

## Marking Schemes

*This document was prepared for markers' reference. It should not be regarded as a set of model answers. Candidates and teachers who were not involved in the marking process are advised to interpret its contents with care.*

### Paper 1

#### SECTION A

Question No.	Key	Question No.	Key
1.	C (85%)	21.	D (71%)
2.	B (69%)	22.	C (85%)
3.	D (43%)	23.	A (73%)
4.	B (33%)	24.	C (36%)
5.	A (52%)	25.	D (58%)
6.	A (68%)	26.	A (65%)
7.	A (80%)	27.	B (18%)
8.	C (64%)	28.	C (18%)
9.	A (79%)	29.	B (73%)
10.	C (67%)	30.	A (61%)
11.	D (73%)	31.	D (70%)
12.	A (69%)	32.	B (30%)
13.	B (47%)	33.	B (46%)
14.	B (68%)	34.	D (47%)
15.	B (51%)	35.	A (42%)
16.	C (76%)	36.	D (64%)
17.	C (40%)		
18.	D (67%)		
19.	C (34%)		
20.	D (59%)		

*Note: Figures in brackets indicate the percentages of candidates choosing the correct answers.*

## General Marking Instructions

1. In order to maintain a uniform standard in marking, markers should adhere to the marking scheme agreed at the markers' meeting.
2. The marking scheme may not exhaust all possible answers for each question. Markers should exercise their professional discretion and judgment in accepting alternative answers that are not in the marking scheme but are correct and well-reasoned.
3. The following symbols are used:

/ A single slash indicates an acceptable alternative within an answer.

\* Correct spelling required

4. In questions asking for a specified number of reasons or examples etc. and a candidate gives more than the required number, the extra answers should not be marked. For instance, in a question asking candidates to provide two examples, and if a candidate gives three answers, only the first two should be marked.
5. In cases where a candidate answers more questions than required, the answers to all questions should be marked. However, the excess answer(s) receiving the lowest score(s) will be disregarded in the calculation of the final mark.
6. Award zero marks for answers which are contradictory.
7. Where applicable, markers should put a tick (✓) against the answer which counts for a point of merit and the aggregated mark awarded for each question should be entered into the mark box of the OSM system in the right-hand side. If no marks are to be given, a cross (X) should be inserted there instead.

Paper 1 Section B

Marks

1.	Condition	Part of the brain	
	Difficulty in breathing	medulla / brain stem (1)	(3)
	Difficulty in balance during movement / walking (1)	cerebellum	
	Difficulty in speech and vision	cerebrum / cerebral cortex (1)	

3 marks

2. (a) • amniotic fluid (1) (1)
- (b) • \* placenta with labeling pointing to the correct location (1) (1)
- (c) Any *two* of the following:
- to avoid clumping of blood in case their blood types are incompatible (1)
  - to prevent the entry of some pathogens / toxins from maternal blood directly (1)
  - to avoid breakage of foetal blood vessels by the high blood pressure of maternal blood (1)

4 marks

3. (a) A: \* thylakoid membrane (1) (2)
- B: \* stroma (1)
- (b) • mesophyll cell / palisade mesophyll cell / spongy mesophyll cell / guard cell (1) (1)
- (c) • photochemical reactions take place at A (1)
- which supplies ATP and NADPH (1)
- for carbon fixation that takes place at B (1)
- Or (3)
- carbon fixation takes place at B (1)
- which regenerate NADP (1)
- for photochemical reactions that take place at A (1)

6 marks

4. (a)

	Leaves with parallel veins	Leaves with network veins	a single flower	a cluster of flowers	other features	
lesser celandine		✓	✓		heart-shaped leaf	
hyacinth	✓			✓	funnel-like flower	
wild daffodil	✓		✓		trumpet-like flower	(2)
primrose		✓	✓		club-shaped leaf	
dead nettle		✓		✓	two-lipped flower	

(1) (1)

