Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2022

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, 2022 (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, nitrogen, ~~aluminium~~*

There is a surplus answer, which is incorrect, but it has been cancelled so the candidate may be awarded **4(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 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 2022: Q11 (b) (i); Q13 (a) (i); Q14 (c) (iii); Q15 (b) (ii); Q15 (c) (ii); Q16 (a) (ii); Q16 (b) (i).
	This symbol is used to indicate an incorrect response for a label on a diagram. Used in the following questions in 2022: Q11 (b) (i); Q13 (a) (i); Q14 (c) (iii); Q15 (b) (ii); Q15 (c) (ii); Q16 (a) (ii); Q16 (b) (i).
	This symbol is used to indicate a correct response for a diagram. Used in the following questions in 2022: Q11 (b) (i); Q13 (a) (i); Q14 (c) (iii); Q15 (c) (ii); Q16 (a) (ii).
	This symbol is used to indicate an incorrect response for a diagram. Used in the following questions in 2022: Q11 (b) (i); Q13 (a) (i); Q14 (c) (iii); Q15 (c) (ii); Q16 (a) (ii).
	This symbol is used to indicate a missing word or phrase.
	This symbol is used to indicate that the examiner has seen a page or question where there is no response from the candidate.

Section A	**Best 4**	**80**

Question 1 **5(4)**

(a) *Name the **four** elements found in **all** proteins.*

Carbon (C), Hydrogen (H), Oxygen (O), Nitrogen (N) **4**

(b) *Name an element that is only sometimes found in proteins.*

Phosphorous (P) **or** Sulfur (S) **4**

(c) *How many common amino acids are found in proteins?*

Twenty (20) **4**

(d) *Name any **one** fibrous protein.*

Keratin **or** myosin **or** collagen **or** any other valid example **4**

(e) *Give **one** metabolic role of proteins.*

Enzymes **or** hormones **or** antibodies **or** any other valid example **or** any role described **4**

(f) *Give **one** good source of protein in the diet.*

Meat **or** fish **or** chicken **or** nuts **or** lentils **or** eggs **or** dairy **or** any other valid example **4**

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) *Ecology*

The study of the (interactions between) organisms and their environment (or habitat)

(b) *Food chain*

Sequence of organisms showing transfer of energy from one to the next

(c) *Edaphic factor*

(Factor relating to) soil

(d) *Quantitative study*

Measuring the amount (or number) of organisms.

(e) *Omnivore*

(Organism that) eats plants and animals

(f) *Contest competition*

Struggle for a resource (in short supply) with one winner or described

(g) *Nitrogen fixation*

(Conversion of atmospheric) nitrogen (N_2) to usable form (or example)

Q2 (a) – (g)	**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 **two** chemical components that make up chromosomes.*

DNA

Protein

(b) *Is the karyotype shown above from a female or a male?*

Female

(c) *Justify the answer you have given at part (b) above.*

Has two X chromosomes **or** no Y chromosome

(d) *What evidence is shown in the karyotype that this person has the genetic condition Down's syndrome?*

There is an extra chromosome present **or** three (copies) of a chromosome 21 **or** three copies of one of the chromosomes.

(e) *Name this other type of mutation.*

Gene **or** point (mutation)

(f) *Give **one** other application of tissue culture*

Cancer research **or** plant breeding **or** stem cell research **or** skin grafts **or** any valid example.

Q3 (a) – (f)	**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) *Explain why the image cannot be produced by a light microscope.*

(Mitochondria) are too small (to be seen using a light microscope).

(b) *Name **one** type of animal cell that does **not** have mitochondria.*

Red blood cell (or erythrocyte)

(c) *(i) Name **and** give the location of the stage of aerobic respiration that does **not** occur in the mitochondrion.*

Name: Glycolysis

Location: Cytosol (accept cytoplasm)

(ii) Name the series of chemical reactions, involving acetyl Co. A, which does occur in the mitochondrion.

Krebs' cycle

(iii) State the number of carbon atoms in a molecule of acetyl co-enzyme A.

