Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2023

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, 2023 (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**.

Sample answer: ~~*Lignin*~~

The answer, which is correct, has been cancelled by the candidate, but there is no additional or surplus answer, therefore the candidate may be awarded **4 marks**.

Sample answer: *Lignin,* ~~*chitin*~~

There is a surplus answer, which is incorrect, but it has been cancelled and as the candidate has given more than one answer (i.e. the candidate is answering the question more than once only), the cancelling can be accepted and s/he may be awarded **4 marks**.

(ii) **Sample question 2**: *Name the four elements that are always present in protein.*
Marking scheme states: Carbon / hydrogen / oxygen / nitrogen **4(3)**

Sample answer: *Carbon, hydrogen, oxygen, nitrogen, calcium*

There is a surplus answer, which is incorrect, which cancels one of the correct answers, therefore the candidate is awarded **3(3)** marks.

Sample answer: *Carbon, hydrogen, oxygen, calcium*

There is no surplus answer – there are three correct answers, and therefore the candidate is awarded **3(3)** marks.

Sample answer: *Carbon, hydrogen, oxygen, calcium, aluminium*

There is a surplus answer, which is incorrect, and cancels one of the three correct answers, therefore the candidate is awarded **2(3)** marks.

Sample answer: *Carbon, hydrogen, oxygen, calcium,* ~~*aluminium*~~

There is a surplus answer, which is incorrect, but it has been cancelled so the candidate may be awarded **3(3)** marks.

In the other sections of the paper (Sections B and C), there may be instances where a correct answer is nullified by the addition of an incorrect answer. This happens when the only acceptable answer is a specific word or term. Each such instance is indicated in the scheme by an asterisk *.

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 that one mark has been awarded.
	This symbol indicates that two marks have been awarded.
	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 diagram. Used in the following questions in 2023: Q9 (b) (i); Q15 (b) (i); Q16 (d) (iv); and Q17 (d) (vi).
	This symbol is used to indicate an incorrect response for a diagram. Used in the following questions in 2023: Q9 (b) (i); Q15 (b) (i); Q16 (d) (iv); and Q17 (d) (vi).
	This symbol is used to indicate a correct response for a label on a diagram. Used in the following questions in 2023: Q9 (b) (i); Q14 (b) (i); Q15 (b) (i); Q16 (d) (iv); and Q17 (d) (vi).
	This symbol is used to indicate an incorrect response for a label on a diagram. Used in the following questions in 2023: Q9 (b) (i); Q14 (b) (i); Q15 (b) (i); Q16 (d) (iv); and Q17 (d) (vi).

Bonus marks for answering through the medium of Irish

Bonus marks at the rate of 10% of the marks obtained will be given to a candidate who answers entirely through Irish and who obtains 75% or less of the total mark available in (i.e. 300 marks or less). In calculating the bonus to be applied, decimals are always rounded down, not up ¬ e.g., 4.5 becomes 4; 4.9 becomes 4, etc. See below for when a candidate is awarded more than 300 marks.

Marcanna Breise as ucht freagairt trí Ghaeilge

Léiríonn an tábla thíos an méid marcanna breise ba chóir a bhronnadh ar iarrthóirí a ghnóthaíonn níos mó ná 75% d'iomlán na marcanna.

N.B. Ba chóir marcanna de réir an ghnáthráta a bhronnadh ar iarrthóirí nach ngnóthaíonn níos mó ná 75% d'iomlán na marcanna don scrúdú. Ba chóir freisin an marc bónais sin **a shlánú síos**.

Tábla 400 @ 10%

Bain úsáid as an tábla seo i gcás na n-ábhar a bhfuil 400 marc san iomlán ag gabháil leo agus inarb é 10% gnáthráta an bhónais.

Bain úsáid as an ngnáthráta i gcás 300 marc agus faoina bhun sin. Os cionn an mharc sin, féach an tábla thíos.

Bunmharc	Marc Bónais
301 - 303	29
304 - 306	28
307 - 310	27
311 - 313	26
314 - 316	25
317 - 320	24
321 - 323	23
324 - 326	22
327 - 330	21
331 - 333	20
334 - 336	19
337 - 340	18
341 - 343	17
344 - 346	16
347 - 350	15

Bunmharc	Marc Bónais
351 - 353	14
354 - 356	13
357 - 360	12
361 - 363	11
364 - 366	10
367 - 370	9
371 - 373	8
374 - 376	7
377 - 380	6
381 - 383	5
384 - 386	4
387 - 390	3
391 - 393	2
394 - 396	1
397 - 400	0

Section A	**Best 5**	**100**

Question 1	**Best five answers from (a) – (f)**	**3(6) + 2(1)**

(a) *Name the **three** chemical elements that are present in **all** carbohydrates.*

