Neap

Final Examination 2021

NSW Year 11 Biology

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

Total Marks: 75

Section I – 15 marks (pages 2–6)

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

Section II – 60 marks (pages 7–25)

- Attempt Questions 16–27
- 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

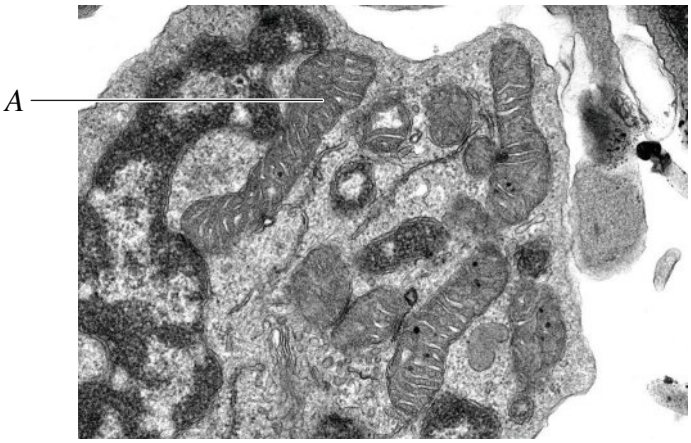
Use the multiple-choice answer sheet for Questions 1–15.

1 A biochemist investigated the effect of pH on the rate at which the enzyme lactase breaks down lactose into galactose and glucose.

Which of the following correctly identifies two controlled variables for this investigation?

A. amount of lactose and temperature
B. amount of lactase and pH
C. amount of lactose and time taken for the lactose to decompose
D. temperature and pH

2 Consider the micrograph.



Source: Modified from the Wellcome Collection, Dr Jeremy Skepper, 'TEM Normal cell'. Accessed February 2021. https://wellcomecollection.org/works/ku2hehbr
Attribution 4.0 International (CC BY 4.0). https://creativecommons.org/licenses/by/4.0

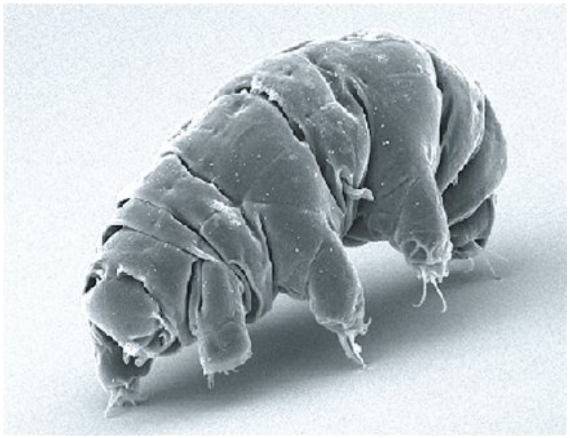
The organelle labelled *A* in the micrograph is

A. a mitochondrion.
B. the nucleolus.
C. a chloroplast.
D. the nucleus.

3 The process that describes translocation in plants is the

A. sink-to-source mechanism.
B. pressure–flow mechanism.
C. transpiration-cohesion-tension theory.
D. root-pressure mechanism.

4 Tardigrades, known colloquially as 'water bears' or 'moss piglets', are 0.5 mm long. An image of a tardigrade is shown.



Source: Reproduced from Schokraie E, Warnken U, Hotz-Wagenblatt A, Grohme MA, Hengherr S, et al. (2012). 'Comparative proteome analysis of *Milnesium tardigradum* in early embryonic state versus adults in active and anhydrobiotic state'. PLoS ONE 7(9): e45682. https://doi.org/10.1371/journal.pone.0045682

What type of microscope generated the image of the tardigrade?

A. compound monocular light microscope
B. binocular dissecting microscope
C. scanning electron microscope (SEM)
D. transmission electron microscope (TEM)

5 Some birds, including vultures and storks, urinate on their own legs to create an evaporative cooling effect. This is known as 'urohydrosis'.

What type of adaptation is urohydrosis?

