

Paper 2 Section A

Marks

1. (a) (i) Any *two* of the following:
- sperm count (1) / abundance (2)
 - appearance of sperm (1) for abnormality
 - motility of sperm (1)
- (ii) (1) • there should be a surge / an increase in the levels of FSH and LH before ovulation (1)
- such that there are enough FSH to stimulate the development of follicles in the ovaries (1) (3)
 - and enough LH to trigger ovulation (1)
- both are essential to the fertility of a woman
- (2) • to make sure that the oviducts are not blocked (1) (2)
- so that the ovum and sperm can go through for fertilization (1)
- (iii) (1) • this shows that the uterine lining has not broken down in the last cycle (1) (2)
- which indicates possible implantation of embryo (1)
- (2) • the yellow body continues to secrete progesterone and oestrogen (1) (2)
- these hormones maintain / further increase the thickness of the uterine lining (1)
- therefore, there is no menstruation
- (b) (i) • increase the nervous output from cardiovascular centre of the brain to the pacemaker (1) (2)
- increase the secretion of adrenaline from adrenal glands (1)
- (ii) increase blood flow to skeletal muscles can
- supply more oxygen and nutrients to the muscles (1) (3)
 - for respiration to provide energy (1) for muscle contractions
 - and to remove carbon dioxide (1) from muscle at adequate speed
- (iii) • muscle contractions/exercise produce heat (1)
- thermoreceptors in the hypothalamus / skin detect the increase in body temperature (1)
 - heat loss centre in the hypothalamus is stimulated to send out nerve impulses (1) (4)
 - to cause vasodilation of the arterioles near the skin surface (1) to increase the blood flow to promote heat loss

Paper 2 Section B

Marks

2. (a) (i) • carbon dioxide traps / absorbs heat radiation reflected from ground (1)
• leading to an increase in the atmospheric temperature (1) (2)
- (ii) • carbon dioxide is a raw material for photosynthesis (1)
• an increase in atmospheric carbon dioxide concentration will result in an increase in the overall photosynthetic rate (1) (3)
• hence, more carbon dioxide will be absorbed (1) to counteract the increase
- (iii) (1) • stomatal density of plants decreases with an increase in atmospheric carbon dioxide concentration (1)
• as a result, it will reduce the rate of gas exchange in plants (1) (3)
• this offsets the effect of increase in carbon dioxide concentration / this reduces the uptake of carbon dioxide from the atmosphere (1)
photosynthetic rate may not increase to the expected extent
- (2) • a decrease in stomatal density will reduce the transpiration in plants (1) (2)
• this will reduce precipitation (1) / less condensation / less rainfall
and hence the regional climate will be altered
- (b) (i) (1) • dissolved oxygen content decreases as water flows from location 1 to location 2 (1) (4)
• because sewage contains a large amount of organic matter (1)
• microorganisms downstream consume dissolved oxygen (1)
• for the decomposition of the organic matter (1)
- (2) • as dissolved oxygen content is very low at location 2, active animal species die of suffocation / migrate to other region of the river (1) (2)
• only hypoxia tolerant species (low-oxygen tolerant species) can survive at location 2 (1)
- (ii) (1) • as organic matter has been used up, decomposition activity decreases / less microorganisms carry out decomposition (1) (2)
• oxygen continues to dissolve in the stream water due to running water / photosynthesis of aquatic plants (1)
- (2) • the biotic and abiotic properties of Location 3 are different from those of Location 1 (1) / different habitats (2)
• Such as the rate of water flow is slower in Location 3 / there are shadings / fallen leaves from trees nearby (1)

