

Marking Scheme

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 (73%)	21.	D (83%)
2.	D (33%)	22.	C (82%)
3.	A (68%)	23.	B (68%)
4.	B (63%)	24.	C (37%)
5.	D (61%)	25.	C (93%)
6.	A (79%)	26.	B (82%)
7.	A (76%)	27.	C (79%)
8.	A (81%)	28.	B (58%)
9.	D (87%)	29.	B (46%)
10.	C (69%)	30.	C (35%)
11.	A (64%)	31.	A (90%)
12.	D (48%)	32.	D (75%)
13.	B (54%)	33.	C (76%)
14.	A (61%)	34.	C (74%)
15.	B (63%)	35.	B (71%)
16.	C (78%)	36.	B (70%)
17.	C (80%)		
18.	D (78%)		
19.	A (31%)		
20.	B (64%)		

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

Paper 1 Section B

Marks

1. C (1)
A (1)
B (1)

3 marks

2.

<i>Method</i>	<i>How it works</i>	<i>Comment (advantage or disadvantage)</i>	
Spraying of pesticides or larvicidal oil to mosquito's habitat	Directly kills the larvae / adult mosquitoes (1) so that they cannot serve as vector	Pros: quickly puts mosquito population down in short term (1) Cons: mosquitoes may develop resistance to the pesticides (1) / environmental contamination when pesticides leak to water bodies / pesticides are toxic to humans	(1),(1)
Clearance of accumulated water in the neighbourhood	Eradicates the breeding places of mosquitoes (1)	Pros: does not have adverse impacts on environment (1) Cons: it is virtually impossible to clear up all stagnant water (1)	(1),(1)

4 marks

3. (a) • the cell wall of cell type Q is much thicker than that of cell type P (1) (1)
- (b) • when there is ample supply of water (1) (1)
• cell type P provides turgidity to the plant (1) (1)
• cell type Q has thickened cell wall (1) (1)
• which provides rigidity to the plant (1) (1)

5 marks

4. (a) • Class A (1) (1)
- (b) • the light intensity of the habitat is very low / the habitat is completely dark (1) (1)
• as organism X does not have eyes to survive in the habitat (1) (1)
- (c) • the key is constructed based on the morphological characteristics of existing organism found (1) / not all the morphological characteristics of the phylum are listed in the key (1)
- (d) • carry out a comparative study about the amino acid sequence of similar proteins / base sequence of DNA template / mRNA of similar proteins found in organism Y and other organisms in this phylum (1) (1)
• to establish the phylogenetic relationship between them (1) (1)

6 marks

5. (a) • 7:00 and 18:00 (1) (1)
- (b) • shorter light period (1) (1)
• overall rate lower (1) (1)

		<u>Marks</u>
5.	(c) • the area below the line showing oxygen production rate represents the food production in 24 hrs (1) • whereas the area below the line showing carbon dioxide production rate represents the food consumption in 24 hrs (1) • it is therefore important for food production to be greater than food consumption such that there is a net amount of food produced (1) • as a result, this provides energy for the plant to survive, grow and produce fruits (1)	(1) (1) (1) (1) <hr/> 7 marks
6.	(a) $(10\,000\,000 - 1\,000\,000) / 10\,000\,000 \times 100\% = 90\%$ Method 1 mark Correct answer 1 mark (b) • some energy is not obtained by the organisms of higher trophic level as not the whole body of the prey is consumed / part of the food is not digestible or is egested (1) • some energy is lost by the organisms of the higher trophic level through excretion / respiration / in the form of heat (1) (c) • the percentage decrease in energy content is greater (1) • as caterpillars mainly feed on leaves of trees, leaving most of the part of the biomass of trees unconsumed (1)	(1) (1) (1) (1) (1) (1) <hr/> 6 marks
7.	(a) • despite an increase in blood glucose level was detected in Tom's blood, his insulin level was lower than that of the healthy person (1) • and the insulin level only showed little change (1) • this showed that Tom failed to produce the normal amount of insulin (1) • therefore, Tom suffered from insulin-dependent diabetes (1) (b) • with insufficient insulin, his body cells would not take up extra glucose from the blood as efficiently as the healthy person (1) • as a result, the blood glucose concentration rised to a higher level (1) after glucose consumption • and remained high for a longer time / decreased slower than the healthy person (1) (c) • by injection of insulin / aerosal spray of insulin applied to nasal cavity (1)	(1) (1) (1) (1) (1) (1) (1) (1) (1) <hr/> 8 marks
8.	(a) • soluble sugars lowers the water potential of the kernels (1) while • starch, being insoluble in water, does not affect the water potential of the kernels (1) • during development, kernels of sweet corns draw in a larger amount of / more water by osmosis than those of starch kernels (1) • later on, when the kernels dry up, kernels of sweet corn shrinks as a result of lossing a large amount of water (1) • as the outer layer of the kernels is not elastic (1), thus the kernels of sweet corns become wrinkled	(max. 4)