Carbon, hydrogen and oxygen *(accept C, H and O)*

(b) *Give the general formula for carbohydrates.*

$C_x(H_2O)_y$

(c) *Name the smallest unit of a carbohydrate.*

Monosaccharide

(d) *Name the type of carbohydrate formed when many of the smallest units of a carbohydrate bond together.*

Polysaccharide

(e) *Give **one** structural role of carbohydrates in living organisms.*

Cell wall **or** other correct

(f) *State **one** dietary source of carbohydrates.*

Bread **or** pasta **or** other correct dietary source

6

Q1 (a) – (f)	**Number of correct responses**	1	2	3	4	5	6
	Mark	6	12	18	19	20	20

Question 2	**2(5) + 5(2)**

(a) *Draw a vertical line on the graph that indicates a pH most suitable for the germination of grass seeds.*

Correct vertical line drawn through peak

(b) *Explain the term hypothesis.*

Proposed (or possible) explanation for an observation

(c) *State **one** variable from the investigation described.*

(Soil) pH **or** percentage germination

(d) *What is the function of a control?*

To act as a comparison to the test (or results or experiment)

(e) *Where might the horticulturist first publish the results of their research?*

Scientific journal (or named)

(f) *Give **two** limitations of the scientific method.*

Extent of knowledge / basis of investigation / human error / experimental design / ability to interpret results / application to nature / accidental discovery / bias ***Any two***

7

Q2 (a) – (f)	**Number of correct responses**	1	2	3	4	5	6	7
	Mark	5	10	12	14	16	18	20

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

(a) *Give **two** functions of the skeleton.*

Protection / movement / support / blood cell production ***Any two***

(b) *Name any **two** bones of the axial skeleton.*

Skull / vertebra / rib / sternum / mandible ***Any two***

(c) *Name the biomolecule that is the main component of cartilage.*

Protein

(d)† *What are the innominate bones more commonly known as?*

Pelvis **or** hip (bones)

(e) *Draw an arrow from the letter **X** to show the location of a slightly movable joint.*

Correct arrow to a slightly movable joint

7

Q3 (a) – (e)	**Number of correct responses**	1	2	3	4	5	6	7
	Mark	5	10	12	14	16	18	20

† Award the assigned marks for part (d) where a candidate has attempted Q3.

Question 4 **2(5) + 5(2)**

(a) *Complete **and** label the diagram of the DNA molecule.*

A **and** C correctly drawn **and** labelled

(b) *Draw a rectangle around any **one** DNA nucleotide.*

Rectangle correctly indicating one DNA nucleotide showing one phosphate, one deoxyribose and one base

(c) *What does DNA stand for?*

Deoxyribonucleic acid

(d) *What type of bonding is represented by the letter **X** on the diagram?*

Hydrogen **or** H (bonding)

(e) ***T** is a pyrimidine base. What type of base is **G**?*

Purine

(f) *Name **one** organelle in eukaryotic cells, other than the nucleus, which contains DNA.*

Mitochondrion **or** chloroplast

(g) *Name the base present in RNA that is not present in DNA.*

Uracil **or** U

7

Q4 (a) – (g)	**Number of correct responses**	1	2	3	4	5	6	7
	Mark	5	10	12	14	16	18	20

Question 5 **2(5) + 5(2)**

(a) *Which type represents the bacterial cell in the picture?*

Rod

(b) *Draw an arrow from **X** to the location of the bacterial cell wall.*

Arrow drawn correctly to cell wall

(c) *What term describes how bacteria reproduce asexually?*

Binary fission

(d) *Give any **one** factor that affects the growth of bacteria.*

Temperature **or** pH **or** oxygen **or** food **or** any correctly named factor

(e) *Name any **one** harmful bacterium.*

Any named harmful bacterium

(f) *(i) By drawing **on the graph**, complete the first part of the curve.*

Curve showing both lag **and** log phases

*(ii) Name the stage indicated by the letter **Z**.*

Decline **or** death

7

Q5 (a) – (f)	**Number of correct responses**	1	2	3	4	5	6	7
	Mark	5	10	12	14	16	18	20

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

*Give a brief biological explanation for **each** of the following:*

(a) *Food chains are limited in length.*

Low amount of energy passed on (at each trophic level) **or** large amount of energy lost (at each trophic level)

(b) *There is always competition between members of a species.*

Resources are limited **or** need the same resources **or** overbreeding **or** high reproduction rates

(c) *Fruit formation by plants.*

To protect seeds **or** to aid seed dispersal

(d) *Urine volume will be low if a person does not regularly drink fluids.*

More water is reabsorbed **or** ADH increases permeability of collecting duct (or distal convoluted tubule).

