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 uncancelled 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.

HIGHER LEVEL

Section A **Best 5** **5(20)**

Question 1 (20 marks) Any five

(a)	Carbon/ Hydrogen/ Oxygen *Chemical symbols alone (e.g. C) not accepted*	**2(2)**
(b)	Glycerol / (two) fatty acid (chains) / Phosphate *Chemical symbols (e.g. P) alone not accepted*	**2+1+1**
(c)	Nucleus **or** mitochondrion **or** chloroplast **or** vacuole **or** any other (Golgi, ER etc.)	**4**
(d)	Amino acid	**4**
(e)	Nucleic acid	**4**
(f)	**Name:** Any (keratin, collagen, elastin, myosin, actin) **Role:** Any appropriate matching role (hair, skin, nails, bone, blood vessels, muscles etc.). *exact function not required*	**4**

Question 2 (20 marks)

(a)	*Hypothesis* – proposed (**or** possible **or** temporary **or** tentative) explanation for an observation/that can be tested (***or*** is testable)	**2(2)**
(b)	Changing only one variable (at a time **or** in an experiment) **or** changing one variable while keeping others (relevant variables) the same (**or** controlled **or** fixed)	**4**
(c)	To be sure (**or** be confident **or** know) that results are due to (**or** caused by **or** similar) the variable that was changed.	**4**
(d)	Extent of (**or** insufficient) knowledge/human error/(lack of) ability to interpret results/ (flawed) experimental design/serendipity (**or** accidental discovery)/bias/changing nature ***Any two***	**2(2)**
(e)	Increases accuracy **or** increases precision **or** increases confidence **or** identifies outliers **or** smaller margin of error	**4**

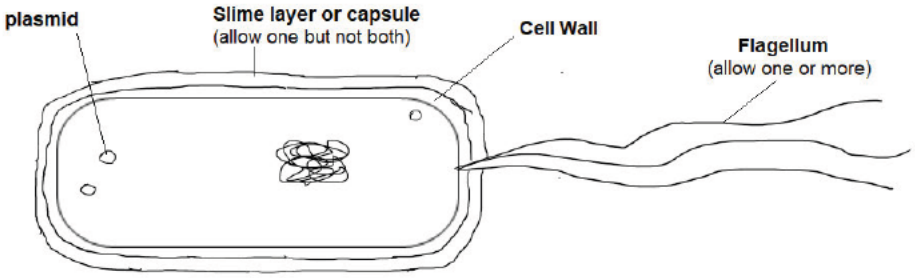
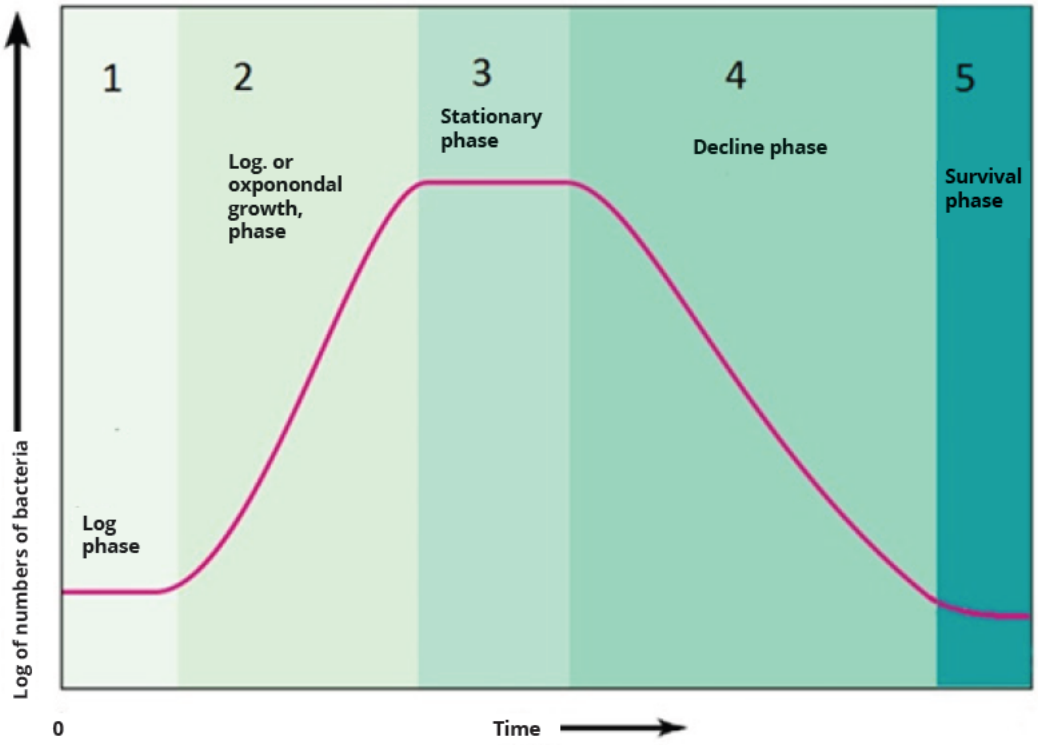
Question 3 (20 marks)

