



Government
of South Australia

SACE
Board of SA

External Examination 2013

2013 BIOLOGY

Monday 11 November: 9 a.m.

Pages: 14
Questions: 25

Multiple-choice Question Booklet

*Write your answers to Section A: Multiple-choice Questions
on the separate blue multiple-choice answer sheet.*

MULTIPLE-CHOICE QUESTION BOOKLET

ND OF SA SACE
ARD OF SA SACE
OARD OF SA SACE
BOARD OF SA SACE

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 blue 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 combinations of a type of macromolecule, its function, and a component found in the type of macromolecule is **incorrect**?

	Type of macromolecule	Function	Component found in the type of macromolecule
J.	nucleic acid	stores information	nucleotide
K.	lipid	controls cellular metabolism	fatty acid
L.	polysaccharide	forms plant cell walls	monosaccharide
M.	protein	regulates cell reactions	amino acid

2. An adipose cell is an animal cell. Most of its volume is taken up by a vacuole containing fat.

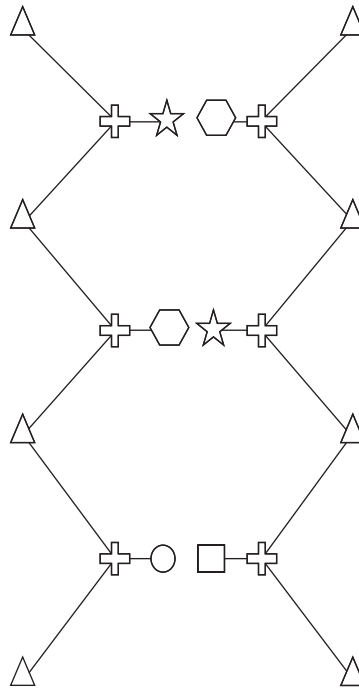
Adipose cells are

- J. inefficient at using food sources.
 - K. used to store energy reserves.
 - L. inactive.
 - M. unable to reproduce.
3. Angiotensin II is a protein produced by healthy human beings. It binds to receptors in blood vessels and causes the blood vessels to constrict, resulting in a rise in blood pressure. Irbesartan is a drug that is used to reduce high blood pressure by blocking the angiotensin II receptors in the walls of the blood vessels.

The information above suggests that the irbesartan molecules

- J. have a shape very similar to that of the angiotensin II receptors.
- K. cause the angiotensin II receptors to denature.
- L. have a shape very similar to that of the angiotensin II molecules.
- M. have a shape complementary to that of the angiotensin II molecules.

4. Refer to the following diagram, which shows a segment of DNA:



Which one of the following combinations identifies the symbols shown in the diagram above?

	+	Δ	⬡	☆	○	◻
J.	sugar	phosphate	thymine (T)	adenine (A)	cytosine (C)	guanine (G)
K.	phosphate	sugar	guanine (G)	cytosine (C)	adenine (A)	thymine (T)
L.	sugar	phosphate	cytosine (C)	thymine (T)	guanine (G)	adenine (A)
M.	phosphate	sugar	adenine (A)	guanine (G)	thymine (T)	cytosine (C)

5. When an apple is cut, an enzyme called polyphenol oxidase (PPO) causes compounds in the apple to react rapidly with oxygen that comes into contact with the exposed tissue. This begins the process that makes the surface of the apple turn brown. If cut pieces of apple are plunged into boiling water for 4 to 5 minutes and then cooled, the browning process is slowed. Browning is not slowed if the cut pieces of apple are plunged into cold water.

Plunging cut pieces of apple into boiling water and then cooling them slows the browning process because

- J. the PPO enzyme is washed from the surface of the apple.
- K. the substrate is denatured, preventing the PPO enzyme from reacting.
- L. boiling water enters the apple cells by osmosis, causing them to burst.
- M. the PPO enzyme permanently changes shape.

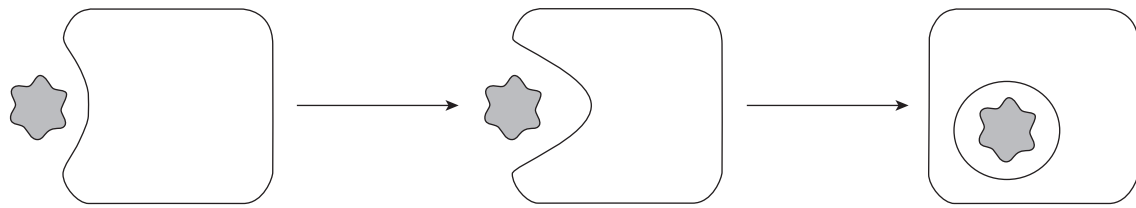
6. Refer to the following table, which shows, for four species (chimpanzee, dog, fruit fly, and roundworm), the percentage similarity to the DNA sequence in the human GAPDH gene and to the amino acid sequence in the human GAPDH protein:

Species	Percentage similarity to DNA sequence in human GAPDH gene	Percentage similarity to amino acid sequence in human GAPDH protein
chimpanzee	99.6	100
dog	91.3	95.2
fruit fly	72.4	76.7
roundworm	68.2	74.3

Which one of the following statements is **not** supported by the data in the table above?