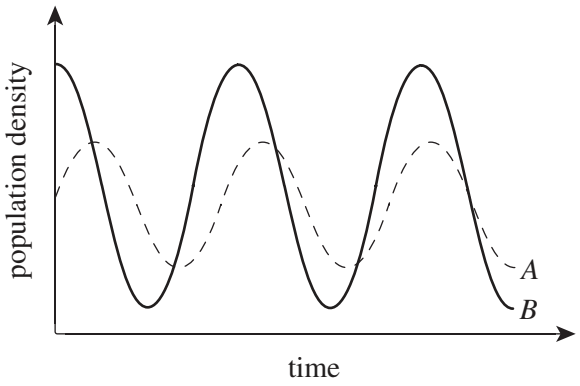
A. behavioural
B. physiological
C. structural
D. biomimicry

6 The North American flying squirrel and the Australian sugar glider have both developed large membranes between their forelimbs and hindlimbs to enable them to glide. They are both covered in soft brown fur with pale underbellies and large eyes. The North American flying squirrel is a placental mammal and the Australian sugar glider is a marsupial mammal.

Which phrase best describes the similarities between these two organisms?

A. parallel evolution
B. convergent evolution
C. divergent evolution
D. adaptive radiation

7 The population density graph shows the predator–prey relationship.



Which statement about the graph is correct?

A. The line labelled *A* represents the predator because there are more predators than prey in a community.

B. The line labelled *A* represents the prey because there are fewer prey organisms than predators in a community.

C. The line labelled *B* represents the predator because there are fewer predators than prey in a community.

D. The line labelled *B* represents the prey because there are more prey organisms than predators in a community.

8 Which of the following correctly defines the process of endocytosis?

A. the movement of substances from an area of high concentration to an area of low concentration

B. the movement of substances from an area of low concentration of solute to an area of high concentration of solute across a semi-permeable membrane

C. the movement of substances into a cell using vesicles created by the cell membrane

D. the movement of substances out of a cell using vesicles created by the cell membrane

9 A food chain is shown.

grass → grasshopper → kingfisher → brown snake

Which statement about the food chain is correct?

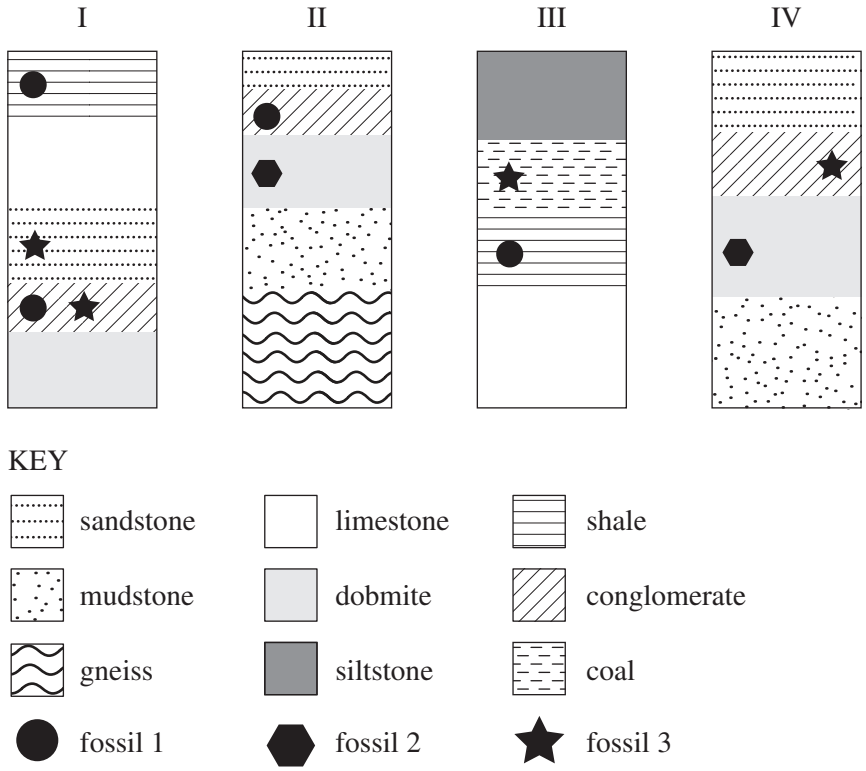
A. The grasshopper occupies the second trophic level and is a first-order consumer.

B. The grasshopper is the herbivore and occupies the first trophic level.

C. The brown snake occupies the third trophic level and is the top carnivore.

D. The grass is the producer and the brown snake is the only carnivore.

10 Consider the strata shown in the diagram.



Which of the following is correct based on the information in the diagram?

