph, which shows the total volume of oxygen produced by three small plants during an experiment:



The measurements for all three plants were taken at the same times during the experiment.

Point A, shown on the graph, is most likely the result of

- J. a random error when measuring the independent variable.
- K. a systematic error when measuring the independent variable.
- L. a systematic error when measuring the dependent variable.
- M. a random error when measuring the dependent variable.

## SECTION B: SHORT-ANSWER QUESTIONS (Questions 26 to 36)

(120 marks)

*You should spend about 110 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 30)

(60 marks)

26. In normal human brain cells the PRNP gene found on chromosome 20 codes for the membrane protein, PrPc. The most likely function of the PrPc protein is to enable the transport of copper ions with the concentration gradient into cells.

- (a) Describe how a membrane protein could enable the transport of copper ions with the concentration gradient into a cell.

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(2 marks)

- (b) Genetic Creutzfeldt–Jacob disease (CJD) is caused by an abnormal PrPc protein.

Genetic CJD occurs when the abnormal PrPc protein is formed because of a mutation in the PRNP gene. Genetic CJD can be diagnosed by identifying the mutation on chromosome 20.

State one way that chromosomes can be distinguished from each other.

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(2 marks)

- (c) State two factors that can increase the rate of mutation.

(i) \_\_\_\_\_

(ii) \_\_\_\_\_ (2 marks)

- (d) The mutation that most commonly causes genetic CJD occurs in DNA base triplet 200 of the PRNP gene as shown below:

DNA base triplet number	199	200	201
normal PRNP gene	TGG	CTC	CAA
mutated PRNP gene	TGG	TTC	CAA

mRNA codon	Amino acid
ACA, ACC, ACG, ACU	threonine
AAA, AAG	lysine
CAA, CAG	glutamine
CUA, CUC, CUG, CUU	leucine
GAA, GAG	glutamic acid
UGG	tryptophan
UUC, UUU	phenylalanine
UUG, UUA	leucine

Using the information in the table above, state the *amino acid* substitution that will occur because of this mutation in DNA base triplet 200:

From: \_\_\_\_\_ to: \_\_\_\_\_ (2 marks)

- (e) The abnormal PrPc protein has an exposed chain of amino acids which the normal protein does not have.

- (i) State how a change in the amino acid sequence of the PrPc protein could expose this chain of amino acids.

\_\_\_\_\_  
 \_\_\_\_\_ (2 marks)

- (ii) State how this exposed chain of amino acids may prevent copper ion transport into a cell.

\_\_\_\_\_  
 \_\_\_\_\_ (2 marks)

27. Refer to the following table, which shows the results of an experiment to test the effect of two minutes of intense exercise on an individual's lactic acid production. The exercise occurred between 9.15 a.m. and 9.17 a.m.:

Time (a.m.)	Mass of lactic acid in the urine (mg)	Volume of urine (mL)	Concentration of lactic acid (mg/mL)
9.00 – 9.15	2.60	16.3	
9.15 – 9.30	200	23.0	
9.30 – 9.45	276	26.5	

- (a) State **one** possible hypothesis for the above experiment.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (2 marks)

- (b) State **two** factors that should have been held constant in this experiment.

(i) \_\_\_\_\_

(ii) \_\_\_\_\_ (2 marks)

- (c) Complete the last column in the table above by using the following formula:

$$\text{concentration of lactic acid} = \frac{\text{mass of lactic acid}}{\text{volume of urine}} \quad (4 \text{ marks})$$

- (d) By referring to the data in the table above, describe the change in the mass of lactic acid produced as a result of exercise.

\_\_\_\_\_

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\_\_\_\_\_

\_\_\_\_\_ (4 marks)

- (e) Use chemical formulae to write a balanced equation for the chemical reaction that produces lactic acid in muscle cells.

\_\_\_\_\_ (2 marks)

- (f) State **one** way that the effects of random errors could have been minimised in this experiment.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2 marks)

- (g) Creatine is a chemical found naturally in the human body. It helps muscles to produce and circulate more ATP and reduces the build-up of lactic acid.

