MA99 EDUCATION

Biology: Practice Paper 1 01

NSW BIOLOGY 11-12 SYLLABUS 2025 FOR HSC 2028 AND LATER

1. Instructions

A complete Year 11 yearly examination in the shape of the HSC Biology examination you will sit in 2028: Section I, 20 multiple choice items; Section II, 80 marks in 20 short answer items, two of them worth 7 or 8 marks. All three Year 11 focus areas are examined, and Working scientifically skills are built into the items, as NESA builds them into the HSC paper. Complete it under timed conditions before reading the marking guidance. A paper you have read the answers to has been studied, not attempted.

General instructions

- Reading time: 10 minutes.
- Working time: 3 hours.
- Write using black pen. Draw diagrams and graphs in pencil.
- NESA approved calculators may be used.
- Attempt all questions.
- In Section II, show all relevant working in questions involving calculations.

Total marks: 100

Section I, 20 marks. Attempt Questions 1 to 20. Spend about 35 minutes on this section. Section II, 80 marks. Attempt Questions 21 to 40. Spend about 2 hours and 25 minutes on this section.

Three hours for 100 marks is 1.8 minutes a mark. Twenty multiple choice items in 35 minutes leaves 145 minutes for 80 marks of writing, a little over 1.8 minutes a mark, because the two extended items (Questions 26 and 40) need two or three minutes of planning each.

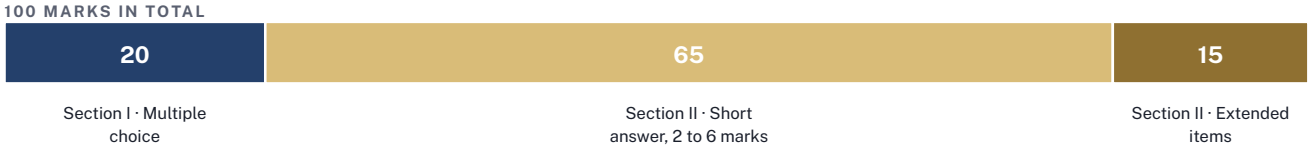


Figure 1 · How the 100 marks are split. Your time should follow the same split.

Real organisms and data in this paper

Questions name real organisms and studies: cyanobacteria at Shark Bay, Escherichia coli, the peppered moth, glyphosate resistant ryegrass, the barramundi, box mistletoe and others. Every real value is sourced in the question or in the marking guidance. Data from a class experiment are labelled hypothetical: use them to answer the question set on them, and never quote them as evidence.

2. Section I · Multiple choice

Section I

20 marks. Attempt Questions 1 to 20. Spend about 35 minutes on this section. Select the alternative A, B, C or D that best answers the question.

2.1 Section I answer grid

Circle the letter on the question, then copy it here.

Q	1	2	3	4	5	6	7	8	9	10
Q	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**

Question 1

1 MARK

Cyanobacteria, such as those that build the living stromatolites at Hamelin Pool, Shark Bay, are photosynthetic prokaryotes. Which structure would NOT be found in a cyanobacterial cell?

A Ribosomes
B A cell wall
C Chloroplasts
D A nucleoid

Question 2

1 MARK

Which organelle modifies, sorts and packages proteins into vesicles for secretion?

A Golgi body
B Ribosome
C Lysosome
D Smooth endoplasmic reticulum

Question 3

1 MARK

Using a mini-grid, a student finds the field of view at 40× is 5.0 mm across. At 400×, eight Elodea leaf cells fit end to end across the field of view (hypothetical data). Each cell is about

A 625 µm long.
B 62.5 µm long.
C 6.25 µm long.
D 4,000 µm long.

Question 4

1 MARK

An Elodea leaf is mounted in 1.0 mol/L sucrose solution, which is hypertonic to its cells. After ten minutes the cells will show

A turgor, because water enters the vacuole by osmosis.
B bursting, because the cell wall cannot resist the pressure.
C no change, because sucrose cannot cross the cell membrane.
D plasmolysis, because water leaves the vacuole and the membrane pulls away from the wall.

Question 5

1 MARK

In an enzyme experiment at constant temperature and pH, the rate stopped rising once the substrate concentration passed a certain value. The best explanation is that

A the extra substrate denatured the enzyme.
B the substrate had been used up.
C the products of the reaction blocked the active sites.
D every active site was occupied, so the amount of enzyme limited the rate.

Question 6

1 MARK

In which phase of the cell cycle is DNA replicated?

A Synthesis (S)
B Gap 1 (G1)
C Gap 2 (G2)
D Prophase

Question 7

1 MARK

A human somatic cell has 46 chromosomes. Meiosis in the testis produces

A two diploid cells, genetically identical to the parent cell.
B four diploid cells, each with 46 chromosomes.
C four haploid cells, each with 23 chromosomes and genetically different from each other.
D two haploid cells, each with 23 chromosomes and genetically identical.

Question 8

1 MARK

At which level of organisation is the xylem of a leaf best classified?

A Organ
B Organelle
C Cell
D Tissue

Question 9

1 MARK

What is the surface area to volume ratio of a block of agar 1 cm × 1 cm × 4 cm?

A 0.22 per cm
B 4.0 per cm
C 4.5 per cm
D 18 per cm

Question 10

1 MARK

A plant grown in a nutrient solution with no magnesium ions develops yellow leaves. Magnesium is needed to make

A chlorophyll.
B cellulose.
C ATP and DNA.
D amino acids.

Question 11

1 MARK

Transpiration from a eucalypt is much lower at night than at midday, mainly because

A the xylem stops carrying water at night.
B most stomata close in the dark.
C the leaf cells stop respiring at night.
D root pressure stops at night.