(e) *Doctors do not prescribe antibiotics for viral infections.*

(Antibiotics) do not affect viruses **or** (antibiotics) only kill bacteria (or fungi)

(f) *Meiosis halves the number of chromosomes in cells.*

To produce gametes (for sexual reproduction) **or** to allow for the diploid number following fertilisation **or** to restore chromosome number

(g) *The septum separates the two sides of the human heart.*

To prevent oxygenated **and** deoxygenated blood from mixing

7

Q6 (a) – (g)	**Number of correct responses**	1	2	3	4	5	6	7
	Mark	5	10	12	14	16	18	20

Question 7 **20**

4 + 2(1)

(a) (i) *Which colour of light is absorbed most by chlorophyll **a**?*

Violet

(ii) *Which colour of light is absorbed most by chlorophyll **b**?*

Blue

(iii) *What happens to green and yellow light when they strike chlorophyll?*

It is reflected **or** not absorbed

3

Q7 (a) (i) – (iii)	**Number of correct responses**	1	2	3
	Mark	4	5	6

3(4) + 2(1)

(b) *Give **two** possible fates of these energised electrons.*

Returns to chlorophyll **or** enters a cyclic pathway (or pathway 1) **or** pass to electron carriers (acceptors)

Transferred to $NADP^+$ (accept NADP) **or** to make $NADP^-$ (or NADPH) **or** enters a non-cyclic pathway (or pathway 2) **or** added to CO_2 to make carbohydrate (glucose)

(c) *Name another molecule which can provide electrons during photosynthesis.*

Water

(d) *Identify a source of the molecule you named at part (c) above for photosynthesis in the plant.*

Soil (or other correct)

(e) *Suggest **one** reason why horticulturists might use carbon dioxide enrichment in a greenhouse.*

Improve (crop) yield **or** increased photosynthesis

5

Q7 (b) – (e)	**Number of correct responses**	1	2	3	4	5
	Mark	4	8	12	13	14

Section B	**Best 2**	**60**

Question 8 **30**

2(3)

(a) *Write down the terms that describe each of the following:*

(i) *The parts of the Earth where life can exist.*

Biosphere **3**

(ii) *Living factors that have an effect on an ecosystem.*

Biotic **3**

2

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

8(3)

(b) (i) *Identify the following animal collection apparatus **and** describe how they would be used.*

Apparatus: Pooter **3**

How used: Suck through A **and** animal enters through B. **3**

Apparatus: Tullgren funnel **3**

How used: Heat (or warmth or light) causes animals to move downwards **3**

(ii) *Describe how you carried out a quantitative survey of plants using the percentage cover technique.*

Quadrat **3**

Random (sample) / how random / count (plants) or estimate cover or frequency / repeat **or** a number of times / a correct calculation described ***Any three*** **3(3)**

8

Q8 (b) (i) – (ii)	**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 the term anaerobic?*

Oxygen is absent **or** oxygen is limiting **3**

(ii) *What other substance is produced in animal cells as a result of anaerobic respiration?*

***Lactic acid **3**

2

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

2(3)

(b) (i) *Draw a labelled diagram showing how you set up the apparatus to prepare alcohol using yeast.*

Diagram: container **and** solution **3**

indication of anaerobic conditions (e.g. oil on top **or** anaerobic lock) **3**

2

Q9 (b) (i) Diagram:	Number of correct responses	1	2
	Mark	3	6

3(1)

Labels: flask **or** beaker / water bath / another correct piece of apparatus / yeast / glucose / oil **or** anaerobic lock / ***Any three*** **3(1)**

3

Q9 (b) (i) Labels:	Number of correct responses	1	2	3
	Mark	1	2	3

5(3)

(ii) *Explain the importance of keeping the yeast cells at an optimum temperature.*

Allows the enzymes to work at their best (rate of activity) **3**

(iii) *Explain why alcohol production eventually stops.*

(The yeast) runs out of glucose (nutrients or substrate) **or** build-up of waste (alcohol) **3**

(iv) *How did you know when the reaction had stopped?*

Bubbles stop **or** solution (or yeast) settles **3**

(v) *Name a test for alcohol **and** give the final colour observed if alcohol was present.*

Name: Iodoform **3**

Final colour: Yellow **3**

5

Q9 (b) (ii) – (v)	Number of correct responses	1	2	3	4	5
	Mark	3	6	9	12	15

Question 10 **30**

2(3)

(a) *Distinguish between the terms, asepsis **and** sterility, as applied to living organisms.*

Asepsis: Free from pathogens **3**

Sterility: Free from (micro)organisms **3**

2

Q10 (a)	**Number of correct responses**	1	2
	Mark	3	6

8(3)

(b) (i) *Answer the following based on the growth of leaf yeast using agar plates.*

1. *Name a nutrient added to the agar to enable the growth of leaf yeast.*
   Malt **3**
2. *Describe the control you used in this investigation.*
   (Agar plate) without a leaf (or a sterilised leaf) **3**

(ii) *Answer the following based on dissecting, displaying and identifying an ox's or sheep's heart.*

