

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 (67%)	21.	B (53%)
2.	B (67%)	22.	C (63%)
3.	A (34%)	23.	D (49%)
4.	C (23%)	24.	C (87%)
5.	A (60%)	25.	A (79%)
6.	C (73%)	26.	D (73%)
7.	C (58%)	27.	C (71%)
8.	B (79%)	28.	A (66%)
9.	A (53%)	29.	C (53%)
10.	D (58%)	30.	D (87%)
11.	D (81%)	31.	D (65%)
12.	B (71%)	32.	D (56%)
13.	A (57%)	33.	C (62%)
14.	B (53%)	34.	B (62%)
15.	A (76%)	35.	A (56%)
16.	D (61%)	36.	A (78%)
17.	C (51%)		
18.	D (49%)		
19.	B (78%)		
20.	B (76%)		

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

		<u>Marks</u>
1.	<ul style="list-style-type: none"> • D (1) • A (1) • B (1) 	<p>(3)</p> <hr style="width: 100%;"/> <p>3 marks</p>
2.	<ul style="list-style-type: none"> • sugar solution has a lower water potential than the cell content of fresh pineapple (1) • as a result, water moves out of pineapple cells to the sugar solution by osmosis (1) • pineapple cells become flaccid (1) and fail to press against one another hence, the texture of pineapple preserved in sugar solution is softer than that of fresh pineapple 	<p>(3)</p> <hr style="width: 100%;"/> <p>3 marks</p>
3.	<p>(a) • cross-pollination (1)</p> <p>(b) • after landing on the stigma, pollens germinate to form pollen tubes (1)</p> <ul style="list-style-type: none"> • which carry the male gametes (1) • pollen tubes grow along the style towards the ovary to reach the ovules / micropyle (1) • the male gametes will be released to fuse with the female gametes in the ovules (1) <p>(c) • process Y involves combination of genes from two different individuals, hence the zygotes / offspring produced from process Y have greater genetic variations than those from process X (1)</p> <ul style="list-style-type: none"> • individuals with variants would be candidates for natural selection (1) 	<p>(1)</p> <p>(4)</p> <p>(2)</p> <hr style="width: 100%;"/> <p>7 marks</p>
4.	<p>(a) • A: endoplasmic reticulum* (1)</p> <ul style="list-style-type: none"> • B: nucleus* (1) <p>(b) • interphase (1)</p> <ul style="list-style-type: none"> • because DNA is in the format of chromatin / the chromosomes are invisible (1) <p>(c) • B carries the genetic materials (1) coding for the hormone / digestive enzymes</p> <ul style="list-style-type: none"> • transcription takes place in B to produce mRNA (1) • which is transported to A for translation / protein synthesis (1) • to produce protein hormones / digestive enzymes (1) for discharge / secretions 	<p>(2)</p> <p>(1+1)</p> <p>(4)</p> <hr style="width: 100%;"/> <p>8 marks</p>
5.	<p>(a) • intercostal muscle contracts to result in upward and outward movement of rib cage / raise the rib cage (1)</p> <ul style="list-style-type: none"> • diaphragm muscle contracts to flatten the diaphragm (1) • both actions increase the volume of the thoracic cavity (1) • as a result, the pressure inside the lungs drops below atmospheric pressure (1) hence air is forced into the lungs <p>(b) • air will leak into the pleural cavity (1) from outside through the lungs / the negative pressure of pleural cavity cannot be maintained</p> <ul style="list-style-type: none"> • the lung collapses due to its own elasticity (1) 	<p>(4)</p> <p>(2)</p> <hr style="width: 100%;"/> <p>6 marks</p>

		<u>Marks</u>
6.	(a) • Protista* (1)	(1)
	(b) Microscopy:	
	• microscopy allows the observation of cellular structures (1)	
	• this distinguishes prokaryotic cells from eukaryotic cells (1), giving rise to the basis of the two empire system proposed	
	DNA sequencing:	
	• DNA sequencing determines the nucleotide sequence of the DNA of different organisms (1)	(4)
	• so that the scientists can work out the phylogenetic relationship (1), giving rise to the basis of the three domains system	
		<hr/> 5 marks
7.	(a) • the rate of respiration remains constant throughout the experiment (1)	
	• so that any change in the net production of oxygen can be attributed to the change in the photosynthetic rate (1)	(2)
	(b) • place a thermometer in the beaker (1)	
	• to ensure the temperature is constant (1)	
	• as temperature is also a factor that may affect the photosynthetic rate (1)	
	OR	
	• add a heat shield / water bath between the light bulb and the beaker / use a cold light source to conduct this experiment (1)	
	• to avoid the heating up of water in the beaker (1)	(3)
	• as temperature is also a factor that may affect the photosynthetic rate (1)	
	(c) • photochemical reactions produce ATP (1)	
	• which provides energy to drive the light-independent reactions / for the regeneration of CO ₂ acceptor (1)	
	• photochemical reactions also produce NADPH (1)	(4)
	• which provides reducing power for the reduction of 3-C compound to form glucose (1)	
		<hr/> 9 marks
8.	(a) Bacterium A: inhibits the growth of plant X (1)	
	Bacterium B: promotes the growth of plant X (1)	(3)
	Bacterium C: has no obvious effect on the growth of plant X (1)	
	(b) Bacterium A: parasitic (1)	
	Bacterium B: mutualistic (1)	(2)
	(c) (i) Bacterium A: 30(°C) ±1	
	Bacterium B: 35(°C) ±1 } (1)	(1)
	(ii) • population size of bacterium A decreases (1)	
	• population size of bacterium B increases (1)	(2)
	(d) • inhibition on the growth of plant X decreases as the population size of bacterium A decreases / the growth of plant X increases as the population size of bacterium B increases (1)	(2)
	• hence, native plant community decreases in size / diversity due to the increased threat of plant X (1)	
		<hr/> 10 marks

