Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2019

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.

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**: 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, 2019* (section 5.3, p.14)"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**: 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

- **In Section A, a surplus wrong answer cancels the marks awarded for a correct answer**.
  - *Sample 1 Question*: *The walls of xylem vessels are reinforced with ……*
  - **Marking Scheme**: Lignin **(4 marks)**
  - *Sample 1 answers*:
    - Chitin, lignin – there is a surplus answer, which is incorrect, therefore the candidate scores 4 – 4 marks = 0.
    - 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.
    - 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.

  - *Sample 2 Question*: *Name the **four** elements that are always present in protein.*
  - **Marking Scheme**: Carbon/ hydrogen/ oxygen/ nitrogen **4(3)**
  - *Sample 2 answers*:
    - Carbon, hydrogen, oxygen, nitrogen, calcium – there is a surplus answer, which is incorrect, and which cancels one of the correct answers, therefore the candidate is awarded **3(3)** marks.
    - Carbon, hydrogen, oxygen, calcium – there is no surplus answer, there are three correct answers,
    - and therefore the candidate is awarded **3(3)** marks.
    - Carbon, hydrogen, oxygen, calcium, aluminium – there is a surplus answer, which is incorrect, and which cancels one of the three correct answers, therefore the candidate is awarded **2(3)** marks.
    - 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 *.

Conventions

- 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.
- 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 answer.

Annotations used in the marking

Annotation	Meaning
	correct
	incorrect
	surplus answer or part of answer
	blank page or part of page
	part of answer of significance
	Correct response in Q14(a)(i) **only**

Section A — Answer any 5 questions — 5(20)

1 **5(4) i.e. best five answers from (a) – (f)**

(a) *Two reasons why food necessary:*

Energy (source) **or** (cellular) respiration **2 + 2**

(Raw materials for) growth **or** (raw materials for) repair (of tissue) **(Any two)**

(b) *Ratio of H to O in carbohydrate:* **4**

2:1

(c) *Structural role of lipids in cells:*

(Component of) membrane(s) **4**

(d) *Metabolic role of lipids in cells:*

Energy (source or store) **4**

(e) *Fat-soluble vitamin:*

A, D, E, K [*allow letters or names*] **4**

(f) *Disorder matched to answer at (e):*

A = e.g. Night blindness D = e.g. Osteomalacia **or** osteoporosis (adults)/ **or** rickets (children) **4**

E = e.g. Anaemia K = e.g. Bleeding (or easy bruising)

2 **4 + 2 + 2 + 2 + 2 + 2 + 6**

(a) *Hypothesis:*

Proposed (or possible) explanation **or** an explanation of an observation **or** an educated guess **or** untested (or unproven) idea **or** prediction

(b) *Double-blind testing:*

Neither the tester nor the subject knows who gets the drug (or who gets the placebo)

(c) *Necessity for random selection:*

Reduces bias **or** greater reliability **or** greater validity (or accuracy) (of results or of data)

or fair (test)

(d) *Other good experimental design features:* ***Any two***

A control/ only one variable/ safe (procedure)/ large sample size/ repeatable/ replicates

[*do not allow random selection or double-blind testing*]

(e) *Where results of scientific research published:*

A scientific journal (or publication or website) **or** named scientific journal

(f) *Why important to publish research:*

For peer review **or** so that others can learn (from their work) **or** so others can repeat it **or** information made widely available

3 **4 + 2 + 2 + 2 + 2 + 2 + 6**

(a) *Tissue:*

(A group of) cells with the same function **or** (a group of) cells working together

(b) *Animal tissues:* ***Any two***

Epithelial (or epidermis)/ muscle/ connective/ nervous/ adipose/ blood/ bone/ cartilage/ tendon/ ligament/

(c) *How each at (b) adapted:* ***Any two***

Correct adaptation **matching** named tissues

(d) *Tissue culture:*

Growth of cells on (or in) a medium **or** growth of cells *in vitro*

[*Allow* growth of cells outside an organism **or** growth of cells outside the body]

(e) *Another tissue culture application:* ***Any one***

Plant breeding/ micro-propagation or example/ plant propagation/ vegetative propagation/ skin grafts/ cancer research or example of cancer research/ IVF or described/ vaccine production/ antibody production/ replacement organs

