

SUGGESTED ANSWERS

Paper 1 Section A

Question No.	Key	Question No.	Key
1	C	19	C
2	B	20	D
3	A	21	D
4	C	22	B
5	D	23	A
6	A	24	B
7	B	25	D
8	C	26	B
9	C	27	A
10	C	28	D
11	D	29	C
12	D	30	C
13	A	31	B
14	D	32	C
15	B	33	C
16	A	34	B
17	B	35	A
18	A	36	D

Paper 1 Section B

- | | | Marks | | | | | | | | |
|-------------------------------|--|----------------|----------|------------------------------|---------------------------------|-------------------------------|--------------------------------------|--------------------|-------------------------|--------------------|
| 1. | C (1)
B (1) | (2) | | | | | | | | |
| 2. | <ul style="list-style-type: none"> • in the first way, humans feed directly on the crops grown, while in the second way humans feed on cattle, which in turn feed on grass / In the first way, humans obtain food through a shorter food chain / a smaller number of trophic levels (1) • since energy is lost along the food chain (1) • through respiration, death, excretory products and faeces (1) • more energy will be available to form organic matter for human consumption in the first way (1) | (4) | | | | | | | | |
| 3. | <p>(a)</p> <ul style="list-style-type: none"> • streamlined body / smooth skin to reduce resistance when moving in water (1) • presence of tail / flippers to facilitate locomotion in water / swimming (1) <p>(b) <u>Any two of the following:</u>
(State the human activity and briefly describe its effect)</p> <ul style="list-style-type: none"> • reclamation in the coastal areas / construction / dredging of seabed in areas nearby causes deterioration of the water quality of its natural habitats (1) • disturbance caused by tourism drives the animal away from the habitat (1) • fishing activity may accidentally kill or injure the animal (1) • heavy sea traffic may drive away the animal (1) / accidentally injure the animal / interfere with its food-finding (due to the noise created) | (2)

(2) | | | | | | | | |
| (c) | <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="width: 50%;">Dolphin</th> <th style="width: 50%;">Goldfish</th> </tr> </thead> <tbody> <tr> <td>• presence of mammary glands</td> <td>• absence of mammary glands (1)</td> </tr> <tr> <td>• no scales covering the skin</td> <td>• body covered with slimy scales (1)</td> </tr> <tr> <td>• absence of gills</td> <td>• presence of gills (1)</td> </tr> </tbody> </table> | Dolphin | Goldfish | • presence of mammary glands | • absence of mammary glands (1) | • no scales covering the skin | • body covered with slimy scales (1) | • absence of gills | • presence of gills (1) | any two

(2) |
| Dolphin | Goldfish | | | | | | | | | |
| • presence of mammary glands | • absence of mammary glands (1) | | | | | | | | | |
| • no scales covering the skin | • body covered with slimy scales (1) | | | | | | | | | |
| • absence of gills | • presence of gills (1) | | | | | | | | | |
| 4. | <p>(a)</p> <ul style="list-style-type: none"> • replication of DNA (1) / duplication of chromosomes • synthesis of organelles (1) such as mitochondria / ER
(accept other correct alternatives) <p>(b) <u>Any two of the following:</u></p> <ul style="list-style-type: none"> • the homologous chromosomes pair up when they arrange themselves on the equator of the cell (1) / each pair of homologous chromosomes arranges on the same spindle, after separation, the daughter cells / gametes formed would have only one member of each homologous pair (1) / be haploid • crossing over occurs between homologous chromosomes (1), resulting in the formation of new combinations of alleles in the daughter cells (1) / variation in the gametes (#) • homologous chromosomes assort themselves independently (1), resulting in different combinations of chromosomes / alleles in the daughter cells (1) / variation in the gametes (#) | (2)

