

Final Examination 2023

## NSW Year 11 Biology

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### General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using black pen
- Draw diagrams using pencil
- Calculators approved by NESA may be used

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### Total Marks: 75

#### Section I – 15 marks (pages 2–8)

- Attempt Questions 1–15
- Allow about 30 minutes for this section

#### Section II – 60 marks (pages 10–22)

- Attempt Questions 16–26
- Allow about 1 hour and 30 minutes for this section

**SECTION I**

**15 marks**

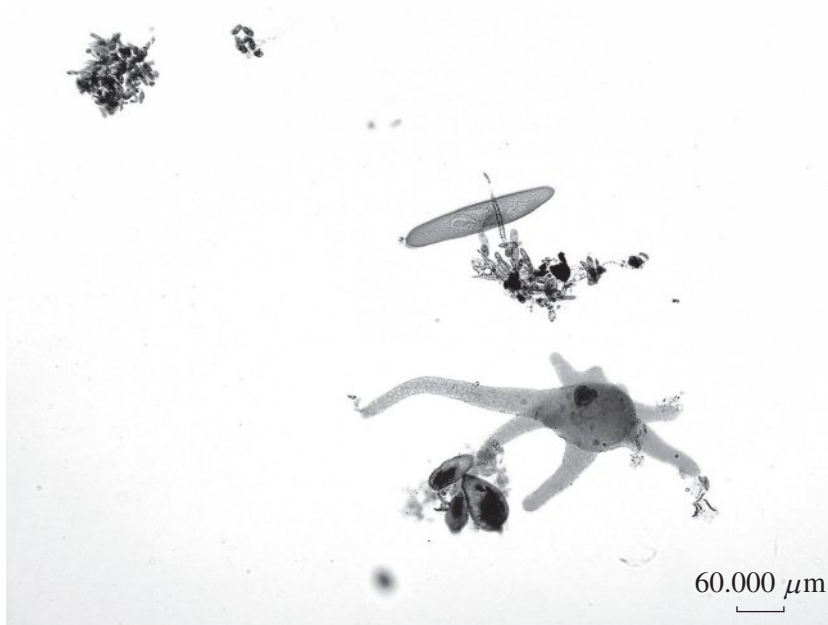
**Attempt Questions 1–15**

**Allow about 30 minutes for this section**

Use the multiple-choice answer sheet for Questions 1–15.

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- 1 A Biology student viewed a group of cells with a school microscope that was set to low power. The student took the photograph shown.



Source: Reproduced with permission from Cheesewright, Rhiannon (2022).

The student identifies the cells as

- A. animal cells because each cell has a nucleus, a cell wall and an odd shape.
- B. mixed protozoa because each cell is a unicellular organism such as amoeba and paramecium.
- C. plant cells because each cell has a chloroplast, a stomate and a regular shape.
- D. bacterial cells because each cell is very small and does not have a visible nucleus.