Question 12

1 MARK

Which feature of the lining of the small intestine most directly increases the rate at which glucose is absorbed?

A Lacteals inside each villus
B Mucus from goblet cells
C Peristalsis by the muscle layers
D Microvilli on the epithelial cells

Question 13

1 MARK

In which form is most of the carbon dioxide carried in the blood?

A Bound to the iron in haemoglobin
B Inside white blood cells
C In the plasma, mostly as hydrogen carbonate ions
D Dissolved in the plasma as carbon dioxide gas

Question 14

1 MARK

A person has not eaten for six hours. Which hormone is secreted in larger amounts, and what is its effect?

A Glucagon: the liver breaks down glycogen and releases glucose.
B Insulin: body cells take up more glucose.
C Glucagon: the liver converts glucose into glycogen.
D Adrenaline: muscle cells store glucose as glycogen.

Question 15

1 MARK

In industrial areas such as Manchester, where soot had blackened tree bark, the dark form of the peppered moth made up 80 per cent or more of the moths (Cook and Saccheri, Heredity, 2013). The best explanation is that

A soot on the bark caused mutations that made the moths dark.
B dark moths were harder for birds to see on sooty bark, so more survived to reproduce and pass on the dark form.
C moths darkened their wings to match the sooty bark and passed the darker wings to their offspring.
D birds preferred to eat dark moths, so the dark form increased.

Question 16

1 MARK

The sugar glider, a marsupial, and the flying squirrel, a placental mammal, both have a gliding membrane between the front and back limbs. These membranes are

A homologous structures, produced by divergent evolution.
B homologous structures, produced by convergent evolution.
C vestigial structures, inherited from a common ancestor.
D analogous structures, produced by convergent evolution.

Question 17

1 MARK

On hot days the red kangaroo licks its forearms, and the saliva cools it as it evaporates. Licking is

A a structural adaptation.
B a physiological adaptation.
C a behavioural adaptation.
D not an adaptation, because the cooling is caused by evaporation.

Question 18

1 MARK

A clownfish shelters among the stinging tentacles of a sea anemone on the Great Barrier Reef and drives off fish that feed on the anemone. This relationship is

A mutualism.
B parasitism.
C commensalism.
D predation.

Question 19

1 MARK

A student wants to show how the plant species change from the bank of a creek up to a dry ridge 40 m away. The most suitable technique is

A ten quadrats placed at random over the whole area.
B a line transect from the creek to the ridge.
C mark-release-recapture.
D one large quadrat placed halfway up the slope.

Question 20

1 MARK

Which change would raise the carrying capacity of a grassland for eastern grey kangaroos?

A A drought that reduces the growth of grass
B A wet year that increases the growth of grass
C An increase in the number of dingoes in the area
D An increase in the number of joeys born that year

3. Section II · Short answer

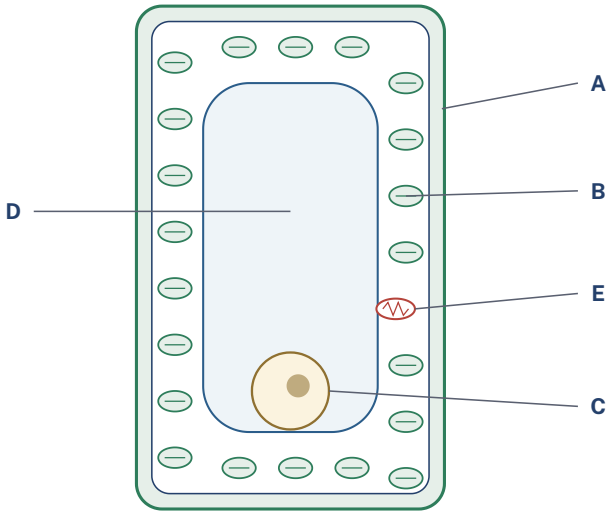
Section II

80 marks. Attempt Questions 21 to 40. Spend about 2 hours and 25 minutes on this section. Answer in the spaces provided. Show all working in calculations, with units.

Question 21

3 MARKS

Figure 2 shows a palisade mesophyll cell from a leaf.



Not to scale. Drawn from a light micrograph and an electron micrograph.

Figure 2 · A palisade mesophyll cell. Source: MA99 Education, general plant cell structure.

(a) Identify the structures labelled A and D. (1 mark)

(b) Contrast this cell with a human skeletal muscle cell, relating TWO differences in their organelles to the function of each cell. (2 marks)

Question 22

2 MARKS

Most bacterial cells are around 2 µm long (Volland et al., Science, 2022). Escherichia coli is a rod-shaped bacterium of about this length. Other than size, state TWO differences between the structure of an E. coli cell and the cell in Figure 2.

Question 23

4 MARKS

A student prepared a wet mount of onion bulb epidermis and stained it with iodine solution.

(a) Explain why the epidermis is stained, and why it must be a layer only one cell thick. (2 marks)

(b) With a mini-grid on the stage, the field of view at 40× measured 4.0 mm across. At 100×, five onion cells fitted end to end across the field of view (hypothetical data). Calculate the length of one onion cell in micrometres. (2 marks)

Question 24

4 MARKS

A bag of dialysis (Visking) tubing was filled with 30 per cent sucrose solution, fitted to a narrow glass tube and stood in a beaker of distilled water. The height of the liquid in the glass tube was recorded every 5 minutes. Hypothetical data.

TIME (MIN)	0	5	10	15	20	25	30
Height of liquid above the start (mm)	0	14	25	33	38	41	42

(a) Explain why the liquid rose in the glass tube. (2 marks)

(b) Calculate the mean rate of rise in the first 10 minutes and in the last 10 minutes, in mm per minute. (2 marks)

Question 25

6 MARKS

Students investigated the effect of temperature on the protein digesting enzyme trypsin. They mixed trypsin solution with a cloudy suspension of milk powder and timed how long the mixture took to clear. Hypothetical data.