- J. The human GAPDH gene and the chimpanzee GAPDH gene code for exactly the same protein.
- K. There is a greater difference in the amino acid sequence between the roundworm and the fruit fly GAPDH protein than between the human and the chimpanzee GAPDH protein.
- L. More than 30% of the DNA sequence in the roundworm GAPDH gene is different from that in the human GAPDH gene.
- M. The percentage similarity in the DNA sequence of the dog and the human GAPDH gene is greater than the percentage similarity in the amino acid sequence of the dog and the human GAPDH protein.
7. A cell that has a high proportion of ribosomes attached to the endoplasmic reticulum is most likely specialised to produce
- J. glucose for energy.
- K. phospholipids for cell growth.
- L. starch for storage.
- M. proteins for export.
8. Individual cells are usually very small because
- J. there is a greater concentration of enzymes in smaller cells than in larger cells.
- K. materials move more efficiently in and out of smaller cells than larger cells.
- L. the cell membrane encloses the cell and prevents it from increasing in size.
- M. by osmosis, water enters smaller cells more slowly than it enters larger cells.

9. Refer to the following diagram, which shows a type of transport that occurs in some cells:



[This diagram is not drawn to scale.]

Which type of transport is shown in the diagram above?

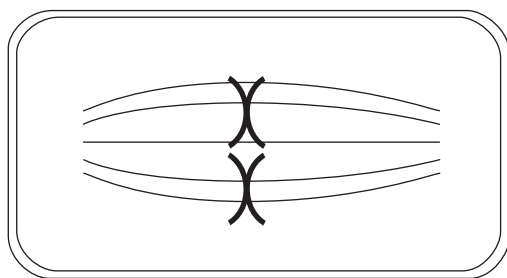
- J. Endocytosis.
- K. Exocytosis.
- L. Osmosis.
- M. Active transport.

10. A colony of bacterial cells was grown in the laboratory in a medium containing radioactive nucleotides.

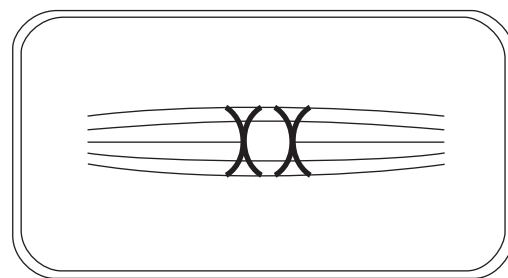
After a number of generations these radioactive nucleotides would most likely be found in

- J. the nucleus.
- K. the cytoplasm.
- L. protein.
- M. the cell wall.

11. Refer to the following diagrams, which show how the arrangement of the **same pair of homologous chromosomes** would look at two different stages of cell division:



Stage 1

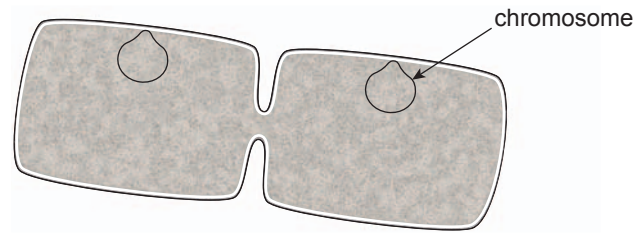


Stage 2

Which one of the following alternatives is unique to mitosis?

- J. Stage 1.
- K. Stage 2.
- L. Both Stage 1 and Stage 2.
- M. Neither Stage 1 nor Stage 2.

12. Refer to the following diagram, which shows a cell undergoing division:



Which one of the following combinations identifies the type of cell and the type of division shown in the diagram above?

	Type of cell	Type of division
J.	prokaryotic	mitosis
K.	prokaryotic	binary fission
L.	eukaryotic	meiosis
M.	eukaryotic	mitosis

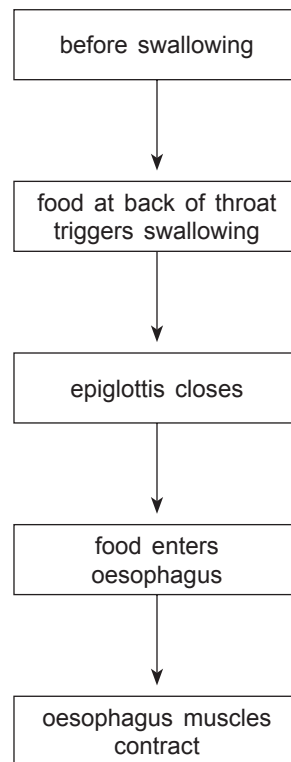
13. Evolution

- J. enables all offspring with suitable characteristics to survive and reproduce.
- K. results in a genetic change in an individual of a species that enables it to survive and reproduce after environmental change.
- L. involves the accumulation of favourable characteristics that increases the chance of survival and reproduction.
- M. occurs only in populations of different species that are geographically isolated.

