Paper 2 Section A

					Marks
1.	(a)	(i)	•	sinoatrial (SA) node / pacemaker (1)	(1)
		(ii)	•	the structure initiates electrical impulses that spread through the walls of both atria (1)	(4)
			•	prompting the atria to contract at the same time (1)	
			•	the impulses then pass to atrioventricular (AV) node (1)	
			•	which relays signals to the ventricular walls to initiate contraction of both ventricles after the contraction of the atria (1)	
		(iii)	•	blood flows from lungs via the pulmonary vein (1)	(3)
			•	and then enters into left atrium (1)	
			•	as the bicuspid valve is open at this stage, the blood flows further into the left ventricle (1)	
		(iv)	•	adrenal gland secretes more adrenaline (1)	(3)
			•	which stimulates the heart muscle to contract more rapidly (1) and more strongly (1)	
	(b)	(i)	•	high level of progesterone inhibits the secretion of FSH (1) and LH (1) from the pituitary	(5)
			•	the low level of FSH is not sufficient to stimulate follicular development (1)	
			•	the low level of LH is not sufficient to stimulate ovulation (1)	
			•	as a result, no fertilization takes place (1)	
		(ii)	(1) •	breakdown of uterine lining (1) which may lead to possible miscarriage / abortion (1)	(2)
			(2) •	progesterone maintains the thickness / thickening of the uterine lining / increases vascularisation / blood supply (1)	(2)
			•	so that the placenta / embryo can attach to the uterine lining more securely (1)	

Paper 2 Section B

				Marks
2.	(a)	(i)	• acid rain / acidic water retards the growth of bean seedlings (1) • presence of heavy metal X in the soil retards the growth of bean seedlings (1) • least growth occurs under the combined effect of low pH and heavy metal X (1)	(3)
		(ii)	• acid rain releases the heavy metal ions X in the soil (1) • therefore there is a higher concentration of heavy metal ions X in the soil (1) • resulting in a greater effect of inhibition on the growth of bean seedlings (1)	(3)
		(iii)	• sulphur dioxide (1) and nitrogen oxides (1) from the burning of fossil fuels • these acidic gases may cause irritation to eye / respiratory tract (1)	(3)
	(b)	(i)	Any three of the following: • high fat solubility (1) • cannot be metabolized easily / non-biodegradable (1) • cannot be excreted (1) • stable and persistent (1)	(max. 3)
		(ii)	• birds (1) • highest amount of pollutant Y was detected in birds (1) • since the top consumers feed on a large number of organisms at the lower trophic levels, they usually have the highest amount of heavy metal ions accumulated / since the pollutant is accumulated along the food chain, the top consumer has the highest level of the pollutant (1)	(3)
		(iii)	• producers (1) • capture solar energy and turn it into its biomass / chemical energy (1) • this provides food / energy source to other organisms in the ecosystem (1) Or • decomposers (1) • break down organic matters into inorganic matters (1) • this allows the cycling of materials in the ecosystem (1)	(3)
		(iv)	• liver (1) • because it is the organ responsible for detoxification, thus toxic substances are captured and metabolised / processed there (1)	(2)

Paper 2 Section C

Marks

3. (a) (i)
- Phase 1: temperature increases from 20°C to 80°C (1)
- as microbial utilize the organic matter for respiration which produces a large amount of heat (1)
- Phase 2: temperature decreases to close to the ambient level / 20 °C (1)
- as nutrients have been depleted by the microbes / waste accumulates (1)
- resulting in a drop in microbial activity / a decrease in respiration rate (1)

(5)

(ii)
- different species of bacteria would have a different level of resistance / tolerance to heat (1)
- the increase in temperature eliminates species that are not able to live in high temperatures / selects for species that are heat resistant / tolerant / thermophilic (1)

(2)

(iii) (1)
- it increases the surface area for microorganisms to act on (1)

(1)

(2)
- adequate and continuous stirring ensures a continuous supply of air / oxygen into the compost pile (1)
- so that microorganisms can carry out aerobic respiration to release more energy (1)
- for faster decomposition of the organic matter (1)

(3)

(b) (i)
- pectinase can break down pectin (1)
- so that the cell wall of the plant cells can be broken down (1)
- as a result, hyphae can grow deeper into the fruit (1)
- and secrete enzymes to carry out external digestion and absorb nutrients from the deeper tissue of the fruit (1)

(4)

(ii) (1)
- as cell wall has been broken down (1), more juice can be released

(1)

(2)
- the digestion of cell wall releases some nutrients which cannot be obtained by humans (1)
- as the human digestive system does not produce enzymes to digest the cell wall (1)

(2)

(iii)
- food-borne infection is caused by the ingested pathogens which multiply inside our body / attack the body cells / causes illness (1)
- whereas food poisoning is caused by the toxin left in the food which is produced by the microorganisms (1)

(2)

Paper 2 Section D

Marks

4. (a) (i)
- primers (1)
- deoxyribonucleoside triphosphates (dNTPs) (1)

(2)

(ii)
- insulin produced from GM bacteria has the same amino acid sequences as the insulin produced by our body (1)
- so that the patient's immune system does not normally produce antibodies against the insulin after injection / rejection on the insulin occurs (1)
- whereas the amino acid sequence of animal insulin is slightly different from that of human insulin (1)
- thus some patients' immune systems produce antibodies against it to degrade / inactivate / lower the effect of insulin (1)

(4)

(iii)
- due to the high growth rate of bacteria, the product yield from GM bacteria is much higher than that from animal pancreas because it takes long time to rear animals (1)
- insulin can be produced continuously from the bacterial culture whereas each animal can provide only a limited amount of animal pancreas (1)
- the cost of purification of insulin from bacterial culture is lower than that from the animal pancreas (1) as it is less complicated

(max. 2)

(iv)
- GM plants are often grown out in the open areas (1)
- thus pollen grains from GM plants may pollinate other non-GM crops and are spread to other plants (1)

(2)

(b) (i)
- child 2 (1)
- because some of the bands resembles the pattern of the mother (1)
- while the other bands cannot be found in the pattern of the father (1)

(3)

(ii)
- they are resulted from fusion of different gametes / random fertilization (1)
- due to independent assortment / crossing over of chromosomes (1)
- each gamete bears different copies of chromosomes from the parents (1)

(3)

(iii)
- as VNTRs are located in the non-coding region of chromosomes, any mutations do not affect the survival of the organisms (1)
- and the mutations can pass on to the next generation (1)
- mutations in functional genes, however, may lead to expression of non-functional proteins / failure of expression of these genes (1)
- which may affect the survival of the organisms (1)

therefore, variations of VNTRs pass on from generation to generation leading to huge variations

(4)