



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2021

Marking Scheme

Biology

Higher Level

Note to teachers and students on the use of published marking schemes

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.

Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.

Introduction

The marking scheme is a guide to awarding marks to candidates' answers. It is a concise and summarised guide and is constructed so as to minimise its word content. Examiners must conform to this scheme and may not allow marks for answering outside this scheme. The scheme contains key words, terms and phrases for which candidates may be awarded marks. This does not preclude synonyms or terms or phrases which convey the same meaning as the answer in the marking scheme. Although synonyms are generally acceptable, there may be instances where the scheme demands an exact scientific term or unequivocal response and will not accept alternatives. The descriptions, methods and definitions in the scheme are not exhaustive and alternative valid answers are acceptable. If it comes to the attention of an examiner that a candidate has presented a valid answer and there is no provision in the scheme for accepting this answer, then the examiner must first consult with his/ her advising examiner before awarding marks. As a general rule, if in doubt about any answer, examiners should consult their advising examiner before awarding marks.

How to use the marking scheme

- Where only one answer is required alternative answers are separated by 'or'.
- Where multiple answers are required each word, term or phrase for which marks are allocated is separated by a solidus (/) from the next word, term or phrase.
- The mark awarded for an answer appears in **bold** next to the answer, e.g. **3**.
- Where there are several parts in the answer to a question, the mark awarded for each part appears in brackets, e.g. **5(4)** means that there are five parts to the answer, each part allocated **4 marks**.
- The answers to subsections of a question may not necessarily be allocated a specific mark; e.g. there may be six parts to a question – (a), (b), (c), (d), (e), (f) and a total of **20 marks** allocated to the question. The marking scheme might be as follows, **2(4) + 4(3)**. This means that the first two correct answers encountered are awarded **4 marks** each and each subsequent correct answer is awarded **3 marks**.
- A word or term that appears in brackets () is not a requirement of the answer, but is used to contextualise the answer or may be an alternative valid answer.

Some examples of the marking process

1. **Key words or terms or phrases may be awarded marks, only if presented in the correct context.**

Sample question: *Outline how water from the soil reaches the leaf.*

Marking scheme states: Concentration gradient / osmosis / root hair / root pressure / cell to cell / xylem / transpiration or evaporation / cohesion (or explained) or adhesion (or capillarity or explained) or tension (or explained). **Any six 6(3)**

Sample answer: *Water is drawn up the xylem by osmosis.*

Although the candidate has presented two key terms (xylem, osmosis), the statement is incorrect and the candidate can only be awarded **3 marks** for referring to the movement of water through the xylem.

2. **Cancelled answers**

The following is an extract from **S.63o Instructions to Examiners, 2021 (for subjects being marked online)** (section 5.4, p.19):

“Where a candidate answers a question or part of a question once only and then cancels the answer, you should ignore the cancelling and treat the answer as if the candidate had not cancelled it.”

Sample question: *What is pollination?*

Marking scheme states: Transfer of pollen / from anther / to stigma. **3(3)**

Sample answer: ~~*Transfer of pollen by insect to stigma.*~~

The candidate has cancelled the answer and has not made another attempt to answer the question and may be awarded **2(3)** marks.

If an answer is cancelled and an alternative version given, the cancellation should be accepted and marks awarded, where merited, for the un-cancelled version only.

If two (or more) un-cancelled versions of an answer are given to the same question or part of a question, both (or all) should be marked and the answer accepted that yields the greater (greatest) number of marks. Points may not, however, be combined from multiple versions to arrive at a manufactured total.

3. **Surplus answers: [only in Section A] - A surplus wrong answer cancels the marks awarded for a correct answer.**

(i) **Sample question 1:** *The walls of xylem vessels are reinforced with.....*










Marking scheme states: Lignin **4 marks**

Sample answer: *Chitin, lignin*

There is a surplus incorrect answer, therefore the candidate scores **4 – 4 = 0 marks**.

Annotations used in the marking

The scripts were marked by examiners using an online marking platform. The following table illustrates the various annotations (symbols) applied by the examiners when marking the scripts. The meaning and use of each of the annotations applied are also explained in the table. These annotations will be seen on a script if viewed as part of the appeal process. Annotations applied by an examiner will be viewed in red. Scripts that were also marked by an advising examiner will show annotations in a green colour.

Annotation	Meaning
	This symbol indicates a correct response / answer.
	This symbol indicates an incorrect response /answer.
	Surplus incorrect answer. A surplus incorrect answer has cancelled a correct answer.
	This symbol is placed on all blank pages or part of page to indicate it has been seen by the examiner.
	This symbol can be used by an examiner to indicate a part of a question answer of significance.
	This symbol is used to indicate a correct response for a label on a diagram. Used in the following questions in 2021: Q14 (c) (iv); Q15 (b) (i); Q16 (b) (i)
	This symbol is used to indicate an incorrect response for a label on a diagram. Used in the following questions in 2021: Q14 (c) (iv); Q15 (b) (i); Q16 (b) (i)
	This symbol is used to indicate a correct response for a diagram. Used in the following questions in 2021: Q14 (c) (iv); Q16 (b) (i)
	This symbol is used to indicate an incorrect response for a diagram. Used in the following questions in 2021: Q14 (c) (iv); Q16 (b) (i)

Question 1

Best five answers from (a) – (f)

5(4)