		Marks	
	(b) 2a The plant has a cluster of / funnel-like flowers	(1)	
	2b The plant has a single / trumpet-like flower		
	3a dead nettle	(1)	
	3b 4		
	4a The plant has heart-shaped leaves	(1)	
	4b The plant has club-shaped leaves		
	(c) • this is incorrect (1)	(2)	
	• because a dichotomous key is used to identify organisms from a group based on the observable / morphological features which may not be related to their evolutionary / phylogenetic relationship (1)		
			7 marks
	5.	(a) • species B (1)	(3)
• the lower shore has a higher algal biomass which indicates that it is a more favourable area (1)			
• a stronger competitor normally occupies a more favourable habitat (1)			
(b) • mean temperature at the lower shore is lower than that at the middle shore / vice versa (1)		(4)	
• if temperature tolerance is a determining factor, middle shore should be unfavourable to species A / lower shore should be more favourable to species A (1)			
• however, species A occupied middle shore instead of lower shore (1)			
• therefore, there are other factors determining the distribution / temperature tolerance is not the determining factor (1)			
(c) • quadrat sampling relies on counting organisms in a confined area (1)		(2)	
• so it is only useful for studying plants or very slow moving organisms / crabs may move away from the quadrat (1)			
		9 marks	
6.	(a) (i) Karen is genetically identical to Kitty, hence they both have the cancer-causing genes (1)	(1)	
	(ii) Kitty's eating habit would trigger the development of colon cancer earlier (1)	(1)	
	(b) Any <i>two</i> of the following:	(2)	
	• smoking, excessive drinking, stress, lack of exercises (1,1)		
			4 marks
7.	(a) phagocyte (1)	(1)	
	(b) • arterioles of the tissue with inflammatory response dilate, increasing blood flow to the tissue and makes it red (1)	(3)	
	• permeability of capillary wall increases, increasing the formation of tissue fluid and its accumulation, and leads to swelling (1)		
	• more tissue fluid presses against nerve endings, stimulating the pain receptors and gives the pain sensation (1)		

- (c) • activity of B-lymphocytes will lead to the production of antibodies (1) against the specific pathogens  
 • activity of T-lymphocytes will lead to the destruction of infected cells (1)  
 • memory cells will be formed for future immunity / quicker response in the second attack (1) (3)
- 
- 7 marks
8. (a) • those with the cap removed could regenerate the cap / the stalk and foot alone could regenerate the cap (1)  
 • those with the foot removed could not regenerate the foot / the cap and stalk alone could not regenerate the foot (1) (2)
- (b) (i) (1) RNA (1) (1)  
 (2) • RNA directs the protein synthesis through translation (1)  
 • the protein produced determine the morphology of the cap by acting as enzymes or structural proteins (1) (2)
- (ii) • the final morphological feature of the cap resembles that of Species 2 (1)  
 • showing that the trait is determined by the foot of Species 2 but not the stalk from Species 1 (1) (2)  
 thus the permanent heredity information is stably stored in the foot
- (c) • scientific knowledge is based on or derived from observations of the natural world (i.e. empirically based or evidence based) (1)  
 • Hämmerling's observation on the regeneration of the cap from the algae leads to the confirmation of the location of genetic materials (1)
- Or
- doing science requires creativity and imagination (1) (2)  
 • Hämmerling designed experiment to test his hypothesis, the process required creativity and imagination (1)
- Or
- science is a process of ongoing inquiries (1)  
 • Hämmerling's grafting experiment has led to the inquiries about short-lived instructions (1)
- 
- 9 marks
9. (a) • dry the harvested plant in an oven at around 100°C (1)  
 • until a constant mass is obtained upon repeated weighing (1) (2)
- (b) (i) • without magnesium, chlorophyll cannot be formed (1), leaving the leaves yellow (1)
- (ii) • without chlorophyll, the rate of photosynthesis of the plant is lowered (1)  
 • as a result, there is not enough food produced for the growth of plants (1)  
 • therefore, both the shoot and root dry mass are smaller than that of the control / that grown in complete nutrient solution (1) (3)
- (c) (i) • the overall dry mass of the plant under P deficient conditions is much smaller (1)  
 • because P is necessary for the formation of protein / nucleic acids / ATP (1) which are important for growth (2)