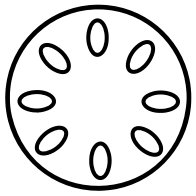
1. *Name **one** instrument you used to make the incisions.*
   Scalpel **or** blade **3**
2. *Describe **one** difference between the walls of the right and left ventricles.*
   The walls of the left (ventricle) were thicker (than the walls of the right) **3**

(iii) *Answer the following based on investigating the effect of IAA on plant tissue.*

1. *Name a suitable plant tissue you used.*
   Root **or** shoot **or** seed **or** named seed **3**
2. *Describe how you measured the effect of IAA on plant tissue.*
   Measured lengths using a ruler (or grid) **3**

(iv) *Answer the following based on viewing a TS of a dicot stem using the light microscope.*

1. *Explain the importance of the section being thin.*
   So that light can pass through the section **or** section can be seen more clearly **3**
2. *Sketch what you observed under the light microscope.*
   Sketch showing dermal and vascular tissue



3

8

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

Section C	**Best 4**	**4(60)**

Question 11 **60**

3(3)

(a) *Explain each of the following terms as used in ecology:*

(i) *Ecosystem*

Organisms and their environment **3**

(ii) *Habitat*

Place where an organism lives **3**

(iii) *Niche*

Role of an organism **3**

3

Q11 (a) (i) – (iii)	**Number of correct responses**	1	2	3
	Mark	3	6	9

9(3)

(b) (i) *Name the type of ecological relationship between ash and the pathogen.*

Parasitism **3**

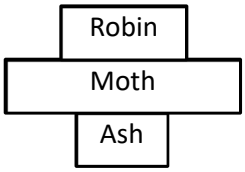
(ii) *State a way that ecologists could ensure the survival of ash trees in Ireland.*

Establish a gene bank of resistant (or tolerant) trees **or** thinning **or** diversifying species **or** other correct way **3**

(iii) *Write down a food chain based on the information given in the passage.*

Ash → Moth → Robin **3**

(iv) *Sketch a pyramid of numbers based on the food chain*



Correct order with Ash on the bottom **3**

Partially upright pyramid drawn **3**

(v) *Suggest **two** possible effects on the ecosystem if all ash trees in Ireland died.*

Moth (or other consumers of ash) population falls / robin (or other consumer of moths) population falls / other plant populations increase / soil erosion / any correct environmental effect ***Any two*** **2(3)**

(vi) *1. Name the type of ecological relationship that exists between the robin and the moth.*

Predation **or** predator-prey **3**

2. Explain the importance of this type of ecological relationship in nature.

Population control **or** described **3**

9

Q11 (b) (i) – (vi)	**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)

8(3)

(c) *Describe the main events of each of the following:*

(i) *The nitrogen cycle*

Nitrogen (gas) to usable compounds / plant protein to animal protein / waste releasing N compounds / decomposition releases N compounds / ammonium to nitrite / nitrite to nitrate / nitrates to plant protein / nitrogen compounds to nitrogen gas / any one named process ***Any four*** **4(3)**

(ii) *The carbon cycle*

Carbon dioxide is fixed into plant carbohydrate (or sugars) / plant carbohydrate to animal carbohydrate / living organisms releases carbon dioxide / decay of organisms releases carbon dioxide / combustion of fossil fuels releases carbon dioxide / any one named process ***Any four*** **4(3)**

8

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

Question 12 **60**

3(3)

(a) (i) *Explain the term metabolism.*

(All) chemical reactions in an organism (or in a cell) **3**

(ii) *Is the reaction shown below an anabolic or catabolic?*

***Catabolic** **3**

Explain your answer.

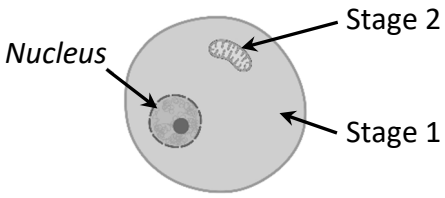
Large molecule broken down into smaller molecules **or** energy released **3**

3

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

9(3)

(b) (i) *Copy the diagram of the cell **and** indicate clearly the specific locations of stage **1** and stage **2**.*



3

3

(ii) *What is the name given to stage **1**?*

***Glycolysis** **3**

(iii) *Stage **1** ends with the formation of a three-carbon compound. Name this compound.*

***Pyruvate **or** pyruvic acid **3**

(iv) *Describe in detail what happens to these electrons after they are removed.*

Pass to $NAD^{(+)}$ / to make NADH / pass to electron transport chain / lose energy / pass to oxygen / and to protons (H^+ or hydrogen ions) / to make water ***Any three*** **3(3)**

(v) *Complete the missing parts of the equation.*

ADP + P + *Energy* → *ATP* + H_2O **2(3)**

9

Q12 (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 12 (continued)

8(3)