14. The specialised cells that comprise a kidney of a healthy human being

- J. contain different tissues.
- K. contain identical cellular structures.
- L. all have the same function.
- M. all have the same number of chromosomes.

15. Refer to the following flow diagram of the swallowing reflex:



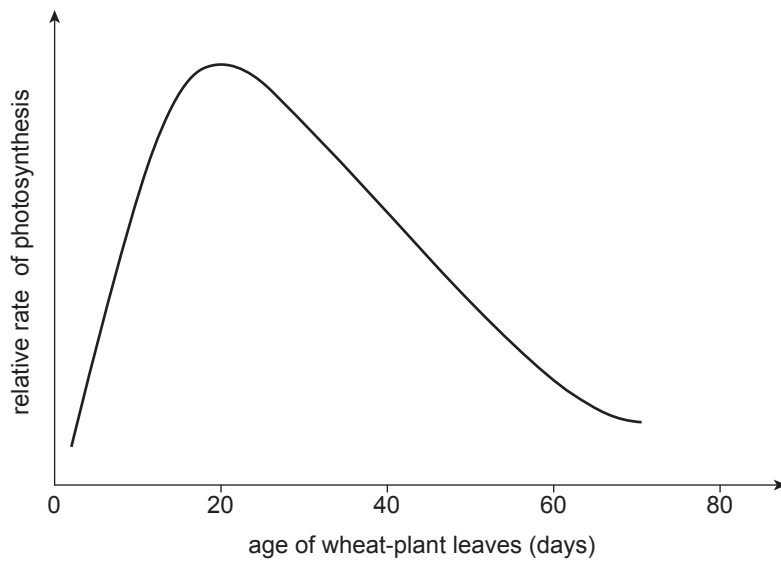
Which one of the following statements best describes one stage in the swallowing reflex?

- J. Food entering the oesophagus is the stimulus.
- K. The reflex requires only a motor neuron for the response to occur.
- L. The muscles in the oesophagus are effectors.
- M. A sensory neuron transmits a nerve impulse directly to the epiglottis.

16. Which one of the following combinations matches a type of organism, its type of nutrition, and one of its products of fermentation?

	Type of organism	Type of nutrition	Product of fermentation
J.	yeast	heterotrophic	ethanol
K.	animal	heterotrophic	carbon dioxide
L.	decomposer	autotrophic	water
M.	plant	autotrophic	oxygen

17. Refer to the following graph, which shows the effect that the age of wheat-plant leaves has on their rate of photosynthesis:

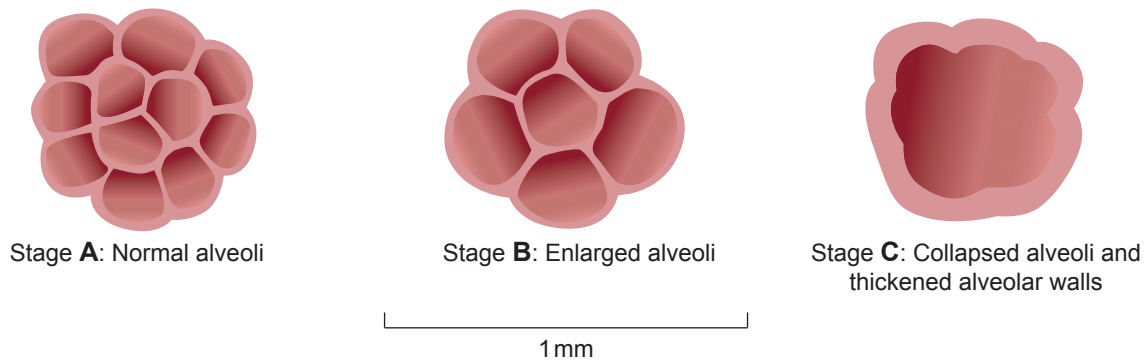


Research has shown that, as wheat-plant leaves increase in age past 20 days, the amount of nitrogen available to the wheat plant decreases. Nitrogen is found in many molecules in plant cells, including nucleic acids, proteins, and chlorophyll.

The best explanation for the change in the rate of photosynthesis in wheat-plant leaves more than 20 days of age is that nitrogen is required for

- J. the active transport of water into the roots of the plant.
- K. the production of enzymes involved in photosynthesis.
- L. a gene to be converted into a protein that is needed for photosynthesis.
- M. the removal of oxygen produced by photosynthesis.