- (a) Identify **one** difference between fats and oils at room temperature:
Fats are solid and oils are liquid (**Allow** Fats are saturated and oils are unsaturated)
- (b) Identify **one** difference between a triglyceride and a phospholipid:
Triglyceride has three fatty acids and phospholipid has two fatty acids
or
Triglyceride has no phosphate and phospholipid has a phosphate
- (c) Identify **one** metabolic role for lipids in cells:
Energy (source **or** store)
- (d) Name **one** fat soluble vitamin in the diet:
A or D or E or K
- (e) Name **one** deficiency disorder:
A: Night blindness **or D:** Rickets (or osteomalacia) **or E:** Poor nerve impulse conduction
or K: Inability to clot blood **or** other valid fat-soluble vitamin disorder
- (f) Name **one** element present in dissolved salts:
Sodium (Na) **or** Calcium (Ca) **or** Magnesium (Mg) **or** Chlorine (Cl) **or** Potassium (K)

Q1 (a) - (f)	Number of correct responses	1	2	3	4	5	6
	Mark	4	8	12	16	20	20

Question 2

6(3) + 2

- (a) Why do organisms need nitrogen?
To make protein (or named type of protein) **or** to make DNA (or RNA or nucleic acid) **or** to make ATP (or ADP or NAD(P))
- (b) Name the processes that occur at **A** and **B**:
A: Nitrogen fixation
B: Denitrification
- (c) Name the type of bacteria involved in process **C**:
C: Nitrifying (bacteria) (or correctly named bacteria)
- (d) **Two** possible outcomes of this practice (application of fertilisers):
More nitrification / more nitrogen absorbed by plants / more plant growth / more food for animals / more denitrification / more atmospheric nitrogen / water pollution (or eutrophication or algal blooms or described)/any other valid outcomes **Any two**
- (e) On diagram, place letter **D** on **one** location where decomposers act:
On one arrow to soil ammonia (from animals or from pea plants)

Q2 (a) – (e)	Number of correct responses	1	2	3	4	5	6	7
	Mark	3	6	9	12	15	18	20

Question 3**6(3) + 2**

- (a) Name the stage of mitosis shown in the diagram:
Anaphase
- (b) Justify your answer:
Spindle (or X) shortening or spindle contracting or chromosomes pulled apart or chromosomes moving to the poles
- (c) Identify the part labelled X in the diagram:
Spindle
- (d) Explain what is meant by the term diploid:
Two copies of each chromosome (in the nucleus) or chromosomes in pairs or two sets of chromosomes
- (e) State the diploid number of the cell containing this nucleus:
Four
- (f) Outline **one** function of mitosis in humans:
Growth or repair tissue or replace tissue (cells)
- (g) Give **one** example of a human cell not produced by mitosis:
Sperm or egg or gamete or sex cell

Q3 (a) – (g)	Number of correct responses	1	2	3	4	5	6	7
	Mark	3	6	9	12	15	18	20

Question 4**6(3) + 2**

- (a) Identify the parts labelled A and B:
A: Substrate
B: Enzyme-substrate complex
- (b) What theory is illustrated in the diagram?
Induced fit or active site (theory) (**Accept** 'lock and key')
- (c) What type of metabolic reaction is illustrated by the diagram?
Catabolic
- (d) Justify your answer at (c) above:
Substrate (or molecule or A) broken down
- (e) What is meant by the term specificity in relation to enzymes?
Only acts on one substrate (type)
- (f) Identify the cell organelle where enzymes are produced:
Ribosome

Q4 (a) – (f)	Number of correct responses	1	2	3	4	5	6	7
	Mark	3	6	9	12	15	18	20

Question 5**6(3) + 2**

- (a) Name the event that occurs at **A**:
A: Ovulation
- (b) Identify the hormone responsible for the event named at (a):
Luteinising (hormone) or LH
- (c) Identify the stages labelled **B** and **C**:
B: Morula
C: Blastocyst
- (d) What event is illustrated by **D**?
Implantation (or described)
- (e) Name the **two** tissues involved in the formation of the placenta:
Tissue 1: Endometrium or uterine or uterus lining
Tissue 2: Embryonic or embryo (tissue) (**Accept** chorionic or trophoblastic)

Q5 (a) – (e)	Number of correct responses	1	2	3	4	5	6	7
	Mark	3	6	9	12	15	18	20

Question 6**6(3) + 2**

Indicate whether the statements are true or false:

- (a) Adrenaline is secreted into the blood when experiencing a threat.
- (b) Plants are producers; however, they still need mitochondria.
- (c) Neurotransmitters are transported in the blood.
- (d) A potato is a root modified to store food.
- (e) Tissue culture involves growing cells on an artificial medium.
- (f) There are four bones in the middle ear.
- (g) Monocotyledonous plants are almost always herbaceous.