TEMPERATURE (°C)	10	20	30	40	50	60
Time to clear (s)	500	250	125	80	160	did not clear in 600 s
Rate (1000 ÷ time)	2.0	4.0	8.0			0

(a) Complete the table by calculating the rates at 40 °C and 50 °C. (1 mark)

(b) Plot the rate against temperature on the grid in Figure 3, and draw a suitable line. (3 marks)

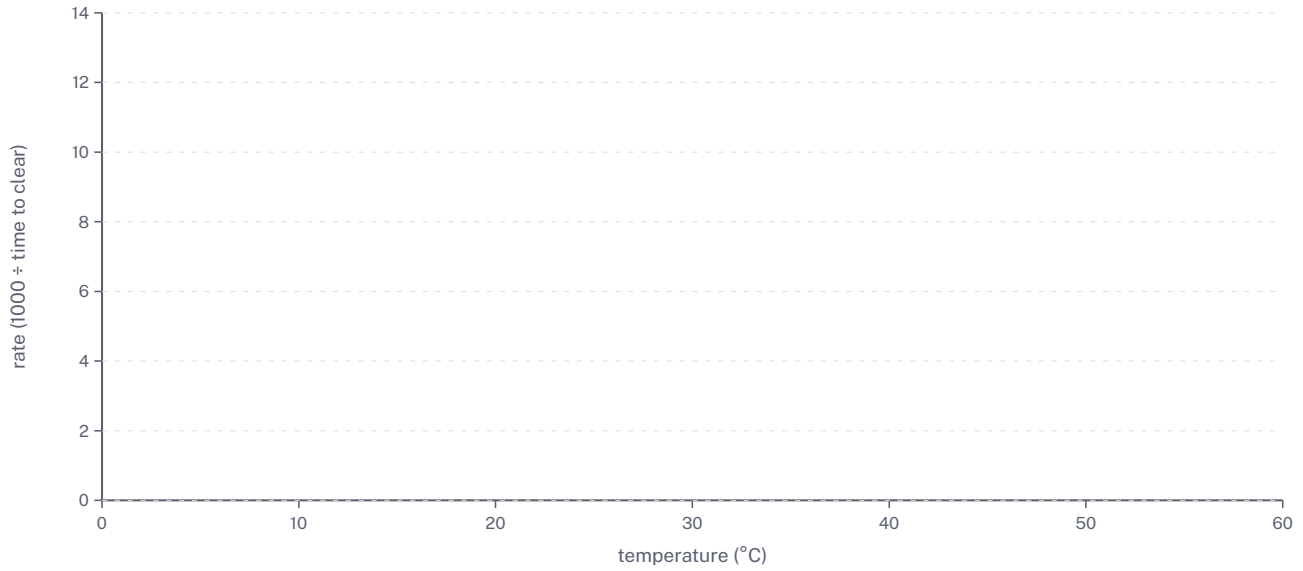


Figure 3 · Grid for Question 25(b).

(c) Explain the change in rate between 40 °C and 60 °C. (2 marks)

Question 26

7 MARKS

Compare mitosis and meiosis, and explain how meiosis produces gametes that are genetically different from each other. In your answer, refer to somatic and gametic cells.

Question 27

3 MARKS

A cell can be modelled as a cube of side 10 μm. If it is divided once in each of the three directions, it forms eight cubes of side 5 μm with the same total volume.

Calculate the surface area to volume ratio before and after division, and explain the significance of the change for the cell.

Question 28

4 MARKS

A student placed a sprig of the pondweed Elodea in sodium hydrogen carbonate solution and counted the bubbles of gas released per minute with an LED lamp at different distances. Refer to Figure 4.

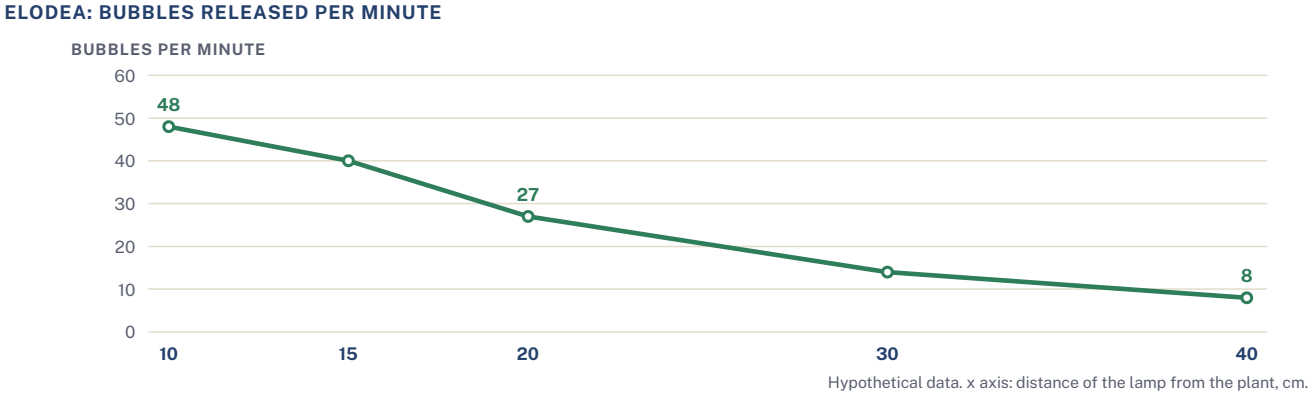


Figure 4 · Bubbles released per minute at five lamp distances. Hypothetical data, mean of three counts at each distance.