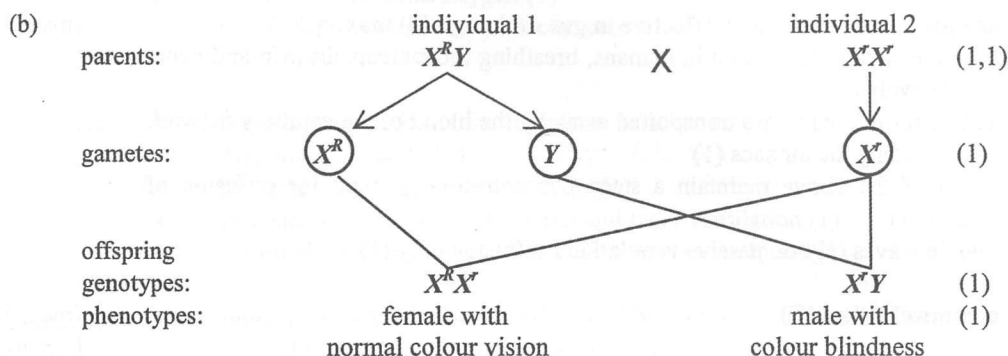
- (ii) • without P, more photosynthetic product is transported from leaves to root (1)  
 • as a result, the shoot dry mass is a lot lower than that of control (1)  
 • while the root dry mass maintains more or less the same (1)

(3)

11 marks

10. (a) • cone cells (1)  
 • they are concentrated at the yellow spot (1) of the retina

(2)



(5)

Wrong format: deduct 1 mark

Wrong use of symbols: deduct 1 mark

- (c)

(1)

- (d) • as David is a male, he has only one X-chromosome (1)  
 • having normal colour vision, this X-chromosome must bear the allele for normal colour vision (1)  
 • and this X-chromosome that bears the allele for normal colour vision must be inherited to his daughter (1)  
 • because the allele for normal colour vision is dominant over the allele for colour blindness / will be expressed over the allele for colour blindness (1)  
 • even if the baby girl receives an allele for colour blindness from Daisy, the baby girl will have normal colour vision (1)

(5)

13 marks

11. **Adaptations to be an effective organ for gas exchange (A) max.=5**

(max. 5)

- large surface area for diffusion of gases (1)
  - numerous air sacs in the lungs of humans vs spongy mesophyll with numerous air spaces in leaves / numerous leaves in plants (1)
- a moist surface for dissolving of gas (1)
  - presence of a water film on the inner surface of the air sac vs that of the surface of spongy mesophyll (1)
- short diffusion distance for exchange of gas between internal and external environment (1)
  - one-cell thick wall of air sacs and capillary versus flat and thin leaves (1)

**Human lungs are considered more effective in gas exchange (S) max. = 3**

(max. 3)

- there is active ventilation in humans, breathing movements draw in and expel air actively (1)
- oxygen diffused in are transported away by the blood of the capillary network surrounding the air sacs (1)
- both of the above maintain a steep concentration gradient for diffusion of gases (1)
- while leaves rely on passive ventilation / diffusion only (1)

**Effective communication (C)**

(max. 3)

11 marks

Mark award for communication:

Mark	Clarity of expression and relevance to the question	Logical and systematic presentation
3	<ul style="list-style-type: none"> <li>• Answers are easy to understand. They are fluent showing good command of language.</li> <li>• There is no or little irrelevant material.</li> </ul>	<ul style="list-style-type: none"> <li>• Answers are well structured showing coherence of thought and organisation of ideas.</li> </ul>
2	<ul style="list-style-type: none"> <li>• Language used is understandable but there is some inappropriate use of words.</li> <li>• A little irrelevant material is included, but does not mar the overall answer.</li> </ul>	<ul style="list-style-type: none"> <li>• Answers are organised, but there is some repetition of ideas.</li> </ul>
1	<ul style="list-style-type: none"> <li>• Markers have to spend some time and effort on understanding the answer(s).</li> <li>• Irrelevant material obscures some minor ideas.</li> </ul>	<ul style="list-style-type: none"> <li>• Answers are a bit disorganised, but paragraphing is evident. Repetition is noticeable.</li> </ul>
0	<ul style="list-style-type: none"> <li>• Language used is incomprehensible.</li> <li>• Irrelevant material buries the major ideas required by the question.</li> </ul>	<ul style="list-style-type: none"> <li>• Ideas are not coherent and systematic. Candidates show no attempt to organise thoughts.</li> </ul>