Marks

9. (a) • mosquitoes (1) (1)
- (b) • certain lymphocytes differentiated into memory cells when they encountered the antigens of the vaccine in the first injection (1)
• in the second injection, these memory cells encountered the same antigens again (1)
• these memory cells differentiated into specific B-lymphocytes / specific T-lymphocytes (1) (4)
• resulting in production of a large amount of antibodies / killer T-cells within a shorter time (1)
leading to the sharp rise in the protection against the infection
- (c) • the protective effect does not wear off / remains high (1) from day 35 to 56 (1)
- (d) (i) • vaccination treatment B (1)
• as it offers protection over the minimum level of effective protection from day 10 to day 47 which fully covers Mathew's trip (1) (1+1)
- (ii) • even if he has contracted JE during the trip, the precaution can help prevent / reduce the risk of transmission of the virus (1) to other people as the insect repellent prevents mosquito bite. (1)

9 marks

10. (a) (i) • discontinuous trait (1) (2)
• because there are distinctive categories with no intermediate categories (1)
- (ii) • in case I, non-rolling offspring appeared even when both parents were tongue rollers (1)
• this shows that the allele for non-tongue rolling was masked in the parents (1)
hence, tongue rolling should be the dominant phenotype and non-tongue rolling should be the recessive phenotype (2)
- OR (2)
- in case I, non-tongue rolling offspring must have inherited at least one allele for non-tongue rolling from at least one of their roller parents (1)
• however, both parents showed tongue rolling phenotype, i.e. non-tongue rolling phenotype was masked (1)
hence, tongue rolling should be the dominant phenotype and non-tongue rolling should be the recessive phenotype
- (b) • no, it did not support the conclusion (1)
• if non-tongue rolling was the recessive phenotype, all the offspring of the non-tongue rolling parents would be non-tongue rollers (1) (2)
- (c) (i) • the genetic composition of the identical twins is exactly the same (1)
• they should show the same phenotype (1) if the trait is controlled by genetic factors (2)

(ii)

Conclusion	Evidence
Genetic factor plays a significant role in the determination of the tongue rolling trait.	82% of the identical twins showed same phenotype (1)
There are other factors influencing the tongue rolling trait.	18% of the identical twins showed different phenotypes (1)

(2)

(d) (i)	Ideas about Science	
	Science is a process of ongoing inquiries.	✓
	Science is affected by social and cultural factors.	
	Scientists having the same set of data may not arrive at the same conclusions.	
	Scientific investigation need not necessarily be doing experiments in laboratories.	✓

(2)

- (ii) • scientists who conducted tongue rolling experiments in 1965 or 1971 should have been skeptical and have looked for evidence from different sources / perspectives (1) / have been ready to review / challenge current ideas / knowledge / theories

(1)

13 marks

11. Formation of lymph and its return (max. 5)

- blood pressure / hydrostatic pressure at the arteriole end of the capillary bed is higher than that of the tissue fluid, this forces some of the plasma out (1)
- the remaining blood cells / proteins are left in the blood and drain to the venous end (1)
- water moves into the capillary bed at the venous end by osmosis (1)
- excess tissue fluid will enter the lymph vessels to form the lymph due to the higher hydrostatic pressure (1) in the tissue spaces
- with the assistance of the contraction of skeletal muscles to squeeze the lymph vessels (1)
- and the presence of valves in lymph vessels to prevent the back flow of lymph (1)
- thus, the lymph will flow along the lymph vessels and eventually return to the heart (1)

(max. 5)

whether the claims are scientifically valid

Improvement of Circulation (max. 1)

Valid:

- as the valves of the lymph vessels prevent back flow, pressing along the lymph vessels, especially along the limbs towards the trunk, does help the return of lymph to the heart (1)

(max.1)