(c) (i) *What is an enzyme?*

Protein (or biological) catalyst **3**

(ii) *Describe in detail the active site theory of enzyme action.*

Complementary shape to substrate / active site changes shape **or** induced fit / to accommodate substrate / enzyme substrate complex is formed / product formed / enzyme unchanged **or** active site changes back to original shape **or** enzyme can be reused ***Any four*** **4(3)**

(iii) *Describe what happens to an enzyme if it is overheated.*

Loses shape **or** loses function **or** becomes denatured **3**

(iv) *Give **one** example of a catabolic enzyme **and one** example of an anabolic enzyme.*

Catabolic enzyme: Amylase **or** any correct example **3**

Anabolic enzyme: Polymerase **or** any correct example **3**

8

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**

3(3)

(a) (i) *Which famous scientist is regarded as the father of genetics?*

(Gregor) Mendel **3**

(ii) *State the Law of Segregation.*

Each trait is controlled by a pair of factors / these factors separate during the formation of gametes / each gamete contains only one factor for each trait

Any two **2(3)**

3

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

9(3)

(b) (i) *Explain each of the underlined terms ('gene' and 'recessive').*

Gene: Piece of DNA (or chromosome) that codes for a protein **or** unit of inheritance **3**

Recessive: Allele masked by the dominant allele or explained **3**

(ii) *Give **one** possible cause of gene mutations.*

Chemicals **or** radiation **or** named example **3**

(iii) *Name another type of genetic mutation **and** give a condition caused by this type of mutation.*

Name: *Chromosome **3**

Give: Down's syndrome (or other correctly named condition) **3**

(iv) *Explain how it is possible for two unaffected parents to have a child who suffers from the condition.*

Parents: Hh x Hh **3**

Allele passed on from both parents (in gametes): h **3**

Offspring: hh **and** sufferer indicated **3**

(v) *How might they check to see if their child was a carrier?*

Genetic screening **or** described **3**

9

Q13 (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 13 (continued)

8(3)

(c) (i) *What term is used to describe an allele present on the X chromosome?*

Sex linked or X-linked **3**

(ii) *Draw **two** fully labelled chromosome diagrams showing the positions of each allele:*

Chromosome diagrams showing XX and XY **3**

Correct alleles and loci for each parent **3**

Male and/or female correctly indicated **3**

(iii) *Show how it is possible for the parents to have a male child who does **not** suffer from haemophilia.*

Gametes from Parent 1: XN **3**

Gametes from Parent 2: Y– **3**

Genotype of son: XYN– genotype indicated as a non-sufferer **3**

(iv) *Explain why it would be almost impossible for person **7** to be the parent of a child with haemophilia.*

Person 7 does not have the recessive allele or described **3**

8

Q13 (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 14 **60**

3(3)

(a) (i) *What is the meristem?*

Region where mitosis can occur **or** region of (rapid) cell production **or** region of (active) cell division **3**

(ii) *Give **two** locations in plants where meristematic tissue may be found.*

Shoot tip / root tip / bud / seed / vascular bundles / other correct ***Any two*** **2(3)**

3

Q14 (a) (i) – (ii)	**Number of correct responses**	1	2	3
	Mark	3	6	9

3(1)

(b) (i) *Name structures **A**, **B** and **C**.*

A: Stigma **1**

B: Anther **1**

C: Sepal **1**

3

Q14 (b) (i) Labels:	**Number of correct responses**	1	2	3
	Mark	1	2	3

8(3)

(ii) *Give **one** function for **each** structure **A** and **B**.*

A: Trap pollen or described **3**

B: Produce (or release) pollen **3**

(iii) *Describe **one** way in which a wind-pollinated flower would differ from the animal-pollinated flower.*

Anthers (or stigmas) outside of flower **or** petals green or not colourful or absent **or** no scent **or** no nectar **3**

(iv) *Describe embryo sac development in detail.*

Diploid / megaspore mother cell / divides by meiosis / to produce four haploid cells (or tetrad) / three degenerate / divides by mitosis 3 times / embryo sac containing 8 nuclei (cells) / one becomes egg (cell) / two polar nuclei (formed)

Any four **4(3)**

(v) *What does the ovule develop into if fertilisation occurs?*

*****Seed **3**

8

Q14 (b) (ii) – (v)	**Number of correct responses**	1	2	3	4	5	6	7	8
	Mark	3	6	9	12	15	18	21	24

Question 14 (continued)

8(3)

(c) (i) *What is meant by the term vegetative propagation?*

Asexual reproduction (in plants) **or** growing a new plant using non-reproductive parts (or named part) **3**

(ii) *Name any **two** methods of vegetative propagation used by plants **and** for **each** named method, give **one** example of a plant that carries out that method of vegetative propagation.*

Methods: Stem / root / leaf / bud ***Any two*** **2(3)**

Examples: *Stem:* *e.g.* strawberry (or other correct)

Root: *e.g.* dahlia (or other correct)

Leaf: *e.g.* kalanchoe (or other correct)