(a) Write a hypothesis for this investigation. (1 mark)

(b) Explain why using an LED lamp, rather than a filament lamp, improves the validity of this investigation. (1 mark)

(c) Explain the trend shown in Figure 4. (2 marks)

Question 29

4 MARKS

For a flowering plant, compare xylem with phloem in structure and in function.

Question 30

4 MARKS

A cheese sandwich contains starch, protein and fat. Describe how digestion and absorption make these nutrients available to body cells, and state one use a cell makes of the product of each.

Question 31

3 MARKS

A human red blood cell is approximately 8 µm across (Chen et al., Journal of Nanobiotechnology, 2023). Explain how the structure of a red blood cell suits its function.

Question 32

4 MARKS

Glucose and urea are both present in the blood plasma that enters a glomerulus. In a healthy person, urea appears in the urine but glucose does not. Explain this difference, with reference to glomerular filtration and selective reabsorption.

Question 33

5 MARKS

(a) Construct a negative feedback loop to show how blood glucose concentration is returned to normal after a meal. Label the stimulus, receptor, control centre, effector and response. (4 marks)

(b) Identify the hormone secreted when blood glucose falls, and the organ it acts on. (1 mark)

Question 34

4 MARKS

After about 15 years of successful use, glyphosate failed to control a population of rigid ryegrass (Lolium rigidum) in Australia, which proved 7 to 11 times more resistant than a susceptible population (Powles et al., Weed Science, 1998). Glyphosate is a herbicide sprayed on farms to kill weeds.

Explain how repeated spraying with glyphosate could produce a population of ryegrass that is resistant to it. Refer to genetic variation, inheritance and selective pressure.

Question 35

3 MARKS

The barramundi (Lates calcarifer) lives in rivers and moves down to salty estuaries and tidal flats to spawn. Explain how its water and salt balance must change when it moves from fresh water into salt water.

Question 36

4 MARKS

Students compared water loss from the needle-like leaves of a hakea and the broad leaves of a lilly pilly (Syzygium), a rainforest tree. Leaves were weighed, hung in the same conditions for 3 hours and reweighed. Hypothetical data.

SPECIES	TRIAL 1	TRIAL 2	TRIAL 3	MEAN
Hakea, loss in mass (%)	4.0	4.4	3.8	
Lilly pilly, loss in mass (%)	12.5	13.1	11.9	

(a) Calculate the mean loss in mass for each species. (1 mark)

(b) Explain why the results were recorded as a percentage of the starting mass. (1 mark)

(c) Explain TWO structural features of hakea leaves that could account for the difference. (2 marks)

Question 37

3 MARKS

To estimate the population of a native violet (Viola hederacea) on a 120 m^2 area of lawn, a student placed eight 0.25 m^2 quadrats at random and counted the plants in each: 6, 3, 0, 5, 8, 2, 4, 4. Hypothetical data.

(a) Calculate the mean density of violets per m^2. (1 mark)

(b) Estimate the population of violets on the lawn. (1 mark)

(c) Explain why the quadrats were placed at random. (1 mark)

Question 38

2 MARKS

To estimate the population of bush rats (Rattus fuscipes) in a gully, 24 rats were trapped, ear tagged and released. A week later 30 rats were trapped, and 6 of them carried tags. Hypothetical data.

(a) Estimate the population of bush rats. (1 mark)

(b) State ONE assumption on which this estimate depends. (1 mark)

Question 39

3 MARKS

Box mistletoe (Amyema miquelii) grows on eucalypts. Its haustorium penetrates the host's stem and connects to the host's xylem, from which it obtains water and mineral nutrients. Its sticky seeds are spread by the mistletoebird, which eats the fruit and wipes the seeds onto twigs.

Distinguish between the relationship of box mistletoe with its eucalypt host and its relationship with the mistletoebird.

Question 40

8 MARKS

Analyse how evolution causes species diversity. In your answer, refer to genetic variation, selective pressures and isolation, and use at least ONE named example.

End of paper.

4. Marking guidance

Complete the paper first, under timed conditions. A generous mark finds nothing. The criteria are MA99's own, written in the style of NESA marking guidelines; NESA has published no Year 11 sample questions for the 2025 syllabus.

> Mark Section I first. It takes two minutes and tells you which focus area to reread before you mark the rest.

4.1 Section I · Answer key

One mark each. Every distractor is an error students make, so a lost mark identifies a distinction not yet made.

