

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. | D (49%) | 21. | D (39%) |
| 2. | A (78%) | 22. | A (86%) |
| 3. | B (60%) | 23. | C (84%) |
| 4. | D (57%) | 24. | D (78%) |
| 5. | C (74%) | 25. | C (64%) |
| 6. | B (53%) | 26. | A (42%) |
| 7. | D (47%) | 27. | C (72%) |
| 8. | A (76%) | 28. | A (59%) |
| 9. | B (36%) | 29. | D (91%) |
| 10. | C (43%) | 30. | C (79%) |
| 11. | B (96%) | 31. | B (58%) |
| 12. | D (60%) | 32. | A (38%) |
| 13. | B (73%) | 33. | C (80%) |
| 14. | A (67%) | 34. | D (47%) |
| 15. | A (76%) | 35. | B (81%) |
| 16. | C (88%) | 36. | D (34%) |
| 17. | B (75%) | | |
| 18. | A (78%) | | |
| 19. | D (40%) | | |
| 20. | C (67%) | | |

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. A (1)
 E (1)
 D (1)
-
- 3 marks

2. (a) * chromosome / chromatid (1) (1)
- (b) • stage A (1)
 • genetic materials are dispersed / loosely packed at stage A (1), which indicates that the DNA molecules are ready for transcription (2)

(c)

| | Outcome | | Cause | |
|-------------------------------|---------|---------|---|-----|
| | Mitosis | Meiosis | | |
| Number of daughter cells | 2 | 4 | mitosis involves one division while meiosis involves two divisions (1) | (2) |
| DNA content in daughter cells | 2N | 1N | homologous chromosomes pair up and separate into each daughter cell in meiosis but not in mitosis (1) | |

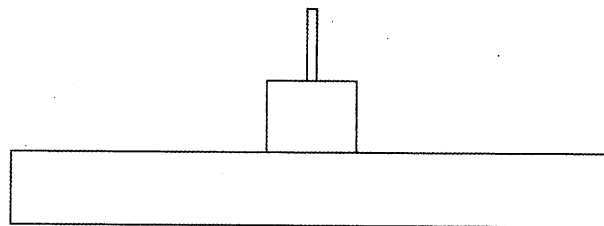
5 marks

3. (a) • phytoplankton → fish → shark (1) (1)

(b) Shark:

Fish:

Phytoplankton:



correct shape (1)
 labels (1)

- (c) • when energy in the lower trophic level is transferred to the next higher level, there is energy lost (1)
 • and the individuals at lower levels are smaller in size (1)
 • therefore, a larger number of individuals at a lower trophic level is required to support those at upper levels (1) (3)

(d) Any *two* of the following:

- by dissecting the gut of the predators to find out what prey items are inside (1)
- field observation of the feeding relationship (1)
- laboratory study by offering different preys to a predator (1)

8 marks

- Marks
4. (a) blood type O (1) (1)
- (b) (i) ii (1) (1)
- (ii) Father: I^Ai (1) Mother: I^Bi (1) (2)
- (c) • antibodies A and B are already present in Roger's blood (1)
 • these antibodies will act against the antigens of the parents' red blood cells (1)
 • and causes blood cells clumping / hemolysis of blood cells (1) if Roger receive blood transfusion from his parents (3)

7 marks

5. (a) • motor neurone (1) (2)
 • it is connected to an effector (1), i.e. muscle fibre in this case
- (b) • S provides energy (1)
 • for the synthesis / secretion / resynthesis of the neurotransmitter / chemical messenger stored in T (1) (2)
- (c) • arrival of nerves impulses at the motor nerve ending triggers the release of neurotransmitters / chemical messengers into the neuromuscular junction (1)
 • these neurotransmitters / chemical messengers diffuse across the synapse (1) (3)
 • bind to the receptor sites on the membrane of the muscle fibre (1) to trigger muscle contraction