True False

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Q6 (a) – (g)	Number of correct responses	1	2	3	4	5	6	7
	Mark	3	6	9	12	15	18	20

Question 7**10(2)**

Distinguish between the following pairs of terms:

- (a) *Carpal*: Bones in the wrist
Tarsal: Bones in the ankle or heel
- (b) *Tendon*: Connects muscle to bone
Ligament: Connects bone to bone
- (c) *Biceps*: (Muscle) contracts to bend arm or (muscle) at front of humerus (upper arm)
Triceps: (Muscle) contracts to straighten arm or (muscle) at back of humerus (upper arm)
- (d) *Osteoblast*: (Cell that) builds up bone
Osteoclast: (Cell that) breaks down bone
- (e) *Axial skeleton*: Skull and vertebrae (or spine or backbone)
Appendicular skeleton: Limbs (or arms and legs) or pectoral girdle (or shoulders) and pelvic girdle (or hips)

Q7 (a) – (e)	Number of correct responses	1	2	3	4	5	6	7	8	9	10
	Mark	2	4	6	8	10	12	14	16	18	20

Section B	Best 1	30
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Question 8	30
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2(3)

- (a) (i) *Where are the results of an investigation normally reported and published?*
 Scientific journal or scientific website **3**
- (ii) *Explain why random selection is important in experiment design:*
 Reduces bias or increases reliability or fair (test) **3**

Q8 (a) (i) – (ii)	Number of correct responses	1	2
	Mark	3	6

8(3)

- (b) (i) 1. *What reagent or chemicals did you use to test for the presence of protein?*
 *Biuret (reagent) (or copper sulphate (CuSO₄) and sodium hydroxide (NaOH)) **3**
2. *What colour indicates the presence of protein in a food sample?*
 *Purple (or lilac or violet) **3**
- (ii) 1. *Why did you chop the plant tissue?*
 To break (or disrupt) the cell walls or allow cytoplasm to leak out or to increase surface area **3**
2. *Why add salt to the chopped tissue?*
 To cause the DNA to clump or protect (shield) the DNA from the protein **3**
3. *Why add washing up liquid to the chopped tissue and salt?*
 Breaks down membranes (cell or nuclear) or to release (or free) DNA from nucleus (within cell) **3**
4. *Describe how the DNA was then isolated:*
 Cool / blend for 3 seconds / filter (solution) / (add) protease (or named protease) / add ethanol / how (ethanol) added / DNA is precipitated or DNA is visible or DNA removed **Any three 3(3)**

Q8 (b) (i) – (iii)	Number of correct responses	1	2	3	4	5	6	7	8
	Mark	3	6	9	12	15	18	21	24

Question 9

30

2(3)

- (a) (i) *What is meant by enzyme denaturation?*
 Active site destroyed or loss of shape or loss of function **3**
- (ii) *Other than temperature, give **one** condition that will denature an enzyme:*
 (Unsuitable) pH or agitation or ethanol or radiation **3**

Q9 (a) (i) – (ii)	Number of correct responses	1	2
	Mark	3	6

8(3)

- (b) *Heat denaturation of an **named** enzyme:* *Answers must match named enzyme*

- (i) *Describe how the enzyme was treated in the:*
- Test:* Boiled (or heated to above 60° C) **3**
- Control:* Not boiled (or not heated strongly) **3**

- (ii) *Compare the results:*
- Test:* No activity or no foam (or bubbles) or blue-black **3**
- Control:* High level of activity or foam (or bubbles) produced or no blue-black **3**

*The effect of temperature on the rate of a **named** enzyme:*

- (iii) *How did you measure the rate of activity of the enzyme?*
- Catalase:* height (or volume or amount) of foam (or bubbles)
- Amylase:* disappearance of blue-black colour
- Pepsin:* disappearance of purple or violet colour **3**
- per minute (or per unit time or time taken for change to occur) **3**

- (iv) *Label axes **and** draw a curve to show how the rate of enzyme activity varies with temperature:*
- Axes:* **x:** Temperature (°C) and **y:** Rate (or indication of time) **3**
- Plot:* Rising and falling curve **3**

Q9 (b) (i) – (iii)	Number of correct responses	1	2	3	4	5	6	7	8
	Mark	3	6	9	12	15	18	21	24

Question 10

30

2(3)

(a) (i) *Is leaf yeast cell unicellular or multicellular?*

*Unicellular

3

(ii) *Name the type of asexual reproduction in yeast:*

*Budding

3

Q10 (a) (i) – (ii)	Number of correct responses	1	2
	Mark	3	6

8(3)

(b) *Growth of leaf yeasts:*

(i) *What is the purpose of malt on these plates?*

Food (or nutrients)

3

(ii) *Why was the underside of the leaf facing the agar?*

Leaf yeast mostly live on under-surface or more yeast on the underside or so that yeast could fall onto the agar

3

(iii) *What is the purpose of plate A in this experiment?*

A control (or described) or to compare to the results

3

(iv) *Describe the colour of leaf yeast colonies on the plate B:*

Pink (or red)

3

(v) *Suggest **one** reason for the difference in results between plates B and C:*

(More) pollution in the urban air or less pollution in rural air or described (smoke / sulphur dioxide / harmful chemicals)

3

(vi) *Describe **two** aseptic techniques that were carried out to prevent the growth of other microbes:*

Wipe surface with disinfectant (or antiseptic or alcohol or named) / minimal opening of plates or seal plates / flame (or sterilise) equipment / wear gloves or use hand sanitiser or wash hands with soap / keep Bunsen lit (nearby) **Any two**

2(3)

(vii) *State **one** correct disposal method for these plates:*

Soaked in disinfectant (or named disinfectant) or autoclaved (**allow** pressure cooker) or biohazard bag

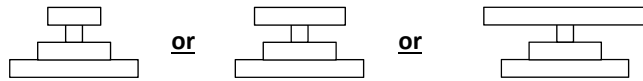
3

Q10 (b) (i) – (vii)	Number of correct responses	1	2	3	4	5	6	7	8
	Mark	3	6	9	12	15	18	21	24

Question 11

60

- (a) (i) Draw a pyramid of numbers:



3

Correct organism at each trophic level

Cowslips must be at the bottom

3

- (ii) Give
- one**
- limitation with the use of pyramid of numbers:

Does not take size (or mass) of organisms into account or difficult to draw to scale or may be inverted or size of some populations cannot be estimated

3

Q11 (a) (i - ii)	Number of correct responses	1	2	3
	Mark	3	6	9

- (b) (i) Suggest
- one**
- advantage of females giving birth in early summer and not in spring:

More (insects) food (for bats to feed offspring) or warmer or longer gestation period or other relevant point

3

- (ii) Name
- and**
- explain
- one**
- human activity that impacts on Irish bat populations:

Name: Development (building or disruption) or (use of) pesticides or other reasonable suggestion or building bat boxes or other named conservation practice

3

Explain:

Development: (Decreases (or reduces) bat population due to) less roosting (or nesting) sites or too noisy or any valid impact orPesticides: (Decreases (or reduces) bat population due to) poisoning of bats or (due to) poisoning of prey (or less food) or any valid impact or

Conservation: (Increases bat population due to) conservation activity explained

3

- (iii) Sketch and label a predator-prey relationship graph:

Axes: Time on horizontal axis and Population (number) on vertical axis

3

Graph: Two curves with indication of a repeating cycle

3

Bat (predator) showing lower peaks and predator curve showing time lag

3

- (iv) Name
- one**
- type of adaptation necessary for organisms to survive:

Structural or behavioural or competitive

3

- (v) Give
- two**
- adaptations that bats possess:

Hibernate / nocturnal / sleep upside down / varied diet / can fly / use echolocation / light (or slender) bones / webbed limbs / endotherm / have fur / any valid example

Any two 2(3)

Q11 (b) (i - v)	Number of correct responses	1	2	3	4	5	6	7	8	9
	Mark	3	6	9	12	15	18	21	24	27

Question 11 (continued)

- (c) (i) *What is meant by the conservation of species?*
 Management (or preservation or protection) of organisms (or their habitats or environments or ecosystems) **3**
- (ii) *Name **and** describe **one** conservation practice from agriculture **or** fisheries **or** forestry:*
Agriculture: Mixed farming or crop rotation or biological controls or spreading slurry (or fertiliser) correctly or correct use of herbicides (or pesticides) or gene banks
or
Fisheries: Large mesh size or quotas or re-stocking or returning young
or
Forestry: Re-planting or broadleaf-conifer mix
or
 Any valid example **3**
 Practice correctly described or expansion point given **3**
- (iii) 1. *Suggest **one** advantage of carrying out surveys on animal populations:*
 Monitor (or investigate) changes or biodiversity or human impact or to prevent (protect) species from extinction **3**
2. *Describe the steps taken to estimate the population of a named animal species:*
 Named animal **Animal must match method below** **3**
For moving animals:
 Captured (or how captured) /
 marked (or how marked) /
 released back into the same place /
 recaptured (or how recaptured) /
 counted /
 formula (or calculation) described
or
Steps for sessile or slow-moving animals:
 Quadrat /
 random (or how random) /
 counted /
 repeated (several times) /
 recorded numbers (or area) /
 calculated population (density) **Any three** **3(3)**

Q11 (c) (i - iii)	Number of correct responses	1	2	3	4	5	6	7	8
	Mark	3	6	9	12	15	18	21	24

Question 12 **60**

(a) (i) State **two** agents that can be responsible for mutation rates:
Chemicals or named chemical / radiation or UV or X-ray / biological agent (or named) **Any two 2(3)**

(ii) Identify **one** characteristic of mutant alleles in a population:
Random occurrence or low frequency or disadvantageous or advantageous **3**

Q12 (a) (i - ii)	Number of correct responses	1	2	3
	Mark	3	6	9

(b) (i) Write the genotype of a plant heterozygous for both traits:
*RrYy **3**

(ii) What are the possible gametes produced by this plant?
*RY / *Ry / *rY / *ry **Any two = 3 marks; final 2 for further 3 marks 2(3)**

(iii) How do these gametes demonstrate Mendel's second law?
R or r can combine with either Y or y, and vice versa or either allele (member) of a pair can combine with either allele of another pair (at gamete formation) **3**

(iv) Show using a Punnet square how these results were obtained:
Punnet square **3**
Gametes of the other parent: *ry **3**
Genotypes of offspring: *RrYy : Rryy : rrYy : rryy **Must be in a 1:1:1:1 ratio 3**

(v) Identify the genotypes of the offspring that introduce variation:
*Rryy **3**
*rrYy **3**

Q12 (b) (i - iv)	Number of correct responses	1	2	3	4	5	6	7	8	9
	Mark	3	6	9	12	15	18	21	24	27

(c) (i) Explain the meaning of:
Gene: Unit of inheritance or piece of DNA that codes for a protein **3**
Sex-linked: Gene located on the sex (or X or Y) chromosome **3**
Genetic engineering: (Artificial) manipulation (or alteration) of genes **3**

(ii) Outline what happens in each of the following steps of genetic engineering:
1. Isolation: Removing (a piece of) DNA (or gene or plasmid) from a cell **3**
2. Cutting: DNA (or plasmid) is cut using (restriction) enzymes or gene is cut out using (restriction) enzymes **3**
3. Gene expression: Production of protein **3**

(iii) Give **one** application in animals:
Any valid example **3**

(iv) Give **one** application in plants:
Any valid example **3**

Q12 (c) (i - iv)	Number of correct responses	1	2	3	4	5	6	7	8
	Mark	3	6	9	12	15	18	21	24