Two (2)

(d) *Sometimes lactic acid is produced during respiration. Describe a condition during which this may occur.*

Anaerobic (conditions) **or** oxygen deficiency or described

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

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

		True	False
(a)	*Copper (Cu) is one of the common elements present in food.*	☐	☑
(b)	*Response is a characteristic of life.*	☑	☐
(c)	*An animal cell will burst if placed in a concentrated sugar solution.*	☐	☑
(d)	*Macrophages are white blood cells that secrete perforin.*	☐	☑
(e)	*Organs are groups of tissues with a shared function.*	☑	☐
(f)	*Ethene is used to ripen fruit.*	☑	☐
(g)	*All members of the Kingdom Fungi are heterotrophic.*	☑	☐

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

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

(a) *What conclusion could the student make about lipid digestion based on the graph of results?*

(Lipid digestion) is faster (higher rate) with both lipase and bile salts (than with lipase alone)

<u>or</u>

(Lipid digestion) is slower (lower rate) with lipase alone.

(b) *Name the **two** products of complete lipid digestion by lipase.*

Fatty acids

Glycerol

(c) *Name a location in the digestive system where lipase digests lipids.*

Duodenum (accept jejunum **<u>or</u>** ileum **<u>or</u>** small intestine **<u>or</u>** stomach)

(d) *Suggest an optimum pH for digestion of lipids, in the location you have given at part (c) above.*

7-9 (matched to small intestine) *(accept in range of 1-5 matched to stomach)*

(e) *Describe the action of bile on lipids.*

Emulsifies (or described) **<u>or</u>** increases surface area

(f) *Name the structure inside each villus that absorbs the products of lipid digestion*.

Lacteal

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

Question 7 **6(3) + 2**

(a) *Name molecule A.*

Nucleic acid **or** RNA **or** DNA

(b) *Draw an arrow from 'X' to accurately show the location of an antigen.*

Correct arrow

(c) *Explain why viruses are described as obligate parasites.*

Need a host to replicate (or reproduce) **or** cannot replicate by themselves

(d) *Explain in detail what is meant by the term vaccination.*

What it is: Administration of a non-disease-causing (non-living) dose of a pathogen (or antigen or part of a pathogen) or described

What it does: Stimulates production of antibodies **or** stimulates active immunity **or** stimulates memory cells

(e) *Name **one** harmful virus other than SARS-CoV-2.*

Any valid harmful virus.

(f) *Give **one** example of a beneficial application of a virus.*

Genetic engineering (vector) **or** treat bacterial infection **or** vaccine production **or** any other valid answer

Q7 (a) – (f)	**Number of correct responses**	1	2	3	4	5	6	7
	Mark	3	6	9	12	15	18	20

Section B	**Best 1**	**30**

Question 8 **30**

(a) *Distinguish between:*

Eukaryotic:

Contains a nucleus **or** organelles enclosed by membranes **3**

Prokaryotic:

Does not contain a nucleus **or** does not contain organelles enclosed by membranes **3**

2

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

8(3)

(b) (i) *Which image, A or B, represents a plant tissue?*

*B **3**

(ii) *Give a reason for your answer at part (b) (i) above.*

Cell wall present **or** comment on shape of cells (image **B** more regular shape **or** image **A** more irregular shape) **or** all cells joined (linked) to each other **or** any valid comment **3**

(iii) *Identify structure **Z**.*

*Nucleus **3**

(iv) *When examining cells with a microscope:*

1. *Name a stain you used.*

   Methylene blue **or** iodine **or** other correct example **3**

2. *Give **one** benefit of using a stain.*

   Make (cells) more visible **or** (make cells) easier to see **3**

(v) *The image of the cell in **A** was 2 cm wide. What is the actual width of this cell?*

0.005 (cm) **or** 2/400 (cm) **or** 1/200 (cm) **or** 5×10^{-3} (cm) (accept other units if correct) **3**

(vi) *Image **B** shows cells at x100. Describe the steps taken to view these cells at x400.*

Select (or use) high power **or** select (or use) x40 (objective lens) **3**

Use fine focus **3**

8

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

Question 9 **30**

(a) (i) *What is meant by the term autotrophic?*

(An organism that) can make its own food **3**

(ii) *Explain why photosynthesis is an anabolic reaction.*

Glucose is built up from CO_2 and H_2O **or** (Building up of) small molecules to large molecules **or** Photosynthesis requires input of energy. **3**