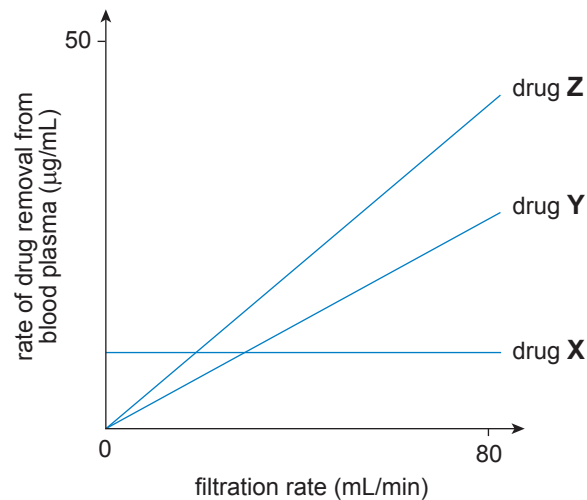
18. Refer to the following diagrams, which show stages **A**, **B**, and **C** in the progression of an injury to the lungs of a patient:



Which one of the following statements is consistent with the diagrams of stages **A**, **B**, and **C** above?

- J. The efficiency of exchange of gases across the walls of the alveoli in stage **A** will be greater than in stage **C** because in stage **A** the alveoli have a smaller surface area.
- K. The efficiency of exchange of gases in stage **B** will be greater than in stage **A** because the walls of the alveoli in stage **B** have decreased in surface area.
- L. The efficiency of exchange of gases in stage **C** will be lower than in stage **B** because the gases must travel an increased distance across the walls of the alveoli in stage **C**.
- M. The efficiency of exchange of gases in stages **B** and **C** will be greater than in stage **A** because in stages **B** and **C** the alveoli have a larger volume.

19. Refer to the following graphs, which show the relationship between the rate of drug removal from the blood plasma ($\mu\text{g/mL}$) and the filtration rate (mL/min) for three different drugs (**X**, **Y**, and **Z**) in a person with **healthy** kidneys:



It is important that drugs are successfully removed from the body of patients with damaged glomeruli (renal failure). The route of drug removal is critical to the patients' survival. Some drugs are removed from the blood only by filtration, whereas other drugs are removed from the blood directly into the nephron tubule.

For patients **with damaged glomeruli**

- J. all three drugs (**X**, **Y**, and **Z**) are removed from the blood primarily by filtration.
- K. the most suitable drugs are those that are more rapidly removed from the blood as the filtration rate increases.
- L. drug **X** is the only drug that is effectively removed from the blood.
- M. drug **Z** is removed from the blood more efficiently than drugs **X** and **Y**.

20. A gene pool is the sum of all the genes of

- J. an individual.
- K. a species.
- L. individuals in the same habitat.
- M. a population.

21. *The biomasses of all organisms of species A, B, C, and D in a grassland community were measured. The results are shown in the following table:*

Species	A	B	C	D
Biomass (kg dry weight)	200	15 000	1800	25

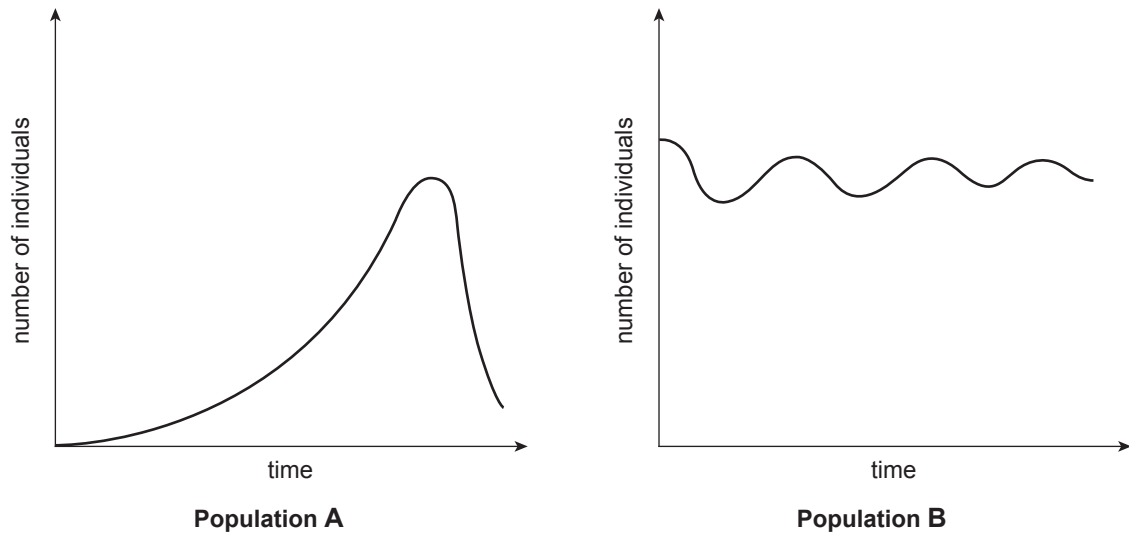
Which one of the following alternatives represents a food chain from this community?

- J. **A** → **B** → **C** → **D**.
- K. **D** → **C** → **B** → **A**.
- L. **D** → **A** → **C** → **B**.
- M. **B** → **C** → **A** → **D**.