2 Which row of the table identifies the features of light and electron microscopes?

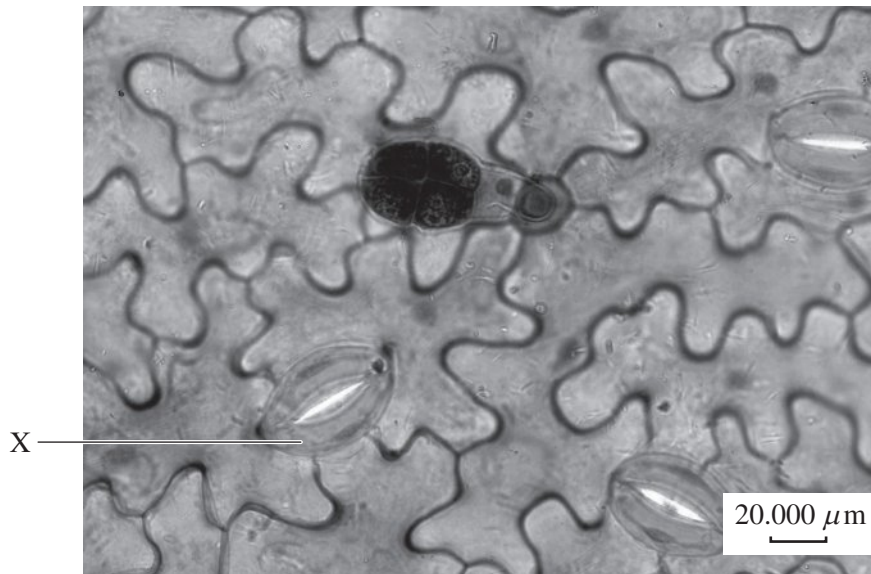
	<i>Light microscopes</i>	<i>Electron microscopes</i>
A.	<ul style="list-style-type: none"> <li>• can view live specimens</li> <li>• produce colour images</li> <li>• have a magnification of up to <math>\times 10\ 000</math></li> <li>• produce images with a low resolution</li> </ul>	<ul style="list-style-type: none"> <li>• cannot view live specimens</li> <li>• produce colour images</li> <li>• have a magnification of up to <math>\times 50\ 000</math></li> <li>• produce images with a high resolution</li> </ul>
B.	<ul style="list-style-type: none"> <li>• can view live specimens</li> <li>• produce colour images</li> <li>• have a magnification of <math>\times 1000\text{--}2000</math></li> <li>• produce images with a high resolution</li> </ul>	<ul style="list-style-type: none"> <li>• can view live specimens</li> <li>• produce black-and-white images</li> <li>• have a magnification of up to <math>\times 50\ 000</math></li> <li>• produce images with a low resolution</li> </ul>
C.	<ul style="list-style-type: none"> <li>• can view live specimens</li> <li>• produce colour images</li> <li>• have a magnification of <math>\times 1000\text{--}2000</math></li> <li>• produce images with a low resolution</li> </ul>	<ul style="list-style-type: none"> <li>• cannot view live specimens</li> <li>• produce black-and-white images</li> <li>• have a magnification of up to <math>\times 50\ 000</math></li> <li>• produce images with a high resolution</li> </ul>
D.	<ul style="list-style-type: none"> <li>• can view live specimens</li> <li>• produce black-and-white images</li> <li>• have a magnification of <math>\times 1000\text{--}2000</math></li> <li>• produce images with a high resolution</li> </ul>	<ul style="list-style-type: none"> <li>• can view live specimens</li> <li>• produce black-and-white images</li> <li>• have a magnification of up to <math>\times 50\ 000</math></li> <li>• produce images with a low resolution</li> </ul>

3 Which of the following statements about the movement of substances into and out of cells is correct?

- Osmosis and diffusion both require energy to occur.
- Endocytosis is the movement of substances into a cell and requires energy to occur.
- Exocytosis and diffusion involve the passive transport of substances across the cell membrane.
- Osmosis is the movement of salts across a semipermeable membrane from a low solute concentration to a high solute concentration.

Use the following information to answer Questions 4 and 5.

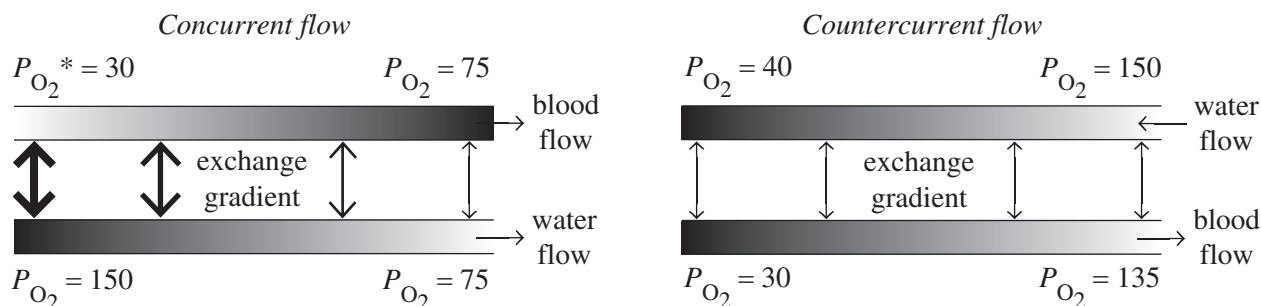
The photograph shows the epidermis of a leaf. Cell X is labelled.



Source: Reproduced with permission from Cheesewright, Rhiannon (2022).

- 4 What is the name of cell X?
- A. epidermal cell
  - B. sieve plate
  - C. stomate
  - D. guard cell
- 5 Using the scale provided in the photograph, what is the estimated length of cell X?
- A. 20 μm
  - B. 60 μm
  - C. 200 μm
  - D. 600 μm

- 6 Countercurrent exchange mechanisms are used for a variety of reasons in living organisms. The diagram shows the concurrent and countercurrent flows in the gills of a fish.