Question 13 **60**

- (a) (i) *Define metabolism:*
All the chemical reactions in a cell (or organism or in the body) **3**
- (ii) *Write a balanced chemical equation for aerobic respiration:*

$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$$
 All chemical formulae correct **3**
 Correctly balanced **3**

Q13 (a) (i - ii)	Number of correct responses	1	2	3
	Mark	3	6	9

- (b) (i) *Give the name of stage 1:*
*Glycolysis **3**
- (ii) *Identify molecule V:*
ATP (adenosine triphosphate) or NADH **3**
- (iii) *Explain how this molecule V is made:*
If ATP: ADP + P (+ energy) or adenosine diphosphate combines with phosphate (+ energy)
If NADH: NAD⁺ + H⁺ + (2)e⁻ or NAD⁺ picks up a proton and (2) electrons **3**
- (iv) *Name the 3-carbon molecule formed in stage 1:*
*Pyruvic acid (or pyruvate) **3**
- (v) *Identify organelle W:*
*Mitochondrion **3**
- (vi) *Name the 2-carbon molecule X:*
*Acetyl (co-enzyme A) **3**
- (vii) *Name the series of events represented by Y:*
*Krebs' cycle **3**
- (viii) *What substance is represented by the letter Z in the diagram?*
*Lactic acid (or lactate) **3**
- (ix) *Amount of energy released when oxygen is used **and** not used:*
 When O₂ is used: high energy or high levels of ATP (released)
and
 when O₂ is not used: low energy or low levels of ATP (released) **3**

Q13 (b) (i - ix)	Number of correct responses	1	2	3	4	5	6	7	8	9
	Mark	3	6	9	12	15	18	21	24	27

Question 13 (continued)

- (c) (i) *Name the cell organelle which contains chlorophyll:*
*Chloroplast **3**
- (ii) *What is the function of chlorophyll in plants?*
To absorb (or trap) light (energy) **3**
- (iii) *Suggest why it is an advantage that chlorophyll contains a number of chemicals:*
Absorb (or trap) more energy or absorb (or trap) a greater range of light (or colours or wavelengths) **3**
- (iv) *Outline the events of the dark stage of photosynthesis:*
Energy from ATP /
NADPH releases electrons (or e⁻) /
NADPH releases protons (or H⁺ ions) /
CO₂ combines with electrons (or e⁻) or CO₂ is reduced/
CO₂ combines with protons (or H⁺ ions) /
to form glucose (or carbohydrate) **Any three 3(3)**
- (v) *Explain how the dark stage is necessary for the continuation of the light stage:*
Product(s) (or named product(s)) of dark stage is used in the light stage **3**
- (vi) *Describe **one** way to increase plant production in a greenhouse:*
Heat to (or keep at) optimum temperature or increase the (artificial) lighting
or described or use a range colours of lights or increase the (artificial) CO₂ or
described **3**

Q13 (c) (i - vi)	Number of correct responses	1	2	3	4	5	6	7	8
	Mark	3	6	9	12	15	18	21	24

Question 14 **60**

- (a) (i) *What is meant by the term digestion?*
The breakdown of food **3**
- (ii) *Why is digestion necessary in humans?*
To make nutrients (or food) soluble or for absorption of nutrients (or food) or for transport of nutrients (or food) **3**
- (iii) *What name is given to the removal of undigested wastes from the human body?*
*Egestion **3**

Q14 (a) (i - iii)	Number of correct responses	1	2	3
	Mark	3	6	9

- (b) (i) *Give the precise location in the where these villi are most abundant?*
Small intestine or ileum or duodenum or jejunum **3**
- (ii) *What is the main function of villi in the human digestive system?*
To increase surface area or for absorption (of nutrients) **3**
- (iii) *Name the part labelled X and state its role:*
Name: *Lacteal **3**
Role: To absorb (digested) fats (or fatty acids) **3**
- (iv) *Name the blood vessel that carries the digested nutrients:*
*Hepatic portal vein **3**
- (v) *To what organ in the body are these nutrients first transported?*
*Liver **3**
- (vi) *Give one other function of the liver other than storage:*
Detoxification or produces bile or breaks down red blood cells or deamination or any other valid function **3**
- (vii) *Name the process and explain how food is moved along the digestive system:*
Name: *Peristalsis **3**
Explain: Muscular contractions **3**

Q14 (b) (i - vii)	Number of correct responses	1	2	3	4	5	6	7	8	9
	Mark	3	6	9	12	15	18	21	24	27

Question 14 (continued)

- (c) (i) Which plant would you expect to show the lowest rate of transpiration?
*B **3**
- Explain your answer:
Lowest number (or density) of stomata **3**
- (ii) Indicate **two** other methods plants use to control transpiration:
Waxy cuticle / action of stomata / location of stomata / any other valid methods
Any two 2(3)
- (iii) Give **two** structural differences between xylem and phloem:
Xylem has pits and phloem does not /
Xylem has lignin and phloem does not /
Phloem has companion cells and xylem does not /
Phloem has nuclei and xylem does not /
Phloem has sieve plates and xylem does not /
Xylem is a continuous tube and phloem is not /
Xylem has vessels or tracheids and phloem does not **Any two 2(3)**

Q14 (c) (i - iii)	Number of correct responses	1	2	3	4	5	6
	Mark	3	6	9	12	15	18

- (iv) Draw **and** label a detailed longitudinal section (L.S.) of a xylem vessel:
Drawing: Continuous vessel(s) with lignin or pits **3**