22. Succession involves a change in environmental conditions that results

- J. from geographical isolation of populations of the same species.
- K. in the increased growth rate of all populations.
- L. in the evolution of new species.
- M. from the activities of organisms, and suits populations of other species.

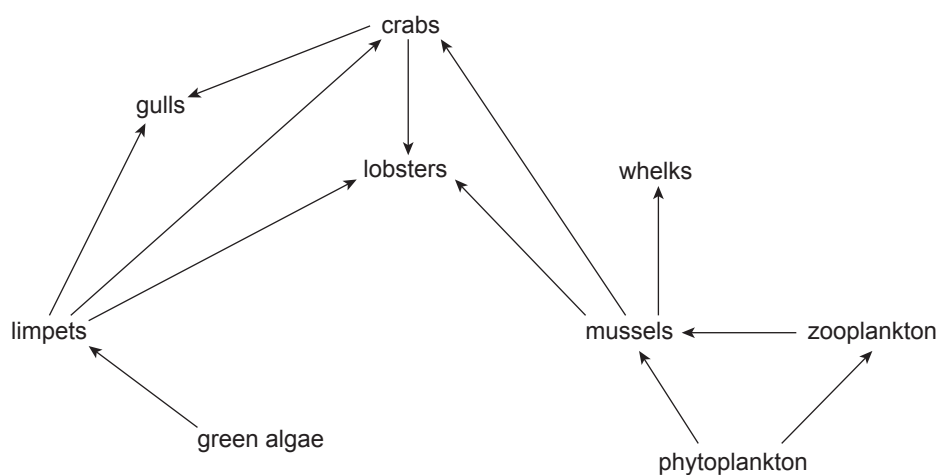
23. Refer to the following graphs, which show the change in the number of individuals in two populations, **A** and **B**, over the same time:



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

- J. Population **A** is *r*-selected and more common in disturbed communities.
- K. Population **B** is *r*-selected and more common in early succession.
- L. Population **B** is *K*-selected and more common in disturbed communities.
- M. Population **A** is *K*-selected and more common in early succession.

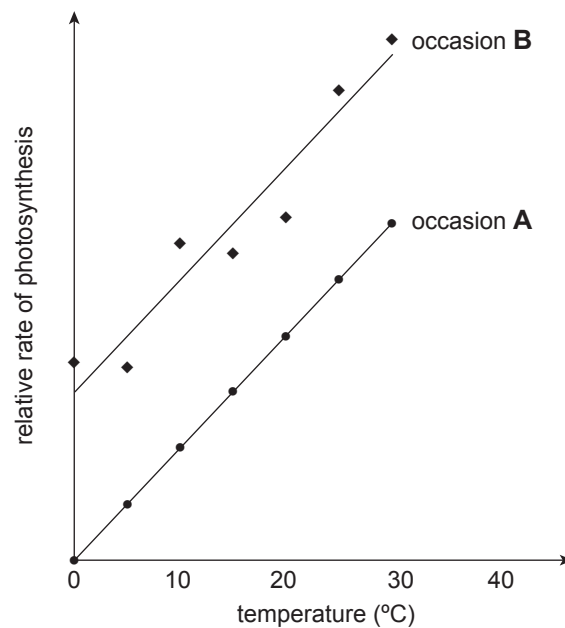
24. Refer to the following diagram, which shows a food web in a marine ecosystem. The arrows represent the flow of energy.



Which one of the following statements is **incorrect**?

- J. Crabs belong only to the third trophic level.
- K. Lobsters belong to both the third and fourth trophic levels.
- L. Limpets and zooplankton belong to the same trophic level.
- M. Whelks and gulls both belong to more than one trophic level.

25. Refer to the following two graphs, which show the measurements taken on two separate occasions (**A** and **B**) by a student when investigating the effect of temperature on the rate of photosynthesis. The same experiment was conducted on each occasion, but different measuring equipment was used.



The graphs indicate that

- J. precision was lower on occasion **A** than on occasion **B**.
- K. there were random errors on occasion **B** but not on occasion **A**.
- L. there was a systematic error.
- M. an instrument with lower resolution was used on occasion **A**.



2013 BIOLOGY

FOR OFFICE USE ONLY

SUPERVISOR CHECK

RE-MARKED

ATTACH SACE REGISTRATION NUMBER LABEL TO THIS BOX

QUESTION BOOKLET
1
10 pages, 6 questions

Monday 11 November: 9 a.m.

Time: 3 hours

Section B: Short-answer Questions

Part 1

Examination material: Question Booklet 1 (10 pages)
 Question Booklet 2 (10 pages)
 Question Booklet 3 (8 pages)
 Multiple-choice Question Booklet (14 pages)
 one blue multiple-choice answer sheet
 one SACE registration number label

Approved dictionaries and calculators may be used.