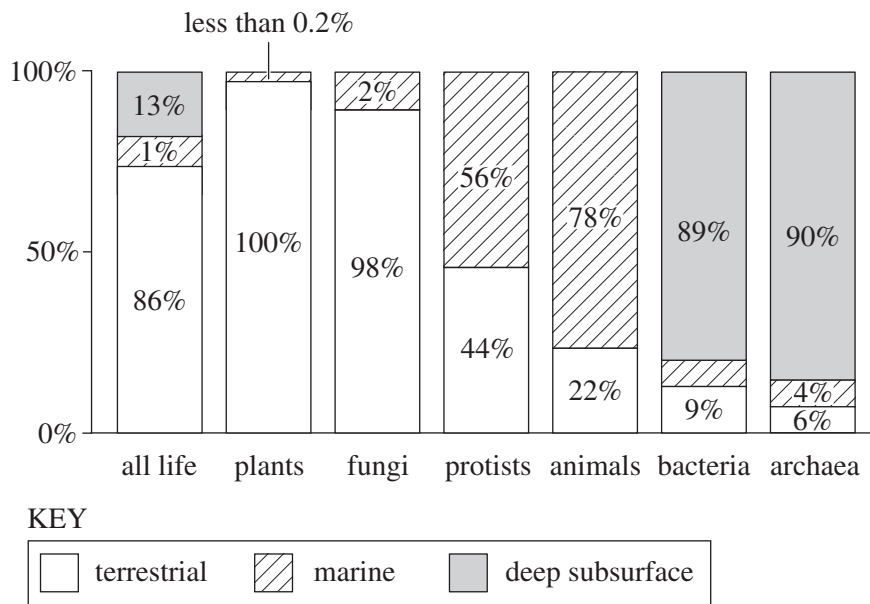


\* $P_{O_2}$  refers to the partial pressure (concentration) of oxygen.

Why does a fish benefit from a countercurrent flow across the lamellae in its gills?

- Countercurrent flow maintains a concentration gradient so that oxygen flows easily into the gills.
  - Countercurrent flow maintains a concentration gradient so that carbon dioxide flows into the gills.
  - Blood flows through the gills in the same direction as water, which allows oxygen to flow easily into the gills.
  - Oxygen flows easily from the gills into the water because it exists in a high concentration in the gills.
- 7 Radioactive tracers can be used to investigate biochemical pathways in living things. Oxygen-18 ( $O^{18}$ ) is an isotope used to investigate biochemical processes in plants. When  $O^{18}$ -enriched water ( $H_2O^{18}$ ) is used in photosynthesis, a  $O^{18}_2$  molecule is produced.
- This provides evidence that water is
- the source of carbon dioxide liberated (produced) during photosynthesis.
  - the source of oxygen liberated during respiration.
  - the source of oxygen liberated during photosynthesis.
  - released through the plant's roots.
- 8 Which of the following statements is correct?
- As blood passes through the kidney, the amount of oxygen in the blood increases and the amount of urea in the blood decreases.
  - As blood passes through the lungs, the amount of oxygen in the blood increases and the amount of glucose increases.
  - As blood passes through a muscle, the amount of carbon dioxide in the blood increases and the amount of glucose in the blood decreases.
  - As blood passes through the digestive tract, the amount of glucose increases and the amount of urea decreases.

9 The graph shows the percentage distribution of biomass across Earth’s environments.



Source: Adapted from Ritchie, H. and Roser, M. and based on Bar-On, Y.M., Phillips, R. and Milo, R. (2018). ‘Where do we find life on Earth?’ *Our World in Data*. Accessed November 2022. <https://ourworldindata.org/life-by-environment>. Licensed by CC BY 4.0, <https://creativecommons.org/licenses/by/4.0/>.

Based on the information in the graph, what percentage of bacteria live in marine environments?

- A. 2%
- B. 9%
- C. 89%
- D. 98%

10 Sharks and dolphins occupy similar marine environments. Sharks are cartilaginous fish, while dolphins are mammals.

Sharks and dolphins are an example of convergent evolution because they

- A. have similar environmental pressures that select similar traits such as streamlining and a grey colour.
- B. occupy different niches within similar environments, so they have developed different feeding strategies.
- C. share a common ancestor, so they show very similar traits.
- D. share the same DNA, so they show very similar traits.