Q	ANSWER	WHY THE KEY IS RIGHT, AND WHY EACH OF THE OTHER THREE IS NOT
1	C	Prokaryotes have no membrane-bound organelles, so no chloroplasts: cyanobacteria carry their pigments on membranes in the cytoplasm. (A) Every cell has ribosomes. (B) Bacteria, cyanobacteria included, have a cell wall. (D) The nucleoid is where a prokaryote keeps its DNA.
2	A	The Golgi body modifies proteins and buds them off in vesicles. (B) Ribosomes make proteins but do not package them. (C) Lysosomes digest material. (D) Smooth ER makes lipids.
3	B	Field of view at 400× = 5.0 mm × 40 ÷ 400 = 0.50 mm = 500 µm; 500 ÷ 8 = 62.5 µm. (A) uses the 40× field. (C) converts 0.50 mm to 50 µm, multiplying by 100 instead of 1,000. (D) multiplies by 8.
4	D	In a hypertonic solution water leaves by osmosis, the vacuole shrinks and the membrane pulls away from the wall. (A) and (B) describe a hypotonic solution. (C) Water, not sucrose, is what moves.
5	D	At high substrate concentration all active sites are busy, so only more enzyme would raise the rate. (A) Substrate does not denature enzymes. (B) There is more substrate, not less. (C) A build up of product would slow the reaction, not hold the rate steady while substrate rises.
6	A	DNA is copied in S phase, so each chromosome has two chromatids before mitosis. (B) G1 is growth before copying. (C) G2 is growth and checking after copying. (D) Chromosomes condense in prophase; they were copied earlier.
7	C	Two divisions give four cells, each haploid (23) and each different. (A) describes mitosis. (B) keeps the diploid number. (D) has the right number but one division and no variation.
8	D	Xylem is a group of cells doing one job together: a tissue. (A) The leaf is the organ. (B) and (C) are smaller levels.
9	C	SA = 2 × (1 × 1) + 4 × (1 × 4) = 18 cm^2; V = 4 cm^3; 18 ÷ 4 = 4.5 per cm. (A) is V ÷ SA. (B) leaves out the two ends. (D) is the surface area alone.
10	A	Magnesium sits at the centre of every chlorophyll molecule. (B) Cellulose is made from glucose. (C) needs phosphate. (D) needs nitrate.
11	B	Stomata close in the dark, so far less water vapour escapes. (A) The xylem still holds water. (C) Plant cells respire day and night. (D) Transpiration is driven by the pull from the leaves, not root pressure.
12	D	Microvilli multiply the area of membrane across which glucose crosses. (A) Lacteals absorb fats. (B) Mucus protects. (C) Peristalsis moves food along.
13	C	Most carbon dioxide travels as hydrogen carbonate ions in plasma. (A) Haemoglobin's iron carries oxygen. (B) White cells defend the body. (D) Some is dissolved, but only a small part.
14	A	Low glucose is the stimulus for glucagon, which makes the liver break down glycogen. (B) Insulin rises after a meal. (C) reverses glucagon's effect. (D) Adrenaline breaks glycogen down.
15	B	Variation already existed; birds removed the moths they could see. (A) Soot does not cause the mutation. (C) Individuals do not change to suit the bark. (D) reverses the selective pressure.
16	D	Unrelated mammals evolved similar structures under similar pressures: analogy, by convergence. (A) and (B) Homologous means inherited from a common ancestor with that structure. (C) Vestigial structures have lost their function.
17	C	Licking is something the animal does. (A) is a body part. (B) is a body process. (D) The evaporation explains how the behaviour works; it is still an adaptation.

Q	ANSWER	WHY THE KEY IS RIGHT, AND WHY EACH OF THE OTHER THREE IS NOT
18	A	Both benefit: the fish gains shelter, the anemone is defended. (B) Neither lives at the other's expense. (C) The anemone is not unaffected. (D) Neither eats the other.
19	B	A transect along the gradient shows where each species starts and stops. (A) Random quadrats suit one uniform area. (C) is for mobile animals. (D) samples one point.
20	B	Carrying capacity depends on resources such as food; more grass raises it. (A) lowers it. (C) Predators lower numbers but not the resources. (D) Births change numbers, not the capacity.

The key has five of each letter: no letter above 25 per cent.

4.2 Section II · Criteria and sample answers

Each question shows where the marks sit, then a sample answer. A sample answer is one way to earn full marks, not the only way.

QUESTION 21 · 3 MARKS

(a) 1 mark. A is the cell wall and D is the (large central) vacuole. Both are needed for the mark.

(b) 2 marks. 1 mark for each difference that is related to the function of the cell, to a maximum of 2.

Sample answer. (b) The palisade cell is packed with chloroplasts because it is the main site of photosynthesis in the leaf; the muscle cell has none, because it is not in the light and obtains its glucose from the blood. The palisade cell has a cellulose wall and a large vacuole that keep it turgid and hold the leaf in shape; the muscle cell has no wall, which lets it change shape as it contracts, and instead it has very many mitochondria to release the energy contraction needs.

QUESTION 22 · 2 MARKS

1 mark for each correct difference, to a maximum of 2.

Sample answer. E. coli has no nucleus: its DNA is one circular chromosome in a nucleoid, while the palisade cell's DNA is in linear chromosomes inside a nucleus. E. coli has no membrane-bound organelles, such as the chloroplasts, mitochondria and vacuole of the palisade cell. Also accepted: a peptidoglycan wall rather than cellulose; smaller (70S) ribosomes; plasmids; flagella or pili.

QUESTION 23 · 4 MARKS

(a) 2 marks. 1 for the stain making transparent structures visible, such as the nucleus. 1 for light needing to pass through a single layer, so overlapping cells do not hide each other.

(b) 2 marks. 1 for the field of view at 100×. 1 for the cell length with its unit.

Sample answer. (a) Most cell structures are almost transparent, so iodine is added because it stains some structures, such as the nucleus, more strongly than others, making them visible against the cytoplasm. A single layer lets light pass through each cell; a thick specimen would be a dark mass of overlapping cells. (b) Field of view at 100× = 4.0 mm × 40 ÷ 100 = 1.6 mm = 1,600 µm. Cell length = 1,600 ÷ 5 = 320 µm.

QUESTION 24 · 4 MARKS

(a) 2 marks. 1 for water moving into the bag by osmosis, from the distilled water (lower solute concentration) to the sucrose solution (higher). 1 for sucrose molecules being too large to pass through the tubing, so the volume inside rises and pushes liquid up the tube.

(b) 2 marks. 1 for each rate.

Sample answer. (a) The tubing is selectively permeable: water molecules pass through it but sucrose molecules are too large. The distilled water has a lower solute concentration than the sucrose solution, so there is a net movement of water into the bag by osmosis. The extra volume can only go up the glass tube. (b) First 10 minutes: 25 mm ÷ 10 min = 2.5 mm per minute. Last 10 minutes: (42 minus 38) mm ÷ 10 min = 0.4 mm per minute.