OR

Not valid:

lymph vessels are usually found deep inside the body (1) which makes it difficult improve the circulation by pressing

Reduction in Body weight (max. 2)

Not valid:

- this may reduce the accumulation of tissue fluid / lymph at the limbs (1), giving a slimmer appearance temporarily
- the lymph only returns to the circulatory system but is not eliminated (1), i.e. no change in body weight
- this does not affect the energy input / energy output / food consumption of the body (1)
- therefore, there should be no effect on body weight (1)

(max. 2)

Effective communication (0-3)

(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) • motor area of the cerebrum (1) (1)
- (ii) (1) • high / increased concentration of carbon dioxide in blood (1)
• when she held her breath in water, the body cells continued to produce carbon dioxide through respiration (1) (3)
• however, the carbon dioxide could not be excreted through exhalation during the breath holding (1)
as a result, carbon dioxide accumulated in the blood
- (2) • the high concentration of carbon dioxide was detected by the chemoreceptors at medulla / carotid body / aortic arch (1)
• this, in turn, stimulated the respiratory centre in the medulla (1) (4)
• more nerve impulses were then sent to the respiratory muscles (i.e. intercostal muscles and diaphragm muscles) (1)
• the respiratory muscles contracted faster and more powerfully (1)
- (iii) • vasoconstriction of arterioles in her skin occurs (1)
• this reduces blood flow to the skin surface (1), thus lower skin temperature
• to reduce heat loss to the surrounding / to conserve core body temperature (1) (3)
- Or
- shivering (1)
 - the respiration rate of muscle increases (1)
 - to produce more heat (1) to increase body temperature
- (b) (i) • useful solutes, e.g. glucose, sodium ion, amino acids, are reabsorbed back into the capillary by active transport along the first coiled tubule (1)
• hence, water potential of the blood surrounding the tubule decreases / water potential of the filtrate increases (1)
• as a result, water moves out of the first coiled tubule along the water potential gradient by osmosis / water molecules move along with solutes (1) (4)
• the amount of water reabsorbed is proportional to the amount of solutes reabsorbed (1)
hence, solute concentration remains the same as the fluid flow from point A to point B
- (ii) • fluid at point D without ADH has a lower solute concentration than that with ADH (1)
• ADH increases the permeability of the second coiled tubule and the collection duct (D) to water (1) (3)
• as a result, a larger proportion of water is reabsorbed (1), resulting in a higher solute concentration
- (iii) • glomerulus (1)
• the wall of glomerulus is impermeable to plasma protein / protein molecules are too large to pass through the wall of glomerulus (1) (2)
if protein is present in the kidney tubule, it is most likely that the wall of glomerulus is damaged

Paper 2 Section B

		<u>Marks</u>
2.	(a) (i)	<ul style="list-style-type: none"> • stir up sediments or pollutants at sea bottom / turbidity of water increases (1) (2) • destruction of habitats / shelters / breeding grounds at sea bottom (1)
	(ii) (1)	<ul style="list-style-type: none"> • sites A and C > sites B and E > sites D and F (1) • this shows that the closer the site to the protected area, the higher the animal biomass / the further the site to the protected area, the lower the animal biomass (1) (2)
	(2)	<ul style="list-style-type: none"> • protected area is undisturbed by fishing, thus providing a breeding ground for marine animals / at non-protected area, fish or marine animals are constantly caught (1) • therefore, the marine protected area has more food resources as indicated by the highest animal biomass at sites A and C (1) (3) • some of them have migrated to the adjacent area (1), resulting in higher animal biomass in sites B and E than that sites D and F
	(iii)	<ul style="list-style-type: none"> • animal biomass only indicates the total amount of biological / organic materials of all the species (1) • it cannot reflect the impact on individual species (1) (4) • this can be rectified by counting the total number of species (1) • to show the impact on biodiversity of the protected area as well (1)
	(iv)	<ul style="list-style-type: none"> • Hoi Ha Wan Marine Park / Yan Chau Tong Marine Park / Sha Chau and Lung Kwu Chau Marine Park / Tung Ping Chau Marine Park / Cape D'Aguilar Marine Reserve / The Brothers Marine Park (1) (Any one) (1)
	(b) (i)	<ul style="list-style-type: none"> • Because the provision of food / nutrients from Zooxanthella has been cut off (1) (1)
	(ii)	<ul style="list-style-type: none"> • the heat / infra-red radiation reflected from the earth (1) • is trapped by carbon dioxide in the atmosphere (1) • hence increases the atmospheric temperature (1) and hence the water temperature increases (3)
	(iii) (1)	<ul style="list-style-type: none"> • increased water temperature resulted in a greater health deterioration in native corals than transplanted corals (1) as reflected by (<i>any two</i>) (3) <ul style="list-style-type: none"> - more healthy cases in transplanted corals than in native coral (1) - more bleached cases in native coral than in transplanted coral (1) - more dead cases in native coral than in transplanted coral (1)
	(2)	<ul style="list-style-type: none"> • thermal tolerance of the corals can be enhanced by exposing them to higher temperatures / corals may gradually adapt to the rise in seawater temperature (1) (1)