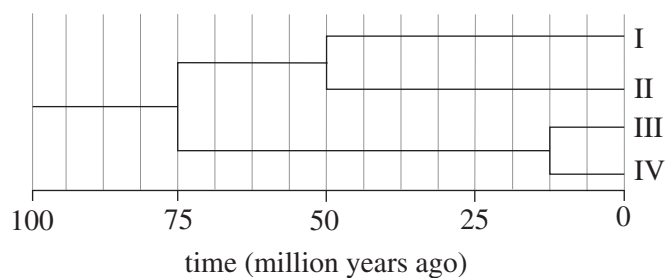
- 11** Malaria, a disease that kills over half a million people each year, is caused by the *Plasmodium* parasite, which is transmitted by mosquitoes. To combat the spread of malaria through mosquitoes, an insecticide called DDT was used. Over time, populations of mosquitoes became resistant to DDT. Which of the following explains the evolution of DDT resistance in mosquitoes?
- Being exposed to DDT caused a mutation in some mosquitoes that made them resistant. When these mosquitoes reproduced, the population became resistant over time.
  - Being exposed to DDT caused a mutation that killed the *Plasmodium* parasite and rendered it harmless to humans.
  - Natural variation in the mosquito population led to some mosquitoes being resistant to DDT. The resistant organisms survived and reproduced, causing the population to become resistant over time.
  - Natural variation in the human population led to some humans being resistant to DDT. When the resistant individuals were bitten by mosquitoes, the mosquitoes also became resistant to DDT.

- 12** A student investigated the biomass of leaf litter at two different field sites. The following measurements were recorded in grams per cubic metre ( $\text{g}/\text{m}^3$ ).

Field site X	11.4	10.9	11.8	10.6	1.5	11.1		
Field site Y	25	27	22	26	28	23	25	27

What is the average biomass of leaf litter, in  $\text{g}/\text{m}^3$ , for field site X, to three significant figures?

- 9.6
  - 11.2
  - 17.28
  - 23.4
- 13** The diagram shows an evolutionary cladogram for organisms I, II, III and IV.



What conclusion can be drawn about the evolution of the organisms from the graph?

- Organism I is the ancestor of all the organisms shown in the graph.
- Organisms II and III are more similar to each other than organisms III and IV.
- Organisms III and IV are most likely a chimpanzee and a human.
- Organisms I, II, III and IV shared a common ancestor.

**14** State regulations in New South Wales require that all new dwellings must apply for a certificate to show that housing construction will comply with sustainable planning regulations. In the process of providing the certificate, the following factors are assessed.

- the size of the garden
- the area covered by low-water-use plant species
- the water source used for irrigating the landscape

Landscape architects and homeowners are encouraged to design gardens that feature indigenous plant species.

Based on the information above, this is because indigenous plant species

- A. look better than exotic species in an Australian garden setting.
- B. have adapted to the Australian environment and thus have hard leaves and small flowers.
- C. will promote the growth of a healthier garden ecosystem that is suited to the Australian environment.
- D. have adapted to the Australian environment and thus can survive with less water than exotic species.

**15** Which of the following statements about using quadrats for ecological studies is correct?

- A. Quadrats can be used to estimate the abundance of populations of organisms.
- B. Quadrats can be used to estimate the abundance of large animals.
- C. Quadrats can be used to estimate the distribution of large animals.
- D. Quadrats are more effective than transects in estimating the distribution of plants.



# NSW Year 11 Biology

## Section II Answer Booklet

**60 marks**

**Attempt Questions 16–26**

**Allow about 1 hour and 30 minutes for this section**

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**Instructions**

- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
  - Show all relevant working in questions involving calculations.
  - Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.
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**Please turn over**

**Question 16** (4 marks)

Outline ONE benefit and ONE limitation of using models in the study of biology. In your answer, refer to ONE example of a process or structure that can be modelled in biology.

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**Question 17** (3 marks)

Diabetes is a disease in which the body is unable to regulate blood sugar levels. Individuals with diabetes often have elevated levels of glucose in their blood because the hormones required to maintain regular glucose levels are not produced or do not function effectively. A high concentration of sugars in the blood can dehydrate the body cells.

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With reference to osmosis, explain why a high blood glucose concentration is dangerous in individuals with diabetes.

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**Question 18** (6 marks)

Consider the information about digestive enzymes.

Amylase begins the chemical digestion process in the mouth, breaks down starch and works best in weak acidic conditions. Its optimum pH is 6.7–7. Amylase cannot work in the stomach, where the pH is 1.5–3. Similarly, it loses its ability to catalyse reactions in basic conditions such as in the duodenum, which has a pH level of 8–9. Catalase has an optimum pH of 9 and a working pH range of 7–11. Rennin is a digestive enzyme found in gastric juices in the stomach. It loses the ability to function in neutral and basic conditions.