2

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

8(3)

(b) *Investigation into effect of light intensity or CO_2 concentration on the rate of photosynthesis*

(i) *Name a suitable photosynthetic organism you used for this investigation.*

Elodea (or Pondweed) **or** other correctly named organism **3**

(ii) *Why was the organism named at part (b) (i) above suitable for this investigation?*

Aquatic plant **or** bubbles can be seen **or** (concentration or volume of) gas can be measured **3**

(iii) *Why was it important to keep other factors constant?*

Only one variable **or** (they) don't affect the rate **or** the rate is dependent only on the factor being changed **or** for a fair test **or** more reliable results **or** to maintain enzyme activity **3**

(iv) *How did you keep the temperature of the organism constant for this activity?*

Water-bath or described **3**

(v) *Explain how you measured the rate of photosynthesis.*

Count the number of bubbles **or** measure volume **3**

per minute (or unit time) **or** over set period of time **3**

(vi) 1. *Sketch of expected result at 25°C (——),*

Increasing line (from zero) (eventually levelling off) **3**

2. *Sketch of expected result at 60°C (------),*

Line on x axis **or** very close to x axis **3**

8

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

Question 10 **30**

(a) (i) *State a location in plants where growth regulators are produced.*

Meristem **or** root tip **or** shoot tip **or** any correctly named meristem or location **3**

(ii) *How are growth regulators transported around a plant?*

(By) diffusion **or** (through) vascular tissue **or** phloem **or** xylem

(accept dissolved in water) **3**

2

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

8(3)

(b) *Effect of IAA growth regulator on a plant tissue.*

(i) *Name a suitable plant tissue you used in this investigation.*

Root **or** shoot **or** seed (or named seed) **3**

(ii) *Describe how you set up the investigation.*

Different concentrations (of IAA) / more than one seed or tissue / fair test or described (e.g. equal volumes added) / control described / named piece of apparatus / leave for suitable time / any other correct practical step

Any four **4(3)**

(iii) *Describe how you measured the effect of IAA on the plant tissue.*

Use ruler (or grid) to measure length (or growth) of tissue **3**

(iv) *Describe any **one** result of your investigation.*

More root growth in low concentration **or** more shoot growth in high concentration **3**

(v) *Describe **one** safety precaution you took in carrying out this investigation.*

Use gloves **or** lab coat **or** mask or any other correct precaution **3**

8

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

Section C	**Best 3**	**180**

Question 11 **60**

(a) (i) *Give **one** precaution scientists use when working with microorganisms in the laboratory.*

Wipe surface with disinfectant (or antiseptic or alcohol or named) **or** minimal opening of plates or seal plates **or** flame (or sterilise) equipment **or** wear gloves **or** use hand sanitiser **or** wash hands with soap **or** keep Bunsen lit (nearby) **or** dispose of correctly **or** any other correct precaution (i.e. PPE) **3**

(ii) *Explain the terms applied to living organisms.*

Asepsis: free of pathogens **3**

Sterility: free of microorganisms **3**

3

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

(b) (i) *Drawing of a typical bacterial cell:*

Cell wall + cell membrane + indication of nucleic acid **3**

1

Q11 (b) (i) Drawing:	**Number of correct responses**	1
	Mark	3

Labels:

Cell wall / cell membrane / cytoplasm / chromosome / plasmid / flagella / capsule **or** slime layer ***Any three*** **3(1)**

3

Q11 (b) (i) Labels:	**Number of correct responses**	1	2	3
	Mark	1	2	3

(ii) *Describe the main events of endospore formation.*

DNA replicates / moves to ends of cell / shrinkage (or water loss) of cytoplasm (or cell) / thick wall forms (or described) / inside original cell / encloses DNA (strand) / (cell) rounds up ***Any three*** **3(3)**

(iii) 1. *Give any **two** examples of harmful bacteria.*

Any two correctly named bacteria **or** named bacterial diseases **2(3)**

2. *Bacterial infections can be treated with antibiotics. What is an antibiotic?*

A chemical that kills (or inhibits growth of) bacteria **3**

3. *State **one** possible reason why antibiotic resistance has arisen in bacteria.*