[*Do not allow any reference to stem cells*]

4 **4 + 2 + 2 + 2 + 2 + 2 + 6**

(a) *School laboratory microscope:*

Light (microscope)

(b) *Observable prophase events:* ***Any two***

Nuclear membrane disappears (or breaks down)/ spindle forms /

chromosomes are visible **or** chromosomes become shorter (or thicker)/ chromosomes are

double stranded

(c) ***M*** *on metaphase:* Sixth cell from LH end

(d) ***A*** *on anaphase:* Second cell from LH end

(e) *Next after mitosis: In animal cells:* Cleavage (or furrow) **or** described

In plant cells: (Cell) plate **or** described

5 **4 + 2 + 2 + 2 + 2 + 2 + 6**

(a) *Word to describe shape of the two faces:*

Concave **or** biconcave

(b) *Red blood cell feature to get through capillaries:*

Flexible or described

(c) *O_2-carrying molecule in red blood cells:*

Haemoglobin

(d) *Reason for red blood cell limited lifespan:*

No nucleus **or** no mitochondria **or** no organelles **or** cannot reproduce

(e) *Where red blood cells produced:*

(Bone) marrow

Where red blood cells usually broken down:

Liver **or** spleen

(f) *Human transport fluid not containing red blood cells:*

Lymph

6 **4 + 2 + 2 + 2 + 2 + 2 + 6**

(a) *Blood vessel that capillary arises from:*

Pulmonary artery (arteriole)

(b) *Features for efficient gas exchange:* ***Any three***

Alveoli		Capillaries
Membrane (or wall) is thin (or is 1 cell thick)/		Wall is thin (or is 1 cell thick)/
Large surface area/		Close contact with alveoli/
Large numbers/		Large number **or** (capillary) network or highly branched/
Moist surface/		large surface area

(c)

Disorder:	**Asthma**	**OR**	**Bronchitis**
Cause:	Pet dander **or** allergens **or** smoke **or** dust		Viruses **or** bacteria **or** smoke **or** airborne particles
Treatment:	An inhaler (bronchodilator) [*allow named ones*]		Cough medicine **or** inhalers **or** bronchodilators **or** mucolytics **or** anti-inflammatories **or** antibiotics

Section B Answer any 2 questions 2(30)

7 (a) **4 + 2**

Biuret:

(i) (To test for) protein

(ii) *Benedict's / Fehling's:*

(To test for) reducing sugar

7 (b) **4 + 2 + 2 + 2 + 2 + 2 + 2 + 8**

(i) 1. *Why coverslip:*

To prevent (the cells) from drying out **or** to protect the (objective) lens (from water or from stain) **or** to hold sample in place **or** easier to see

2. *Why methylene blue:*

To stain (the cells) **or** to make (the cells) easier to see

(ii) 1. *Why washing-up liquid:*

Breakdown membrane

2. *Why freezer-cold ethanol:*

To precipitate (the DNA) **or** to make (the DNA) insoluble

or take (the DNA) out of solution **or** to make (the DNA) visible

(iii) 1. *Why serial dilution:*

(To make solutions of) different concentrations (of IAA)

2. *Why seeds on Petri dish grid:*

To measure the growth (of root or shoot accurately)

(iv) 1. *Why Visking™ tubing:*

To act as a selectively permeable membrane **or** to mimic the plasma membrane

2. *How know osmosis has happened:*

Mass of tubing increased (or decreased) **or** tubing got fuller (or less full) **or** increased turgidity

8 (a) **4 + 2**

(i) *Does fermentation need oxygen:*

*No

(ii) *Location of fermentation in cell:*

*Cytosol **or** *cytoplasm

(b) (i) *Drawing:* Reaction vessel with liquid surface and anaerobic condition **3**

(b) (i) *Label:* Airlock **or** oil/ yeast/ sugar (or named sugar) (solution) ***Any one*** **3**

(b) **4 + 2 + 2 + 2 + 2 + 6**

(ii) *Which substance alcohol made from:*

Glucose **or** sugar **or** other named sugar [allow starch]