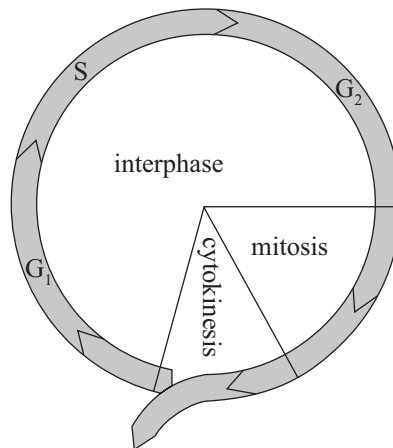
It is estimated that 80% of Olympic athletes take creatine as a dietary supplement during their training. Currently, the use of creatine is not banned for athletes competing in the Olympic Games.

Some people believe that the use of creatine supplements by athletes competing in the 2008 Beijing Olympic Games should be banned because of the health risks of excessive creatine use, such as damage to the kidneys, liver, and heart. However, others have argued against any ban on the use of creatine.

State two reasons for **not** banning the use of creatine supplements by athletes competing in the 2008 Beijing Olympic Games.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (4 marks)

28. Refer to the following diagram, which shows some of the events in the cell cycle of eukaryotic cells:



- (a) Compare the amount of DNA in a cell at  $G_2$  with the amount of DNA in a cell at  $G_1$ .

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(2 marks)

- (b) Compare the genetic composition of the daughter cells produced by mitotic cell division with the genetic composition of the parent cell.

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(2 marks)

- (c) State *one* function of the cytoskeleton during mitotic cell division.

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(2 marks)



- (d) Researchers think that cells from elderly people may not respond to growth hormones as effectively as cells from a baby.

Explain one possible reason for this, based on the structure of the cell membrane.

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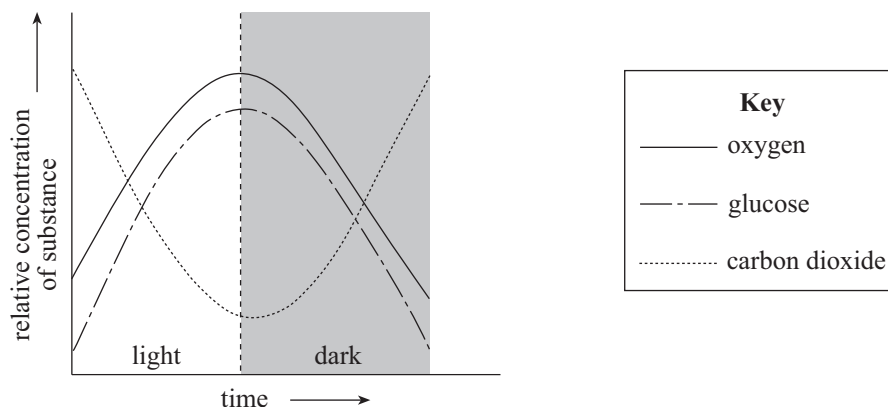
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(4 marks)

29. Refer to the following graph, which represents the results of an experiment that measured the concentration of glucose, oxygen, and carbon dioxide in a plant under light and dark conditions over a period of time:



*Note:* the three graphs are not drawn to the same scale.

- (a) Describe the **pattern** of results for the relative concentration of carbon dioxide for the period of time shown in the graph.

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(4 marks)

- (b) Using words or formulae, write a chemical equation to summarise the process occurring in the plant under dark conditions that explains the pattern of results shown in the graph above.

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(2 marks)

(c) Explain the changes in the relative concentration of glucose under light conditions.

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(4 marks)

30. Transgenic sheep have been developed that produce a human protein used to treat people suffering from the disease cystic fibrosis. This protein can be easily extracted from the sheep's milk.

- (a) Explain why the gene for the human protein must be transferred into the sheep at the zygote stage of the sheep's development rather than into the cells of an adult sheep.

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(4 marks)

- (b) (i) State one *ethical* reason *against* the production of transgenic organisms.