(4) | | | | | | | | |

(#): marks would be awarded once only

5. (a)
- | Prokaryota | Eukaryota | |
|--|--|---|
| • no distinct nucleus / nuclear membrane | • distinct nucleus / nuclear membrane | 1 |
| • single circular DNA lying free in the cytoplasm | • multiple copies of linear DNA present in the nucleus | 1 |
| • no membranous organelles such as mitochondrion or chloroplast / infolding of cell membrane forms mesosomes for respiration | • membranous organelles present / mitochondria present for respiration | 1 |
- (any two)
(2)
- (b) (accept other correct alternatives) (3)
- 1a Predominantly unicellular..... Protista
 1b Multicellular..... 2
 2a Cell wall present..... 3
 2b Cell wall absent..... Animalia } (1)
 3a Chlorophyll present..... Plantae (1)
 3b Chlorophyll absent..... Fungi (1)
- (c) • as new evidence arises (e.g. new knowledge developed / new species found) (1), the existing classification systems will be modified if they cannot accommodate the new evidence (2)
 • different scientists place emphases on different classification criteria (1), so giving rise to different classification systems
6. (a) • upon the arrival of nerve impulses, the nerve endings release a neurotransmitter (1) / a chemical (3)
 • which diffuses across the gap between the nerve ending and the muscle fibre (1)
 • the neurotransmitter / chemical will stimulate the membrane of muscle cells (1), resulting in muscle contraction
- (b) • the joint serves as the fulcrum (1) of the lever system, which allows the movement of adjoining bones relative to one another (1) (2)
7. (a) • fraternal twins (1) / non-identical twins (3)
 • because they have different blood groups (1), indicating that they have different genotypes (1)
- (b) • $I^A i$ (1) and $I^B i$ (1) (2)
- (c) • allele I^A is transcribed to form mRNA (1) by complementary base pairing (1) (max. 6)
 • mRNA moves out of the nucleus to attach to the ribosomes (1) in the cytoplasm
 • tRNA carrying specific amino acids with anticodons matching the codons of mRNA (1) will attach to ribosomes in sequence (1)
 • a peptide bond will be formed between adjacent amino acids (1), thus forming the polypeptide / protein which subsequently forms the enzyme (1)

		Marks	
8.	(a)	<ul style="list-style-type: none"> • difference in oxygen content for running = 13 mL per 100 mL blood (1) • difference in oxygen content for cycling = 9 mL per 100 mL blood (1) 	(2)
	(b)	<ul style="list-style-type: none"> • the difference in blood oxygen content between the aorta and the vena cava increases with increased exercise intensity (1) • because, as the exercise intensity increases, the rate of aerobic respiration in muscles increases (1) to release more energy (1) for muscle contraction • this implies an increase in oxygen consumption (1) in the muscles / oxygen uptake from blood for respiration 	(4)
	(c)	<ul style="list-style-type: none"> • oxygen uptake increases with increasing energy requirements of exercise (1) • this increase in oxygen uptake can be brought about by an increase in the rate and depth of breathing (1) / increase in blood flow to the lungs 	(2)
9.	(a)	<ul style="list-style-type: none"> • the biological washing powder contains lipase / a fat-digesting enzyme (1) • lipase breaks down the fat stain into fatty acids and glycerol (1) • both the digested products are soluble in water (1) and thus can be removed from the skirt 	(3)
	(b)	<ul style="list-style-type: none"> • the washing powder is more effective / works better at higher water temperatures (1) 	(1)
	(c)	<p><u>Concept for mark award:</u></p> <ul style="list-style-type: none"> • controlled variable kept constant (max. 2) • choose the water temperature at which the washing powders are most effective (1) • how to measure and interpret the results (2) • repeat the investigation using different water temperatures (1) 	(max. 5)
	e.g.	<ul style="list-style-type: none"> • use two similar skirts with identical fat stains (1) • put the two skirts separately into equal volumes of the two washing powder solutions which contain the same quantity of washing powder (1) / which have the same concentration • time of washing should be the same (1) • the water temperature used for washing should be kept at 50°C (1) • compare the size / intensity of the stains after washing (1); the more effective the washing powder, the smaller / lighter the stain (1) • repeat the investigation at different water temperatures to see if the effectiveness of different washing powders is affected by water temperature (1) 	} max. 2 (max. 5)
10.	(a)	<ul style="list-style-type: none"> • it is transmitted by droplets (1) / air 	(1)
	(b)	<ul style="list-style-type: none"> • flu is caused by a virus which cannot be destroyed by antibiotics (1) • indiscriminate use of antibiotics may lead to an increase in resistant bacterial strains (1) 	(2)
	(c)	<ul style="list-style-type: none"> • the flu virus may undergo mutation frequently (1) to form new strains • the epidemic strains may vary in different seasons (1) 	(2)
	(d)	<p><u>Any two of the following:</u></p> <ul style="list-style-type: none"> • they have good personal hygiene (1) so they are not infected easily • they have strong immunity that can combat the flu virus (1) • they have been infected by the same flu virus before (1) 	(2)