(a)	Reaction centre	**4**
(b)	Grana **or** (stacked **or** disc-shaped) inner membranes Fluid **or** liquid-filled **or** stroma **or** described	**2** **2**
(c)	ATP	**4**
(d)	*Pathway 1*: returns to chlorophyll *Pathway 2*: is transferred to the dark stage ***or*** *described*	**2** **2**
(e)	Provides electrons **and** protons (**or** hydrogen ions)/for glucose manufacture (**or** to combine with carbon dioxide to form glucose) *answer must include* ***both*** *electrons* ***and*** *protons for first* ***2*** *marks.* *"Hydrogen" only not acceptable, must refer to ion.* do not accept *'traps and transfers electrons and protons'* or similar for first 2 marks	**2(2)**

Question 4 (20 marks) *any* **6(3) + 2**

	True	False
(a)		**X**
(b)	**X**	
(c)	**X**	
(d)		**X**
(e)		**X**
(f)	**X**	
(g)	**X**	

Question 5 (20 marks)

(a)	Monera	**2**
(b)	 Flagellum Plasmid Cell wall Capsule **or** Slime layer (not both) ***Any three*** *drawn and labelled correctly*	**3(2)**
(c)	no nucleus **or** no membrane-bound organelles (**or** explained)	**2**
(d)	Any named bacterium **or** associated disease *e.g.* Salmonella **or** tuberculosis **or** Listeria **or** Cholera **or** botulism **or** anthrax **or** leprosy ***etc.*** Allow *E. coli,* exact or full species name not required (*e.g. Vibrio cholerae* **or** *Mycobacterium tuberculosis etc.* are not necessary*)* *Do not allow* food poisoning **or** dysentery **or** *non-specific bacterial disease.*	**2**
(e)	*2 marks for* ***each*** *of four correctly labelled phases on correctly drawn graph.* 	**4(2)**

Question 6 (20 marks)

(a)	Anaphase	**3**
(b)	A: chromosome B: spindle (fibres) *do not allow chromatin **or** DNA **or** nucleus*	**2** **2**
(c)	A: *chromosomes:* (carrying) genetic information **or** hereditary information **or** inherited characteristics **or** packaging DNA **or** regulating gene expression. B: *spindle fibres*: attaching to chromosomes **or** separating chromosomes **or** ensuring equal division of chromosomes **or** maintaining cell continuity **or** explained	**2** **2**
(d)	Telophase	**3**
(e)	Cell plate formed **or** described	**3**
(f)	Reproduction	**3**

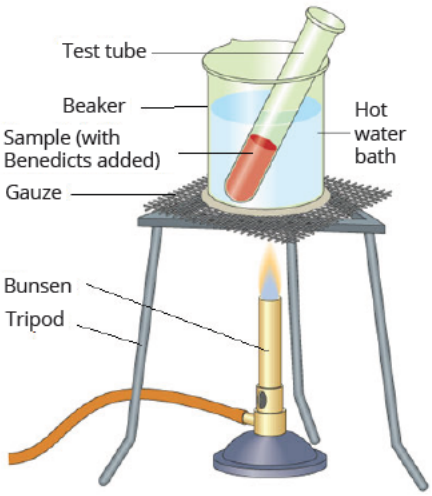
Question 7 (20 marks)

(a)	**A:** Ground **or** Cortex ***or*** Parenchyma **B:** Phloem **C:** Dermal (**or** dermis **or** epidermis **or** epidermal) **D:** Xylem	**4(1)**
(b)	Translocation (**or** transport) of / sucrose (**or** sugar **or** amino acids **or** products of photosynthesis **or** sap containing nutrients) *Do not accept only "*nutrients" *for second 2 marks*	**2(2)**
(c)	1. Vessels/ 2. Tracheids	**2** **2**
(d)	Lignified walls/no end walls/pits/dead/hollow/narrow ***Any two***	**2(2)**
(e)	Tips (apexes **or** apices) of roots (shoots) **or** in between xylem and phloem (**or** vascular cambium **or** cork cambium) **or** base of leaf blades in monocots. ***Any one***	**4**