A. The gneiss is the oldest layer.

B. Fossil 1 is the oldest fossil.

C. The layer of coal was deposited after the layer of siltstone.

D. Fossil 3 is the best index fossil.

11 The Australian *Banksia* plant species have hard, serrated leaves with a thick cuticle, no petals, an inflorescence and hard seeds.

Which major change in the environment resulted in these adaptations evolving over time?

A. decrease in global temperatures

B. gradual increase in temperature and decreased rainfall on the Australian continent

C. increased rainfall and gradual warming on the Australian continent

D. predation from animal species

12 'Nanny ants' tend to and protect the silvery blue caterpillar (*Glaucopsyche lygdamus*). The caterpillar has a dorsal nectary organ, a gland that secretes a nutritious sugary liquid. Nanny ants consume the food and take it back to their colonies. The caterpillar is protected against predation from other organisms by the nanny ants.

Which of the following best describes the relationship between nanny ants and the silvery blue caterpillar?

A. parasitism

B. commensalism

C. mutualism

D. amensalism

13 A cube has a length of 4 cm.

What is the surface-area-to-volume ratio for the cube?

A. 1 : 4

B. 4 : 1

C. 1 : 1.5

D. 1.5 : 1

14 Which of the following best summarises the changes to blood composition as it passes through the muscles?

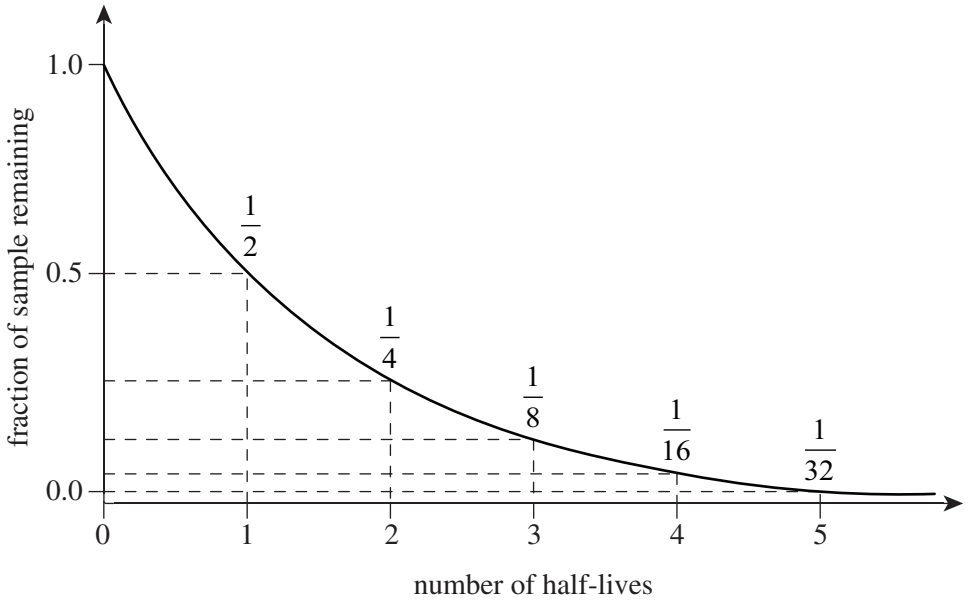
A. increase in oxygen and decrease in glucose and carbon dioxide

B. decrease in oxygen and increase in glucose and carbon dioxide

C. increase in carbon dioxide and decrease in oxygen and glucose

D. decrease in carbon dioxide and increase in oxygen and glucose

15 The graph shows a generic radioactive decay curve.



The radioisotope potassium-40 decays to a stable isotope of argon. Its half-life is about 1300 million years. Scientists can date igneous rocks by measuring the amount of potassium and argon in samples using a mass spectrometer.

Using the potassium-argon clock method, scientists dated an igneous rock (tuff) in a layer directly below a sedimentary layer of sandstone containing a trilobite fossil. The rock sample was analysed and was found to have 25% argon.

What is the best estimate for the age of the fossil?

A. 400 million years

B. 700 million years

C. 2.6 billion years

D. 2.8 billion years

NSW Year 11 Biology

Section II Answer Booklet

60 marks
Attempt Questions 16–27
Allow about 1 hour and 30 minutes for this section

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.