Overuse (misuse) **or** mutation in bacteria **3**

7

Q11 (b) (ii) – (iii)	**Number of correct responses**	1	2	3	4	5	6	7
	Mark	3	6	9	12	15	18	21

Question 11 (continued)

(c) (i) *Give **two** factors that affect the growth of microorganisms.*

Temperature / oxygen concentration / pH / external solute concentration **or** water availability / pressure / food availability / presence of antibiotics / presence of waste products ***Any two*** **2(3)**

(ii) *Explain how **one** these factors affect growth.*

Matching explanation (accept enzyme activity as explanation for temperature, pH, water availability, etc) **3**

(iii) *Distinguish between:*

Batch: organisms go through all phases of the growth curve (or named phases) **or** fixed amount of nutrients added at start **or** bioreactor emptied at end. **3**

Continuous flow: organisms maintained in one (log or stationary) growth phase **or** nutrients constantly added **or** products constantly removed. **3**

(iv) *Sketch plot of a growth curve. Label the axes **and** label the curve with the five phases.*

Sketch: All five phases visible on curve **3**

Axes labels: *x-axis*: Time **and** *y-axis*: Population **or** Number of organisms **3**

Curve labels: Correctly labelled with all five phases in the correct order **3**

8

Q11 (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 12 **60**

(a) *Explain the following **three** ecological terms:*

Biosphere: Part of the earth where life can exist. **3**

Niche: Role of the organism (or plant or animal) **3**

Symbiosis: Relationship between species involving benefit (or described) **3**

3

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

(b) (i) *Suggest **one** reason why dragonflies are such successful predators.*

Huge eyes **or** compound eyes **or** dazzling aerobatics **or** opportunistic **or** ambush or other correct **3**

(ii) *Give **two** benefits for dragonfly populations living near freshwater vegetation.*

Protection **3**

Laying eggs **3**

(iii) *Suggest a benefit of the adult and the nymph having different food sources.*

Not in competition (for same resource) **or** greater chance of survival **3**

(iv) *What type of ecological relationship exists between birds and dragonflies?*

Predator-prey **or** predation **3**

(v) *Suggest **one** possible effect on the dragonfly population of:*

1. *a disease affecting swallows:* Increases **3**
2. *cutting of vegetation on riverbank:* Decreases **3**

(vi) *Suggest **one** reason why volunteers are being asked to identify dragonflies.*

Conservation **or** monitor numbers **or** biodiversity **or** protect from extinction **or** monitor effect of climate change **or** monitor water quality **3**

(vii) *What might a volunteer use to help them identify a dragonfly?*

Key **or** compare pictures **or** charts **3**

9

Q12 (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

(c) (i) *Outline the main events of the carbon cycle.*

Brief note on role of: Photosynthesis / respiration / decay or decomposition / combustion / carbon sinks / any other valid point ***Any three*** **3(3)**

(ii) *Explain why the carbon cycle is critical to life on Earth.*

For C to be reused by organisms **or** finite amount of C **or** so C won't run out **or** to balance carbon dioxide levels **or** (photosynthesis is) basis of food chains **3**

(iii) *Explain the term 'pollution'.*

Any harmful addition to environment **3**

(iv) *Give **one** example of waste management from agriculture **or** fisheries **or** forestry.*

Any valid example **3**

(v) *Other than global warming or pollution, give **two** factors that can have an effect on human population*

War / famine / contraception / disease / any valid example ***Any two*** **2(3)**

8

Q12 (c) (i) – (v)	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) *Draw **and** label the structure of any one nucleotide.*

Drawing **6, 3, 0**

2

Q13 (a) Diagram:	Number of correct responses	1	2
	Mark	3	6

Phosphate (or P) **1**

Deoxyribose **or** ribose **1**

Base or any one named base or letter **1**

3

Q13 (a) Labels:	Number of correct responses	1	2	3
	Mark	1	2	3

(b) (i) *What is the name of process **K** that results in the formation of molecule **L**?*

*Transcription **3**

(ii) *Name molecule **L**.*

*mRNA **or** *messenger RNA **3**

(iii) *Write out the complementary sequence of bases of **ACGTGCTGA***

U G C A C G A C U ***(all must be correct for 3)*** **3**

(iv) *Give the name of the opening through which molecule **L** leaves the organelle **J**.*