What a marker wants

"Water moves from high to low concentration" earns nothing without stating concentration of what. Write "from lower to higher solute concentration". The fall in rate has a reason: as water enters, the sucrose is diluted, so the gradient falls, and the weight of the rising column pushes back.

QUESTION 25 · 6 MARKS

(a) 1 mark. 40 °C: 1000 ÷ 80 = 12.5. 50 °C: 1000 ÷ 160 = 6.25, or 6.3. Both for the mark.

(b) 3 marks. 1 for the six points plotted correctly (60 °C plotted at 0). 1 for a single smooth curve through the plotted points, not straight segments joining the dots, and not extended beyond the data. 1 for using the given axes correctly, with the peak at 40 °C. Deduct 1 for a line extended beyond the data.

(c) 2 marks. 1 for the rate falling above the optimum because the enzyme is denatured. 1 for explaining denaturing: heat breaks the bonds holding the enzyme's shape, the active site changes shape, and the substrate no longer fits.

Sample answer. (c) The rate peaks near 40 °C, falls by half to 6.25 at 50 °C and is zero at 60 °C. Above the optimum, heat breaks the bonds that hold the trypsin molecule in its three dimensional shape. The active site changes shape, so fewer casein molecules fit it, and at 60 °C so many molecules are denatured that the milk did not clear in 600 s.

QUESTION 26 · 7 MARKS

MARKS	CRITERIA
6 to 7	Compares mitosis and meiosis clearly (number of divisions, number and type of cells, chromosome number, genetic identity, role in somatic and gametic cells). Explains how crossing over, independent assortment and random segregation produce genetically different gametes. Uses correct terminology.
4 to 5	Compares the two processes with some differences, and describes at least one source of variation in meiosis.
2 to 3	Describes features of mitosis or meiosis with limited comparison.
1	Identifies a relevant feature of mitosis or meiosis.

Sample answer

Both mitosis and meiosis follow DNA replication in S phase, and both use a spindle to separate chromosomes, followed by cytokinesis. They differ in purpose and outcome. Mitosis is one division that produces two diploid daughter cells, genetically identical to the parent cell, so it makes the somatic (body) cells used for growth and repair: a human somatic cell has 46 chromosomes. Meiosis is two divisions that produce four haploid cells, each with one set of chromosomes, 23 in humans, which become the gametes. Halving the number means fertilisation restores 46 in the zygote.

Meiosis also makes each gamete different. In prophase I, homologous chromosomes pair, and chromatids from the two partners swap matching segments at chiasmata (crossing over), so each chromatid carries a new combination of alleles. In metaphase I each homologous pair lines up on the equator facing either pole by chance, independently of every other pair (independent assortment). In anaphase I the members of each pair separate, so which allele enters which gamete is a matter of chance (random segregation). With 23 pairs, independent assortment alone gives 2^{23}, about 8.4 million, combinations, before crossing over adds more. Mitosis has none of these steps: homologues do not pair, so daughter cells are identical.

What separates 7 from 5. A comparison uses words such as "whereas" and "both" in the same sentence. A 5 mark answer describes mitosis, then meiosis, and leaves the marker to compare. The 7 mark answer also places each source of variation in its phase.

QUESTION 27 · 3 MARKS

1 for SA:V before (0.6 per µm). 1 for SA:V after (1.2 per µm). 1 for the significance: more membrane per unit volume, so exchange by diffusion can meet the cell's needs, which is why cells divide rather than grow very large.

Sample answer. Before: SA = 6×10^2 = 600 µm^2; V = 10^3 = 1,000 µm^3; SA:V = 0.6 per µm. After: each cube has SA = 6×5^2 = 150 µm^2 and V = 125 µm^3, so SA:V = 1.2 per µm (total 1,200 µm^2 for the same 1,000 µm^3). Division doubles the membrane available for each cubic micrometre of cytoplasm and halves the distance to the centre, so oxygen and nutrients can diffuse

in, and wastes out, fast enough to meet the cells' needs.

QUESTION 28 · 4 MARKS

(a) 1 mark. A testable hypothesis linking light intensity (or lamp distance) to the rate of photosynthesis, with a direction.

(b) 1 mark. A filament lamp heats the water as it is moved closer, so temperature would change with distance; an LED gives little heat, so only light intensity changes and the test measures what it intends to.

(c) 2 marks. 1 for the trend with data. 1 for the explanation: less light reaches the plant at greater distance, so less light energy is absorbed by chlorophyll, photosynthesis slows and less oxygen is released; light is the limiting factor over this range.

Sample answer. (a) If the lamp is moved further from the Elodea, then fewer bubbles will be released per minute, because lower light intensity reduces the rate of photosynthesis. (c) The number of bubbles falls from 48 per minute at 10 cm to 8 per minute at 40 cm, one sixth as many. Light intensity falls as the lamp moves away, so chlorophyll absorbs less light energy, photosynthesis slows and less oxygen gas is produced. Light is the limiting factor across this range.

QUESTION 29 · 4 MARKS

1 mark each for up to four correct points of comparison that pair a structure or function of xylem with one of phloem. A list of xylem facts followed by phloem facts, with no comparison, earns at most 2.

Sample answer. Xylem carries water and dissolved mineral ions, whereas phloem carries sugars (mainly sucrose), amino acids and hormones. Xylem flow is upward only, from roots to leaves, whereas phloem flow runs from source to sink, up or down. Xylem vessels are dead, hollow tubes with no end walls and lignified walls, whereas phloem sieve tubes are living cells with thin cellulose walls and sieve plates, each with a companion cell. Water moves in xylem without the plant spending energy, pulled by transpiration, whereas loading sucrose into phloem uses ATP in the companion cells.