			<u>Marks</u>
8.	(b) (i)	<ul style="list-style-type: none"> as both parents are pure-bred plants, the F₁ produced are all heterozygous (1) in heterozygous condition, dominant alleles will be expressed while recessive alleles will be masked (1) therefore, purple colour and smooth surface are the dominant phenotypes (1) 	(1) (1) (1)
	(ii)	<ul style="list-style-type: none"> only one type of gametes will be produced from the pre-bred corn plant with yellow and wrinkled kernels (1) as the individuals in F₁ are heterozygous with genes for the two traits located on different chromosomes, the alleles for the traits are assorted independently (1) therefore, four different types of gametes will be produced from the F₁ (1) after random fertilisation, zygotes with four different combinations of genotypes will be produced (1) leading to the expressions of all the possible phenotypes (A, B, C and D) in the F₂ generation (1) 	(1) (1) (max. 2)
	(c)	<ul style="list-style-type: none"> Mendel collected a large amount of experimental evidence (1) and based on his observation on the number of offspring with different phenotypes (1) he worked out a possible explanation for the observation by logical deduction (1) 	(1) (1) (1)
			14 marks
9.	(a)	<ul style="list-style-type: none"> drug X inhibited glycolysis (1) as glycolysis is the first step in the respiratory pathway, the inhibition of glycolysis will halt the processes that follow (1), i.e. Krebs cycle and oxidative phosphorylation hence, the overall production of pyruvate, ATP and NADH are greatly reduced (1), showing that the whole respiratory pathway was jeopardized 	(1) (1) (1)
	OR	<ul style="list-style-type: none"> Pyruvate is the product of glycolysis (1) As the production of pyruvate is greatly reduced after treating with drug X (1) Glycolysis was inhibited in this case (1) 	(1) (1) (1)
	(b)	<ul style="list-style-type: none"> drug Y inhibited Krebs cycle (1) when the respiratory pathway is halted at Krebs cycle, pyruvate will not be metabolised (1) but glycolysis still proceeds as usual and produce pyruvate (1), as a result, pyruvate will accumulate 	(1) (1) (1)
	(c)	<ul style="list-style-type: none"> in anaerobic conditions, muscle cells undergoes anaerobic respiration which produce less ATP (1) and less NADH (1) than that of aerobic respiration lactic acid level rises as it is a product of anaerobic respiration (1) 	(1),(1) (1)
	(d)	<ul style="list-style-type: none"> glycolysis: cytoplasm (1) Krebs cycle: mitochondrial matrix (1) oxidative phosphorylation: mitochondrial inner membrane (1) 	(1) (1) (1)
			12 marks

Marks

10. (a) • bile salts emulsify fat into droplets (1) (1)
 • such that there is an increase in surface area for the action of lipase / enzyme (1) (1)
- (b) • as the bile supplementation increased, the fat content of the faeces decreased (1) (1)
 • this indicates increased digestion of fat (1) (1)
- (c) • to show that the addition of bile supplementation does not adversely affect the growth of the pigs (1) / indicate the effectiveness of the bile supplementation on promoting pigs' growth / effectiveness of fat absorption (1)
- (d) Concept for mark award:
 (1): suitable substrates and correct enzyme used in the experiment (1) (1)
 (2): identification of parameter for measuring the dependent variable (1) (1)
 (3): expected results was provided (1) (1)
- e.g. • prepare an alkaline mixture of lipase, bile salts and oil (1)
 • add pH indicator into the mixture / use a data logger with pH sensor / pH meter to show the change in pH of the mixture (1)
 • the faster the drop in the pH of the mixture, the faster the digestion of fat (1)
- Accept other reasonable experiments

8 marks

<i>Differences</i>	<i>Significance</i>	
<ul style="list-style-type: none"> Pairing of homologous chromosomes along the equatorial plane in first division of meiosis but no such process in mitosis (1) The pairs of homologous chromosomes segregate into the daughter nuclei during the first meiotic cell division (1) 	<ul style="list-style-type: none"> Such that the daughter cells formed contain the whole set of chromosome / one member of each homologous pairs (1) after meiosis Random segregation of homologous chromosomes results in variations between gametes formed (1) Crossing over may occur, the exchange of genetic materials between chromatids gives rise to new genetic combinations (1) 	(5)
<ul style="list-style-type: none"> Mitosis involves one division only but meiosis involves two divisions (1) 	<ul style="list-style-type: none"> The daughter cells resulted from mitosis are genetically identical to the parent cell (1) which is important for growth of the organisms (1) / asexual reproduction The daughter cells / gametes formed in meiosis contain half / haploid the genetic content of the parent cell (1) such that the amount of genetic content can be restored after fertilisation (1) 	(5)