Instructions to Students

- You will have 10 minutes to read the paper. You must not write in your question booklets, or on your blue multiple-choice answer sheet, or use a calculator during this reading time but you may make notes on the scribbling paper provided.
- This paper is in three sections: Section A is in the Multiple-choice Question Booklet; Part 1 of Section B is in Question Booklet 1; Part 2 of Section B is in Question Booklet 2; and Section C is in Question Booklet 3.
 - Section A: Multiple-choice Questions** (Questions 1 to 25)
Answer Section A on the separate blue multiple-choice answer sheet, using black or blue pen. Answer **all** questions in Section A.
 - Section B: Short-answer Questions** (Questions 26 to 35)
Answer **all** questions in Part 1 of Section B (Questions 26 to 31) in the spaces provided in Question Booklet 1. Write on page 10 of Question Booklet 1 if you need more space.
Answer **all** questions in Part 2 of Section B (Questions 32 to 35) in the spaces provided in Question Booklet 2. Write on page 10 of Question Booklet 2 if you need more space.
 - Section C: Extended-response Questions** (Questions 36 and 37)
Answer **both** questions in Section C in Question Booklet 3. Write on page 8 of Question Booklet 3 if you need more space.
- 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.
- 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	180 minutes
- 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 blue multiple-choice answer sheet and on the front covers of Question Booklets 2 and 3.
- At the end of the examination, place Question Booklets 2 and 3, and your blue 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 results for the examination cancelled or amended
- be liable to such further penalty, whether by exclusion from future examinations or otherwise, as the SACE Board of South Australia determines.

SECTION B: SHORT-ANSWER QUESTIONS (Questions 26 to 35)

(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 31)

(60 marks)

26. Refer to the following table, which shows the sequence of bases in a short section of the SWS opsin gene in two species of mammal. The SWS opsin gene codes for the SWS opsin protein, which allows an organism to see certain wavelengths of light.

cow (<i>Bos taurus</i>)	TTT	CTT	CTG	TTC	AAG	AAC	ATC	TCC	TTG
bottlenosed dolphin (<i>Tursiops truncatus</i>)	TTT	*TT	CTG	TTC	AAG	AAC	AT*	***	TTG

* = deleted base

Pseudogenes, also known as 'fossil genes', are genes that have changed and are no longer functional. The SWS opsin gene is a functional gene in the cow and a pseudogene in the bottlenosed dolphin.

- (a) State the term that describes a change to the sequence of bases in a gene.

_____ (2 marks)

- (b) State the number of amino acids that are coded for by the sequence of bases shown for the:

(i) cow. _____ (2 marks)

(ii) bottlenosed dolphin. _____ (2 marks)

- (c) Explain how information such as that shown in the table above can be used to help determine how closely related the cow and the bottlenosed dolphin are to each other.

_____ (4 marks)

27. In February 2013 a skeleton was identified 'beyond reasonable doubt' as that of King Richard III of England, who died in 1485. The evidence used to identify the skeleton included mitochondrial DNA (mtDNA), a small, circular DNA molecule found in each of a cell's mitochondria. It is inherited only from the mother. The mtDNA in the skeleton was compared with that of living people known to share a common ancestor with King Richard III and was found to have significant similarities.

Normally, samples of DNA from the nucleus of the cell (nuclear DNA) are collected. These samples then undergo the polymerase chain reaction (PCR) before further analysis.

Explain why examining mtDNA rather than nuclear DNA from a sample of tissue may reduce the need for PCR.

(4 marks)

28. B-cell lymphoma is a cancer of white blood cells that usually affects the lymphatic system.

(a) State one factor that is potentially carcinogenic.

_____ (2 marks)

The cancerous B-cells are dependent on the uptake of high-density lipoproteins (HDLs) to obtain their lipid content. HDLs contain a type of lipid called 'cholesterol'. The HDL molecules attach to the surface of the cancerous B-cells and the cholesterol diffuses into the cells.

(b) Draw a labelled diagram that shows the structure of the cell membrane according to the fluid mosaic model.

(4 marks)

(c) State two features of the process by which cholesterol diffuses into the cancerous B-cells after the HDL molecules have attached to the surface of the cells.

Feature 1: _____

Feature 2: _____

_____ (4 marks)

Patients with advanced forms of B-cell lymphoma often have depleted HDL levels.

- (d) State one reason why the depletion of a lipid such as cholesterol could result in cell death.

(2 marks)

Scientists have designed a nanoparticle that can be attached to a chemotherapy drug called 'paclitaxel'. This nanoparticle then accumulates in the cancerous cells, but not in other parts of the body.

Paclitaxel works by preventing the normal assembly of the spindle fibres at the beginning of cell division.

- (e) Describe how paclitaxel is effective in the treatment of cancer.

(4 marks)

29. The build-up of plaque in the arteries may cause heart disease. Scientists have genetically modified tomatoes by adding a gene that can produce a peptide known as 6F. Mice that were fed genetically modified tomatoes containing 6F had reduced build-up of plaque in their arteries.

(a) Describe how a selected gene can be removed from a chosen type of cell before it is transferred into a tomato cell.

(4 marks)

(b) Explain how bacteria can be used to transfer a selected gene between species.