- (a) Using the information provided, draw **THREE** graphs on the grid below to show the effect of pH on the activity of amylase, catalase and rennin. **4**



- (b) The optimum pH range for the enzyme trypsin is 7.5–8.5. **2**  
 Identify where in the digestive tract trypsin would most likely act to digest proteins. Explain your answer.

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**Question 19** (4 marks)

Compare the structure and function of chloroplasts and mitochondria in plant cells.

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**Question 20** (7 marks)

*Chlamydomonas reinhardtii* is a unicellular organism that is motile (capable of moving). The cell is oval shaped and has a length of 10  $\mu\text{m}$  and a width of 3  $\mu\text{m}$ . It has a cell wall, two flagella and two contractile vacuoles near the bases of the flagella. The cell contains a chloroplast, a nucleus and an eyespot.

(a) In the space provided, draw a fully labelled biological diagram of *Chlamydomonas reinhardtii*. **3**

(b) Determine whether *Chlamydomonas reinhardtii* is a eukaryotic or prokaryotic cell. **2**  
Justify your answer.

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(c) Determine whether *Chlamydomonas reinhardtii* is an autotroph or heterotroph. **2**  
Justify your answer.

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**Question 21** (3 marks)

Using examples, explain the importance of cell differentiation in the functioning of an organism.

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**Question 22** (4 marks)

Identify TWO examples of gas exchange structures and explain how the features of these gas exchange structures facilitate their function.

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**Question 23** (10 marks)

Animals have adaptations that make them suited to their environment. Polar bears from the Arctic region have thick fur. Elephants from Africa spray water on themselves. The spinifex hopping mouse from the Australian desert can produce highly concentrated urine.

- (a) Complete the table by classifying each adaptation as behavioural, structural or physiological and describing how each adaptation helps the animal to survive in its respective environment. **3**

	<i>Animal and their adaptation</i>	<i>Function of the adaptation</i>
<i>Behavioural</i>		
<i>Structural</i>		
<i>Physiological</i>		

**Question 23 continues on page 16**

Question 23 (continued)

Insulation, such as fur or wool, and evaporative cooling, such as sweating or panting, are two types of animal adaptations that relate to thermoregulation. A student decided to measure the effect of insulation and evaporative cooling on heat loss. They filled three conical flasks with 250 mL of hot water and applied the following conditions to the flasks.

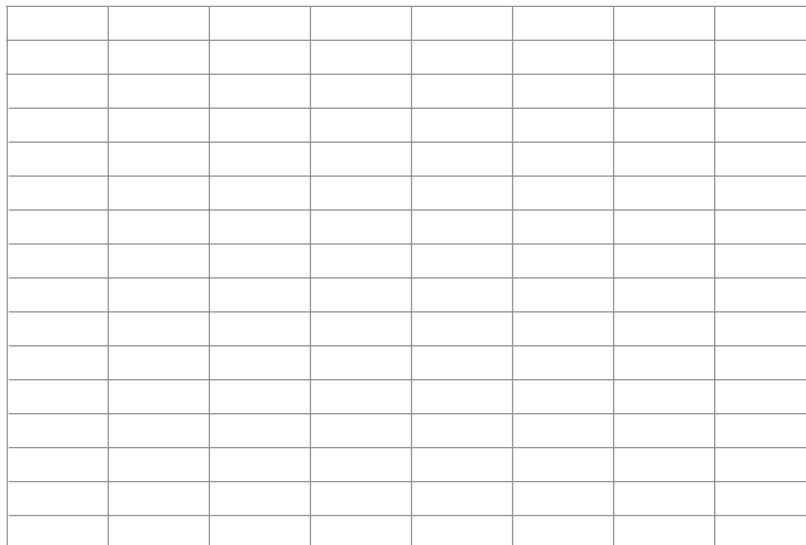
- Flask 1 was wrapped in wool.
- Flask 2 was not altered.
- Flask 3 was continually wiped with a damp cloth for the duration of the investigation.

The student recorded the temperature of the water in each flask every 10 minutes for 40 minutes. The table shows the data recorded by the student.