Section B **Best 2** **2(30)**

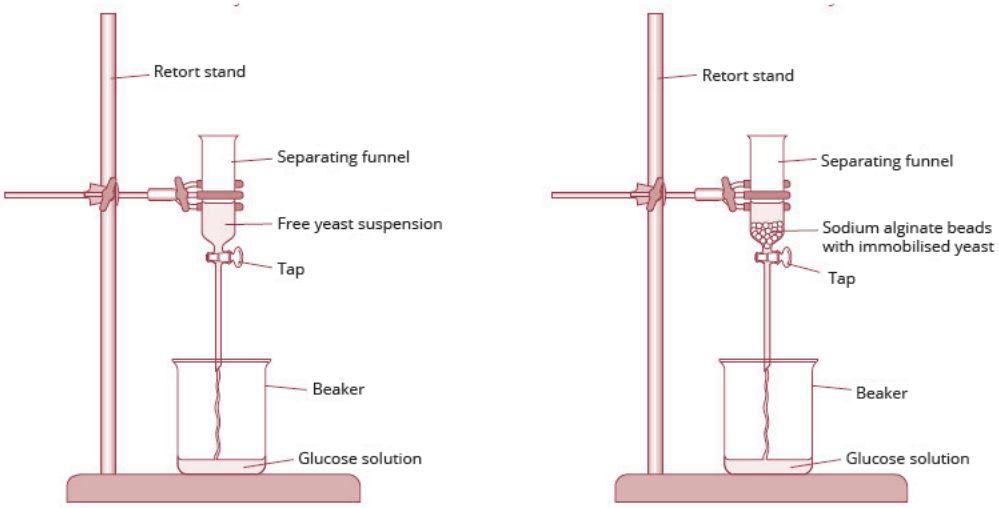
Question 8 (30 marks)

(a)	(i)	cheek	**2**
	(ii)	finger (**or** cotton bud *etc.)* rubbed on inside of cheek	**2**
	(iii)	Methylene blue	**2**
(b)	(i)	(applied sample onto centre of) microscope slide/allowed to dry/placed a drop of water (or stain) onto sample/ coverslip/at an angle *Any three*	**3(2)**
	(ii)	1. Starch	**2**
		2. Iodine	**2**
		3. *Initial colour*: (yellow-)brown	**2**
		Final colour: (blue-)black	**2**
	(iii)	1. Benedict's **or** Fehling's	**3**
		2. Diagram	**3**
		Labels: **must** include **either** a thermostatically controlled hot water bath **or** indicating how beaker (**or** similar) is heated (with Bunsen and tripod for example) Any **two** other appropriate labels (*e.g.* test tube, control, sample, Benedict's reagent)	**2(2)**



Question 9 (30 marks)

(a)	(i)	Speeds up (**or** changes the rate of) (chemical) reaction	**3**
	(ii)	Trapped in **or** attached to **or** fixed to a gel **or** insoluble (**or** inert) substance (**or** material)	**3**
(b)	(i)	Enzyme: Sucrase **or** invertase (**or** other appropriate)	**3**
		Substrate: Sucrose (**or** other substrate matching enzyme)	**3**
	(ii)	Sodium (**or** calcium) alginate	**3**
	(iii)	Calcium chloride. Accept $CaCl_2$	**3**
	(iv)	To remove unbound enzyme (**or** [yeast] cells) **or** to remove salt	**3**
	(v)	Beads in funnel (**or** suitable vessel)/added sucrose (**or** other substrate)/ named product (matching substrate)/glucose test strips (**or** other product test described)/control setup described.	**3(2)**
		Note: a labelled diagram (like the one shown below) can be awarded marks if it is in support of, or adds to, part of the student's answer.	
	Any three		
	(vi)	More stable (than free enzyme) **or** reusable **or** no need for separation (from product) **or** pure product (obtained)	**3**



Application of the immobilised enzyme

Question 10 (30 marks)

(a)	Time for embryo development/surviving unfavourable conditions/ time for seed dispersal/development of seed banks/germination when time (**or** conditions) are suitable **Any two**	**2(3)**
(b)	(i) Any suitable seeds *e.g.* broad beans **or** faba beans **or** lima beans **or** other suitably large seed	**2**
	(ii) To break dormancy **or** necessary for metabolism **or** to activate enzymes **or** to begin germination **or** to soften the testa **Any one**	**2**
	(iii) To kill them/denature enzymes/act as a control **Any two**	**2(2)**
	(iv) split seeds (**or** beans) / sterilise (**or** soak in disinfectant **or** described) / flat (**or** exposed) side down onto agar / live seeds on one plate / dead seeds on another (**or** control plate) **Any three**	**3(2)**
	(v) (skimmed) milk (agar) **or** starch (agar)	**2**
	(vi) Biuret (**or** copper sulfate and sodium hydroxide **or** $CuSO_4$ and NaOH) **or** Iodine (*must be linked to appropriate agar)*	**2**
	(vii) Added (**or** placed **or** poured **or** covered agar with) named reagent to the (surface of the) agar	**2**
	(viii) Purple with clear zone (**or** area) around (**or** under) seed **or** (blue-) black with clear (***or*** [yellow-]brown zone [**or** area]) around (**or** under) seed. / No (clear) zone around control seeds (or described) *Answers must be appropriate to reagent used*	**2** **2**