(iii) *Optimum temperature:*

Any temperature or range within 20 $^{\circ}$C – 35 $^{\circ}$C

(iv) *How optimum temperature maintained:*

Water bath **or** incubator

(v) *How know fermentation finished:*

No more gas (carbon dioxide) produced / no more bubbles

(vi) *Test for alcohol:*

Iodoform test **or** (potassium) iodide (or I^-) **and** (sodium) hypochlorite (or ClO^-)

Positive colour:

(vii) *Yellow

9 (a) **4 + 2**

Dicotyledonous:

Two

Seed leaves

(b) (i) – (v) **4 + 2 + 2 + 2 + 2 + 6**

(b) (i) *Plant used:*

Buttercup **or** sunflower **or** rose **or** ivy **or** busy lizzy **or** geranium **or** other named dicot

(ii) *Why thin section:*

To allow light to pass through (effectively or well) **or** to see (the cells) clearly

(iii) *To cut stem safely:*

Microtome **or** (backed or safety) blade **or** scalpel **or** sharp knife / stem held in pith (or named support)/cut away from body ***Any two***

(iv) *How section transferred to slide:*

Paintbrush **or** forceps **or** tweezers **or** blade **or** finger

(v) *Part of microscope for sharp focus:*

Fine (or coarse) wheel (or knob or adjuster)

9 (vi) *Drawing:* Epidermis **and** vascular bundles in a ring **3**

(vi) *Label:* Vascular (bundle or tissue) **or** xylem **or** phloem **or** dermal **or** ground **3**

Section C — Answer any 4 questions — 4 (60)

10 (a) (i) *Importance of recycling:*

To return (elements) to environment **or** so that (elements) can be reused (by organisms) **or** finite amount **3**

(ii) *Bacterial types in N-cycle:*

Nitrogen fixing/ nitrifying/ denitrifying/ decomposers **or** saprophytes ***Any two*** **2(3)**

(b) (i) *1. Predation:*

Catching (or hunting) and killing and eating another organism **3**

2. Conservation (of species):

Management of the environment (or of ecosystem or of habitat) **or** management of species (or of plants and animals) **or** maintenance of biodiversity **or** protect a species **or** prevention of extinction **3**

(ii) *Why mink successful predator of gulls:*

Mink have adaptations suitable (for catching gulls) **or** example **or** can kill both adults and chicks **or** chicks have no adaptations to escape or to avoid capture **or** gulls have never encountered mink before **or** lack of competition **3**

(iii) *Why omnivory advantageous to mink:*

They can benefit from both animal and plant matter as food **or** able to survive from a greater range of food **3**

(iv) *Another way mink could cause gull population decline:*

Introduce disease **or** introduce a parasite **or** eat the food that gulls normally eat **or** disturbance **3**

(v) *Another food chain impact caused by mink:*

Could lead to an overpopulation of the gull's prey **or** overpopulation of primary consumers **or** the population of producers could decline **or** decline in other predators **3**

(vi) *Predator-prey graph:*

Drawing: Two curves with indication of a repeating cycle **3**

Predator showing lower peaks **or** predator curve showing time lag [*Either predator or prey line must be labelled for this point*] **3**

Predator-prey graph:

Labels: Time on horizontal axis **and** Population on vertical axis **3**

10 (c) (i) *Quantitative:* Number of (or amount of or measurement of) organisms (or species or plants or animals present) **or** measurement of an abiotic factor **3**

Qualitative: Presence of (or absence) an organism (or species or plant or animal) **3**

(ii) *Quantitative survey of ecosystem flora:*

Named ecosystem **3**

Quadrat/ Random (sample)/ how random/repeat a number of times/ count (or record or take average or note)

OR

Transect/ select starting position/ why selected/ (survey) regular points/count (or record or note)

Any three **3(3)**

(iii) *Presentation of results:*

Table **or** chart **or** graph **3**

(iv) *Possible source of error:*

Not random **or** sample too small **or** plant misidentified **or** miscounting **or** Miscalculating **3**