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(2 marks)

- (ii) State one *biological* reason *against* the production of transgenic organisms.

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(2 marks)

[illegible]





# SSABSA

SENIOR SECONDARY ASSESSMENT BOARD OF SOUTH AUSTRALIA

EXTERNAL EXAMINATION 2007

## 2007 BIOLOGY

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**QUESTION  
BOOKLET**

**2**

13 pages, 8 questions

**Monday 12 November: 9 a.m.**

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

*Write your answers to Part 2 of Section B in this question booklet.*

*Write your answers to Section C in the separate script book.*

SSABSA



## SECTION B: SHORT-ANSWER QUESTIONS

### Part 2 (Questions 31 to 36)

(60 marks)

Answer *all* questions in the spaces provided.

31. ATP supplies energy for intracellular transport.

- (a) Name the structure responsible for the transport of proteins from the ribosome to the Golgi body.

\_\_\_\_\_ (2 marks)

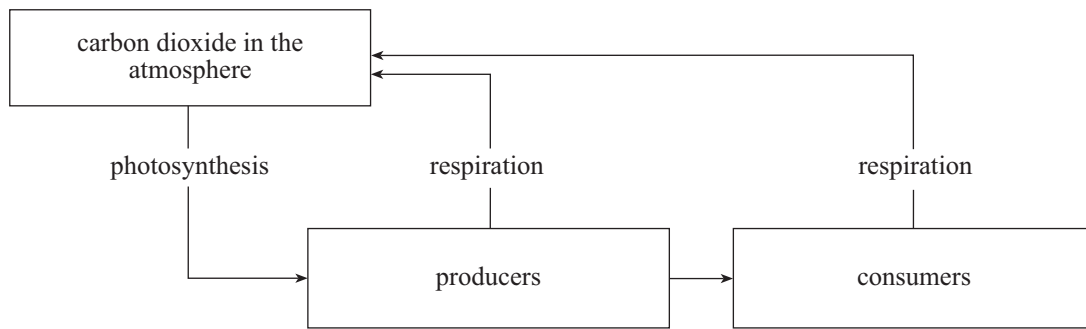
- (b) ATP synthase is an enzyme that catalyses the synthesis of ATP within the mitochondria. Identify the substrates for the reaction catalysed by ATP synthase.

\_\_\_\_\_ (2 marks)

- (c) State why large numbers of mitochondria are found near the parts of the cell membrane that are undertaking active transport.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2 marks)

32. Refer to the following diagram, which shows part of the carbon cycle:



(a) Name the significant group of organisms that is **not** shown in this diagram.

\_\_\_\_\_ (2 marks)

(b) The influence of human activity is not shown in the diagram.

Choose one human activity and explain how it affects the carbon cycle.

Activity: \_\_\_\_\_

Explanation: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (4 marks)

33. Exchange surfaces are found in the lungs.

- (a) State two features that are common to all exchange surfaces in a normal human body.

Feature 1: \_\_\_\_\_

\_\_\_\_\_

Feature 2: \_\_\_\_\_

\_\_\_\_\_ (2 marks)

- (b) Emphysema is a disease caused by smoking. It results in the walls of the alveoli breaking down.

- (i) One treatment for emphysema is to provide the sufferer with an air cylinder containing a higher concentration of oxygen than is found in normal air.

Explain how this treatment would benefit a sufferer of emphysema.

\_\_\_\_\_

\_\_\_\_\_

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\_\_\_\_\_ (4 marks)

- (ii) Explain how reducing the incidence of emphysema in the population would benefit *society*.