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

Question 11

(a)	*Abiotic:* non-living environmental influences Named habitat Named plant Appropriate abiotic factor (should match named habitat) e.g. light, soil pH, water, etc. for woodland **or** grassland **or** hedgerow e.g. salinity for rocky shore e.g. rate of flow for freshwater river		**3** **2** **2** **2**
(b)	(i)	To make protein **or** enzymes **or** nucleic acids **or** DNA **or** similar. Answer must refer to a biomolecule	**3**
	(ii)	Urea **or** uric acid	**3**
	(iii)	Close relationship between bacterium (**or** organism) and roots of plants (legumes)	**2(3)**
	(iv)	Lightning **or** Haber process **or** (industrial) fertiliser manufacture *Do not accept* 'thunder storms'	**3**
	(v)	Nitrification	**3**
	(vi)	Make food using the energy from chemicals (***or*** chemical reactions **or** chemical energy)	**3**
	(vii)	Decomposers **or** saprophytes	**3**
	(viii)	(Carry out) respiration in the absence of oxygen	**3**
(c)	(i)	Place in which organisms live	**3**
	(ii)	Feature (**or** characteristic) that allows (**or** enables) an organism to better survive	**3**
	(iii)	Named animal (must match habitat named in (a)) Matching <u>behavioural</u> adaptation *Examples:* Bats **or** badgers **or** owls etc: nocturnal Badgers: build underground setts Rabbits: dig burrows Deer: herding or stags fighting Blackbird (or similar bird): singing, territorial or to attract mates	**3** **3**
	(iv)	*Competition:* struggle between organisms for (limited or scarce) resources *Do not accept only* "struggle between organisms"	**3**
	(v)	Scramble: all get some (of the resource) Contest: one gets all (of the resource)	**3** **3**
	(vi)	Appropriate example of plant adaptation that matches habitat. *Sycamore* produces (helicopter) seeds for wind dispersal *Briar* - thorns for defence (**or** deterrent from being eaten **or** described) **or** climbing *Oak* (or similar deciduous tree or named plant) - wide leaves (that increase surface area) for absorbing light (for photosynthesis) *Grass* – many shallow (fibrous) roots (in all directions) for (gathering or absorbing) water *Oak or similar tree* - large tap root for (access to) deep water ***Plant must be named to obtain marks, but no marks to be awarded for naming the plant only.***	**3**

Question 12

(a)

(i) Study (**or** science) of heredity (**or** inheritance or inherited characteristics) — **3**

(ii) Every characteristic (**or** trait) is governed by a pair of factors (**or** alleles) that separate during gamete formation/(such that) each gamete receives (only) one of the pair of factors — **2(3)**

(b)

(i) *Homozygous:* (two **or** both) identical alleles present **or** (two **or** both) alleles (in a pair) are the same. — **3**

(ii) *Parent genotypes*: TtPp x ttpp — **2(1)**

(iii) Correct gametes clearly indicated (shown circled in Punnet square below, Punnet square not required): — **5(1)**

	TP	tP	Tp	tp
tp	TtPp	ttPp	Ttpp	ttpp

4(1)

Offspring genotypes: TtPp ttPp Ttpp ttpp

Offspring phenotypes:

Tall Purple	Short Purple	Tall White	Short White

4(1)

3

(iv) 25% each — **3**

(v) Not located on the same chromosome — **3**

(vi) Only (**or** mostly) parental types **or** less variation in offspring **or** explained with examples of traits from this cross. *e.g.* "no short purple (or tall white) offspring" Accept chromosome diagrams showing less variation during gamete formation etc.