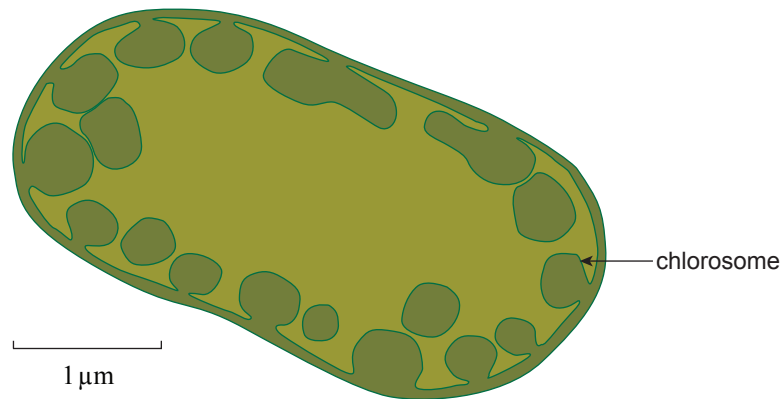
(4 marks)

(c) Prescription drugs are commonly used to reduce plaque in arteries.

Explain one advantage to **society** of using genetically modified foods such as tomatoes, instead of prescription drugs.

(4 marks)

30. Refer to the following diagram, which shows a green sulfur bacterium. Green sulfur bacteria are anaerobic photoautotrophic bacteria. Although they have no chloroplasts, they are able to photosynthesise by using infoldings of the cell membrane called 'chlorosomes'.



- (a) State how a highly folded structure such as a chlorosome can maximise the use of low light levels for photosynthesis.

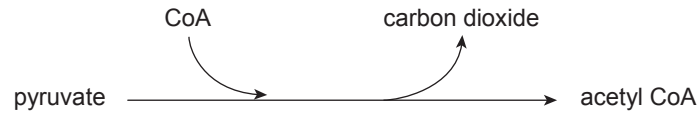
(2 marks)

- (b) Chloroplasts are specialised photosynthetic organelles found in some eukaryotic cells. Describe the process that is thought to have resulted in the presence of chloroplasts in photosynthetic eukaryotic cells. You may use a labelled diagram in your answer.

(4 marks)

31. Aerobic respiration is a metabolic pathway that occurs in many small steps. One of these steps is called the 'link reaction'.

Refer to the following simplified word equation, which shows the link reaction in which an enzyme called CoA (coenzyme A) binds to pyruvate, forming a complex called acetyl CoA and releasing carbon dioxide:



Acetyl CoA is an intermediate compound of aerobic respiration. It feeds into another step in the metabolic pathway, releasing CoA for reuse.

(a) Explain why reactions such as aerobic respiration occur in many small steps.

(4 marks)

(b) Explain how enzymes such as CoA enable reactions to occur.

(4 marks)

(c) Cellular respiration results in the production of ATP, which is an immediate source of energy.

Explain how the energy stored in ATP is released for use in cells.

(4 marks)



Government of South Australia

SACE Board of SA

External Examination 2013

2013 BIOLOGY

FOR OFFICE USE ONLY

SUPERVISOR CHECK

RE-MARKED

SACE REGISTRATION NUMBER									
SEQ	FIGURES					CHECK LETTER	BIN		
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>		
BIOLOGY									

QUESTION BOOKLET
2
10 pages, 4 questions

Monday 11 November: 9 a.m.

Section B: Short-answer Questions Part 2

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

SECTION B: SHORT-ANSWER QUESTIONS

PART 2 (Questions 32 to 35)

(60 marks)

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

32. The komodo dragon (*Varanus komodoensis*), a large species of reptile that lives on a number of Indonesian islands, is shown below. It lives for approximately 30 years and is found in stable communities.

The komodo dragon produces a large number of eggs; when the hatchlings are born the mother provides no parental care.



Source: © Photomaru/Dreamstime.com

- (a) With reference to the information above, state where the reproductive strategy of the komodo dragon would be on the r - K continuum. Give reasons for your answer.

(4 marks)

- (b) Parthenogenesis is a kind of reproduction in which embryos form without the fertilisation of an egg cell. The komodo dragon is able to reproduce by parthenogenesis as well as by normal sexual reproduction. Parthenogenesis produces only male komodo dragon offspring.

State one disadvantage to a population that produces offspring only by asexual reproduction.

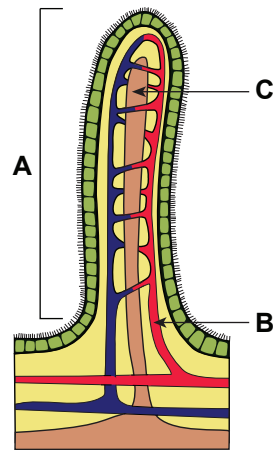
(2 marks)

- (c) The komodo dragon is classified as a 'vulnerable' species. One strategy that has been suggested for protecting the species from extinction is to introduce it to other islands that do not have komodo dragon populations.