\_\_\_\_\_

\_\_\_\_\_

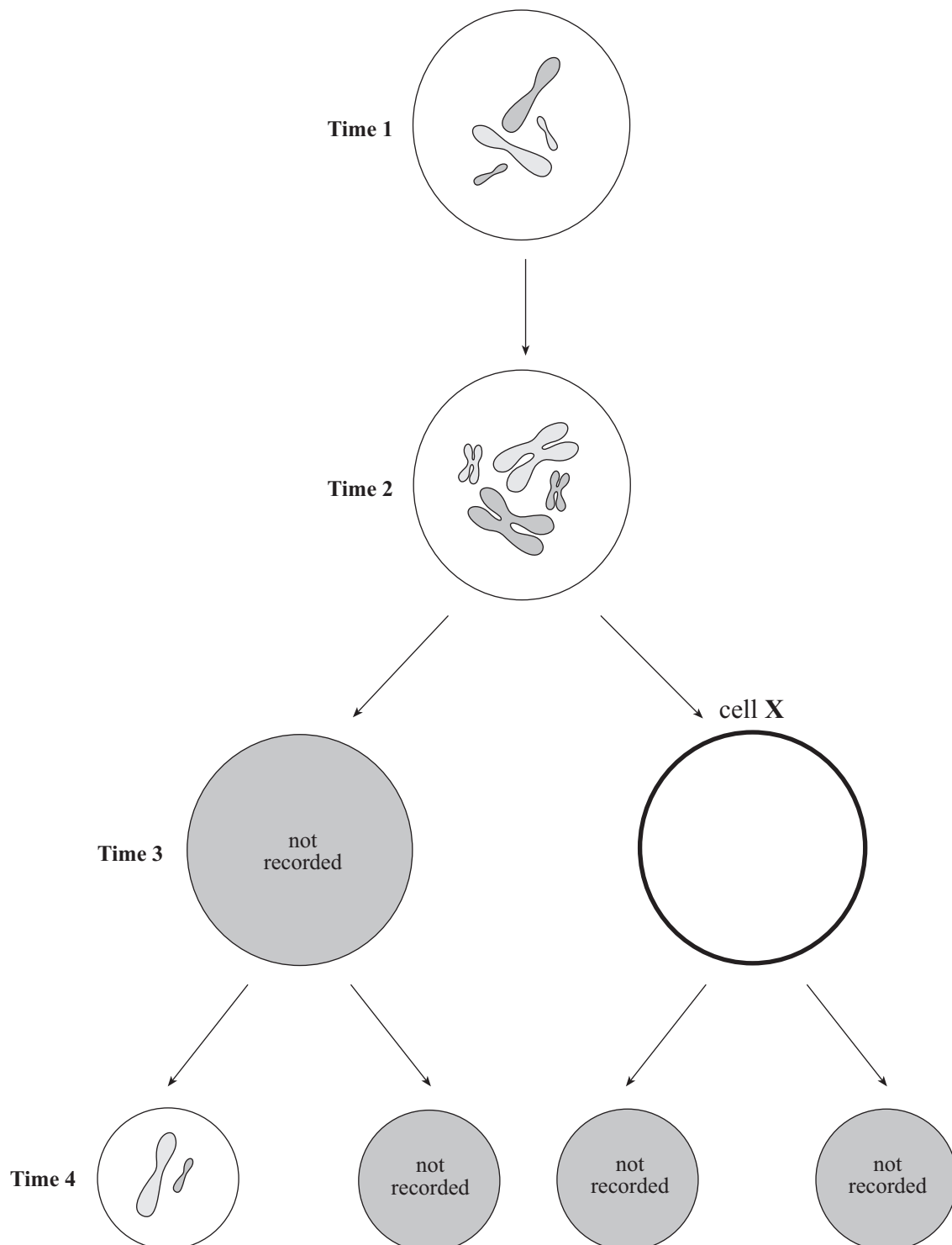
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\_\_\_\_\_ (4 marks)

34. Refer to the following diagram, which shows a cell at different times during meiosis:



- (a) State the diploid number of chromosomes in the cell at time 2.

\_\_\_\_\_ (2 marks)

- (b) On the diagram draw in the chromosomes that would be found in cell X at time 3 of this cell division. Show accurate size and shading.

(4 marks)

- (c) (i) Name one process that occurs before time 3 which results in genetic variation.