QUESTION 30 · 4 MARKS

1 for mechanical and physical digestion (chewing, churning, emulsifying fat with bile) raising the surface area. 1 for chemical digestion of all three (amylase, protease such as pepsin or trypsin, lipase) into glucose, amino acids, fatty acids and glycerol. 1 for absorption in the small intestine across villi and microvilli (glucose and amino acids into capillaries, fats into lacteals). 1 for a use of each product in cells.

Sample answer. Teeth chew the sandwich and the stomach churns it, and bile salts emulsify the fat into small droplets: these steps break no bonds but raise the surface area for enzymes. Amylase digests starch to maltose, and maltase then digests maltose to glucose; pepsin and trypsin digest protein to amino acids; lipase digests fat to fatty acids and glycerol. In the small intestine glucose and amino acids cross the villi and microvilli into the capillaries, and fatty acids and glycerol enter the lacteals. Cells use glucose as the fuel for cellular respiration, amino acids to make proteins such as enzymes, and fatty acids to build membranes or release energy.

QUESTION 31 · 3 MARKS

1 mark for each structure linked to its function, to a maximum of 3.

Sample answer. A red blood cell is packed with haemoglobin, which binds oxygen in the lungs and releases it in respiring tissues. It has no nucleus and no mitochondria, which leaves more room for haemoglobin. Its biconcave disc shape gives a large surface area to volume ratio and a short diffusion distance, so oxygen enters and leaves quickly, and it is flexible enough to squeeze through capillaries narrower than its width of about 8 µm.

QUESTION 32 · 4 MARKS

1 for both being small enough to be filtered from the glomerulus into Bowman's capsule. 1 for filtration being non-selective (by size, under pressure). 1 for all glucose being reabsorbed in the proximal convoluted tubule by active transport. 1 for urea being mostly left in the tubule (only partly reabsorbed), and concentrated as water is reabsorbed, so it leaves in urine.

Sample answer. Blood enters the glomerulus at high pressure, and water and small solutes, including both glucose and urea, are forced through the capillary walls into Bowman's capsule. Filtration selects only by size, so the glomerular filtrate contains glucose and urea at about their plasma concentrations. Selective reabsorption then decides what is kept. In the proximal convoluted tubule, all the glucose is moved back into the blood by active transport, so in a healthy person none reaches the urine. Urea is a waste that is not actively reabsorbed; as water is reabsorbed along the tubules, the urea left behind becomes concentrated, and it leaves the body in urine.

QUESTION 33 · 5 MARKS

(a) 4 marks. 1 for stimulus and receptor. 1 for control centre and the hormone (insulin). 1 for effector and response. 1 for the loop shown returning to the stimulus, with secretion falling as glucose falls (negative feedback).

(b) 1 mark. Glucagon, acting on the liver.



Figure 5 · A model answer for Question 33(a). Source: MA99 Education.

Note. In the glucose loop the beta cells of the pancreas are both the receptor and the control centre: they detect the rise and secrete insulin. Markers accept "pancreas (beta cells)" for both labels. NESA's glossary describes a control centre as a region of the brain, which fits thermoregulation; say which loop you are drawing.

QUESTION 34 · 4 MARKS

1 for genetic variation: some plants already carried alleles giving resistance, before spraying. 1 for glyphosate as the selective pressure, killing susceptible plants. 1 for resistant plants surviving and reproducing, passing resistance alleles to offspring. 1 for the frequency rising over many generations of repeated spraying.

Sample answer. Ryegrass populations are genetically varied, and a few plants already carried alleles that let them survive glyphosate. Each spraying acted as a strong human-induced selective pressure: susceptible plants died, while resistant plants survived and set seed. Their offspring inherited the resistance alleles, so after each season a larger proportion of the population was resistant. Repeated over many seasons, this produced populations in which glyphosate no longer controls the weed, as first found in Australia in 1996. The herbicide did not cause the resistance; it selected it.

QUESTION 35 · 3 MARKS

1 for salt water being hypertonic to its body fluids, so water is lost by osmosis and salt gained. 1 for drinking salt water and actively excreting salt at the gills. 1 for producing a small volume of urine. (Reverse points for fresh water may be credited if contrasted.)

Sample answer. In fresh water the barramundi's body fluids are hypertonic to the water, so it gains water and loses salt; it does not drink, takes up salt actively at the gills and makes large volumes of dilute urine. In salt water the situation reverses: the water is hypertonic to its body fluids, so it loses water by osmosis and gains salt by diffusion. It must drink salt water, switch its gill cells to actively pump salt out, and produce only a small volume of urine to conserve water.

QUESTION 36 · 4 MARKS

(a) 1 mark. Hakea (4.0 + 4.4 + 3.8) ÷ 3 = 4.1 per cent; lilly pilly (12.5 + 13.1 + 11.9) ÷ 3 = 12.5 per cent.

(b) 1 mark. The leaves had different starting masses, so a percentage lets them be compared fairly.

(c) 2 marks. 1 mark for each structural feature linked to reduced water loss: a thick waxy cuticle; sunken stomata; small, needle-like leaves with a smaller surface area.

Sample answer. (c) Hakea leaves are small and needle-like, so they have less surface area from which water can evaporate. They have a thick waxy cuticle, which waterproofs the surface, and stomata sunken in pits, which trap humid air so the gradient for water vapour to diffuse out is smaller. The lilly pilly, from humid rainforest, has broad thin leaves and loses about three times as much water.

QUESTION 37 · 3 MARKS

(a) Total = 32 plants in 8 × 0.25 = 2.0 m^2, so density = 32 ÷ 2.0 = 16 violets per m^2. **(b)** 16 × 120 = 1,920 violets. **(c)** Random placement avoids the bias of choosing spots where violets look common, so the sample represents the whole lawn.