Marks

11. (a) (1) • hormone A (1) (3)
 • when the blood glucose level drops from the normal level to 40 mg per 100 mL, the rate of hormone B secretion remains at a low level (1)
 • but the rate of hormone A secretion increases (1)
- (2) • * glucagon (1) (3)
 • it promotes the conversion of glycogen into glucose in the liver (1)
 • so as to increase the blood glucose level (1) when it is below the normal value
- (b) Any two of the following: (2)
 • eat smaller portions of food but more frequently (1)
 • reduce the intake of food with high sugar content (1) / eat complex carbohydrates
 • take regular exercise (1)
 • frequent monitoring of blood glucose levels (1)
 • take appropriate medication (1)

12. Acquisition:

Hydrogen	Nitrogen
<ul style="list-style-type: none"> mainly acquired in the form of H₂O (1) water in soil is absorbed by root hairs by diffusion (1) / osmosis may also be derived from NH₄⁺ absorbed from the soil (1 bm) 	<ul style="list-style-type: none"> acquired in the form of NO₃⁻ and NH₄⁺ (1) NO₃⁻ and NH₄⁺ are absorbed by active transport and diffusion (1)

4+1 bm

Incorporation:

- inside the chloroplast of mesophyll cells, water is split in the light-dependent stage of photosynthesis, with the H being used to form NADPH (1)
 - H in the NADPH is eventually incorporated into a 3-C compound formed (1) in photosynthesis
 - the 3-C compound is converted to pyruvate and other intermediates of the Krebs cycle (1)
 - absorbed NO₃⁻ and NH₄⁺ are transported to the mesophyll cells and used to form amino acids (1) using the carbon skeleton derived from the intermediates of the Krebs cycle (1)
 - amino acids formed are then condensed together to form proteins (1)
- } max. 2

5

max. 8+1 bm

Communication

3
(11+1 bm)

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 irrelevant 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. Candidate shows no attempt to organise thoughts.

Paper 2 Elective Part

Section A Human Physiology – Regulation and Control Marks

- 1.(a) (i) • shortly after the consumption of ice, his internal body temperature fell (1) with a concomitant rise in the skin temperature (1) (2)
- (ii) • the consumption of the large quantity of ice had a cooling effect on the blood in the gut (1) (2)
• as blood circulated to the hypothalamus (1), a fall in internal body temperature was registered
- (iii) • as the hypothalamus registered a fall in internal temperature (1), homeostatic mechanism would be switched on to conserve heat / to reduce heat loss so as to restore the internal temperature to normal (1) (4)
• a nervous signal was sent to the skin / sweat glands to reduce sweating (1)
• skin temperature increased as less heat is lost to the surroundings by evaporation of sweat (1)
- OR
- as the hypothalamus registered a fall in internal temperature (1)
• a nervous signal was sent to the skin / sweat glands to reduce sweating (1)
• less heat was lost to the surroundings by evaporation of sweat (1)
• skin temperature increased as the rate of heat loss is lower than the rate of heat gain (1)
- (iv) • since the room temperature was kept at 45°C, skin thermoreceptors would have constantly detected this (1) and sent signals to the hypothalamus to bring about heat loss by sweating (1) (3)
• but the findings of this experiment showed that sweating fluctuated with changes in internal body temperature (1), indicating that environmental temperature plays a less dominant role in the control of sweating

Total: 11 marks

- 1.(b) (i) • when the fluid passes from B to A, all glucose will be reabsorbed in the first / proximal coiled tubule (1), so no glucose is present in the fluid in A (2)
• the percentage of water reabsorbed is higher than that of urea (1), so the percentage of urea in A is higher than that in B
- (ii) • after the loss of much water in heavy sweating, the water potential of the blood decreases (1) (5)
• this stimulates the release of ADH from the pituitary (1)
• ADH increases the permeability of the second / distal coiled tubule and the collecting duct to water (1)
• thus a greater proportion of / more water will be reabsorbed (1) from the fluid in A into the blood by osmosis
• as a result, the concentration of the fluid in A increases (1)
- (iii) Similarity: (2)
• both the dialysis membrane and the wall of the nephron allow small molecules such as urea and other waste materials to pass through but not plasma proteins and blood cells (1)
- Difference:
• the cells of the wall of the nephron actively reabsorb useful substances (e.g. glucose) into the blood, while the dialysis membrane has no such function (1)