7 marks

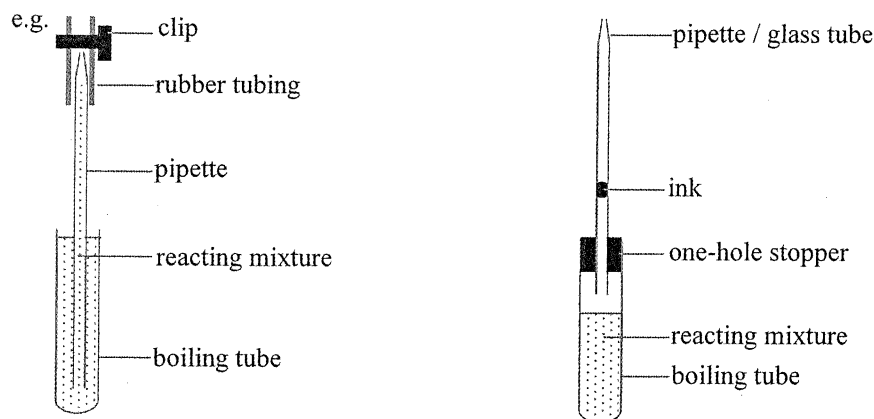
6. (a) phospholipids (1) (1)
- (b) • the water-loving parts of phospholipids point outward while the water-hating parts point inward (1)
 • the medium inside and the medium outside the cell are aqueous solutions (1) (3)
 • hence, only the water-loving part of the phospholipids is in contact with the cell sap and extracellular fluid (1)
- (c) (i) protein (1) (1)
- (ii) • proteins are interspersed in the bilayer (1)
 • in an asymmetric manner / a mosaic pattern (1) (2)

(d)

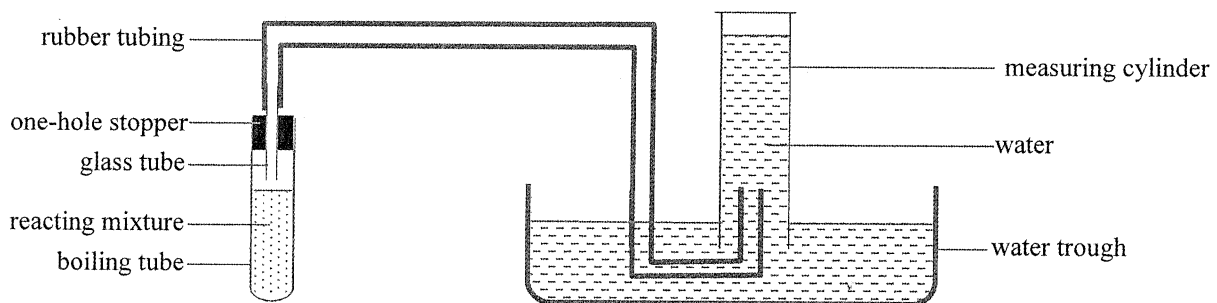
| <i>Nature of science</i> | <i>Elaboration</i> |
|--|--|
| - | Scientific models / theory are built based on experimental findings / observations (1) |
| Doing science requires imaginations / creativity (1) | - |

9 marks

7. (a) • liver (1)
 • it is the organ where many metabolic reactions take place / it is the organ for detoxification (1) (2)
- (b) • the hydrogen peroxide and catalase solution should be incubated at the set temperature for 10 minutes before mixing (1)
 • to ensure that the mixture has reached the set temperature at the beginning of the reaction (1) (2)
- (c) the set-up can collect gas (1)
 the set-up can measure the volume of the gas (1)
 labels (1)



(3)



7 marks

8. (a) • type I diabetes / insulin-dependent diabetes mellitus (1) (1)
- (b) (i) • Lisa's pancreas failed to secrete enough insulin (1)
 • with insufficient stimulation by insulin, there is a reduced uptake of glucose from blood by her body cells for respiration / liver cells for conversion into glycogen (1) (3)
 • hence, her blood glucose level dropped very slowly / remained at high level / exceeded the normal range (1) even after 12 hours of fasting