Bud: *e.g.* onion (or other correct)

(Two examples, must match methods) **2(3)**

(iii) *Name any **three** examples of methods horticulturists may use to artificially propagate plants.*

Cutting / layering / grafting / micro propagation (tissue culture) ***Any three*** **3(3)**

8

Q14 (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 15 **60**

3(3)

(a) (i) *What is meant by the term secondary sexual characteristics?*

Features that distinguish male from female other than sex organs **or** features that emerge at puberty **3**

(ii) *Give **two** examples of a secondary sexual characteristics present in males.*

Deep voice / enlarged muscles / wide shoulders / body hair (or named) / enlargement of penis / other correct ***Any two*** **2(3)**

3

Q15 (a) (i) – (ii)	**Number of correct responses**	1	2	3
	Mark	3	6	9

2(3)

(b) (i) *Labelled diagram of male reproductive system.*

Diagram: Penis, testis, urethra and sperm duct

(Any one missing only 3 marks) **3+3**

2

Q15 (b) (i) Diagram:	**Number of correct responses**	1	2
	Mark	3	6

6(1)

Labels: Testis / sperm duct / prostate gland / epididymis / penis / scrotum **6(1)**

6

Q15 (b) (i) Labels:	**Number of correct responses**	1	2	3	4	5	6
	Mark	1	2	3	4	5	6

5(3)

(ii) *Give **one** function for each of the following parts:*

Prostate gland: To produce seminal fluid **or** described **3**

Epididymis: To store sperm **or** to allow sperm mature **or** to transport sperm from testes to sperm duct **3**

(iii) 1. *How many chromosomes are found in the nucleus of a typical human sperm cell?*

*23 **3**

2. *Copy out the diagram of the sperm cell **and** indicate on it the location of the mitochondria.*

Mitochondria  **3**

3. *Suggest **one** possible cause of male infertility.*

Low sperm count **or** low sperm mobility **or** low testosterone levels **or** blockage **3**

5

Q15 (b) (ii) – (iii)	**Number of correct responses**	1	2	3	4	5
	Mark	3	6	9	12	15

Question 15 (continued)

8(3)

(c) (i) *How long is the typical menstrual cycle in a human female?*

28 – 31 days *(Accept one month)* **3**

(ii) *Name **each** of the hormones **A** and **B**.*

A: ******** Oestrogen **3**

B: ******** Progesterone **3**

(iii) *Describe **one** effect on the female reproductive system of the low levels of hormones **A** and **B**.*

Menstruation **or** FSH produced **or** new follicle starts developing **3**

(iv) *Explain why hormone **A** levels increase after approximately day 5.*

Follicle secretes (more) oestrogen or FSH stimulates production of oestrogen **3**

(v) *What event occurs around day 14 of the menstrual cycle?*

Ovulation **or** release of egg (from the ovary) **3**

(vi) *The event you named above is caused by a surge in a pituitary hormone. Name this hormone.*

******** LH (or luteinising hormone) **3**

(vii) *Explain why hormone **B** levels increase in the days after day 14.*

Corpus luteum secretes progesterone or LH stimulates production of progesterone **3**

8

Q15 (c) (i) – (vii)	**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**

10(3)

(i) *Name the substance that causes the change in mass of the plant tissue.*

***Water** **3**

(ii) *What term is given to the movement in and out of the plant tissue of the named substance?*

***Osmosis** **3**

(iii) *At what sugar concentration is there no change in the mass of the plant tissue?*

***4 g/100cm^3** **3**

(iv) *Explain in detail why there is no change in mass at the named sugar concentration.*

***Movement of water into the cells equals the movement of water out of the cells** **3**

***Due to the sugar concentration inside the cells (cytoplasm) being the same as the sugar concentration outside the cells.** **3**

(v) 1. *What term is used to describe the condition of the cells that have been soaked in the 2 g/100cm^3 solution?*

***Turgid** **3**

2. *Explain how plant cells maintain the condition you named above.*

(Presence of) the cell wall **or** (presence of) the vacuole **or** by taking in as much water as they lose. **3**

(vi) *Explain in detail why the mass of the plant cells reduces in the 12 g/100cm^3 sugar solution.*

Water has moved out of the cells (by osmosis) **3**

(Water moves) from a region of high water concentration (inside the cell) to a region of low water concentration (outside the cell) **or** due to the high sugar concentration outside the cells when compared to inside the cells. **3**

(vii) *What do you think would happen to an animal cell in the 0 g/100cm^3 sugar solution?*

Increase in size **or** swell **or** burst **3**

10

Q16 (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 16 (b) **30**

10(3)

(i) *What is meant by the term genetic engineering?*

(Artificial) manipulation of a gene (or of DNA) **or** alteration of a gene (or of DNA) **3**

(ii) *Describe the process of genetic engineering up to the point of expression of the gene of interest.*