Paper 2 Section C

	<u>Marks</u>
3. (a) (i) • the greater the diameter of the clear zone, the more effective the antibiotic (1)	(1)
(ii) • antibiotic C (1) • because it is a broad-spectrum antibiotic / acts on multiple microorganisms (1) • there is a better chance of combatting the infection (1)	(3)
(iii) (1) • flame the loop to red hot (1) • the mouth of a culture tube should be flamed before and after use (1)	(2)
(2) • after knowing the strains, specific antibiotics can be used for treatment (1) / doctor can decide the best antibiotics to be used • which are more effective in inhibiting the growth of specific microorganisms (1) / will not kill other natural microorganisms inside our body	(2)
(iv) Any <i>two</i> of the followings: • some antibiotics (e.g. B) are specific to a certain kind of microorganisms (1) • while some other antibiotics (e.g. A,C,D) can act on multiple microorganisms (1) • some antibiotics (e.g. D at agar plate 3) are more effective in killing a certain microorganism / different antibiotics may have different effectiveness on a single microorganism (1)	(2)
(b) (i) • sunlight (1) • the UV light in the light spectrum is harmful to microbes (1) • nutrients (1) • therefore microbes die due to starvation as the level of organic matter in unpolluted water is very low (1)	(4)
(ii) • different microbes have different tolerance to environmental stress (1), giving rise to different death rates	(1)
(iii) • B can survive in environment for some time (1), therefore the presence of B can indicate the presence of sewage • A disappears too quickly in the environment (1), even if it is absent, it does not necessarily indicate that the river is not polluted • there is always a certain amount of C present in the river water (1), even if it is present, it does not necessarily indicate the river is polluted	(3)
(iv) • the total number of microbial cells present in the experiments were too low (1) • to give significant changes if biomass measure or optical measurements is used (1)	(2)

4. (a) (i) Any *two* of the following:
- white blood cells are responsible for recognizing pathogens (1) / foreign cells
 - and production of antibodies to fight against pathogens (1)
 - and kill the pathogens (1)
 - without these roles, the kid is more susceptible to infections (1)
- (2)
- (ii)
- cells from bone marrow are stem cells for producing white blood cells (1)
 - once the working gene is inserted into these stem cells, the cells can divide and produce white blood cells that carry the working gene (1)
 - hence, this provides a long-term cure to the disease (1#)
 - on the other hand, if the working gene is inserted into mature white blood cells, the working gene is lost after their death (1), therapy has to be repeated from time to time
 - thus its effect is short-lived (1#)
- (# mark to be awarded once)
- (4)
- (iii)
- a vector is used to carry the working ADA gene (1)
 - it delivers and inserts a working ADA gene / normal gene into Nina's genome / cell (1)
 - this inserted gene is expressed to produce a functional protein / enzyme (1), which should overcome the defect
- (3)
- (iv) Any *two* of the following:
- genes may be inserted at random locations in the genome which may cause harmful mutations to the DNA (1) / failure of the expression of essential genes
 - the target genes may insert regulatory sequences that trigger the expression of nearby genes leading to cancer (like leukaemia) (1)
 - some patients may show an immune reaction to the vector (1) and reject the gene product
 - viral vector may regain the ability to cause diseases (1)
- (2)
- (b) (i)
- DNA molecules are denatured / separated / unwounded to form single strands at the DNA denaturation stage (1)
 - primer with complementary bases anneals to the single-stranded DNA molecule at primer annealing stage (1)
 - complementary free nucleotides (dNTPs in PCR) join to the primer accordingly to extend the DNA molecule at the extension stage (1)
- (3)
- (ii) (1)
- extension stage (1)
- (1)
- (2)
- as all enzymes and substrate are added at the very beginning, enzymes used in PCR cycle should be able to withstand high temperature (~90°C) during the breaking of DNA molecules to single strand (1)
 - the results show that DNA polymerase B still has a high relative activity even after incubation at high temperature (1)
 - while DNA polymerase A loses most of its activity (1)
 - therefore DNA polymerase B is more suitable (1)
- (4)
- (iii)
- amplify the DNA for genetic testing such as parentage / forensic application / detection of specific gene sequence (e.g. genes of genetic diseases, genetic markers of GM food) (1)
- (1)