(c)

(i) *Variation:* differences between individuals of a species (**or** in a population). — **4**

Mutation: a change in (structure of) DNA (***or*** gene **or** amount of [**or** number of] chromosomes **or** genetic material). — **4**

(ii) Both Nn **or** Cc *etc.* — **4**

(iii) 25% **or** ¼ — **4**

(iv) Radiation (**or** X-rays **or** UV) **or** chemicals (**or** named chemical) **or** tobacco smoke **or** named biological agent (*e.g.* virus) **any one** — **4**

(v) Only passed on (**or** transmitted) in gametes **or** explained — **4**

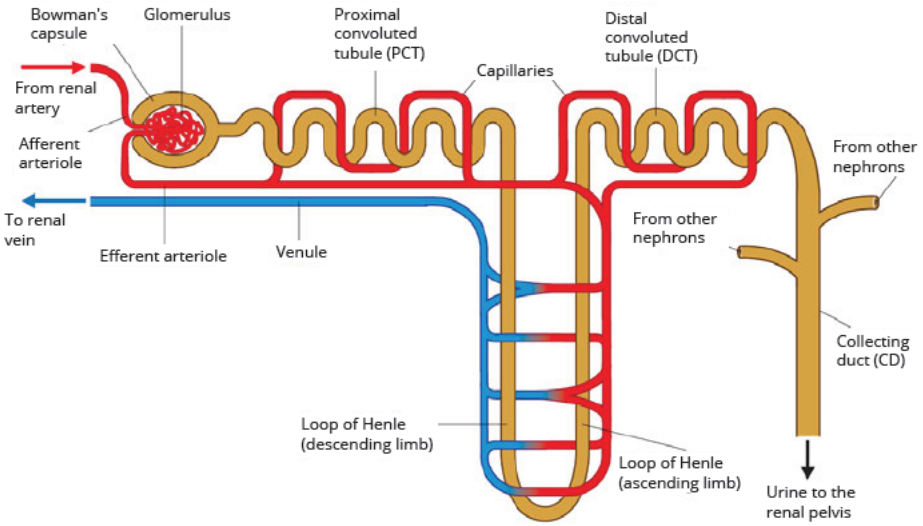
Question 13

(a)	(i)	*Petal*: attracts pollinators Accept named pollinator *Do not accept only* 'insects'	**3**
	(ii)	*Anther*: produces pollen	**3**
	(iii)	*Style*: raises (**or** supports) stigma **or** allows growth of pollen tube **or** prevents inappropriate entry of pollen *Do not accept* 'aids fertilisation'.	**3**
(b)	(i)	*Pollination*: Transfer of pollen from anther to stigma	**3**
	(ii)	*Self-pollination:* transfer from anther to stigma on same plant *Do not accept only 'same species' **or** 'same flower'* *Cross-pollination*: pollen transferred from anther of one plant to stigma on another plant (of same species)	**3**
	(iii)	Large (**or** feathery) stigmas/large anthers/large volume of pollen/stigmas (dangling) outside flower/anthers outside/long style/long filaments/non-sticky pollen/light pollen **Any two**	**2(3)**
	(iv)	Diploid (microspore) mother cell/divides by meiosis/to produce four haploid microspores **or** nuclei/(each) divides by mitosis/to produce two (named) haploid nuclei *The role of both meiosis and mitosis must be included in the answer; if not, only one 3mks can be awarded.* **Any four**	**4(3)**
(c)	(i)	Megaspore mother (cell)	**3**
	(ii)	Only one survives/becomes (haploid) embryo sac/divides by mitosis/three times/to produce eight (haploid) nuclei/two become the polar nuclei/one becomes the egg (nucleus) **Any three**	**3(3)**
	(iii)	Pollen tube grows (through the style) / generative nucleus divides by mitosis / to form two haploid male gamete nuclei (**or** sperm nuclei) / they enter the embryo sac/one fuses with the egg nucleus/the other fuses with the two polar nuclei. **Any three**	**3(2)**
	(iv)	Endosperm (nucleus) / zygote (nucleus)	**2(3)**