Q14 (c) (iv) Drawing	Number of correct responses	1
	Mark	3

- Labels: Pits / lignin / wall **3(1)**

Q14 (c) (iv) Labels	Number of correct responses	1	2	3
	Mark	1	2	3

Question 15	60																		
(a) (i) <i>Explain homeostasis:</i> Maintaining a constant (or stable) internal environment	3																		
(ii) <i>Name one anatomical and one chemical way plants can protect themselves:</i> <i>Anatomical:</i> Thorns <u>or</u> stinging hairs <u>or</u> cuticle <u>or</u> any valid example <i>Chemical:</i> Heat shock proteins <u>or</u> stress proteins <u>or</u> growth regulators (tropism) <u>or</u> unpalatable substances <u>or</u> sting <u>or</u> any valid example	3 3																		
Q15 (a) (i - ii)	<table border="1"> <tr> <td>Number of correct responses</td> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td>Mark</td> <td>3</td> <td>6</td> <td>9</td> </tr> </table>	Number of correct responses	1	2	3	Mark	3	6	9										
Number of correct responses	1	2	3																
Mark	3	6	9																
(b) (i) <i>Name the structures:</i> A: *Anther B: *Filament C: *Ovary	1 1 1																		
Q15 (b) (i)	<table border="1"> <tr> <td>Number of correct responses</td> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td>Mark</td> <td>1</td> <td>2</td> <td>3</td> </tr> </table>	Number of correct responses	1	2	3	Mark	1	2	3										
Number of correct responses	1	2	3																
Mark	1	2	3																
(ii) <i>Is this flower insect or wind-pollinated?</i> *Wind	3																		
(iii) <i>Using the diagram, give two reasons to support your answer at part (ii):</i> Large stigma (or anther) / feathery stigma / stigma (or anthers) outside (the flower) / long style (or long filament) Letter labels from diagram acceptable Any two	2(3)																		
(iv) <i>What are the roles of A and D?</i> A: Produce pollen <u>or</u> release pollen D: Trap (or catch) pollen	3 3																		
(v) <i>Give one disadvantage of self-pollination:</i> Less (genetic) variation <u>or</u> offspring will be more susceptible to disease	3																		
(vi) 1. <i>Which labelled part develops into the fruit?</i> *C (or ovary) 2. <i>Give one way seedless fruit may develop:</i> Spray with growth regulators (auxin) <u>or</u> selective breeding (or described)	3 3																		
Q15 (b) (ii - vi)	<table border="1"> <tr> <td>Number of correct responses</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> <td>8</td> </tr> <tr> <td>Mark</td> <td>3</td> <td>6</td> <td>9</td> <td>12</td> <td>15</td> <td>18</td> <td>21</td> <td>24</td> </tr> </table>	Number of correct responses	1	2	3	4	5	6	7	8	Mark	3	6	9	12	15	18	21	24
Number of correct responses	1	2	3	4	5	6	7	8											
Mark	3	6	9	12	15	18	21	24											

Question 15 (continued)

- (c) (i) *Germination:*
Growth of seed (or embryo) into a (new) plant (or named parts of plant) **3**
- Dispersal:*
Carrying (or scattering) of seed away from the parent plant (or described) **3**
- Dormancy:*
Period of no growth (or reduced growth or low metabolism or inactivity) **3**
- (ii) *Outline how dormancy in seeds benefits the plant species:*
(Seeds) germinate when conditions are suitable or allows time for (greater) dispersal or survive unsuitable conditions or allows embryo time to mature **3**
- (iii) *Give **two** roles of water in the process of germination:*
Soften (or split) testa (seed coat) /
activate enzymes (or plant growth regulators) /
increase (or activate) metabolism (or described)/
transport nutrients /
dissolve nutrients /
dissipate inhibitors **Any two 2(3)**
- (iv) *Identify **two** possible food stores in seeds:*
Cotyledon (or seed leaf) **3**
Endosperm **3**

Q15 (c) (i - iv)	Number of correct responses	1	2	3	4	5	6	7	8
	Mark	3	6	9	12	15	18	21	24

Question 16 **Any two of (a), (b), (c), (d)** **30, 30**

Question 16 (a)	30																						
(i) Which labelled structure is involved in vasoconstriction? *B (or arteriole)	3																						
(ii) Explain the role of vasoconstriction in temperature regulation: In cold conditions / arterioles (or blood vessels) narrow / less blood flow to skin / less heat lost <u>or</u> more heat retained	Any three 3(3)																						
(iii) Which labelled structure is involved in piloerection? *A (or hair)	3																						
(iv) Which labelled structure is involved in both excretion and temperature regulation? *C (or sweat gland)	3																						
(v) Name the excretory product produced by the part named at (iv): Sweat (or two named components)	3																						
(vi) Name given to organisms that can generate their own heat: *Endotherm	3																						
(vii) Name two other systems in which the skin has a role: Nervous (or sensory)	3																						
Defence (or immune)	3																						
Q16 (a) (i - vii)	<table border="1"> <tr> <th>Number of correct responses</th> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td> </tr> <tr> <th>Mark</th> <td>3</td><td>6</td><td>9</td><td>12</td><td>15</td><td>18</td><td>21</td><td>24</td><td>27</td><td>30</td> </tr> </table>	Number of correct responses	1	2	3	4	5	6	7	8	9	10	Mark	3	6	9	12	15	18	21	24	27	30
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Mark	3	6	9	12	15	18	21	24	27	30													