Total: 9 marks

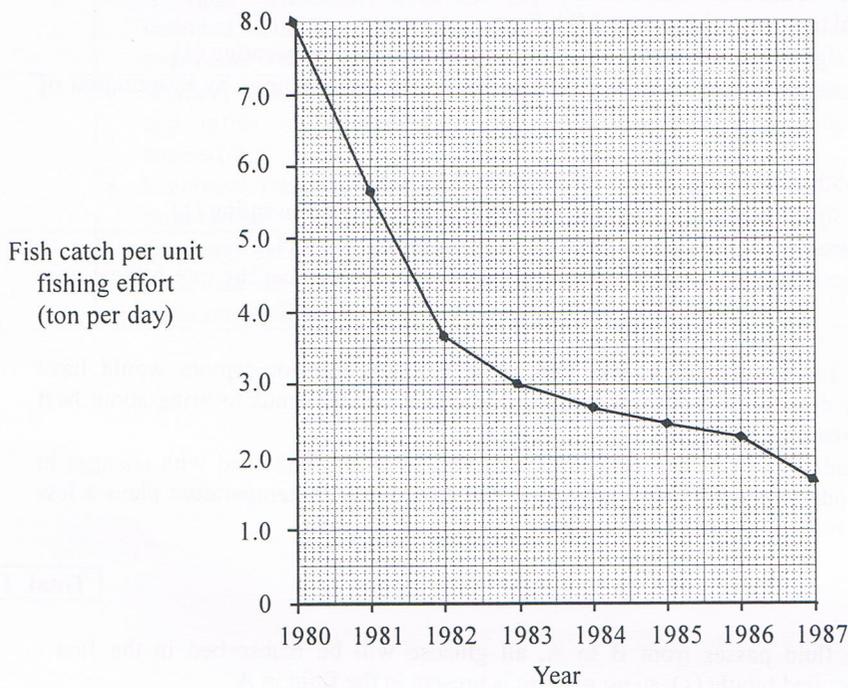
Section B Applied Ecology

Marks

Year	Fish catch per unit fishing effort (ton per day)
1986	2.25
1987	1.67

- (ii) Title (½) (3)
 Correct choice of axes (½)
 Correct labelling of axes with units (1)
 Correct plotting and joining of points (1)

Change in fish catch per unit fishing effort from 1980 to 1987



- (iii) • the fish catch per unit fishing effort decreased from 1980 to 1987 (1) (3)
 • because the fishing effort increased much faster than the total fish catch in these years (1)
 • this is probably due to over-fishing (1) / the fish population in the sea is a limited resource

- (iv) Any two of the following: (accept other reasonable alternatives) 2 x (1, 1) (4)
 • restrict the mesh size of fish net (1), so that smaller or juvenile fish can escape from being caught and can grow to sexual maturity (1)
 • ban fishing activity for a period of time in a year, especially during the spawning season (1) to allow recovery of the population (1)
 • set a quota on the fish catch per fishing trip (1) / restrict the size of fishing boat / the capacity of fishing gear, so that the rate of fish catch does not exceed the rate of recovery of the fish population (1)
 • designate some 'no-take' zones (1) in the sea to provide protected areas for the breeding of fish (1)

Total: 11 marks

Marks

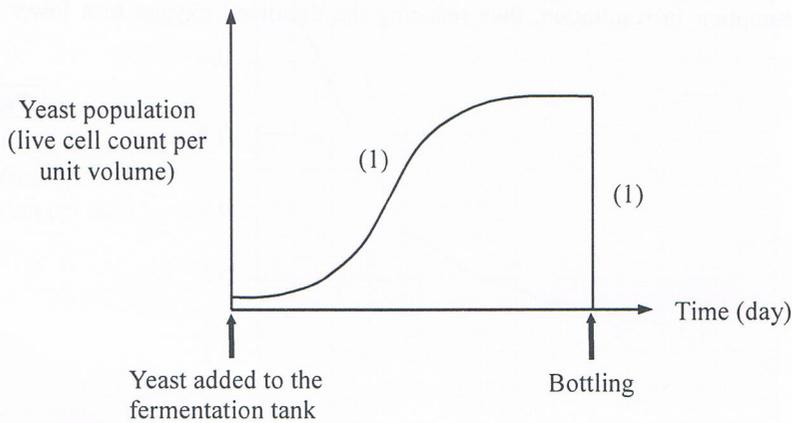
- 2.(b) (i) • as light is absorbed / scattered / reflected when it passes through water, the light intensity decreases with water depth (1) (2)
• thus the rate of photosynthesis decreases (1) with increasing water depth
- (ii) • lake A (1) (3)
• this is because much higher photosynthetic rate is found in the subsurface water in lake A (1) and this indicates that more nutrients are available to encourage the growth of the producers in this lake (1)
- (iii) • lake A (1) (4)
• in the daytime the net photosynthetic rate of lake A is much higher than that of lake B; this implies that the net oxygen production by phytoplanktons in lake A will be greater than that in lake B (1)
• at night, the great phytoplankton population in lake A (1) will have much greater oxygen consumption in respiration, thus reducing the dissolved oxygen to a lower level (1)