*Nuclear pore **3**

(v) 1. *Identify structure **M**.*

*Ribosome **3**

2. *Name the main molecule from which structure **M** is made.*

*rRNA **or** *Ribosomal RNA **3**

(vi) *Describe the events that occur at structure **M**, which allow the production of a functioning protein.*

tRNA brings amino acids to ribosome / tRNA binds to mRNA / with matching codon (triplet) **or** anticodon / sequence of amino acids assembles **or** peptide bond forms / folding / start **or** stop codon ***Any three*** **3(3)**

9

Q13 (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

(c) (i) *Explain the terms:*

Allele: A version (variant) of a gene **or** (alternative) form of a gene **3**

Homozygous: (When) identical alleles are present (for a trait) **3**

(ii) *Draw **two** chromosome diagrams (one for each parent).*

Chromosome diagrams shows 2 pairs of homologous chromosomes for each parent. ***(Chromosomes for first parent must match chromosomes for second parent)*** **3**

1 parent clearly FFDD **or** ffdd **3**

Loci of the alleles for each parent ***(must be correct and matching)*** **3**

(Homozygous) recessive **and** (homozygous) dominant correctly indicated. **3**

(iii) *Using a Punnet square, or otherwise, describe the result of this cross.*

*FfDd **3**

*White and disc-shaped fruit **3**

8

Q13 (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 14 **60**

(a) (i) *In which cell organelle does photosynthesis occur?*

*Chloroplast **3**

(ii) *Name the pigment essential for photosynthesis.*

*Chlorophyll **3**

(iii) *Describe **one** way in which horticulturists can increase plant yields in greenhouses.*

Heat to (or keep at) optimum temperature **or** more light (or described) **or** use a range of colours of light **or** more CO_2 (or described) **or** hydroponics (or described) **or** any valid non-photosynthetic reason **3**

3

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

(b) (i) *Water is split during stage 1 using the energy in light. What is the name given to this process?*

*Photolysis **3**

(ii) *Identify molecule **X**, produced as a by-product of the splitting of water.*

*Oxygen (or O_2) **3**

(iii) *Identify molecule **Y**.*

*NADPH **3**

(iv) *Describe how molecule **Y** is produced.*

Added (or picked up) electrons (e^-) **3**
Added (or picked up) proton (hydrogen ion or H^+) **3**

(v) *Name stage 2 shown in the diagram.*

*Light independent stage (or dark stage or Calvin Cycle) **3**

(vi) *What does ATP stand for?*

*Adenosine triphosphate **3**

(vii) *What is the role of ATP in stage 2 of photosynthesis as shown in the diagram?*

To transfer energy **or** to carry energy **or** to release energy **3**

(viii) *Identify molecule **Z**, the end product of stage 2.*

Glucose (or formula) **3**

9

Q14 (b) (i) – (viii)	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) *Describe **two** events that happen during prophase.*

Nuclear membrane breaks down (dissolves or disappears) / chromosomes become shorter (or visible or thicker) **or** chromatin condenses / chromosomes (or chromatids) become double stranded / spindle forms ***Any two*** **2(3)**

(ii) *Describe **one** event that occurs during metaphase.*

Chromosome along equator (middle) **or** spindles attach to chromosome (or centromere) **3**

3

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

(iii) *Draw a labelled diagram of a cell with a diploid number of four at anaphase of mitosis.*

Diagram: Eight chromosomes **3**

Chromosomes being pulled apart **3**

2

Q14 (c) (iii) Diagram:	**Number of correct responses**	1	2
	Mark	3	6

Labels: chromosome / spindle / equator / poles / centromere ***Any three*** **3(1)**

