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.

Paper 1 Section B

Marks

1.

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

(3)

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)

(2)

4 marks

3. (a) A: * thylakoid membrane (1)
B: * stroma (1) (2)

(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

- carbon fixation takes place at B (1)
- which regenerate NADP (1)
- for photochemical reactions that take place at A (1)

(3)

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
primrose		✓	✓		club-shaped leaf
dead nettle		✓		✓	two-lipped flower

(1) (1)

(2)

			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 ***two*** 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)	

			Marks
(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) thus the permanent heredity information is stably stored in the foot	(2)
(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) • 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)	(2)
			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)

Marks

(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)

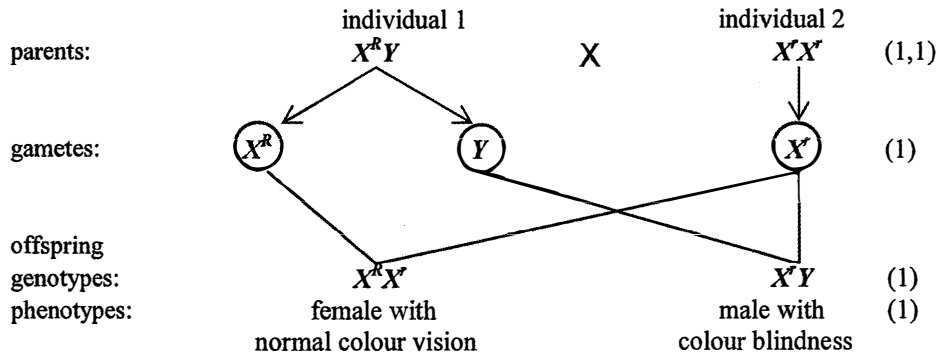
(3)

11 marks

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

(2)

(b)



(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

Marks

11. **Adapations 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 enrivonment (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	• Answers are easy to understand. They are fluent showing good command of language. • There is no or little irrelevant material.	• Answers are well structured showing coherence of thought and organisation of ideas.
2	• Language used is understandable but there is some inappropriate use of words. • A little irrelevant material is included, but does not mar the overall answer.	• Answers are organised, but there is some repetition of ideas.
1	• Markers have to spend some time and effort on understanding the answer(s). • Irrelevant material obscures some minor ideas.	• Answers are a bit disorganised, but paragraphing is evident. Repetition is noticeable.
0	• Language used is incomprehensible. • Irrelevant material buries the major ideas required by the question.	• Ideas are not coherent and systematic. Candidates show no attempt to organise thoughts.

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 excise, the more the contribution of energy from anaerobic respiration (1) (1)

(ii) (1)
- glycogen → glucose → lactic acid / lactate + ATP
  (1) (1) (2)

(2)
- to provide extra oxygen (1)
- for the breakdown of lactic acid / lactate produced (1) during the exercise period (2)

(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)

OR (4)
- 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 (± 20) mg dL^{-1}
- while no glucose is excreted (1)
- beyond 200 (± 20) mg dL^{-1} (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 feaces 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 care improve yield of wheat (1), i.e. grains
- and reduce health risk by reducing the uptake of arsenic in grains (1)

(2)

Paper 2 Section C

Marks

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_2 / H_2S (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)
- and this type of neurotransmitters is vital for coordinating voluntary responses / muscle coordination / muscle contraction (1)

(2)

(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
- and elicit a nerve impulse (1) to mimic the effect of the neurotransmitter

(2)

(iii)
- the transplanted stem cells differentiated into neurones in the patients' brain (1)
- and resume the function of producing the neurotransmitter when needed (1)

(2)

(iv)
- the stem cells are derived from the patients' own tissue, there is no rejection / it will not trigger immune response after transplant (1)
- 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)

(3)

(b) (i)
- isolate the *Bt* genes from the source using a restriction enzyme (1)
- 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)

(4)

(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)
- as a result, the offspring produced will be of heterozygous Bb (1)
- which are susceptible to *Bt* toxin / sensitive to *Bt* toxin (1)

(3)

(II)
- there is no mating between the adult pest from *Bt* areas (1)

(1)