Total: 9 marks

Section C Microorganisms and Humans

Marks

- 3.(a) (i)
 - soaking serves to induce germination of the barley grains (1) by softening the grain coat (1)
 - during germination, the barley grains synthesize amylase / maltase / enzymes (1) which help break down the starch stored in the grains into maltose and then glucose (1)
 - glucose is used as the raw material / substrate for alcoholic fermentation (1) } max. 3 (4)
- (ii)
 - to kill all the microorganisms in the wort (1)
 - to drive away all the dissolved oxygen in the wort (1) (2)
- (iii)
 - yeast carries out anaerobic respiration (1) to ferment / break down glucose to form ethanol, (1) which is one component of beer (2)
- (iv) Labelling of axes (1) (3)



Total: 11 marks

- 3.(b) (i)
 - pasteurization involves heating the milk, which kills many bacteria (1) in it (1)
- (ii)
 - during the two weeks, bacteria left in the milk have multiplied to a significant number (1) (3)
 - the lactic acid bacteria ferment the lactose / sugar in the milk and produce lactic acid (1), giving the milk a sour taste
 - the acid denatures the soluble milk protein which becomes insoluble curds (1)
- (iii) (1)
 - the milk may be contaminated with a large number of bacteria that cause food borne infections (1) (2)
 - some of the bacteria may manage to enter the small intestine and multiply rapidly (1), causing diarrhoea
- (2)
 - * Salmonella (1) (1)
 - (accept other correct alternatives)
- (iv)
 - butter and cheese have a much lower water content than milk (1) (2)
 - bacterial / microbial activities would be slowed down when there is insufficient water supply (1)

Total: 9 marks

Section D Biotechnology **Marks**

- 4.(a) (i) (1) • a plasmid is a small circular piece of extrachromosomal DNA in bacterial cells (1) (1)
- (2) • plasmids can be taken up by bacterial cells because of their small size (1) (2)
 • plasmids contain selective markers e.g. antibiotic resistance gene(s) which allow screening for the transformed bacterial cells (1)
- (ii) • the same restriction enzyme would produce the same sticky ends in the target human gene and in the plasmid (1) (2)
 • so that the cleaved plasmid and the target gene can be ligated together by complementary base pairing between the unpaired bases in their sticky ends (1)
- (iii) • introduce the recombinant plasmids into some bacterial cells / *E. coli* (1) (max. 4)
 • select the transformed bacteria by culturing the bacteria on nutrient agar containing a specific antibiotic (1)
 • mass culture the transformed bacterial cells (1) in a nutrient medium containing the antibiotic
 • induce the expression of the gene that encodes the clotting protein (1)
 • extract and purify the clotting proteins produced (1)
- (iv) Any two of the following: (2)
 • larger quantities of the clotting proteins can be produced (1)
 • lower risk of infection by blood borne diseases (1)
 • less side effects due to higher purity of the clotting proteins (1)

Total: 11 marks

- 4.(b) (i) • extract DNA sample from the individual (1) (4)
 • use restriction enzyme to cut the sample into fragments (1)
 • separate the fragments of different sizes using electrophoresis (1)
 • match the DNA fingerprint patterns between individuals under study (1)
 (accept other correct alternatives)
- (ii) (1) • P is the father / parent of R (1) (2)
 • the bands of R are either common to those of P or those of Q (1), indicating that P and Q are R's parents
- (2) • S (1) (2)
 • there are bands in his DNA fingerprint that are found neither in the DNA fingerprint of P nor that of Q (1)
- (iii) Any one of the following: (accept other correct alternatives) (1)
 • as a forensic tool for identifying suspects / victims / human remains / missing persons (1)
 • applications in palaeontology (1)
 • applications in archaeology (1) (e.g. matching fragments of the Dead Sea Scrolls)
 • applications in medical diagnostics (1) (screening patients and foetuses for inherited diseases)
 • matching organ donors
 • establishing the provenance / composition of foods
 • analysing patterns of human migration (1)
 • analysing claims of ethnicity (1)

Total: 9 marks