Please turn over

Question 16 (8 marks)

A student observed cells using a light microscope. They focused the image on high power (×400).

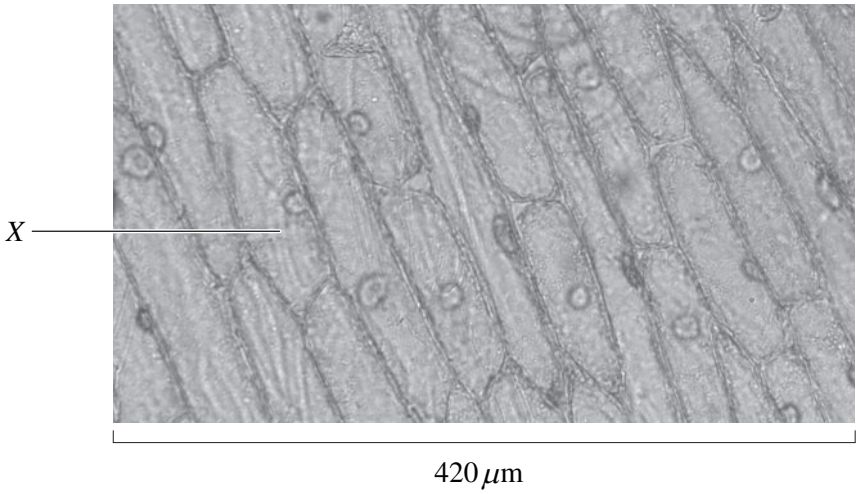
(a) The ocular lens (eye piece) magnification of the microscope was ×10. **1**

Calculate the magnification of the objective lens used by the student to achieve a magnification of ×400.

.....

.....

(b) A photograph of the cells the student observed is shown.



Source: Modified from Fayette A. Reynolds M.S. (2017), Berkshire Community College Bioscience Image Library. Accessed February 2021. https://www.flickr.com/photos/146824358@N03/34062338020/

(i) In the space provided, draw a fully labelled biological diagram of the cell labelled *X*. **3**

Question 16 continues on page 9

Question 16 (continued)

(ii) Demonstrate how you would estimate the length of cell *X*. **2**

.....

.....

.....

.....

(iii) Determine whether the cells are plant or animal cells. Give TWO reasons to justify your answer. **2**

.....

.....

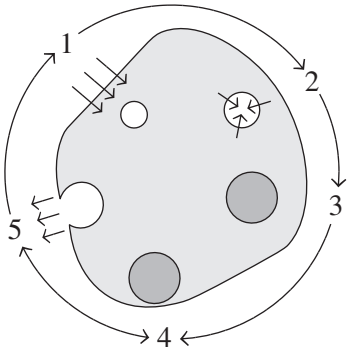
.....

.....

End of Question 16

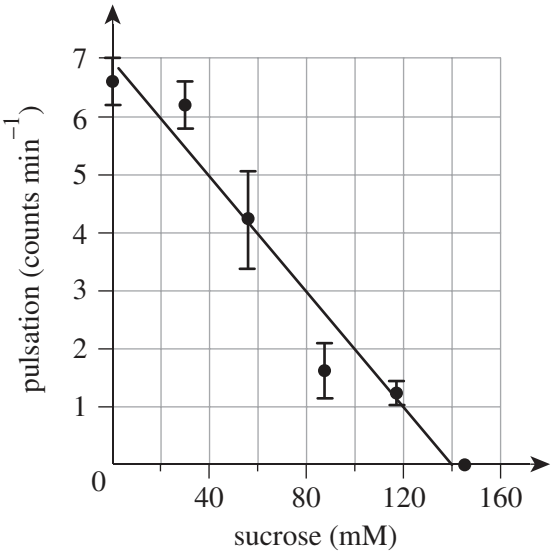
Question 17 (6 marks)

The diagram explains the function of an organelle, the contractile vacuole, in organisms such as the protists *Paramecium spp.* and amoebas. The contractile vacuole is an example of a physiological adaptation. In unicellular organisms, it regulates the osmotic pressure in the cell and maintains homeostasis.



1 Water enters via osmosis.
2 The excess water enters the contractile vacuole.
3 The contractile vacuole swells.
4 The contractile vacuole moves to the edge of the cell.
5 The contractile vacuole bursts, expelling water.