	<i>Temperature (°C)</i>		
<i>Time (minutes)</i>	<i>Flask 1</i>	<i>Flask 2</i>	<i>Flask 3</i>
0	77	77	77
10	68	62	50
20	65	55	32
30	64	50	29
40	63	45	25

- (b) Using the grid provided, graph the data to show the change in water temperature for each flask over the 40-minute period.

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**Question 23 continues on page 17**



Question 23 (continued)

(c) Explain the results of the investigation.

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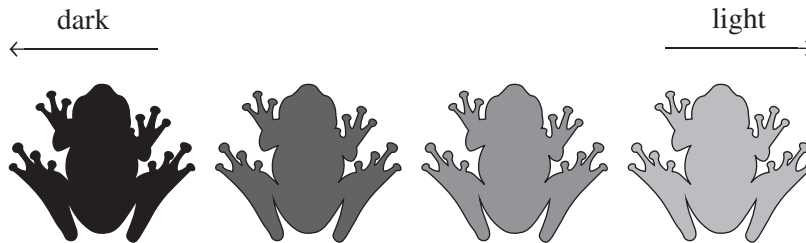
**End of Question 23**

**Question 24** (4 marks)

In 1986, the explosion of one of the reactors at the nuclear power plant in Chernobyl, Ukraine, caused a nuclear disaster. The resulting leak of radioactive material spread ionising radiation into parts of Russia and Europe.

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Scientists have observed the rapid evolution of the Eastern San Antonio frog population since the nuclear disaster. The diagram shows the variation in the colours of the Eastern San Antonio frog (*Hyla orientalis*) population in Chernobyl.



*Colour gradient of the Eastern San Antonio frog*

Prior to 1986, light-coloured frogs were the most abundant variant in the population. In 2016, scientists detected dark-coloured frogs in the Chernobyl area. The dark-coloured frogs are now the dominant variant in Chernobyl, while the light-coloured frogs remain the dominant variant in other parts of Ukraine.

Melanin is the pigment that makes the skin of many animals dark. It can reduce the negative effects of UV radiation and protect against cellular damage. Scientists believe melanin can also help protect against the effects of ionising radiation.

Using your knowledge of Darwin and Wallace’s Theory of Evolution by Natural Selection, explain the evolution of the Eastern San Antonio frog population in Chernobyl since the nuclear disaster.

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**Question 25** (8 marks)

(a) Explain the use of radioactive isotopes (radioisotopes) and ice cores in investigating past ecosystems. **7**

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(b) Hundreds of years in the future, scientists may still be using ice core dating techniques. **1**  
What notable trends might future scientists observe in ice core samples from the 20th century when they are compared with samples from previous centuries?

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**Question 26 (7 marks)**

Describe the impacts of mining and agriculture on ecosystems, and outline the strategies used to restore natural ecosystems.

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**End of paper**





**DIRECTIONS:**

Write your name in the space provided.

Write your student number in the boxes provided below. Then, in the columns of digits below each box, fill in the oval which has the same number as you have written in the box. Fill in **one** oval only in each column.

Read each question and its suggested answers. Select the alternative A, B, C, or D that best answers the question. Fill in the response oval completely, using blue or black pen. Mark only **one** oval per question.

A ○ B ● C ○ D ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ● B ⊗ C ○ D ○

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and draw an arrow as follows.

A ⊗ B <sup>correct</sup> ⊗ C ○ D ○

STUDENT NAME: \_\_\_\_\_

STUDENT NUMBER:

①	①	①	①	①	①	①	①	①
②	②	②	②	②	②	②	②	②
③	③	③	③	③	③	③	③	③
④	④	④	④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦	⑦	○	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨
⑩	⑩	⑩	⑩	⑩	⑩	⑩	⑩	⑩

**SECTION I**  
**MULTIPLE-CHOICE ANSWER SHEET**

1. A ○ B ○ C ○ D ○
2. A ○ B ○ C ○ D ○
3. A ○ B ○ C ○ D ○
4. A ○ B ○ C ○ D ○
5. A ○ B ○ C ○ D ○
6. A ○ B ○ C ○ D ○
7. A ○ B ○ C ○ D ○
8. A ○ B ○ C ○ D ○
9. A ○ B ○ C ○ D ○
10. A ○ B ○ C ○ D ○
11. A ○ B ○ C ○ D ○
12. A ○ B ○ C ○ D ○
13. A ○ B ○ C ○ D ○
14. A ○ B ○ C ○ D ○
15. A ○ B ○ C ○ D ○

**STUDENTS SHOULD NOW CONTINUE  
WITH SECTION II**