Isolation of DNA (from cells) / cutting of gene (from chromosome) / using restriction enzymes / ligation of gene with vector or host DNA / introduction of base sequence changes to host cell **or** transformation of host cell occurs **or** recombinant DNA enters host cell / transformed cells grown (in nutrient medium). ***Any four*** **4(3)**

(iii) *Name the **two** other types of RNA involved in protein synthesis.*

Messenger RNA (mRNA) **3**

Transfer RNA (tRNA) **3**

(iv) *State **one** application of genetic engineering for **each** of the following:*

1. *Animals:* Any correct application given **3**
2. *Microorganisms:* Any correct application given **3**
3. *Plants:* Any correct application given **3**

10

Q16 (b) (i) – (iv)	**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 (c) **30**

10(3)

(i) *Name structures **X** and **Y**.*

X: Protein (coat) **or** capsid **3**

Y: Nucleic acid **or** DNA **or** RNA **3**

(ii) *Explain the difficulty in describing viruses as living.*

Non-cellular **or** no metabolism **3**

(iii) *Name **two** harmful viruses.*

Common cold virus **or** coronavirus **or** HIV **or** hepatitis virus **or** other correct **2(3)**

(iv) *Give **one** way in which viruses can be beneficial to humans.*

Can be used (as a vector) in genetic engineering **or** can be (potentially) used to treat bacterial infection **or** vaccine production **or** any other valid answer **3**

(v) *Give **two** ways in which the general defence system works to defend against viruses **and two** ways in which the specific defence system defends against viruses.*

General: Skin acts as a barrier / mucus traps pathogens / phagocytes engulf (viral)-infected cells / infected cells release chemicals / white blood cells release chemicals that coordinate the immune response to a pathogen / stomach acid kills pathogens / tears keeps eyes free of pathogens / blood clotting prevents entry of pathogens / fever stops pathogen enzymes working properly / other correct answer ***Any two*** **2(3)**

Specific: (B cells) produce antibodies (against the virus) / memory cells recognise virus / T cells coordinate the immune response / killer T cells kill (viral) infected cells / regulatory (or suppressor T cells) control the immune response / other correct answer ***Any two*** **2(3)**

10

Q16 (c) (i) – (v)	**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**

3(3)

(i) *Suggest **one** way in which you could distinguish between edible and poisonous mushrooms.*
Using a key **or** other correct method **3**

(ii) *Name any **one** example of an edible mushroom.*
Field **or** Chestnut **or** other correct **3**

(iii) *Name any **one** example of a poisonous mushroom.*
Death cap **or** destroying angel **or** other correct **3**

3

Q16 (d) (i) – (iii)	**Number of correct responses**	1	2	3
	Mark	3	6	9

2(3)

(iv) *Diagram of Rhizopus:* stolon **and** rhizoid **and** sporangiophore **and** sporangium
(Any one missing only 3 marks) **3+3**

2

Q16 (d) (iv) Diagram:	**Number of correct responses**	1	2
	Mark	3	6

3(1)

Labels: stolon / rhizoid / sporangium **3(1)**

3

Q16 (d) (iv) Labels:	**Number of correct responses**	1	2	3
	Mark	1	2	3

4(3)

(v) *Give **one** function for **each** of the following parts.*
Stolon: spread (out) **or** growth **or** reproduction **or** colonisation **3**
Rhizoid: anchorage **or** secretion **or** absorption (of nutrients) **3**
Sporangium: asexual reproduction **or** to produce (release) spores **3**

(vi) *Name the mode of nutrition used by Rhizopus.*
Saprophytic **or** heterotrophic **or** decomposition **3**

4

Q16 (d) (v) – (vi)	**Number of correct responses**	1	2	3	4
	Mark	3	6	9	12

Question 17	Any two of (a), (b), (c), (d)	30, 30

Question 17 (a) **30**

4(3)

(i) *Give **one** difference between endocrine and exocrine glands.*

Endocrine glands do not have ducts **and** exocrine glands do have ducts

or

Endocrine glands secrete products into the blood **and** exocrine glands secrete products into ducts **3**

(ii) *Name a gland that has **both** an endocrine function **and** an exocrine function. Name its endocrine product **and** its exocrine product.*

Name: Any correct gland (e.g. pancreas **or** testes **or** kidney **or** other correct) **3**

Endocrine product: Correct matching product **3**

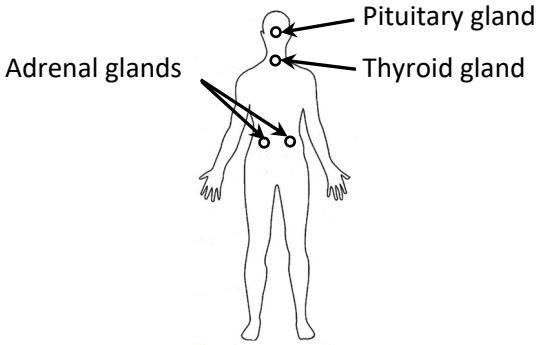
Exocrine product: Correct matching product **3**

