Paper 2 Section A

				Marks
1.	(a)	(i)	• regardless of the sodium concentration of the drinks, the greatest urine output occurred over the 1st hour (1)	(1)
			• the urine output then dropped continuously (1) until the 5th 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) and hence, the volume of urine output increased	(1)
		(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) (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) (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) (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

				Marks
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 ***two*** 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) • measure the turbidity of the culture, the higher the turbidity, the larger the bacterial population (1)	(max. 2)
		(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) due to the depletion of nutrient and accumulation of waste	(1)

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 ***two*** 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) • the bacteria did not infect some of the crop cells (1)	(max. 2)
			(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) thus the crop yield can be increased	(1)
	(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 other acceptable answers	(1)
			(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)