\_\_\_\_\_ (2 marks)

- (ii) Describe how the process named in your answer to part (c)(i) results in genetic variation.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2 marks)

35. Scientists working in the deserts of Western Australia have found underground pools of water called calcrete aquifers. Millions of years ago, these calcrete aquifers were part of a huge network of linked underground pools. Over time the water level decreased and now each calcrete aquifer is completely isolated from the others.

Each calcrete aquifer contains its own group of organisms including unique species of beetle, worm, and snail.

- (a) State the biological term for interacting populations in an ecosystem.

\_\_\_\_\_ (2 marks)

- (b) Over 100 new species of beetle have been discovered in different calcrete aquifers.

State why a decrease in the water level was critical for the evolution of a large number of new species from one ancestral species.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2 marks)

- (c) Explain the process that resulted in each calcrete aquifer now having different species of beetle from the others.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (4 marks)

- (d) Under Western Australian law it is illegal to cause the extinction of a species. In 2001 a major mining company was forced to suspend its operations at one mining site after the discovery of a rare shrimp-like species in a calcrete aquifer.

Explain why the most effective way to prevent the extinction of a species is to preserve its habitat.

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(4 marks)

36. Two species of butterfly, *Lycaena salustius* and *Lycaena feredayi*, were studied in an area that included tussock grasslands surrounding a temperate rainforest. The adult forms of the two butterfly species are very similar in size and appearance.

*L. salustius* was found living mostly in tussock grasslands, whereas *L. feredayi* was found mostly in the rainforest.

After maturing, the adult butterflies survive for about two weeks, during which time they breed. Breeding occurs when the number of adults of the species reaches its maximum.

In one study, adult butterflies were trapped during a six-month period. The number of adults trapped in each month of the study is shown in the following table:

		Month of study					
		1	2	3	4	5	6
<i>L. salustius</i> (no. of adults trapped)	Trap 1	0	0	4	13	19	1
	Trap 2	0	3	29	19	5	6
	Trap 3	0	0	12	43	6	2
	<b>Average</b>	<b>0</b>	<b>1</b>	<b>15</b>	<b>25</b>	<b>10</b>	<b>3</b>
<i>L. feredayi</i> (no. of adults trapped)	Trap 4	10	32	9	3	1	0
	Trap 5	9	31	12	3	2	0
	Trap 6	11	27	12	6	0	0
	<b>Average</b>	<b>10</b>	<b>30</b>	<b>11</b>	<b>4</b>	<b>1</b>	<b>0</b>

- (a) State one biotic factor and one abiotic factor that could affect the distribution of the two butterfly species.

Biotic factor: \_\_\_\_\_

Abiotic factor: \_\_\_\_\_ (4 marks)