**Paper 2 Section A**

Marks

1. (a) (i) • The longer the duration of vigorous exercise, the more the contribution of energy from aerobic respiration / the shorter the duration of vigorous exercise, the more the contribution of energy from anaerobic respiration (1) (1)
- (ii) (1) •  $\text{glycogen} \rightarrow \text{glucose} \rightarrow \text{lactic acid / lactate} + \text{ATP}$  (2)
- (1) (1)
- (2) • to provide extra oxygen (1) (2)
- for the breakdown of lactic acid / lactate produced (1) during the exercise period
- (iii) • more sympathetic nerve impulses will be sent to the intercostal and diaphragm muscles (1)
- for faster and stronger contractions (1)
- that increases the breathing depth and rate / ventilation (1)
- for rapid gas exchange / loading of oxygen to the blood (1) (4)
- OR
- more sympathetic nerve impulses will be sent to the SA node (1)
- for faster and stronger contraction of heart (1)
- that increases the heart rate and stroke volume (1)
- for rapid supply of more blood to the muscle (1) for continuous contraction
- (b) (i) • glucose reabsorption increases with the plasma glucose concentration (1) if it increases between 0 - 200 ( $\pm 20$ ) mg dL<sup>-1</sup>
- while no glucose is excreted (1)
- beyond 200 ( $\pm 20$ ) mg dL<sup>-1</sup> (i.e. the threshold), reabsorption of glucose remains unchanged / levels off / remains constant (1) (4)
- and excretion of glucose in urine begins and increases with the rise in plasma glucose concentration (1)
- (ii) (1) • the first coiled tubule / first convoluted tubule / proximal convoluted tubule (1) (1)
- (2) • because the expression of the gene resulted in greater number of glucose transporters at the kidney tubule (1)
- hence, rate of glucose reabsorption is higher / more glucose can be reabsorbed per unit time / more glucose can be absorbed for the same length of kidney tubule (1) (2)
- (iii) • they fails to reabsorb all glucose from the glomerular filtrate / glucose reabsorption is incomplete / some glucose remains in the glomerular filtrate (1)
- hence the glomerular filtrate of diabetic patients has a lower water potential than that of healthy people (1) (4)
- as a result, less proportion of water can be reabsorbed back at the collecting duct (1)
- larger volume of urine will be produced (1), and they need to urinate more frequently



Paper 2 Section B

Marks

2. (a) (i) • water sample B is household sewage which contains a large amount of organic matters (1)  
 • microorganisms in water decompose these organic matters (1)  
 • hence, oxygen in water sample B is consumed more quickly than that of water sample A (1)  
 • therefore, water sample B (residential area) has a higher BOD than that of water sample A (industrial area) (1) (4)
- (ii) • water sample A shows that the site has been polluted with heavy metals (1)  
 • heavy metal cannot be excreted / broken down metabolically / detoxified (1)  
 • therefore, it will be accumulated along the food chain and reach a certain amount in the bodies of consumers such as fish (1)  
 • hence, people consume fish from river nearby industrial area may suffer from heavy metal poisoning (1) (4)
- (iii) (1) • antibiotics are excreted together with the urine / unabsorbed antibiotic are egested together with faeces by the people in the residential area (1) (1)
- (2) Any **one** of the following:  
 • natural microorganisms may develop antibiotic resistance, some of which may be pathogenic to humans / may cause other ecological effects (1)  
 • natural microorganisms may be killed by the antibiotic residues and thus disturb ecological balance (1) (1)
- (b) (i) • arsenic reduced the growth of both plant body and grain in the contaminated soil (1)  
 • with a greater reduction in the growth of grain (1) (2)
- (ii) • for grains, phosphate addition increased growth under both contaminated and uncontaminated soil (1)  
 • with growth in uncontaminated soil better than that in contaminated soil (1)  
 • for plant body, addition of phosphate did not improve the growth in the uncontaminated soil but improved the growth of plant body in contaminated soil (1)  
 • to values comparable to that in uncontaminated soil with no addition of phosphate (1) (4)
- (iii) • phosphate addition increased the accumulation of arsenic in plant body (1)  
 • but decreased that in grains (1) (2)
- (iv) • addition of phosphate can improve yield of wheat (1), i.e. grains  
 • and reduce health risk by reducing the uptake of arsenic in grains (1) (2)