11 (a) (i) *Sugar in DNA:*

*Deoxyribose **3**

(ii) *Two other structural differences:*

DNA is double-stranded **or** RNA is single-stranded **3**

DNA has Thymine **or** RNA has Uracil **3**

(b) (i) *Location of transcription in animal and plant cells:*

*Nucleus **3**

(ii) *Where translation occurs:*

*Ribosome **3**

(iii) *Three RNAs in protein synthesis:*

Messenger RNA (or mRNA) **3**

Ribosomal RNA (or rRNA) **3**

Transfer RNA (or tRNA) **3**

(iv) *Translation events:* ***Any four***

mRNA (transcribed DNA code) goes to a ribosome / tRNA molecules bring amino acids to the ribosome / tRNA binds to mRNA / with matching codon **or** anticodon / sequence of amino acids assembles **or** peptide bond formed/ (The chain) folds / mention of start (or stop) codon **4(3)**

(c) (i) *1. Sex linkage:*

A gene (or genes) present on the X (or Y, or sex) chromosome **3**

2. Heterozygous:

When two alleles (for a trait) are different **or** alleles for a trait are different **or** dominant and recessive alleles (or genes) present (for a trait) **3**

3. Genotype:

The genetic make-up **or** the genes present **3**

(ii) *Parents' genotypes for both sex and haemophilia:*

1. XNXn **3**
2. XNY **3**

Phenotype and full genotype of daughter's father:

Phenotype: (Male) haemophiliac **3**

Genotype: XnY **3**

Chance of that couple having a carrier daughter: **3**

(From all possible daughters:) 100% **or** (from all possible children:) 50%

12 (a) (i) *Metabolism:*

(All) the chemical reactions in an organism (or in cells or in the body) **3**

(ii) *Anabolic reaction in animals:*

Protein synthesis **or** DNA replication (synthesis) **or** other described **3**

C*atabolic reaction in animals:*

Respiration **or** digestion **or** other described **3**

(b) (i) *Enzyme is:*

Biological catalyst **or** protein catalyst **3**

(ii) *Enzymes are:*

*Protein **3**

(iii) *Factors that affect enzyme action:* ***Any two***

Temperature / pH **2(3)**

(iv) *Specificity:*

(An enzyme) can act on only one (or on a particular or a certain) substrate (group) (or molecule) [*allow* food type for substrate] **3**

(v) *Part of enzyme responsible for specificity*

*Active site **3**

(vi) *How enzymes work:* ***Any three***

Active site complementary shape to substrate / Active site changes shape to allow a perfect fit **or** induced fit / enzyme-substrate complex / Products formed **or** products released / enzyme (or active site) unaltered (or unchanged) **or** enzyme returns to / original shape **or** enzyme (or active site) can be reused **3(3)**

12 (c) (i) *Photosynthesis in A or B:*

*B **3**

(c) (ii) *Balanced photosynthesis equation:*

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ **3 + 3**

(iii) *Products of light dependent stage:* ***Any two***

ATP/ NADPH **or** protons (or H^+ or H ions) **or** electrons)/ oxygen **2(3)**

(iv) *Events of light-independent stage:*

ATP to ADP (+ P) **or** ATP supplies energy **3**

NADPH to NADP **or** NADPH provides electrons **or** NADPH provides H **or** NADPH provides H^+ (or H ions or protons) **3**

CO_2 converted to glucose (or other named carbohydrate) **3**

13 (a) *Natural:* Withdrawal **or** abstinence **or** rhythm **3**

Mechanical: Condom **or** diaphragm **or** coil (or IUD) **or** vasectomy **or** tube ligation **3**

Chemical: Pill **or** hormonal **or** vaginal ring **or** spermicide **or** implant **3**

(b) (i) *Drawing:*

Ovaries + oviducts + uterus + vagina **6, 3, 0**

(b) (i) *Labels:*

Oviduct (Fallopian tube)/ cervix/ ovary/ vagina/ uterus/ endometrium **6(1)**

(b) (ii) ***M** on location of meiosis:* Ovary **3**

***F** on usual location of fertilisation:* Oviduct (Fallopian tube) **3**

(iii) *Menstrual disorder:* Fibroids — Endometriosis **3**

1. *Cause:* Abnormal hormonal response **or** genetic **OR** Menstrual blood flowing into oviduct **or** genetic **3**
2. *Treatment* Surgery **or** HRT — Surgery **or** HRT **3**