Marks

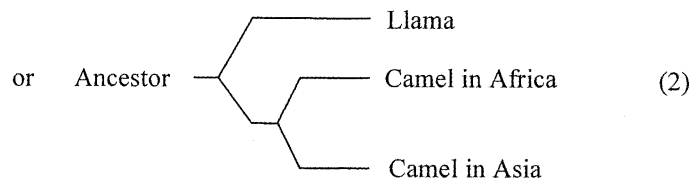
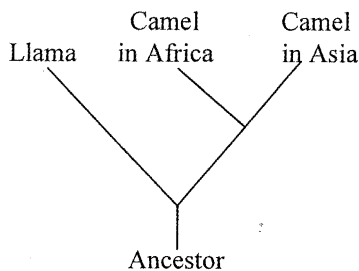
8. (b) (ii) • Without the inhibitory effect of insulin, Lisa's pancreas secretes a large amount of glucagon (1)
• high level of glucagon stimulates liver cells (1)
• to promote the conversion of glucose from glycogen / amino acids (1)
maintaining to a high glucose level in her blood (3)
- (c) • having frequent meals but in small portions (1)
• avoid food which elevates blood glucose level in a short time (1) such as sugars and carbohydrates (2)

9 marks

9. (a) • it is maintained by the rigidity of the veins / vascular bundles / xylem running through the leaves (1)
• and the turgidity of the mesophyll cells / thin-walled cells (1) (2)
- (b) • a large amount of water is lost from the leaves by transpiration (1) / transpiration rate is very high
• water absorption rate cannot keep up with the rate of water loss (1)
• mesophyll cells lose water and become flaccid (1)
thus can no longer support the leaves to maintain their upright position / so the leaves become drooped (3)
- (c) • appearance shown in photograph X (1)
• the leaves are flat / fully extended (1)
• and thus the exposed surface can be oriented towards the light source (1)
• therefore maximizing light absorption for photosynthesis (1) (4)

9 marks

10. (a)



Labeling (1)
Correct Tree (1)

- (b) • separation of the continents resulted in isolation of the two groups of ancestors (1)
• each isolated group was subjected to a different set of environmental conditions (1)
• as a result, they evolved differently from each other due to natural selection (1) / adaptive traits specific to those particular environmental conditions were selected by natural selection (4)
• until their genetic compositions were so different that they could not interbreed again (1)
- (c) • compare their genetic compositions / biochemical composition of essential proteins (1) (1)

Marks

10. (d) Any *two* of the following:
- not all organisms could be fossilized (1)
 - Some fossils are incomplete / damaged (1) / the fossil may contain only part of the body rather than the whole organism
 - some fossils are found in inaccessible areas (1)
 - there are missing links in the fossil records (1)

(2)

9 marks

| 11. Structural differences (S: max. 3) | Ways of maintaining blood flow (F: max. 5) | |
|--|---|-------|
| • wall of arteries is thicker than that of veins (1) | • pumping of heart created a high blood pressure to drive the blood flow in arteries (1), the thick wall can withstand the high blood pressure (1) | (1+2) |
| • wall of arteries contains more elastic tissue than that of veins (1) | • elastic nature of the arterial wall allows recoil of the wall (1) which maintains the blood flow along the arteries | (1+1) |
| • valves are present in veins but not the arteries (1) | • blood flow in veins is maintained by the contraction of adjacent skeletal muscles (1), which squeeze the blood along, presence of valves can prevent the back flow of blood (1) | (1+2) |
| • lumen of veins is larger than that of arteries (1) | • blood pressure inside veins is relatively low (1), having a larger lumen reduces the resistance to blood flow / to increase the rate / amount of blood flow (1) | (1+2) |