3

Q14 (c) (iii) Labels:	**Number of correct responses**	1	2	3
	Mark	1	2	3

(iv) *Describe how cell division occurs in:*

An animal cell: Cleavage furrow forms or described **3**

A plant cell: Cell plate forms or described **3**

2

Q14 (c) (iv)	**Number of correct responses**	1	2
	Mark	3	6

Question 15 **60**

(a) (i) *Explain the underlined terms.*

Excretion: Removal of metabolic waste from a cell (or organism) **3**

Homeostasis: Maintaining a constant internal environment **3**

(ii) *Name **one** excretory organ in plants.*

Leaf **or** stem **or** root (accept stomata and lenticel) **3**

3

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

(b) (i) *What is the function of the layer of fat around the kidney?*

Protection (accept insulation) **3**

1

Q15 (b) (i)	Number of correct responses	1
	Mark	3

(ii) *Identify the regions of the kidney labelled **A, B,** and **C.***

A: *Cortex **1**

B: *Medulla (pyramid) **1**

C: *Pelvis **1**

3

Q15 (b) (ii) Labels:	Number of correct responses	1	2	3
	Mark	1	2	3

(iii) *Identify the region in the kidney, by name or label, where the process of filtration occurs.*

*A **or** *cortex **3**

(iv) *Explain the importance of blood entering the glomerulus under pressure.*

Force filtered (or ultrafiltration) **or** small molecules are forced out of the blood (or described) **3**

(v) *State **two** reasons why there are many capillaries surrounding the PCT, loop of Henle and DCT.*

Reabsorption (or described) **3**

Secretion (or described) **3**

(vi) *Describe how ADH affects the volume of urine.*

(ADH) acts on collecting duct (or DCT) **or** makes walls more permeable **or** more water reabsorbed **3**

(More ADH) leads to low volume of urine ***(converse also accepted)*** **3**

(vii) *Name the structure through which urine travels to the bladder.*

*Ureter **3**

7

Q15 (b) (iii) – (vii)	Number of correct responses	1	2	3	4	5	6	7
	Mark	3	6	9	12	15	18	21

Question 15 (continued)

(c) (i) *By what process does water enter the root hairs?*

*Osmosis **3**

1

Q15 (c) (i)	**Number of correct responses**	1
	Mark	3

(ii) *Drawing T.S of root:*

Dermal tissue + Vascular + Root hair **3**

1

Q15 (c) (ii) Drawing:	**Number of correct responses**	1
	Mark	3

Labels:

Dermal **1**

Ground **1**

Vascular **1**

3

Q15 (c) (ii) Labels:	**Number of correct responses**	1	2	3
	Mark	1	2	3

(iii) *Name the **two** Irish scientists who first described the upward movement of water in plants*

(Henry) Dixon **3**

(John) Joly **3**

(iv) *Describe in detail the upward movement of water in plants.*

Root pressure pushes (water) / in xylem / cohesion **or** water molecules stick together / continuous column / due to H bonding / adhesion **or** water molecules stick to xylem walls / transpiration **or** evaporation / tension **or** pull ***Any three*** **3(3)**

5

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

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

Question 16 (a) **30**

(i) *Name **each** of these parts of the human nervous system.*

Central nervous system (CNS) **3**

Peripheral nervous system (PNS) **3**

2

Q16 (a) (i)	**Number of correct responses**	1	2
	Mark	3	6

(ii) *Drawing of a neuron:*

Cell body + dendrites + axon visible *(any one missing = 3)* **6, 3, 0**

2

Q16 (a) (ii) Drawing:	**Number of correct responses**	1	2
	Mark	3	6

Labels:

Dendrites **1**

Axon **1**

Myelin sheath **1**

3

Q16 (a) (ii) Labels:	**Number of correct responses**	1	2	3
	Mark	1	2	3

(iii) *Distinguish between the function of an interneuron **and** a sensory neuron.*

Interneuron: Transmit impulse within the CNS (or from sensory to motor neuron) **3**

Sensory neuron: Transmit impulse (from sense organ) to CNS **3**

(iv) *How is a nerve impulse conducted along a neuron?*

(Movement of) ions (or example) **3**

(v) *Name the gap that exists between two neurons in close contact.*

*Synaptic cleft **3**

(vi) *Give **one** possible cause for either:*

Paralysis:

Injury (damage) to spinal cord **or** stroke **or** multiple sclerosis **or** other valid cause

or

Parkinson's disease:

Decrease in dopamine levels **or** decrease in serotonin levels **or** genetic **or** drug-induced **or** aging **or** other valid cause