Question 14

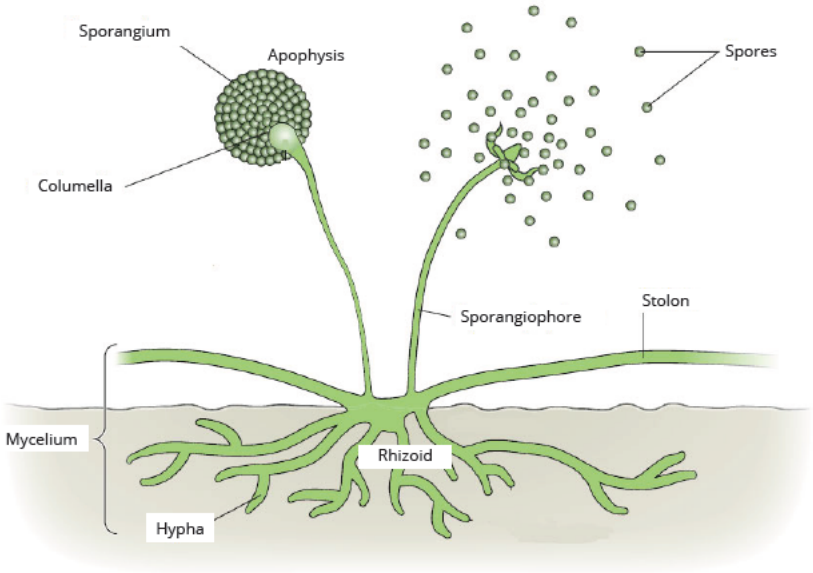
(a)	(i)	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + energy Award three if not fully balanced (**or** if one other number is incorrect) but otherwise correct. No marks awarded for word equation.	**3 + 3**
	(ii)	Lactic acid **or** lactate	**3**
(b)	(i)	Cytosol *Do not accept* cytoplasm	**3**
	(ii)	2	**2**
	(iii)	Pyruvate loses (two) electrons/loses one carbon as carbon dioxide (**or** carbon dioxide is released)/H ions (or protons **or** H^+) released/NADH formed/acetyl (joins with) CoA. Note: Hydrogen alone is insufficient, must indicate ions (**or** protons **or** H^+) are released **Any three**	**3(2)**
	(iv)	Coenzyme A/carbon dioxide/ATP/NADH (**or** or protons **or** H^+ or electrons) **Any two**	**2(2)**
	(v)	Traps (**or** captures) and transfers (**or** transports)/electrons and protons **or** H^+/ to the electron transport system (**or** electron transport proteins).	**3(2)**
	(vi)	Electrons carried (**or** move) along (chain of) / (electron) transport proteins (or molecules) / releasing energy (from electrons) / (which is) used to manufacture ATP. **Any three**	**3(2)**
(c)	(i)	Adenosine triphosphate	**3**
	(ii)	Supplies (**or** provides) energy/for metabolism (**or** cell processes)	**2 + 2**
	(iii)	Energy is easily released **or** (small and) easy to transport **or** releases suitable (**or** manageable) amount of energy **Any one**	**3**
	(iv)	Any suitable example e.g. liver, muscle etc.	**3**
	(v)	Mitochondria **or** ribosomes	**3**
	(vi)	ADP/phosphates	**2 + 2**
	(vii)	Reasons: larger molecule formed from smaller / energy required Note: Marks are awarded only for reasons (not for "anabolic") and can only be awarded if the answer given for the type of reaction is correct.	**2** **2**