Question 16 (b)	30														
(i) Diagram: Penis and urethra and sperm duct and testis	All four 3 + 3														
	Any one missing only 3 marks														
Q16 (b) (i) Drawing	<table border="1"> <tr> <th>Number of correct responses</th> <td>1</td><td>2</td> </tr> <tr> <th>Mark</th> <td>3</td><td>6</td> </tr> </table>	Number of correct responses	1	2	Mark	3	6								
Number of correct responses	1	2													
Mark	3	6													
Labels: Testis / sperm duct / prostate gland / urethra / penis / scrotum	6(1)														
Q16 (b) (i) Labels	<table border="1"> <tr> <th>Number of correct responses</th> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> <tr> <th>Mark</th> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> </table>	Number of correct responses	1	2	3	4	5	6	Mark	1	2	3	4	5	6
Number of correct responses	1	2	3	4	5	6									
Mark	1	2	3	4	5	6									
(ii) Give the differences between the human male and female gametes using the following headings:															
1. Relative numbers:	A low number of female gametes (or eggs) and a high number of male gametes (or sperm) 3														
2. Frequency of production:	Monthly (or from puberty to menopause) in females and continuously (or described) (or from puberty onwards) in males 3														
3. Relative size:	Large in females (or egg is large) and small in males (or sperm are small) 3														
(iii) What is meant by secondary sexual characteristics?	Features that distinguish male from female other than sex organs <u>or</u> features that distinguish the sexes but are not essential for reproduction <u>or</u> features that emerge at puberty 3														
(iv) Name the hormone responsible for male secondary sexual characteristics: *Testosterone	3														
(v) Give one cause of male infertility: Low sperm count <u>or</u> low sperm motility <u>or</u> hormonal	3														
Q16 (b) (ii - v)	<table border="1"> <tr> <th>Number of correct responses</th> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> <tr> <th>Mark</th> <td>3</td><td>6</td><td>9</td><td>12</td><td>15</td><td>18</td> </tr> </table>	Number of correct responses	1	2	3	4	5	6	Mark	3	6	9	12	15	18
Number of correct responses	1	2	3	4	5	6									
Mark	3	6	9	12	15	18									

Question 16 (c)												30
(i)	Name two places in the body where mucous membrane linings are found: Respiratory tract / digestive tract / reproductive tract / any correct examples	Any two										2(3)
(ii)	Give precise location where lymphocytes are produced: *(Red) bone marrow											3
(iii)	Identify the particular type of white blood cell that produces antibodies: *B (lymphocytes)											3
(iv)	Identify one other type of white blood cell: Monocyte <u>or</u> macrophage <u>or</u> phagocyte (phagocytic) <u>or</u> other correctly named WBC											3
(v)	1. Compare the antibody response after vaccine (A) and infection (B): (Antibody response) is slow after vaccine (or A) and fast after infection (or B) Number (of antibodies) produced is low after vaccine (or A) and high after infection (or B)											3
	2. Suggest a reason for this: After A, 1 st time infected (or described) <u>or</u> no memory cells (present) <u>or</u> After B, memory cells present											3
(vi)	Identify the part of the virus that is recognised by antibodies: Protein (coat) <u>or</u> capsid <u>or</u> antigen											3
(vii)	Explain why an antibiotic is not prescribed to cure COVID-19: Antibiotics have no effect against viruses <u>or</u> antibiotics only kill bacteria											3
Q16 (c) (i - vii)		Number of correct responses	1	2	3	4	5	6	7	8	9	10
		Mark	3	6	9	12	15	18	21	24	27	30

Question 16 (d)												30
(i)	Name the structures involved in gaseous exchange: *Alveoli											3
(ii)	State two adaptations of these structures to increase the efficiency of gaseous exchange: Large surface area / rich (blood) capillary supply / moist surface / membranes (or walls) are thin <u>or</u> walls one cell thick	Any two										2(3)
(iii)	Identify the gas that controls the rate of breathing: *Carbon dioxide (CO ₂)											3
(iv)	Identify the region of the human brain that detects the gas you have named at (iii) above: *Medulla oblongata											3
(v)	How does the breathing system respond to a high level of the gas named at (ii) above? Increases rate <u>or</u> increases depth (of breathing)											3
(vi)	Process of inhalation: Brain sends impulse (message) to muscles / intercostal muscles and diaphragm contract / ribcage moves up and out / diaphragm moves down / volume of thoracic cavity (or chest) increases / pressure inside (thoracic cavity or chest) decreases / air moves in	Any four										4(3)
Q16 (d) (i - vi)		Number of correct responses	1	2	3	4	5	6	7	8	9	10
		Mark	3	6	9	12	15	18	21	24	27	30

Question 17	Any two of (a), (b), (c), (d)	30, 30
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- | | | |
|------------------------|--|-----------|
| Question 17 (a) | | 30 |
| (i) | Name: <i>Rhizopus</i> <u>or</u> bread mould | 3 |
| | Kingdom: *Fungus (fungi) | 3 |
| (ii) | Name the parts labelled A :
*Sporangiophore | 3 |
| (iii) | State the mode of nutrition used by this organism:
*Saprophytic <u>or</u> *heterotrophic | 3 |
| (iv) | Discuss the importance of this type of nutrition in nature:
Decomposer <u>or</u> recycles minerals <u>or</u> described | 3 |
| (v) | Name the horizontal hyphae labelled B and state their role:
Name: *Stolons | 3 |
| | State: Spreading the fungus <u>or</u> asexual reproduction | 3 |
| (vi) | Give one function of:
Spores: (Asexual) reproduction <u>or</u> dispersal | 3 |
| | Rhizoids: Absorption <u>or</u> anchorage <u>or</u> secretion | 3 |
| (vii) | Describe one environmental condition which may stimulate sexual reproduction:
Drought <u>or</u> unsuitable temperature <u>or</u> named adverse condition | 3 |