Cause must match name disorder **3**

5

Q16 (a) (iii) – (vi)	**Number of correct responses**	1	2	3	4	5
	Mark	3	6	9	12	15

Question 16 (b) **30**

(i) *Name the parts of the eye labelled **P, Q** and **R**.*

P: *Lens **1**

Q: *Cornea **1**

R: *Optic nerve **1**

3

Q16 (b) (i) Labels:	**Number of correct responses**	1	2	3
	Mark	1	2	3

(ii) *Name the **two** types of light receptor in the retina.*

*Rods **3**

*Cones **3**

*Give **one** function of **each** type.*

Rods: vision in dim light **or** black & white vision **3**

Cones: vision in bright light **or** colour vision **3**

(iii) *Explain why damage to the part labelled **R** could result in blindness.*

No impulse (or message) will be sent to the brain (to be interpreted) **3**

(iv) *Sketch **two** diagrams of the front of the eye to show:*

1. *Iris and pupil in bright light:* Pupil small **3**
2. *Iris and pupil in dim light:* Pupil large **3**

(v) *Describe corrective measures for **one** of the following:*

Long sightedness:		*Short sightedness:*		*Hearing defect:*	Valid named defect **and**
Convex lens	**or**	Concave lens	**or**	*Corrective measure:*	any valid answer **3**

(vi) *Name **one** other sense **and** name an organ associated with this sense **(other than vision and hearing).***

Touch **and** skin **or** smell **and** nose **or** taste **and** tongue **3**

9

Q16 (b) (ii) – (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 16 (c) **30**

(i) *Name **one** type of synovial joint **and** give **one** location in the body where it is found.*

Type: Hinge **or** Ball and socket **3**

Location: Knee or elbow **or** Hip or shoulder ***(must match type)*** **3**

(allow pivot / gliding / sliding with correct location)

(ii) *Name the structure **A** that connect two bones in a joint.*

*Ligament **3**

(iii) *Name part **B:***

*Cartilage **3**

*Give **one** function of part **B**.*

Shock absorber **or** protects bone **or** reduces friction **3**

(iv) *Name the structure that connects muscles to bones.*

*Tendon **3**

(v) *Give **one** function of compact bone.*

Strength **or** rigidity **or** shape **or** structure **or** support **3**

(vi) *Name the tissue that fills these spaces in spongy bone.*

*(Bone) marrow **3**

*Give **one** function of this tissue.*

Makes blood cells **or** stores fat **3**

(vii) *Give **one** possible cause for either arthritis **or** osteoporosis.*

Arthritis: *Osteoporosis:*

Wear and tear (or injury) **or** genetic **or** Hormonal **or** dietary **or** genetic **3**

(must mention which condition)

10

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) *State the collective term used to describe the anther and filament of the flower.*

*Stamen **3**

(ii) *Outline the main events in the development of pollen grains.*

Diploid / microspore mother cell / (divides by) meiosis / to produce four haploid (nuclei or cells) or tetrad formed / (divides by) mitosis / pollen grain with two (haploid) nuclei / the generative nucleus / the tube nucleus. ***Any three*** **3(3)**

(iii) *What is meant by the term 'pollination'?*

Transfer of pollen from the anther to the stigma **3**

(iv) *Name **two** methods by which pollination can occur.*

Wind / insect (animal) / water / self ***Any two*** **2(3)**

(v) *Describe the main events that occur immediately after pollination.*

Pollen grain germinates (develops) / produces (pollen) tube / The tube nucleus digests through the style (pollen tube grows through the style) / reaches the ovary / generative nucleus divides by mitosis / to form two (haploid) male nuclei (gametes) / enter the embryo sac (megaspore) / one (haploid) male nucleus fuses with the (haploid) egg to form the diploid zygote / the second (haploid) male nucleus fuses with the two haploid polar nuclei to form a triploid endosperm. ***Any three*** **3(3)**

10

Q16 (d) (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 17	**Any two of (a), (b), (c), (d)**	**30, 30**

Question 17 (a) **30**

(i) *Name the **two** scientists credited with developing the theory of evolution by natural selection.*

Darwin **3**

Wallace **3**

(ii) *Explain the **three** underlined terms.*

Evolution: Genetic changes in populations in response to environmental conditions. **3**

Species: (Group of) organisms capable of reproducing (or breeding) to produce fertile offspring. **3**