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

Paper 2 Section A

Marks

1. (a) (i) Any *two* of the following:
- sperm count (1) / abundance (2)
 - appearance of sperm (1) for abnormality
 - motility of sperm (1)
- (ii) (1) • there should be a surge / an increase in the levels of FSH and LH before ovulation (1)
- such that there are enough FSH to stimulate the development of follicles in the ovaries (1) (3)
 - and enough LH to trigger ovulation (1)
- both are essential to the fertility of a woman
- (2) • to make sure that the oviducts are not blocked (1) (2)
- so that the ovum and sperm can go through for fertilization (1)
- (iii) (1) • this shows that the uterine lining has not broken down in the last cycle (1) (2)
- which indicates possible implantation of embryo (1)
- (2) • the yellow body continues to secrete progesterone and oestrogen (1) (2)
- these hormones maintain / further increase the thickness of the uterine lining (1)
- therefore, there is no menstruation
- (b) (i) • increase the nervous output from cardiovascular centre of the brain to the pacemaker (1) (2)
- increase the secretion of adrenaline from adrenal glands (1)
- (ii) increase blood flow to skeletal muscles can
- supply more oxygen and nutrients to the muscles (1) (3)
 - for respiration to provide energy (1) for muscle contractions
 - and to remove carbon dioxide (1) from muscle at adequate speed
- (iii) • muscle contractions/exercise produce heat (1)
- thermoreceptors in the hypothalamus / skin detect the increase in body temperature (1)
 - heat loss centre in the hypothalamus is stimulated to send out nerve impulses (1) (4)
 - to cause vasodilation of the arterioles near the skin surface (1) to increase the blood flow to promote heat loss

Paper 2 Section B

Marks

2. (a) (i) • carbon dioxide traps / absorbs heat radiation reflected from ground (1)
• leading to an increase in the atmospheric temperature (1) (2)
- (ii) • carbon dioxide is a raw material for photosynthesis (1)
• an increase in atmospheric carbon dioxide concentration will result in an increase in the overall photosynthetic rate (1) (3)
• hence, more carbon dioxide will be absorbed (1) to counteract the increase
- (iii) (1) • stomatal density of plants decreases with an increase in atmospheric carbon dioxide concentration (1)
• as a result, it will reduce the rate of gas exchange in plants (1) (3)
• this offsets the effect of increase in carbon dioxide concentration / this reduces the uptake of carbon dioxide from the atmosphere (1)
photosynthetic rate may not increase to the expected extent
- (2) • a decrease in stomatal density will reduce the transpiration in plants (1) (2)
• this will reduce precipitation (1) / less condensation / less rainfall
and hence the regional climate will be altered
- (b) (i) (1) • dissolved oxygen content decreases as water flows from location 1 to location 2 (1) (4)
• because sewage contains a large amount of organic matter (1)
• microorganisms downstream consume dissolved oxygen (1)
• for the decomposition of the organic matter (1)
- (2) • as dissolved oxygen content is very low at location 2, active animal species die of suffocation / migrate to other region of the river (1) (2)
• only hypoxia tolerant species (low-oxygen tolerant species) can survive at location 2 (1)
- (ii) (1) • as organic matter has been used up, decomposition activity decreases / less microorganisms carry out decomposition (1) (2)
• oxygen continues to dissolve in the stream water due to running water / photosynthesis of aquatic plants (1)
- (2) • the biotic and abiotic properties of Location 3 are different from those of Location 1 (1) / different habitats (2)
• Such as the rate of water flow is slower in Location 3 / there are shadings / fallen leaves from trees nearby (1)