A scientist conducted an experiment to investigate the function of the contractile vacuole. The scientist observed, recorded and graphed the number of contractile vacuole bursts (pulses) in amoebas submerged in different sucrose solutions with concentrations ranging from 0 to 150 mM.



(a) Identify the independent and dependent variables in the scientist's experiment. Include the units of each variable. **2**

	Independent variable	*Dependent variable*
Name of variable		
Units for variable		

(b) Describe the trend of the graph. **1**

.....

.....

Question 17 continues on page 11

Question 17 (continued)

(c) Using your knowledge of osmosis, explain the trend in the graph. **3**

.....

.....

.....

.....

.....

.....

.....

.....

End of Question 17

Question 18 (2 marks)

Identify a difference between prokaryotic and eukaryotic cells and give ONE example of each type of cell. **2**

.....

.....

.....

.....

.....

.....

Question 19 (1 mark)

Different types of cells have adapted to perform different functions in plants and animals. **1**

Complete the table.

Cell function	*Plant cell*	*Animal cell*
support	vessel element	osteocyte (bone cell)
transport	sieve tube	
absorption		epithelial cells of the villi

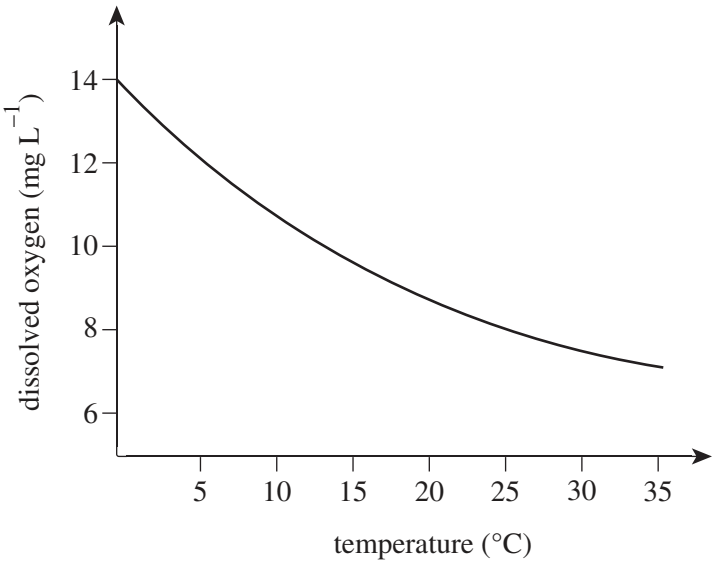
Question 20 (5 marks)

Compare the gas exchange mechanisms in fish, mammals and insects. **5**

Question 21 (2 marks)

Icefish (Channichthyidae) inhabit the coldest waters on the planet. Unlike most vertebrates, these fish have no red blood pigment (haemoglobin). Instead, oxygen is transported in a solution, which is dissolved in the blood plasma. **2**

The graph shows the relationship between temperature and dissolved oxygen.



Use information from the graph to explain why icefish, unlike most fish, can survive without haemoglobin.

.....

.....

.....

.....

.....

.....

Question 22 (5 marks)

As part of the Biology course, you have studied the evolution of an organism. **5**

Explain the evolution of this organism using the main principles of the Theory of Evolution by Natural Selection.

Question 23 (5 marks)

Demonstrate how palaeontology, geology and the use of radioactive isotopes can provide evidence for evolution. Support your answer using examples. **5**

Question 24 (2 marks)

The following phylogenetic tree shows the relatedness of the coronaviruses. Data was produced by analysing the full-length genome sequences of SARS-CoV-2, SARSr-CoVs and other betacoronaviruses.