Inherited: (Passed from parents) to offspring using genes. **3**

(iii) *Explain how meiosis contributes to variation.*

It rearranges genetic material (or described) **or** it produces non-identical cells *(accept crossing over)* **3**

(iv) *Describe **three** points put forward in the theory of natural selection, other than the one described.*

High reproductive rates / competition (or a struggle for survival) / those with the more adaptive characteristics survive (or survival of the fittest) / the others are eliminated (or die out) / the survivors reproduce (or breed) / the genes of the most successful are passed on to the next generation / populations becomes better adapted to their environment with each generation. ***Any three*** **3(3)**

(v) *Give **one** piece of evidence that supports the theory of natural selection.*

Fossils **or** comparative embryology **or** comparative anatomy **or** other correct answer **3**

10

Q17 (a) (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 17 (b) **30**

(i) *Give **two** roles of the placenta.*

Movement of food from mother to foetus **or** movement of wastes from foetus to mother / endocrine gland **or** production of hormones (or named) / prevent bloods (of foetus and mother) from mixing ***Any two*** **2(3)**

(ii) *Give an outline description of the birth process, including the role of hormones.*

Change in level of (named) hormone **3**

Mucus plug falls out (or 'the show') / amniotic fluid expelled (waters break) / labour or uterine contractions / cervix dilates / baby is pushed out / afterbirth (delivery of placenta) / umbilical cord is cut ***Any three*** **3(3)**

(iii) *State **one** method of birth control.*

Condom **or** the (contraceptive) pill **or** IUD **or** natural **or** mechanical **or** chemical **or** hormonal **or** surgical **or** any valid example **3**

(iv) *Name the hormone responsible for milk production.*

*Prolactin **3**

(v) *State **two** biological benefits of breastfeeding.*

Balanced supply of nutrients / supplies antibodies (passive immunity) / correct temperature / any correct benefit ***Any two*** **2(3)**

10

Q17 (b) (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 17 (c) **30**

(i) *State the location where food is usually stored in a:*

Monocotyledonous seed: *Endosperm **3**

Dicotyledonous seed: Cotyledon (accept seed leaf) **3**

(ii) *Describe how seeds contribute to the formation of fruit.*

Produce growth regulators or named **3**

(iii) *Name **one** part of a flower from which a fruit may develop.*

Ovary (accept receptacle) **3**

(iv) *Outline **one** role of genetics in fruit production.*

Seedless fruits **or** more advantageous traits (or described) **3**

(v) *Give **two** advantages of seed dispersal.*

Reduces competition / reduces overcrowding / allows plants to colonise new areas / better chance of survival ***Any two*** **2(3)**

(vi) *Describe the roles of the following in germination:*

Digestion: Produce soluble nutrients **or** make nutrients available **3**

Respiration: Release of energy from food **3**

(vii) *Give **one** example of asexual reproduction in flowering plants.*

Any named example **3**

10

Q17 (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 17 (d) **30**

(i) *Name the period of the heart cycle when the cardiac muscle of the heart is:*

1. *Contracting:* *Systole **3**
2. *Not contracting:* *Diastole **3**

(ii) *In which diagram, **X, Y or Z**, are the ventricles contracting?*

*Z **3**

Explain how you know the ventricles are contracting

(Ventricle) volumes are reduced **or** semilunar valves are open **or** AV valves (or bicuspid or tricuspid) are closed **or** blood is flowing into arteries (or out of heart) **3**

(iii) *State the location of the sinoatrial (SA) in the heart.*

(Wall of) right atrium **3**

(iv) *There is a two-circuit circulatory system in humans. Name the circuit to which:*

1. *The right ventricle pumps blood:* *Pulmonary (circuit) **3**
2. *The left ventricle pumps blood:* *Systemic (circuit) **3**

(v) *What causes these sounds?*

Valves closing **3**

(vi) *What is the function of the coronary (cardiac) artery?*

To supply heart (cardiac) muscle (or tissue or cells) with blood **3**

(vii) *Describe the effect on the circulatory system of either **one** of the following:*

Smoking		*Exercise*
Increase heart rate **or** increase blood pressure **or** any valid effect	**or**	Increase heart rate **or** strengthens heart muscle **or** any valid effect **3**

10

Q17 (d) (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

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