D = (3)

S = (max.5)

max. 8

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">• 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

		<u>Marks</u>
1.	(a) (i)	
	• regardless of the sodium concentration of the drinks, the greatest urine output occurred over the 1 st hour (1)	(1)
	• the urine output then dropped continuously (1) until the 5 th hour,	(1)
	• the urine output became more or less the same (1)	(1)
	• the urine output of the participants who consumed drinks with higher sodium content were usually smaller than those participants who consumed drinks with lower sodium content (1), or vice versa	(1)
	(ii)	
	• after drinking the sports drink with 0 mmol / L sodium, the hypothalamus detected an increased in the water potential of the blood (1)	(1)
	• the pituitary gland released less ADH into the blood circulation (1)	(1)
	• as a result, the wall of the collecting ducts of the kidney tubule became less permeable to water (1)	(1)
	• thus, a smaller proportion of water was reabsorbed (1)	(1)
	and hence, the volume of urine output increased	
	(iii)	
	• sports drink with 100 mmol / L sodium (1)	(1)
	• smaller urine output, indicating that the body retains more water (1)	(1)
	• the net fluid balance remains high than 0 throughout the study (1)	(1)
	(b) (i)	
	during exercise, water is lost mainly	
	• through sweating (1)	(1)
	• as water vapour during expiration / exhalation / breathing (1)	(1)
	(ii)	
	heat is continuously produced during exercise (1) but the participants will experience difficulty in temperature regulation / may suffer from heat stroke / overheating (1) because	(1)
	• heat can not be lost effectively through evaporation of sweat when the humidity is too high (1)	(1)
	• heat lost through convection / radiation is hindered / body may gain heat from the environment (1) when the environmental temperature is high / higher than the body temperature	(1)
	(iii)	
	• more oxygen is taken in (1)	(1)
	• to breakdown lactic acid in the liver / provide additional amount of energy for converting lactic acid in blood to glycogen (1)	(1)
	• so as to restore blood pH to normal (1)	(1)

Paper 2 Section B

Marks

2. (a) (i) • ecological succession takes place at Stage II where the land will be first conquered by fast-growing plants / low nutrient-requiring plants such as ferns / grasses (1) (1)
- the death and decay of these plants increase the soil fertility (1) (1)
- the soil becomes suitable for shrubs / trees to grow and become the dominant species (1), restoring the land (1)
- (ii) the runoff from Stage I is higher than that from Stage III (1) because: (1)
- frequent ploughing destroys soil texture of the land (1), as a result, there are more soil cavities for leaching (1) (1)
- harvesting / removal of crops from the land reduces the return of organic matter to the soil (1), as a result, there are less humus to retain soil water (1) (1)
- (iii) • lacking of magnesium / nitrogen (nitrate) will result in yellowing of leaves (1) (1)
- because the crops cannot synthesize chlorophyll with this nutrient / this nutrient is necessary for the formation of chlorophyll (1) (1)
- (iv) • some soil nutrients dissolve in water and lose together as runoff (1) (1)
- some soil nutrients are attached to soil particles which are washed away by the runoff (1) (1)
- (b) (i) • the AR increases the number of fish species (1)
- until it becomes stable after year 8 (1)
- whereas there is no obvious change in the number of fish species at the sandy seabed area (1) (max. 3)
- the number of fish species in the AR site is greater than that at the sandy seabed area (1)
- (ii) • AR provides different habitats with different characteristics / biotic and abiotic factors (1) and these attract new species to stay because
- there are suitable shelters for fish to hide from predators / survive / live and grow (1)
- there are suitable spawning grounds for fish to breed and reproduce (1) (max. 3)
- as the biodiversity increases, it further attracts other predatory fish species to come and feed on smaller fish (1)
- (iii) Any *two* of the following:
- the materials should be nontoxic to prevent lethal and sublethal effects on / killing of the living organisms (1)
- the materials should be durable / long-lasting to increase the life span of the AR / for a ten-year study (1) (max. 2)
- rough surfaces / more cavities that allows the settlement of the larvae of corals / create more microhabitats (1)