3. (a) (i) Any *two* of the following:
- sushi contains raw food in which the bacteria / microorganisms are not killed (1) by cooking
  - the direct contact between sushi and chef's hand increases the chance of sushi being contaminated by pathogens (1)
  - sushi has high protein / fat content which is favourable for the growth of microorganisms (1)
- (2)
- (ii) • if adequate vinegar is added such that the resultant pH is lower than 5 / acidic (1)
- the growth of *B. cereus* can be inhibited / *B. cereus* can be killed / unfavourable to the growth of *B. cereus* (1)
- (2)
- (iii) • prepare tubes with culture medium at different pH values (1)
- inoculate a small fixed amount of *B. cereus* stock to each tube (1)
- incubate the tubes at 30°C for 24 hours (1)
- measure the turbidity of the bacterial culture / using cell count method (1)
- (4)
- (iv) • sushi is subjected to room temperature for a considerable amount of time, the bacteria can multiply at a high rate (1)
- and cause infection if ingested / produce toxins on the sushi causes poisoning (1)
- (2)
- (b) (i) • the dry mass of the food waste decreased continuously (1) / dropped by half in 50 days
- because the food waste was decomposed by the microorganisms into simple organic and inorganic molecules (1)
- whereas the dry mass of the microorganisms increased continuously (1)
- because the microorganisms grow continuously utilising those molecules (1)
- (4)
- (ii) (1) • 100 kg on day 0 and 55 kg on day 50 (1)
- (1)
- (2) • the total dry mass of food waste and microorganisms has decreased (1)
- microorganisms in the food waste carry out respiration (1) / anaerobic respiration
- which convert organic carbon into carbon dioxide / methane / SO<sub>2</sub> / H<sub>2</sub>S (1)
- these gases escaped from the compost into the air (1)
- (4)
- (iii) • used as fertiliser (1)
- (1)

Paper 2 Section D

Marks

4. (a) (i) • the neurones in that particular area are responsible for producing neurotransmitters (1) (2)
- and this type of neurotransmitters is vital for coordinating voluntary responses / muscle coordination / muscle contraction (1)
- (ii) • since the drug has similar molecular structure as that of the neurotransmitter, they can stimulate the next neurone (1) / bind to the receptor site at the next neurones (2)
- and elicit a nerve impulse (1) to mimic the effect of the neurotransmitter
- (iii) • the transplanted stem cells differentiated into neurones in the patients' brain (1) (2)
- and resume the function of producing the neurotransmitter when needed (1)
- (iv) • the stem cells are derived from the patients' own tissue, there is no rejection / it will not trigger immune response after transplant (1) (3)
- skin cells are actively dividing cells which are of unlimited supply (1)
- using aborted foetal tissue has political and ethical issues while deriving cells from adult skin cells do not (1)
- (b) (i) • isolate the *Bt* genes from the source using a restriction enzyme (1) (4)
- use the same restriction enzyme to cut the plasmid for insertion of *Bt* gene (1)
- join the *Bt* gene and the cut plasmid using DNA ligase (1)
- transfer the recombinant plasmid into a soil bacterium (1)
- (ii) (1) (I) • pollution of adult pests in non-*Bt* areas is much greater than that in the *Bt* areas (1) (1)
- (II) • *Bt* areas: homozygous recessive (1) (1)
- (III) • largest proportion in non-*Bt* areas: homozygous dominant (1) (1)
- (2) (I) • it is likely that the surviving bb adult pests (few) from *Bt* areas will mate with those BB pests (large number) from non-*Bt* areas (1) (3)
- as a result, the offspring produced will be of heterozygous Bb (1)
- which are susceptible to *Bt* toxin / sensitive to *Bt* toxin (1)
- (II) • there is no mating between the adult pest from *Bt* areas (1) (1)