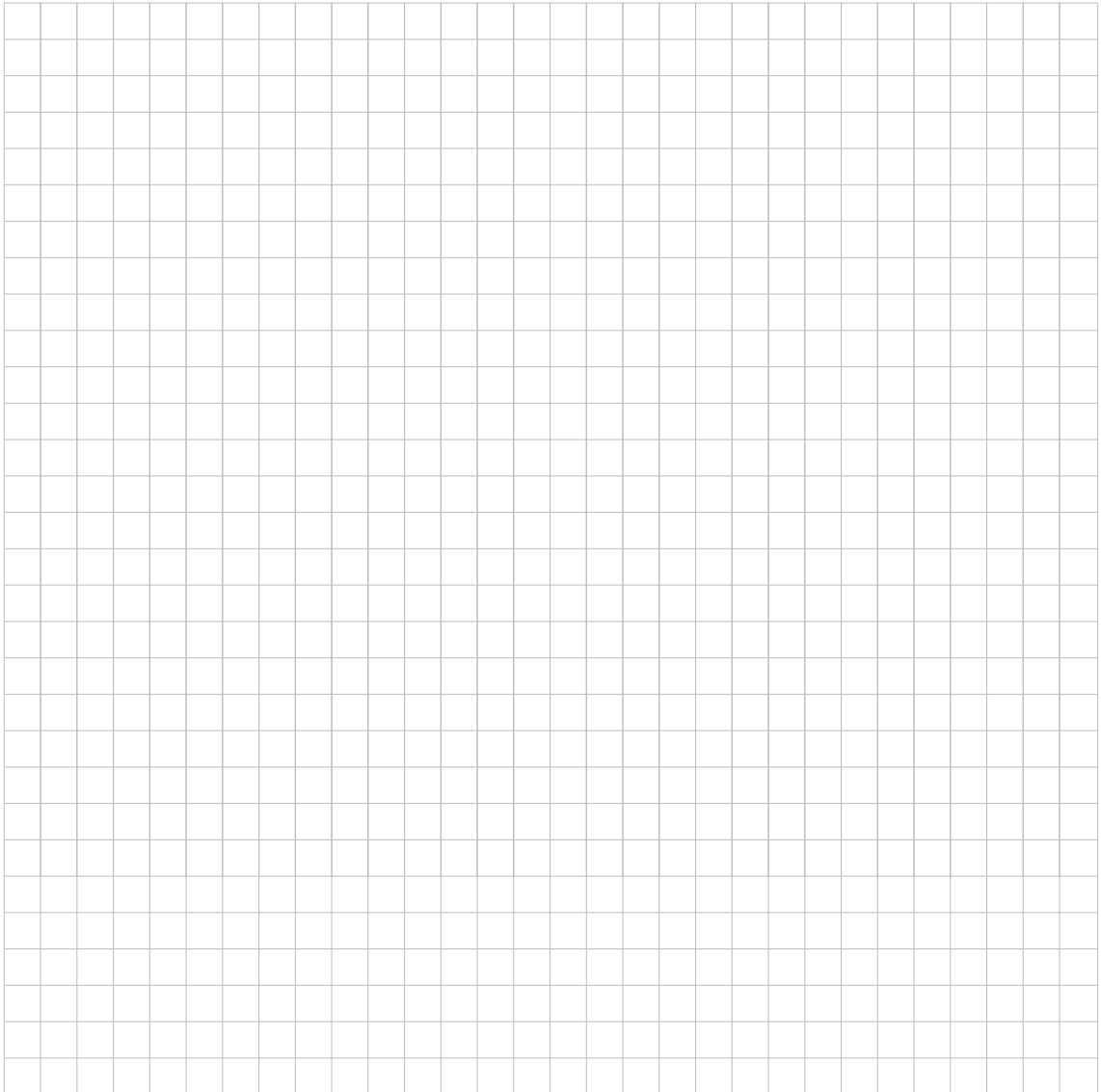
- (b) State one way of determining whether *systematic error* is present in these data.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (2 marks)



- (c) Graph the **average** data for both *L. salustius* and *L. feredayi* on the grid provided using the same axes. **Clearly label both lines.**

**Average number of adult butterflies trapped**



(6 marks)

- (d) Based on the information given, state **two** biological mechanisms that maintain the reproductive isolation between the two species of butterfly.

Mechanism 1: \_\_\_\_\_

\_\_\_\_\_

Mechanism 2: \_\_\_\_\_

\_\_\_\_\_ (4 marks)

[illegible]

## SECTION C: EXTENDED-RESPONSE QUESTIONS (Questions 37 and 38)

(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.

37. The first step in the production of human growth hormone involves inserting the gene for human growth hormone into the DNA of a bacterial cell. The bacterial cell is then cultured to produce human growth hormone.

Describe:

- **one** process that can be used to identify the gene for human growth hormone and **one** process that can be used to insert the gene into the DNA of a bacterial cell;
- the process of protein synthesis used to produce the human growth hormone in cultured bacterial cells.

(15 marks)

38. There is strong evidence for the common ancestry of all living things. Biologists believe that the evolution of eukaryotic cells from prokaryotic cells probably involved endosymbiotic events.

- Explain how the study of DNA provides strong evidence for the common ancestry of all living things.
- Describe differences in the internal structure of prokaryotic and eukaryotic cells.
- Describe the process of endosymbiosis and provide **one** piece of evidence of the evolution of eukaryotic cells by endosymbiosis.

(15 marks)