Explain how the introduction of a single female komodo dragon to a new island could give rise to more than one generation of komodo dragons.

(4 marks)

33. Refer to the following diagram, which shows a healthy exchange surface in the human body:



(a) State the name of the structure labelled **A** in the diagram above.

_____ (2 marks)

(b) State the name of the structure labelled **B**.

_____ (2 marks)

(c) State the function of the structure labelled **C**.

_____ (2 marks)

Coeliac disease is an autoimmune disease of the small intestine; it has also been linked to damage in other parts of the human body, including the nervous system. Gluten — a protein found in wheat and other foods — is thought to be the cause of coeliac disease. The brain detects short chains of amino acids that result from the breakdown of gluten. Nerve impulses from the brain then trigger rapid contractions of gut muscle.

(d) Some people have a genetic predisposition to coeliac disease.

Discuss how the well-being of these people can be affected by the choices they make about nutrition.

_____ (4 marks)

- (e) The process by which wheat cells produce the protein gluten involves steps that occur in the nucleus and the cytoplasm.

Describe the steps in this process that occur in the cytoplasm.

(4 marks)

34.

Question 34 cannot be reproduced here for copyright reasons.

Question 34 cannot be reproduced here for copyright reasons.

Question 34 cannot be reproduced here for copyright reasons.

35. Some ancient plants, including the lotus flower (*Nelumbo nucifera*) and the arum lily (*Zantedeschia aethiopica*), are able to undergo thermoregulation and increase their temperature by as much as 40°C above the temperature of the surrounding air.

It has been hypothesised that the metabolic rate of these flowers increases in response to a decrease in the temperature of their surroundings.

- (a) State why an increase in metabolic rate could result in an increase in temperature in the lotus flower and the arum lily.

_____ (2 marks)

- (b) For the metabolic rate to be increased, oxygen is required.

Write the chemical equation for a process in a cell that requires oxygen and releases energy.

_____ (2 marks)

Body temperature in human beings must be regulated.

- (c) Explain the role of **hormones** in the coordination and control of body temperature that rises above the optimum level in human beings.

_____ (4 marks)

- (d) State two differences between nervous communication and hormonal communication in human beings.

Difference 1: _____

Difference 2: _____

_____ (4 marks)



Government
of South Australia

SACE
Board of SA

External Examination 2013

2013 BIOLOGY

SACE REGISTRATION NUMBER						
SEQ	FIGURES				CHECK LETTER	BIN
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
BIOLOGY						

QUESTION BOOKLET

3

8 pages, 2 questions

Monday 11 November: 9 a.m.

Section C: Extended-response Questions

Write your answers to Section C in this question booklet.

SACE
BOARD
OF SOUTH
AUSTRALIA

SECTION C: EXTENDED-RESPONSE QUESTIONS (Questions 36 and 37)

(30 marks)

Answer **both** questions in this section.

Write your answers in this question booklet:

- Question 36, on pages 4 and 5, is worth 15 marks.
- Question 37, on pages 6 and 7, is worth 15 marks.

*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.*

36. In 1945 Howard Florey, an Australian scientist, shared the Nobel Prize in physiology or medicine for his role in the development of penicillin, the first antibiotic. In a series of experiments, Florey demonstrated that penicillin was able to kill bacterial cells. The use of antibiotics such as penicillin to combat bacterial infection is now widespread.

In May 1940 Florey and his team carried out a classic experiment in which eight mice were injected with a lethal dose of streptococcus, a type of bacterium.

Four of the mice (mice 1 to 4) received no further treatment. One hour after injection of the bacteria two of the remaining mice (mice 5 and 6) were each given a single 10 milligram injection of penicillin, and the other two mice (mice 7 and 8) were given the first of five 5 milligram injections of penicillin.

The results of this experiment are summarised in the table below:

Hours after streptococcus injection	TREATMENT							
	No further treatment				Penicillin injected (mg)			
	Mouse 1	Mouse 2	Mouse 3	Mouse 4	Mouse 5	Mouse 6	Mouse 7	Mouse 8
1					10	10	5	5
4							5	5
8							5	5
10	died							
12		died	died				5	5
14				died				
16							5	5
more than 16					survived 4 days	survived 6 days	survived 13 days	survived 6 weeks

By referring to this experiment:

- choose two factors that would need to be kept constant, and explain why this is important
- explain why some of the mice were given a lethal dose of streptococcus but no further treatment
- state why reliability is important, and describe one improvement to the design of this experiment that could have made it more reliable.

(15 marks)

37. Deflan is a contraceptive cream that is being tested on macaque monkeys. It contains benzamidine, a chemical that acts as an inhibitor of acrosin, an enzyme on the surface of the cell membrane of sperm cells. Sperm cells with ineffective acrosin are unable to bind to and fertilise egg cells.

- Describe the type of cell division that produces egg cells and sperm cells.
- Explain how benzamidine could inhibit acrosin, and hence prevent restoration of the diploid number of chromosomes.

(15 marks)