Common error

Dividing 32 by 8 gives 4 violets per quadrat, not per m^2. Each quadrat is a quarter of a square metre, so multiply by 4.

QUESTION 38 · 2 MARKS

(a) N = (24 × 30) ÷ 6 = 120 bush rats. **(b)** Any one: tags are not lost; tagging does not affect survival or behaviour; tagged rats mix evenly through the population before the second trapping; no births, deaths or migration between the two samples; every rat is equally likely to be trapped.

QUESTION 39 · 3 MARKS

1 for parasitism with the eucalypt, with the reason (the mistletoe takes water and minerals at the host's expense). 1 for mutualism with the mistletoebird, with the reason (the bird gains food, the mistletoe gains seed dispersal onto a host). 1 for a clear distinction, using "whereas" or equivalent.

Sample answer. The mistletoe and its eucalypt host are in a parasitic relationship: the mistletoe benefits by taking water and mineral nutrients from the host's xylem, and the host loses them, so it is harmed. Its relationship with the mistletoebird, however, is mutualism, because both benefit: the bird gains food from the fruit, and the mistletoe's seeds are carried to twigs of new hosts. So the mistletoe is a parasite to one partner whereas it is a mutualist to the other.

QUESTION 40 · 8 MARKS

MARKS	CRITERIA
7 to 8	Analyses the process: shows how genetic variation, selective pressures, isolation and inheritance connect to produce new species, step by step. Supports the analysis with at least one accurate named example. Uses biological terminology throughout.
5 to 6	Explains how natural selection and isolation lead to new species, with an example. Some links between steps.
3 to 4	Describes natural selection or isolation, with limited links or a general example.
1 to 2	Identifies a relevant feature of evolution or diversity.

Sample answer

Species diversity increases when one species splits into two, and the split happens through natural selection acting on isolated populations. Three conditions drive natural selection. Individuals vary genetically, because of mutation and the shuffling of alleles in meiosis. More offspring are produced than can survive. A selective pressure, such as drought, predators or a new food supply, means individuals with some variants survive and reproduce more, and because the variants are inherited, their frequency rises over generations. The medium ground finch on Daphne Major shows this in one population: in the 1977 drought only large, hard seeds were left, more than 80 per cent of the finches died, survivors had larger beaks, and the next generation's beaks were about 4 per cent larger (Boag and Grant, 1981; HHMI BioInteractive).

Natural selection alone changes a species; isolation is what splits it. When a barrier such as a sea, river or desert divides a population, gene flow between the two groups stops, so a new mutation on one side cannot spread to the other. The two sides usually differ in climate, food or predators, so selection favours different variants on each side, and mutation and chance push their allele frequencies further apart. Given enough time, the groups can no longer interbreed and produce fertile offspring even if they meet: they are separate species.

Repeated splitting from one ancestor gives adaptive radiation, which is how a whole continent's diversity can arise. Australia separated from Antarctica, and once the Tasmanian Gateway between them began to open, about 37 to 33 million years ago (Ocean Drilling Program Leg 189 synthesis), Australia's marsupials evolved in isolation from most placental mammals. As the continent drifted north and dried, selection favoured different ways of life, and one ancestral group diversified into grazers, browsers, burrowers, gliders and hunters. Isolation started the process, and different selective pressures finished it: that combination is how evolution causes species diversity.

What separates 8 from 5. Analyse asks how the parts connect. The 8 mark answer joins each step with "so" or "because": variation, then selection, then inheritance, then isolation, then reproductive isolation. A 5 mark answer names the steps correctly but never says how one causes the next.

4.3 What this paper covers

FOCUS AREA	SECTION I	SECTION II	TOTAL
Cells as the basis of life	Q1 to 7 (7)	Q21 to 26 (26)	33
Cells to systems	Q8 to 14 (7)	Q27 to 33 (27)	34
Evolution and ecosystems	Q15 to 20 (6)	Q34 to 40 (27)	33
Whole paper	20	80	100

Working scientifically is built into the items rather than set apart, as NESA does on the HSC paper: the mini-grid calculation (Q23), processing osmosis data (Q24), plotting enzyme data (Q25), a hypothesis and validity (Q28), means and percentages (Q36) and two sampling methods (Q37 and 38).

Real organisms, and hypothetical data

Real organisms and values in this paper come from named sources: Cook and Saccheri, Heredity, 2013 (peppered moth); Boag and Grant, Science, 1981, reported by HHMI BioInteractive (finches); Volland et al., Science, 2022 (bacterial size); Chen et al., Journal of Nanobiotechnology, 2023 (red blood cells); Powles et al., Weed Science, 1998 (glyphosate); the Ocean Drilling Program Leg 189 synthesis (Tasmanian Gateway). Class results in Questions 3, 23 to 25, 28 and 36 to 38 are hypothetical. Use them to answer the question set, and never cite them as evidence.

Attempt record

Come back every few weeks and date it. Improvement in a science is easy to miss from the inside: the marks you gain come from sentences you now write without thinking.

DATE	MARK OUT OF 100	THE ONE THING TO FIX NEXT TIME

Fill one row every time you sit the paper. The pattern you are looking for only shows up across attempts, not inside one.

About this resource

MA99 EDUCATION

Scope

NSW Biology, Year 11. Written to the NSW Biology 11-12 Syllabus 2025, all Year 11 focus areas, for students sitting the HSC in 2028 and later years. Written to the new syllabus, taught in Year 11 from 2027. Real organisms, studies and data are named with their source; any data not from a named source is labelled hypothetical.

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