(c) (i) *Implantation:*

Embedding (or attaching) (of the fertilised egg) (in)to the endometrium (or lining of uterus) **3**

(ii) *Developmental stages:*

1. Morula

2. Blastocyst [*must be in correct order*] **6, 3, 0**

(iii) *1. Progesterone level:* Increases **3**

2. Endometrium: Is maintained **or** thickens **3**

(iv) *Embryo germ layers:*

*Ectoderm **3**

*Mesoderm **3**

*Endoderm **3**

14 (a) (i) *CNS parts:*

A: Cerebellum

B: Cerebrum

C: Pituitary gland

D: Medulla oblongata

E: Spinal cord

F: Hypothalamus **6(1)**

(a) (ii) *1. Medulla oblongata function:*

Controls (or regulates) involuntary actions
or controls (or regulates) breathing (or heart function or digestion or sneezing or coughing or swallowing or blood pressure or vomiting) **3**

2. Cerebellum function:

Controls (or regulates) voluntary movements

or

Controls (or regulates) posture (or balance or walking or writing or fine muscle movements or speech) **or** coordination **3**

(iii) *1. Grey matter:*

Composed of cell bodies **3**

2. White matter:

Composed of myelin **or** composed of axons **3**

(iv) *Endocrine:*

Ductless **or** secretes directly into blood (or into lymph) **3**

(v) *1. Hormone secreted by the pituitary:*

ACTH **or** FSH **or** GH **or** LH **or** TSH **or** ADH (vasopressin) **or** oxytocin **or** prolactin **or** MSH **3**

2. Function of named hormone:

Correct matching function **3**

(vi) *Gland with both endocrine and exocrine function*:

Pancreas **or** testis **or** ovary **or** liver **or** kidney **3**

(b) ***Any three of parts* (i) *to* (v)**

(b) (i) *Vaccination:* ***Any three***

A non-harmful (or attenuated or weakened or dead) dose of the pathogen (or antigen) introduced (or injected) into an organism (or into the body) / Stimulates (active) immunity / Production of antibodies / Production of memory cells (or T cells or B cells) / Prevents infectious disease or prevents spread of disease **4 + 3 + 3**

(b) (ii) *Antibiotic resistance in bacteria:* ***Any three***

(Antibiotic resistant bacteria) are not affected (by antibiotics) / Can be caused by overuse (or misuse) (of antibiotics) **or** by failure to complete a course (of antibiotics)/ bacteria mutate (or evolve or change) / Plasmid carries resistant gene **or** (resistance) acquired by bacteria from / other bacteria/ resistant population (or example) / other bacteria/ resistant population (or example) / antibiotics) produced by microorganisms, which kill (or slow down the growth of) bacteria (or fungi or microorganisms) **4 + 3 + 3**

(b) (iii) *Mechanism of phototropism:* ***Any three***

Auxin produced in shoot tip (or meristem) / Plant shoot exposed to (more) light on one side / Auxin diffuses (moves) down the shaded (dark) side of the shoot / More elongation (or growth) of the shaded side (cells) / (Shoot) grows (or bends) towards the light **4 + 3 + 3**

OR

(b) (iii) *Mechanism of geotropism: in root* ***Any three***

Auxin produced in root tip (or in meristem) / (More) auxin on the lower side of root / Because of gravity/ Less elongation in lower root cells / (Root) growth (or bend) downwards **4 + 3 + 3**

OR

(b) (iii) *Mechanism of geotropism: in shoot* ***Any three***

Auxin produced in shoot tip (or in meristem) / (More) auxin on the lower side of shoot / Because of gravity/ More elongation in shoot cells / (Shoot) grow (or bends) upwards **4 + 3 + 3**

(b) (iv) *Batch processing:* ***Any three***

Carried out in a bioreactor/ Certain amount of micro-organisms (or bacteria or fungi) (or food or nutrients or substrate) / Added at the start (of the process) / Micro-organisms (or bacteria or fungi) go through lag, log and stationary stages **or** micro-organisms (or bacteria or fungi) go through all stages/ Product is removed (at the end of the process)