Q17 (a) (i - vii)	Number of correct responses	1	2	3	4	5	6	7	8	9	10
	Mark	3	6	9	12	15	18	21	24	27	30

- | | | |
|------------------------|--|---------------------|
| Question 17 (b) | | 30 |
| (i) | Name: * <i>Amoeba</i> | 3 |
| | Kingdom: *Protist(a) (or Protoctista) | 3 |
| (ii) | Suggest a typical habitat for this organism:
(Fresh) water <u>or</u> example (pond, lake, etc.) | 3 |
| (iii) | Name structure A :
*Pseudopod | 3 |
| (iv) | Give one function for this structure, other than engulfing prey:
*Movement | 3 |
| (v) | Name the structure labelled B :
*Contractile vacuole | 3 |
| | Function of part B :
Osmoregulation <u>or</u> get rid of excess water (or explained) | 3 |
| (vi) | Name structure C :
*Food vacuole | 3 |
| (vii) | Describe two ways the cell of this organism differs to a bacterial cell:
<i>Amoeba</i> is eukaryotic and bacteria are prokaryotic /
<i>Amoeba</i> has a nucleus and bacteria do not /
Bacteria may have plasmids and <i>Amoeba</i> does not /
Bacteria may have flagella and <i>Amoeba</i> does not /
<i>Amoeba</i> has pseudopods and bacteria do not /
<i>Amoeba</i> has contractile vacuoles and bacteria do not /
<i>Amoeba</i> is a large cell and bacteria are small cells /
Bacteria have a cell wall and <i>Amoeba</i> does not /
Bacteria can have capsule and <i>Amoeba</i> does not | Any two 2(3) |

Q17 (b) (i - vii)	Number of correct responses	1	2	3	4	5	6	7	8	9	10
	Mark	3	6	9	12	15	18	21	24	27	30

Question 17 (c)	30																						
(i) Name the tissue labelled X: X: *Meninges	3																						
(ii) What is a reflex action? Automatic (or involuntary) response to a stimulus	3																						
(iii) Give an example of a reflex action in the human body: Blinking <u>or</u> iris response to light <u>or</u> knee jerk <u>or</u> grasp <u>or</u> startle <u>or</u> any correct example	3																						
(iv) Give one advantage of a reflex action: Protection <u>or</u> fast <u>or</u> involuntary	3																						
(v) Describe how a reflex action works: Stimulus (or named) detected by receptor / impulse (or message) set up (at receptor) / impulse (or message) sent along B (or sensory neuron) / (passes) to C (or interneuron) / in CNS (or grey matter) / (passes) to A (or motor neuron) / to the effector / effector reacts	Any four 4(3)																						
(vi) Give two ways in which a nervous response differs from a hormonal response: Nervous response is fast and hormonal response is slow / nervous response is electrical and hormonal response is chemical / nervous response is short-lived and hormonal response is prolonged	Any two 2(3)																						
Q17 (c) (i - vi)	<table border="1"> <tr> <th>Number of correct responses</th> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td> </tr> <tr> <th>Mark</th> <td>3</td><td>6</td><td>9</td><td>12</td><td>15</td><td>18</td><td>21</td><td>24</td><td>27</td><td>30</td> </tr> </table>	Number of correct responses	1	2	3	4	5	6	7	8	9	10	Mark	3	6	9	12	15	18	21	24	27	30
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Question 17 (d)	30																						
(i) Name of the condition of cells in A: *Turgid	3																						
(ii) Describe how the cells in image A maintain their current shape: Turgor pressure or explained <u>or</u> cell wall	3																						
(iii) Suggest how solution B differs from solution A: Solution B has more solute (or example) (than A) <u>or</u> solution B is more concentrated (than A)	3																						
(iv) Name of process that occurred to cells in B: Osmosis	3																						
Describe: Water moved from high water concentration to low water concentration Across the selectively permeable membrane <u>or</u> from the inside of the cell to the outside	3																						
(v) How could these cells be restored to the condition A? Place in water (with little or no solutes)	3																						
(vi) How can knowledge of the process shown in image B be applied to food production? Can kill bacteria (or fungi or microorganisms) (on food) <u>or</u> food can be preserved <u>or</u> (food) can have a longer shelf-life	3																						
(vii) 1. Outline how the scientist uses a coverslip: Lowered slowly <u>or</u> lowered at an angle <u>or</u> lowered with a needle	3																						
2. Explain why a coverslip is used: Prevent specimen from drying out <u>or</u> to protect the (objective) lens <u>or</u> to hold specimen in place	3																						
Q17 (d) (i - vii)	<table border="1"> <tr> <th>Number of correct responses</th> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td> </tr> <tr> <th>Mark</th> <td>3</td><td>6</td><td>9</td><td>12</td><td>15</td><td>18</td><td>21</td><td>24</td><td>27</td><td>30</td> </tr> </table>	Number of correct responses	1	2	3	4	5	6	7	8	9	10	Mark	3	6	9	12	15	18	21	24	27	30
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