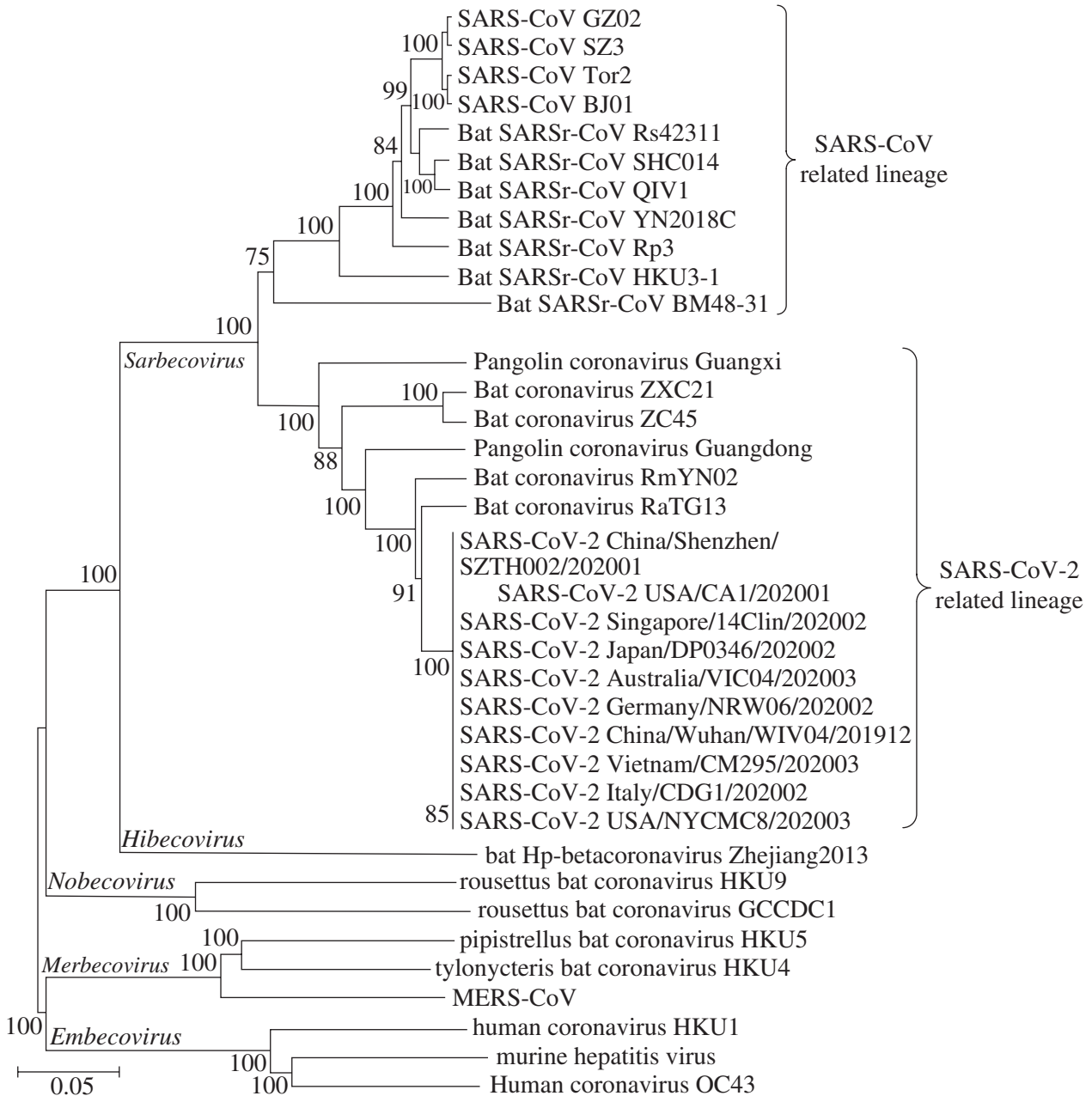


Image credit: Modified with permission. Hu, B., Guo, H., Zhou, P. et al. 'Characteristics of SARS-CoV-2 and COVID-19'. Nat Rev Microbiol (2020). https://doi.org/10.1038/s41579-020-00459-7

(a) Identify the virus that is most closely related to the SARS-CoV-2 virus. **1**

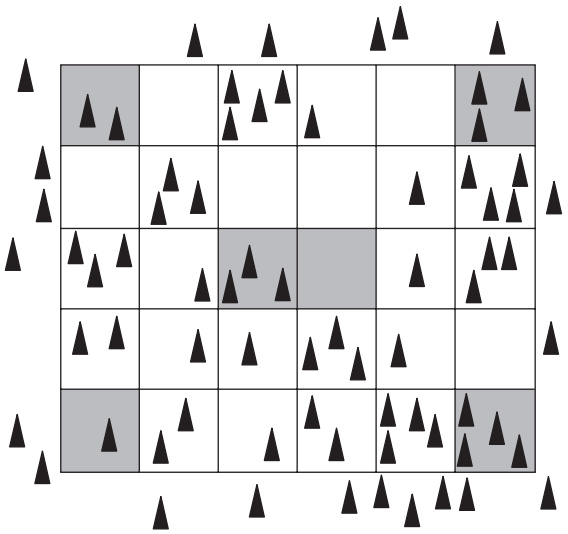
.....