4

Q17 (a) (i) – (ii)	**Number of correct responses**	1	2	3	4
	Mark	3	6	9	12

3(2)

(iii) *Draw in and label the location for each of the listed endocrine glands:*



3(2)

3

Q17 (a) (iii)	**Number of correct responses**	1	2	3
	Mark	2	4	6

4(3)

(iv) *For **each** of the following endocrine glands, name a hormone it secretes **and** give its corresponding function.*

Thyroid: Name of hormone: thyroxine **3**

Function: (stimulates) metabolism **3**

Adrenals: Name of hormone: adrenaline **3**

Function: 'fight or flight' (response) **or** other correct function **3**

4

Q17 (a) (iv)	**Number of correct responses**	1	2	3	4
	Mark	3	6	9	12

Question 17 (b) **30**

10(3)

(i) *What term describes the region where two neurons come into close contact?*

*****Synapse **3**

(ii) *What is the name given to the gap between two neurons, indicated by the letter **B** in the diagram?*

*****(Synaptic) cleft **3**

(iii) *What is the general name given to the chemical **A** in the diagram?*

*****Neurotransmitter **3**

(iv) *Where in a neuron is chemical **A** made?*

*****Cell body **3**

(v) *Describe in detail how nerve impulses travel between two neurons in close contact.*

Impulse arrives (at axon terminal) / neurotransmitter (or chemical A or named neurotransmitter) released / diffuses across gap / binds to receptors (on neuron) / impulse starts in (next neuron) / enzymes break down neurotransmitter **or** neurotransmitter recycled (or reabsorbed) / correct mention of presynaptic or postsynaptic ***Any three*** **3(3)**

(vi) *Give the names of the other **two** types of neuron found in the human nervous system.*

Sensory **3**

Motor **3**

(vii) *Describe **one** possible treatment for **either** paralysis **or** Parkinson's disease.*

Physiotherapy **or** surgery **or** other correct **3**

10

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**
	10(3)		
(i)	*In each of the following, name the vein that best matches the description:*		
	1. Carries blood richest in oxygen:	*****Pulmonary (vein)	**3**
	2. Carries blood between the intestine and the liver.	*****Hepatic portal (vein)	**3**
	3. Carries blood lowest in metabolic wastes:	*****Renal (vein)	**3**
	4. Carries blood into the right atrium of the heart:	*****Vena cava	**3**
(ii)	*Sketch the structure of an alveolus and its associated blood supply.*		
	Sketch: Alveolus and capillary		**3**
	***On your sketch**, clearly indicate the overall directions in which oxygen and carbon dioxide are moving.*		
	Oxygen from alveolus to blood.		**3**
	Carbon dioxide from blood to alveolus.		**3**
(iii)	*1. State which diagram (**X** or **Y**) represents inhalation.*		
	*****X		**3**
	2. Explain in detail how you know inhalation is occurring in this diagram.		
	Ribs are moving outwards (and upward) / volume (of chest) increasing / diaphragm is moving downwards		***Any two*** **2(3)**

10

Q17 (c) (i) – (iii)	**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 (d) **30**

3

(i) *Identify the plant organ.*

*Root **3**

1

Q17 (d) (i)	**Number of correct responses**	1
	Mark	3

3(1)

(ii) *Name tissues **A** and **B** and the structure labelled **C**.*

A: Dermal **1**

B: Ground **1**

C: Root Hair **1**

3

Q17 (d) (ii) Labels:	**Number of correct responses**	1	2	3
	Mark	1	2	3

6(3)

(iii) *Give **one** function for **each** part, **A**, **B** and **C**.*

A: Protection **3**

B: Storage **or** support **3**

C: Absorption **3**

(iv) *Give **one** function of vascular tissue in plants.*

Transport **or** support **3**

(v) *Name the **two** types of vascular tissue present in plants*

Xylem **3**

Phloem **3**

6

Q17 (d) (iii) – (v)	**Number of correct responses**	1	2	3	4	5	6
	Mark	3	6	9	12	15	18

3

(vi) *Draw **and** label a longitudinal section (L.S.) of either type of vascular tissue.*

Drawing: Xylem: Continuous vessel (or tracheid) with either lignin or pits

or

Phloem: Tube with sieve plates **and** companion cell **3**

1

Q17 (d) (vi) Diagram:	**Number of correct responses**	1
	Mark	3

3(1)

Labels: Xylem: pits / lignin / wall / lumen ***Any three***

or

Phloem: sieve plate / sieve tube / companion cell / cytoplasm

Any three **3(1)**

3

Q17 (d) (vi) Labels:	**Number of correct responses**	1	2	3
	Mark	1	2	3

BLANK PAGE

BLANK PAGE