Paper 2 Section C

Marks

3. (a) (i) • simple sugars → ethanol + carbon dioxide (2)
- (ii) • during malting process, seeds absorbs water and germinates (1)
• this activates the production of enzymes in barley grains (1)
• the enzymes catalyse the breakdown of starch / food reserve into simple sugars (1) (4)
• this provides the sugar source for the subsequent growth and fermentation of yeast (1)
- (iii) • this allows aerobic respiration of yeast / it provides sufficient oxygen for respiration of yeast (1)
• to provide energy for reproduction / to increase its number / population (1) (3)
• this facilitates the fermentation that follows / increases fermentation rate (1)
- (iv) • ethanol forms the alcoholic component / alcoholic smell of the beer (1) (2)
• carbon dioxide forms the bubbles of the beer (1)
- (b) (i) • in both cases, the percentage of mice killed increases as the number of viral particles injected increases (1) / the more the number of viruses injected, the higher the death rate (3)
• however, virus X killed all mice at a lower dosage than that of virus Y (1)
• therefore, virus X is more lethal to the mice than Y (1)
- (ii) • a virus only attacks a specific cell type / a certain cell type (1)
• if that cell type belongs to vital organs / body system, it will be more damaging to the host (1)
- OR
- some viruses have faster replication rate in the host (1) (2)
• and lead to serious damage of the body system within a shorter time (1)
- OR
- some viruses have a latent period (1)
• and do not cause apparent damage to the body system at early stage (1)
- (iii) • the virus attaches itself to the host cells (1)
• and injects its genetic content into the host cells (1)
• the virus will take over the host cell's metabolism to make copies of itself at an exponential rate (1) (4)
• once the resources in the cells have been exhausted, the newly formed viruses will burst the host cells (1) and spread other parts to infect nearby cells

Paper 2 Section D

		<u>Marks</u>	
4.	(a) (i)	<ul style="list-style-type: none"> • The GM salmon have an additional copy of gene for producing growth hormone (1) • therefore they should have a faster growth rate / can grow to a larger size in a short time (1) 	(2)
	(ii)	<ul style="list-style-type: none"> (1) • the recombinant DNA does not contain any viral materials which may cause undesirable effects / immune response on humans / which may regain the ability to cause disease (1) (2) • the insertion of the recombinant DNA into the genome of fertilized egg has high failure rate / can cause damage of the fertilized egg / time consuming as only one fertilized egg can be targeted at one time (1) 	(1) (1)
	(iii)	<p>Any <i>two</i> of the following:</p> <ul style="list-style-type: none"> • to ensure that the transgene is inheritable over generations (1) • and the gene can still be expressed / exert its effect after generations of inheritance (1) • to produce salmon which are pure bred / homozygous for the transgene (1) 	(2)
	(iv)	<ul style="list-style-type: none"> (1) • the three sets of homologous chromosomes fail to pair up (1) during meiotic cell division for gamete formation • so low number of viable gametes / no gametes can be formed (1) (2) • to ensure that the GM salmon cannot breed with wild salmon (1) • to avoid passage of the transgene to others even if they escape to the wild (1) 	(2) (2)
	(b) (i)	<ul style="list-style-type: none"> • use restriction enzyme R to cut both the plasmid and DNA fragment (1) • since restriction / cut site of R can be found at both ends of the DNA fragment (1) • as a result, two sticky ends / single-stranded DNA ends will be produced at the plasmid and on the DNA fragment (1) • which are complementary (1) for insertion of the DNA fragments into the plasmid 	(4)
	(ii)	<ul style="list-style-type: none"> • it can be used to select bacteria that contain the plasmid / has been transformed (1) • because bacteria that have successfully picked up the plasmids will possess gene for ampicillin resistance (1) • thus they can survive on the culture plate containing ampicillin (1) <p><i>OR</i></p> <ul style="list-style-type: none"> • it can be used to eliminate bacteria that do not contain the plasmid / have not been transformed (1) • because bacteria that have not picked up the plasmids will not possess gene for ampicillin resistance (1) • thus they are killed on the culture plate containing ampicillin (1) 	(3)

Marks

- (iii)
- after insertion of the DNA fragment, the tetracycline resistance gene has been interrupted / is no longer functional / cannot be expressed (1)
 - therefore, bacteria that have picked up the plasmids with successful insertion do not have tetracycline resistance (1)
 - while bacteria that have picked up self-ligated plasmid / plasmid which has not been cut / plasmid without insertion still possess tetracycline resistance (1)

(3)