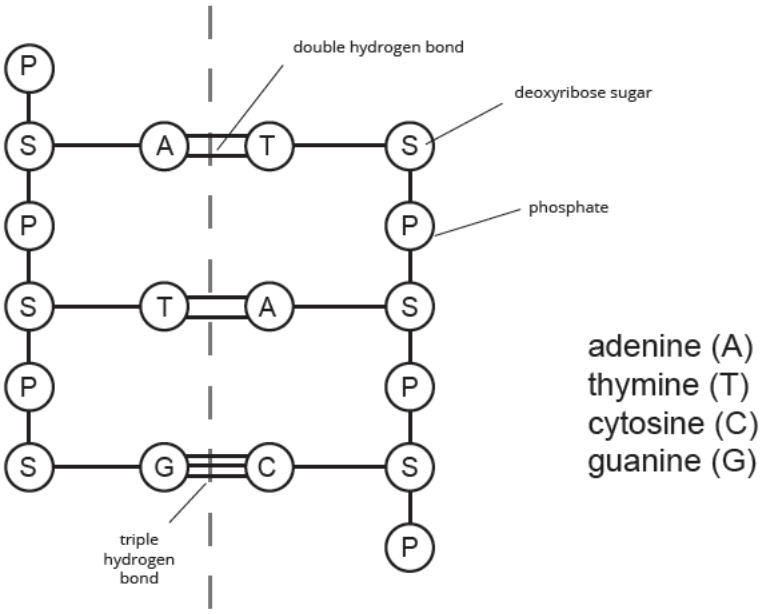
Question 15

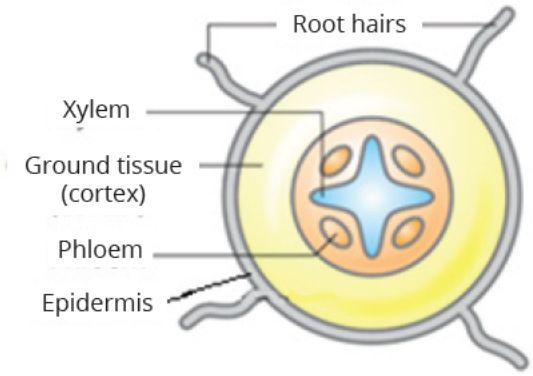
(a)	(i)	*Excretion:* elimination (**or** removal) of metabolic waste from a cell (**or** organism) *Osmoregulation:* control of levels of water **and** salt (in a cell **or** organism)	**3** **3**
	(ii)	Skin **or** lungs	**3**
(b)	(i)	Diagram  Labels 6 marks for including in drawing both convoluted tubules, capillaries, collecting duct, loop of Henle. 3 marks only if any one of the above list is missing 0 marks if two of the above list are missing	**6, 3, 0** **6(1)**
	(ii)	Glomerulus **or** Bowman's capsule	**3**
	(iii)	Too large (to pass through)	**3**
	(iv)	Proximal convoluted tubule (*allow PCT if already labelled correctly in diagram*)	**3**
	(v)	Amino acid(s) **or** salt(s) **or** water **any one**	**3**
	(vi)	Urea **or** uric acid	**3**
(c)	(i)	*Hormone*: chemical messengers/produced in endocrine (**or** ductless) gland/ made in one part of the body, acts in another. ***Any two***	**2(3)**
	(ii)	The level of the hormone controls its own production (**or** production (**or** level) of another hormone)	**3**
	(iii)	Antidiuretic hormone **or** vasopressin *Do not accept* ADH only.	**3**
	(iv)	Pituitary *Do not accept* hypothalamus	**3**
	(v)	Collecting duct **or** distal convoluted tubule (*allow DCT if correctly labelled in diagram*)	**3**
	(vi)	Increases permeability to water	**3**
	(vii)	Low water concentration in the blood **or** high salt concentration in the blood Must mention **blood** concentrations	**3**

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

(a)	(i)	Ability to defend against (**or** resistance to) infectious disease (**or** pathogen). *Allow* resistance to disease (**or** antigen)	**3**
	(ii)	Disease-causing organism	**3**
	(iii)	Physical barrier to entry **or** antimicrobials in sebum **or** low (or acidic) pH (of sweat) **or** other suitable example **Any one**	**3**
	(iv)	Engulf and kill pathogens **or** phagocytosis described **or** leave blood and become (more aggressive) macrophages **or** present antigen to T-lymphocytes. **Any one**	**3**
	(v)	Antibodies bind to (specific) antigens (shape) / disable (**or** deactivate) antigen (**or** pathogen)	**3** **3**
	(vi)	*Names*: Helper / suppressor / killer / memory **Any two** *Roles:* **Helper:** secrete interferon (**or** cytokines) **or** activate B cells (**or** macrophages **or** monocytes **or** killer cells) **or** stimulate antibody production **Killer:** attack (virus-)infected cells (**or** tumour cells) **or** secrete perforin **or** *described.* **Suppressor:** regulate **or** dampen **or** stop immune response **Memory:** long term protection **or** allow stronger, faster secondary response **or** faster response on reinfection **or** *described* **Any two**	**2(3)** **2(3)**

(b)	(i)	Diagram Labels Spores/hyphae/sporangium/mycelium/stolon/sporangiophore/ columella /rhizoid/apophysis **Any six**	**6, 3, 0** **6(1)**
		 	
		6 marks for diagram only if all of the following are present: Both types of aerial hyphae (sporangiophore and stolon) (this requires that the substate level is included in the diagram) Spores (in sporangium or being released) 3 marks only if either of the above is missing. 0 marks if no sporangium, or no mycelium.	
	(ii)	Spores **or** hyphae **or** sporangia **or** mycelium **or** stolon **Any one**	**3**
	(iii)	Plant cell walls made of cellulose **/** fungal cells made of chitin	**2(2)**
	(iv)	Saprophytic	**3**
	(v)	Opposite (or + / –) strains (***or*** hyphae) / produce swellings / nuclei move into swellings / forming progametangia / walls form / gametangia formed / fusion (**or** fertilisation) of (gamete) nuclei / forms diploid zygote (**or** nuclei **or** zygospore) / germinates by meiosis **Any four**	 **4(2)**

(c)	(i)	Deoxyribo/nucleic acid	**2(2)**
	(ii)	Adenine, Guanine, Cytosine, Thymine	**4(2)**
	(iii)	**Diagram (see below):** Two strands / three bases on each / phosphate-sugar backbone drawn correctly / double and triple H bonds / base-pairing correct / all four (correct) bases shown Award **only** three if **any one** incorrect.	**6, 3, 0**
		Labels Hydrogen bonds (both double and triple shown)/phosphate, deoxyribose sugar/ complementary base-pairing shown (both).	**4(2)**
			
	(iv)	Double vs single-stranded **or** thymine vs uracil **or** deoxyribose vs ribose sugar **Any one (**must be structural, and must indicate how the point applies to both RNA and DNA)	**4**