Paper 2 Section C

| | <u>Marks</u> |
|--|--------------|
| 3. (a) (i) • the greater the diameter of the clear zone, the more effective the antibiotic (1) | (1) |
| (ii) • antibiotic C (1) • because it is a broad-spectrum antibiotic / acts on multiple microorganisms (1) • there is a better chance of combatting the infection (1) | (3) |
| (iii) (1) • flame the loop to red hot (1) • the mouth of a culture tube should be flamed before and after use (1) | (2) |
| (2) • after knowing the strains, specific antibiotics can be used for treatment (1) / doctor can decide the best antibiotics to be used • which are more effective in inhibiting the growth of specific microorganisms (1) / will not kill other natural microorganisms inside our body | (2) |
| (iv) Any <i>two</i> of the followings: • some antibiotics (e.g. B) are specific to a certain kind of microorganisms (1) • while some other antibiotics (e.g. A,C,D) can act on multiple microorganisms (1) • some antibiotics (e.g. D at agar plate 3) are more effective in killing a certain microorganism / different antibiotics may have different effectiveness on a single microorganism (1) | (2) |
| (b) (i) • sunlight (1) • the UV light in the light spectrum is harmful to microbes (1) • nutrients (1) • therefore microbes die due to starvation as the level of organic matter in unpolluted water is very low (1) | (4) |
| (ii) • different microbes have different tolerance to environmental stress (1), giving rise to different death rates | (1) |
| (iii) • B can survive in environment for some time (1), therefore the presence of B can indicate the presence of sewage • A disappears too quickly in the environment (1), even if it is absent, it does not necessarily indicate that the river is not polluted • there is always a certain amount of C present in the river water (1), even if it is present, it does not necessarily indicate the river is polluted | (3) |
| (iv) • the total number of microbial cells present in the experiments were too low (1) • to give significant changes if biomass measure or optical measurements is used (1) | (2) |

4. (a) (i) Any *two* of the following:
- white blood cells are responsible for recognizing pathogens (1) / foreign cells
 - and production of antibodies to fight against pathogens (1)
 - and kill the pathogens (1)
 - without these roles, the kid is more susceptible to infections (1)
- (2)
- (ii)
- cells from bone marrow are stem cells for producing white blood cells (1)
 - once the working gene is inserted into these stem cells, the cells can divide and produce white blood cells that carry the working gene (1)
 - hence, this provides a long-term cure to the disease (1#)
 - on the other hand, if the working gene is inserted into mature white blood cells, the working gene is lost after their death (1), therapy has to be repeated from time to time
 - thus its effect is short-lived (1#)
- (# mark to be awarded once)
- (4)
- (iii)
- a vector is used to carry the working ADA gene (1)
 - it delivers and inserts a working ADA gene / normal gene into Nina's genome / cell (1)
 - this inserted gene is expressed to produce a functional protein / enzyme (1), which should overcome the defect
- (3)
- (iv) Any *two* of the following:
- genes may be inserted at random locations in the genome which may cause harmful mutations to the DNA (1) / failure of the expression of essential genes
 - the target genes may insert regulatory sequences that trigger the expression of nearby genes leading to cancer (like leukaemia) (1)
 - some patients may show an immune reaction to the vector (1) and reject the gene product
 - viral vector may regain the ability to cause diseases (1)
- (2)
- (b) (i)
- DNA molecules are denatured / separated / unwounded to form single strands at the DNA denaturation stage (1)
 - primer with complementary bases anneals to the single-stranded DNA molecule at primer annealing stage (1)
 - complementary free nucleotides (dNTPs in PCR) join to the primer accordingly to extend the DNA molecule at the extension stage (1)
- (3)
- (ii) (1)
- extension stage (1)
- (1)
- (2)
- as all enzymes and substrate are added at the very beginning, enzymes used in PCR cycle should be able to withstand high temperature (~90°C) during the breaking of DNA molecules to single strand (1)
 - the results show that DNA polymerase B still has a high relative activity even after incubation at high temperature (1)
 - while DNA polymerase A loses most of its activity (1)
 - therefore DNA polymerase B is more suitable (1)
- (4)
- (iii)
- amplify the DNA for genetic testing such as parentage / forensic application / detection of specific gene sequence (e.g. genes of genetic diseases, genetic markers of GM food) (1)
- (1)