Paper 2 Section C

		<u>Marks</u>
3.	(a) (i) • viruses use bacteria as the host for reproduction / replication (1)	(1)
	(ii) • during Phase I, the virus infects the bacteria and takes over its cellular mechanism for replication / virus needs certain amount of time to encounter and attach to the hosts (1)	(1)
	• as a result, there is not much change / remains low in the population size of virus (1)	(1)
	• during Phase II, the bacteria burst and release the viruses (1),	(1)
	• leading to a rapid / exponential increase in the viral population (1)	(1)
	(iii) • as the population of bacterial host decreases, viruses that cannot find suitable host disintegrate / decay rapidly (1)	(1)
	(iv) • viral infection is highly species-specific (1),	(1)
	• therefore, viruses that infect bacterial pathogens will not infect human cells (1)	(1)
	(v) • viral disinfection can only kill the bacterial species that the viruses are specific to but conventional disinfection is broad spectrum (1)	(1)
	• bacteria may develop resistance to a virus but not conventional disinfection (1)	(1)
	(b) (i) Any <i>two</i> of the following	
	• count the number of cells under microscope / total cell count (1)	
	• spread the liquid culture on an agar plate of the same growth medium and count the number of bacterial colonies / viable cell count (1)	(max. 2)
	• measure the turbidity of the culture, the higher the turbidity, the larger the bacterial population (1)	
	(ii) • in culture C, the water potential of the culture solution is higher than that of the mutant cells (1),	(1)
	• water moves into the mutant cells (1)	(1)
	• without a cell wall, the mutant cells cannot withstand the increase in cell volume and burst (1)	(1)
	• whereas in culture B, the water potential is the same as that of the mutant cells, the mutant cells does not suffer from osmotic lysis (1)	(1)
	(iii) • the addition of fresh culture solution increases the food availability to the wild type bacteria (1)	(1)
	• at the same time, it dilutes the toxic waste present in the original culture (1)	(1)
	• as a result, the bacterial population will increase (1)	(1)
	• after a certain period of time, the population size becomes stationary (1)	(1)
	due to the depletion of nutrient and accumulation of waste	

Paper 2 Section D

		Marks
4.	(a) (i) • cut the DNA containing the gene encoding enzyme Y and plasmid with the same restriction enzyme to produce compatible sticky ends (1)	(1)
	• join the enzyme gene and plasmid together using DNA ligase (1)	(1)
	(ii) (1) Any <i>two</i> of the following:	
	• in constructing the plasmid, some cut plasmids joined by itself to restore the original form without picking up the DNA fragment (1)	
	• in transferring the plasmid to plant cells, some bacteria did not pick up any plasmid at all (1)	(max. 2)
	• the bacteria did not infect some of the crop cells (1)	
	(2) • grow all the plant cells on an agar plate with the antibiotic (1)	(1)
	• only those plant cells that has picked up the functional plasmid can survive (1)	(1)
	• as they contain the plasmid with the antibiotic resistance gene (1)	(1)
	OR	
	• cut the DNA obtained from the plant cells with restriction enzymes (1)	(1)
	• amplify the DNA fragment using PCR (1)	(1)
	• run a DNA electrophoresis to check for the presence of the DNA fragment which has been inserted into the plasmids (1)	(1)
	(iii) • when applying chemical X, plants that are not genetically modified / do not carry the gene encoding the mutant form of enzyme Y cannot survive (1)	(1)
	• on the other hand, the GM crops can survive (1)	(1)
	• because these GM crops produce another enzyme that will not be inhibited by chemical X, as a result, they can carry out photosynthesis and survive (1)	(1)
	• without competition, the GM crops have more resources for growth (1)	(1)
	thus the crop yield can be increased	
	(b) (i) • the immune system may treat the transplanted organ as 'foreign', resulting in rejection (1)	(1)
	• have to wait for long time for a suitable donation / no enough donors (1)	(1)
	(ii) • illegal to produce a human clone / wastage of many embryo during cloning / killing one person to help another person is morally not accepted (1)	(1)
	(iii) (1) • bone marrow (1) / dermis of skin / umbilical cord blood or embryonic cells which were obtained long time ago	(1)
	other acceptable answers	
	(2) • the stem cells proliferate to increase in cell number (1)	(1)
	• then they are differentiated into nerve stem cells (1)	(1)
	• which is introduced to Keith's body to repair the damaged tissue (1)	(1)

4. (b) (iii) (3) Any *two* of the following:

- not all adult stem cells are identified (1)
- the conditions for culturing stem cells have not been figured out (1)
- some stem cell continue to proliferate after transplant and become cancer cells (1)
- the conditions needed to initiate the differentiation of stem cells into specialised cell types have not been figured out (1)

(max. 2)