(b) Identify a coronavirus that you would expect to have the greatest genetic differences when compared with the SARS-CoV-2 virus. **1**

.....

Question 25 (6 marks)

The diagram represents a population of pine trees in a forest. Each quadrat is 10 m^2. Randomly selected quadrats have been shaded.



(a) Use the shaded quadrats to estimate the total population of pine trees in the marked area of the forest. Show your working. **2**

.....

.....

.....

.....

.....

.....

(b) Outline ONE way to improve the reliability of your estimate in part (a). **1**

.....

.....

.....

.....

Question 25 continues on page 19

Question 25 (continued)

(c) Assess quadrat sampling for animal populations. **3**

.....

.....

.....

.....

.....

.....

.....

.....

End of Question 25

Question 26 (3 marks)

Rock paintings can provide evidence for past changes in ecosystems. For example, a thylacine (*Thylacinus cynocephalus*), commonly known as the Tasmanian tiger, is depicted in rock art at Ubirr in Kakadu National Park in the Northern Territory. The art has been dated as being around 2000 years old. **3**

Discuss how the study of the culture and history of Aboriginal and Torres Strait Islander peoples can provide information about past environments.

.....

.....

.....

.....

.....

.....

.....

.....

Question 27 (15 marks)

(a) Describe the function of a stomate. **2**

.....

.....

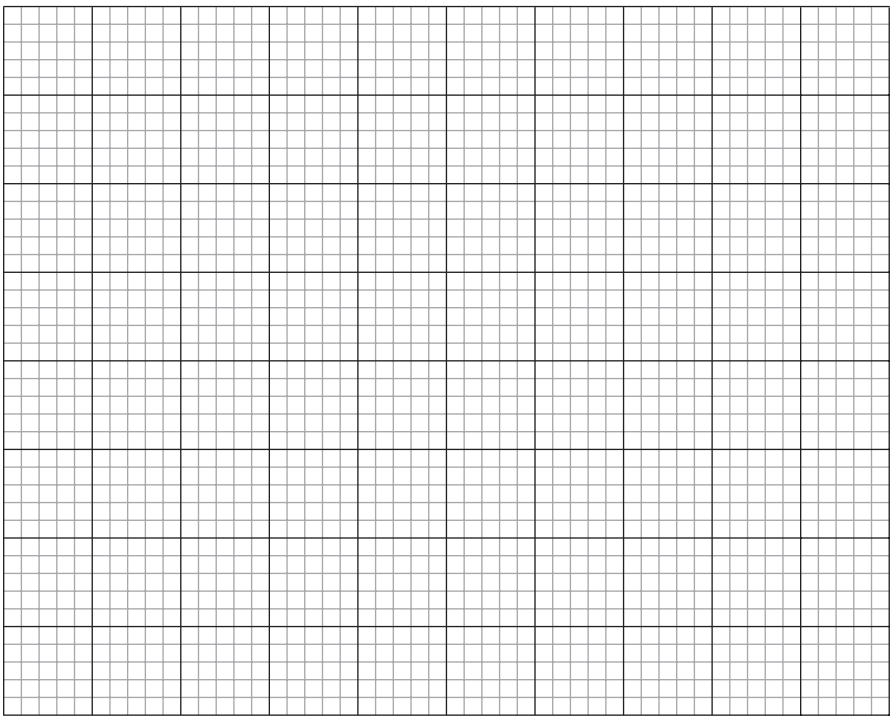
.....

.....

(b) Scientists compared the density of stomates of a variety of plants from different environments. The results are shown in the table. **3**

Plant	*Stomatal density (mm^2)*
daisy leaf (*Bellis perennis*)	100
squash leaf (*Cucurbita argyrosperma*)	185
zucchini leaf (*Cucurbita pepo*)	198
cowhorn agave tissue (*Agave bovicornuta*)	8
Christmas cactus tissue (*Schlumbergera russelliana*)	17

Graph the data on the grid.