4 + 3 + 3

(b) (v) *The sounds created during the cardiac cycle:* ***Any three***

The sounds are 'lub' + 'dub'/ Caused by valves closing/ Tricuspid and bicuspid (or sinoatrial valves) close / Causes 'lub' sound **or** creates first sound / Semilunar valves clos/ Causes 'dub' sound **or** creates second sound **4 + 3 + 3**

(c) (i) *Functions of skeleton:* ***Any two***

Movement / protection (of internal organs) / support (or shape) / production of blood cells **2(3)**

(ii) *Limbs are attached to:*

Pectoral girdle (or shoulders) **3**

Pelvis (or pelvic girdle or hips) **3**

(iii) *Types of bones in the foot:* ***Any two***

Tarsals/ metatarsals/ phalanges (or digits) **2(3)**

(iv) *Antagonistic muscle pair:*

(Two) muscles that work with opposing actions **or** (two) muscles that have opposite effects **or** when one contracts the other relaxes **3**

(v) *An antagonistic muscle pair:*

Biceps **and** triceps **3**

(vi) *How given antagonistic muscle pair works:*

(Biceps) contract to flex (or raise or bend) the arm (or elbow) **3**

(Triceps) contract to extend (or lower or straighten) the arm (or elbow) **3**

15 (a) (i) *Rhizopus during asexual reproduction:*

Drawing: Stolon and sporangiophore and sporangium and rhizoids **6, 3, 0**

Labels ***Any six*** Mycelium / rhizoid / hypha / stolon/ sporangiophore / apophysis / columella / sporangium / sporangiospores (spores) **6(1)**

(ii) *Rhizopus nutrition:*

*Saprophytic (saprophyte) **or** *heterotrophic **3**

(iii) *Environmental condition to cause Rhizopus to reproduce sexually.*

Lack of water **or** unsuitable (or adverse or extreme) temperature **or** unsuitable (or adverse or extreme) pH **or** lack of nutrients **3**

(iv) *Sexual reproduction in Rhizopus:* ***Any four***

Opposite (or + and -) strains (of hypha) / Swellings form (or nuclei move into swellings) / Production of progametangia / Formation of gametangia / Fusion of nuclei (or fertilisation or zygote formation) / Zygospore formation/ Germination of zygospore / By meiosis **4(3)**

(b) (i) *Digestion:*

Breaking down food **3**

(ii) *Why digestion necessary:* ***Any two***

To make food soluble/ easier to absorb/ easier to transport **2(3)**

(iii) *How food passed along alimentary canal:*

*Peristalsis **3**

Description of peristalsis:

Muscular contractions (of the walls of the alimentary canal) **3**

(iv) *Enzyme that digests dietary protein:*

Protease **or** pepsin (or other named protease) **3**

(v) *Where this enzyme produced:*

Stomach **or** small intestine **or** duodenum **or** ileum **or** pancreas

[must match answer (iv)] **3**

(vi) *Where this enzyme active:*

Stomach **or** small intestine **or** duodenum **or** ileum
[must match answer (iv) and must also match (v) where (v) is answered correctly] **3**

(vii) *Products formed by complete protein digestion:*

*Amino acids **3**

(viii) *Blood vessel that transports protein digestion products to liver:*

*Hepatic portal vein **3**

(c) (i) *Megaspore mother-cell development:* ***Any four***

(Diploid megaspore mother-cell) divides by meiosis / Giving four haploid (daughter) cells / Only one survives **or** three die / This becomes the embryo sac / (The embryo sac) nucleus divides by mitosis / Three times **or** gives eight (haploid) nuclei / Two (of the haploid nuclei) become the polar nuclei / One (haploid nucleus) becomes the egg (nucleus). **4(3)**

(ii) *1. What happens during each fertilisation:*

One (male) gamete (or sperm nucleus) fuses (or joins or combines) with the egg **3**

One (male) gamete (or sperm nucleus) fuses (or joins or combines) with the (two) polar nuclei **3**

2. What is produced by each fertilisation:

A (diploid) zygote **3**

A triploid nucleus **or** a triploid endosperm **3**

[*if order not agreeing with 1, must say which fusion gives which result*]

(iii) *Drawing:* Testa and plumule and radicle **3**

(iii) *Labels* Testa / plumule / radicle **3(1)**

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