(d)	(i)	The loss of water (vapour) from the surface of a plant	**2**
	(ii)	Osmosis	**2**
	(iii)	(Force that) pushes water up the stem (of a plant)	**2**
	(iv)	Cohesive (or adhesive) water (molecules) / narrow xylem / heat energy from sun (**or** kinetic energy from wind) / pull of transpiration / tension/ **Any two**	**2(3)**
	(v)	Diagram Two marks lost for **any** of the following: root hairs absent **or** shape of xylem inaccurate **or** vascular tissue is not in the centre of the root **or** xylem/phloem arranged inaccurately.	**4, 2, 0**
			
		Labels: xylem / phloem	**2(2)**
	(vi)	1. Companion cells – control activity of sieve elements	**3**
		2. Sieve plates – allow movement (translocation) of (named) substances between cells	**3**
	(vii)	Xylem: one-way	**2**
		Phloem: two-way	**2**

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

(a)	(i)	Can only replicate (or reproduce) in a cell (or by using a cell) **or** require a host to replicate (or reproduce)	**4**
	(ii)	Obtains food from other organisms (or their waste) **or** does not make its own food (so relying on other organisms for food)	**4**
	(iii)	Substance produced by microorganisms (or bacteria and fungi)/that kills (or inhibits growth of) bacteria.	**2(4)**
	(iv)	(Antibiotics) do not affect viruses **or** only kill bacteria (**or** are effective against [or work against] bacteria **or** only against diseases caused by bacteria).	**4**
	(v)	smallpox/chicken pox/measles/mumps/rubella/German measles/polio/flu/ common cold/Covid(19)/tobacco mosaic/tomato mosaic/ebola/Sars **Any two**	**2(4)**
	(vi)	Making vaccines **or** controls population size **or** bacteriophage kills bacteria **or** used (as vectors) in genetic engineering **or** gene therapy	**2**
(b)	(i)	*Distilled water:* mass (and/or volume) increased as water entered potato cells/ by osmosis/from distilled water (***or*** high water concentration)/ to interior (**or** cytoplasm) of (lower water concentration) potato cells. **Any two**	**2(3)**
	(ii)	Yes (it is valid) Diffusion: movement of a substance from an area of high concentration to an area of low concentration. Osmosis: Movement of (only) **water** from an area of high water concentration to low water concentration **or** osmosis only (a special case of diffusion) through a selectively permeable membrane. *Note: do not accept* "semi-permeable"	**3** **3** **3**
	(iii)	Water moves by osmosis from the microorganism to the high salt (**or** high sugar food) / causing microorganism to (dehydrate and) die / food does not spoil (**or** does not rot **or** shelf-life is extended). **Any two**	**2(3)**
	(iv)	Movement of substance(s) from low to high concentration (**or** up [or against] a concentration gradient) / requires energy (**or** ATP).	**2(3)**
	(v)	Reabsorption (of suitable substance e.g. amino acids, sugars) in (specific location of) nephron **or** absorption (of suitable substance) in villus (**or** small intestine) **or** Secretion (**or** release) of neurotransmitter into synaptic cleft **or** other suitable example. **Any one**	**3**
(c)	(i)	Pituitary gland	**3**
	(ii)	Ovulation	**3**
	(iii)	B	**3**
	(iv)	Oestrogen	**3**
	(v)	Builds (**or** maintains) the **lining of** the uterus (**or** endometrium) *Note: do not accept* only 'uterus', must state 'lining of' or use the term endometrium.	**3**
	(vi)	Corpus luteum / formed from Graafian follicle after release of the egg (**or** ovulation).	**2(3)**
	(vii)	Placenta	**3**
	(viii)	FSH: (signals testes to) produce sperm LH: (signal testes to) produce testosterone	**3** **3**

(d)	(i)	Cell body	**3**
	(ii)	Schwann cells	**3**
	(iii)	Insulation **or** protection **or** more efficient impulse **Any one**	**3**
	(iv)	Impulse arrives at axon terminal / vesicles mobilised / neurotransmitter released / into synaptic cleft / diffuse across gap (**or** cleft) / binds to receptors on next neuron / causes impulse (in next neuron) / enzyme digests neurotransmitter / reuptake into first neuron (**or** presynaptic membrane) **Any five**	**5(3)**
	(v)	Parkinson's:	
	1.	decrease in dopamine **or** serotonin **or** genetic **or** environmental factors **or** aging **or** drugs **or** stroke **Any one**	**3**
	2.	L-dopa (**or** levodopa) **or** increasing serotonin **or** dopamine (production) **or** taking MAOIs **or** brain simulation **or** physiotherapy **or** ultrasound **or** any other valid answer. **Any one** *Allow other named disorder of the nervous system with matching cause and prevention or treatment.*	**3**