Question 27 continues on page 22

Question 27 (continued)

(c) Analyse the data to determine which plants are adapted to a desert environment. Justify your conclusion. **3**

.....

.....

.....

.....

.....

.....

(d) A scientific project called the Fossil Atmospheres experiment is being conducted by the Smithsonian Institution. Scientists are growing *Ginkgo biloba* trees in specific concentrations of carbon dioxide (CO_2). These concentrations start at 400 parts per million (ppm), a standard present-day concentration, and range up to 1000 ppm, 2.5 times the modern concentration.

The scientists have enlisted citizens from around the world to assist with their research. Citizen scientists count stomates and epidermal cells on pictures of the gingko leaves to calculate a 'stomatal index' and build a database. Palaeontologists also perform similar counts on fossilised ginkoes. A comparison of present-day leaves and a fossilised leaf is shown.

Ginkgo biloba leaves

6.1 million year old fossil Ginkgo biloba leaf

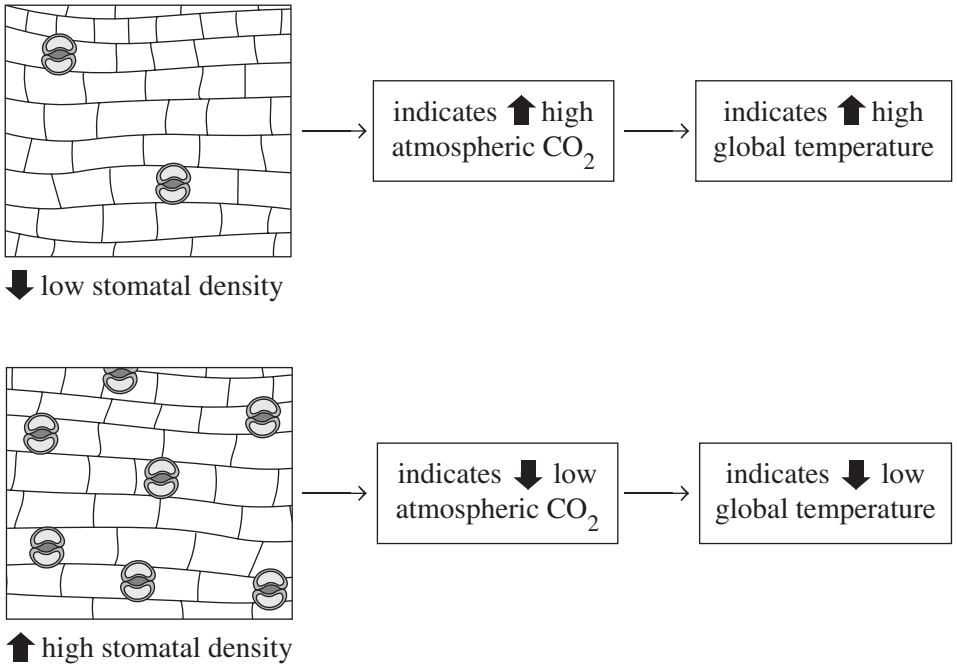
Source: Reproduced with permission from the Smithsonian Institution National Museum of Natural History. Rich Barclay (2017). Accessed February 2021. www.smithsonianmag.com/blogs/national-museum-of-natural-history/2017/06/08/can-you-help-us-clear-fossil-air/

Question 27 continues on page 23

Question 27 (continued)

Comparisons of the stomatal index are made between the plants growing in different CO_2 environments and fossils of gingko leaves. Palaeontologists and climatologists can use the gingko fossils to determine information about past environments, as the plants have essentially remained unchanged for millions of years.

The diagram shows the relationship between stomate density and atmospheric CO_2 levels.



(i) Explain why stomatal density is low when carbon dioxide levels in the atmosphere are high. **2**

.....

.....

.....

.....

.....

.....

Question 27 continues on page 24

Question 27 (continued)

(ii) Explain how analysing stomatal data from ancient plant fossils can reveal information about past environments. **2**

(iii) Using examples, outline how an understanding of past environments informs our approach to managing future ecosystems. **3**

End of paper

Section II extra writing space

If you use this space, clearly indicate which question you are answering.

Final Examination 2021

NSW Year 11 Biology

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.

correct ↓

A ⊗ B ⊗ 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	7
8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9
0	0	0	0	0	0	0	0	0

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