21-22 F6 mock

Paper 2

Section A

1 a i The increase in the levels of the two hormones was due to the intake of the contraceptive pills, which contain the two hormones. 1m

The decrease in the levels of the two hormones was due to the excretion / metabolism of the hormones. 1m

ii The woman did not take the pills from day 21 to day 28 / the pills taken from day 21 to day 28 did not contain oestrogen and progesterone. 1m

menstruation is allowed with low levels of progesterone and oestrogen 1m

iii Due to the high levels of progesterone and oestrogen, release of FSH and LH from the pituitary is inhibited 1m

Low level of FSH is not sufficient to stimulate follicular development 1m

Low levels of LH is not sufficient to stimulate ovulation during the 28-day period. 1m

Thus no ova were released into the oviducts for fertilization. 1m

iv There are no follicles to develop/remaining follicles cannot develop so that the levels of oestrogen and progesterone remain low. 1m

without the inhibitory effect of oestrogen and progesterone, levels of FSH and LH remains high. 1m

2 i(1) more vesicles fuse with the cell membrane upon stimulation of increased level of ADH 1m

More channel proteins for water will be available on the cell membrane of the epithelial cells 1m

(2) with more channel proteins, reabsorption of water from collecting duct is at a higher rate/ a larger proportion of water is reabsorbed from the lumen of the collecting duct. 1m

leaving the urine to be more concentrated and in a smaller volume 1m

ii (1) There are inhibitors that block the ADH receptors/ ADH receptors are damaged 1m

There is a genetic disease that the patient is unable to produce ADH receptors 1m

(2) Without enough ADH receptor proteins, the walls of the collecting ducts of the patients are not as permeable to water as normal people (1)

Only a smaller proportion of water in the glomerular filtrate can be reabsorbed. (1)

The water potential of their blood is kept low. (1)

This stimulates the hypothalamus which in turn stimulates the pituitary gland to release more ADH into the blood circulation. (1)

Section B

2. (a)i Fish species Q is being overfished. 1m

Most fish species Q are caught before the age of sexual maturity. 1m

Therefore, the population of fish species Q is unlikely to be replenished./the reproductive rate of the species may not keep up with the rate the fish is caught. 1m

ii The time required for sexual maturity of fish species Q is longer than that of fish species P. 1m

Therefore, fish species Q is less likely to reproduce before it is caught. 1m

or

The number of eggs laid per mass of fish species Q is lower than that of fish species P. 1m

Therefore, fish species Q is likely to produce less offspring than fish species P. 1m

iii Adopt fish moratorium/ ban fishing during the breeding season of species Q/others 1m

iv As ciguatoxin is high fat-soluble, stable and not easily metabolized nor excreted, 1m

It accumulates in organisms once taken in 1m

and the concentration of it increases along the food chain when predators eat a lot of preys 1m

Fish species Q has larger (maximum) body size

This indicates that it may be at a higher trophic level in the food chain and accumulated with higher concentration of the toxin. 1m

or

As ciguatoxin is high fat-soluble, stable and not easily metabolized nor excreted, 1m

It accumulates in organisms once taken in 1m

As the lifespan of the fish species Q is longer, 1m

it accumulates the toxin for a longer period of time resulting in a higher concentration of toxins in its body. 1m

2. (b)(i) As shown in Figure 2B, the ice near Russia was lost in 2014 1m

(ii) With the decrease in artic sea ice extent near Russia (shown in figure 2B), the size of habitat for polar bear is declining 1m

the competition among polar bears is increased 1m

Polar bears migrated southward to search for food/resources 1m

Therefore, there is an increasing trend of polar bear sub-populations near Canada while those near greenlandand russia are declining 1m

(iii) The increase in the release of greenhouse gases traps more radiation reflected from the Earth's surface 1m

This intensifies/enhances the greenhouse effect, 1m

causing the global temperature to rise and hence a larger area of Artic sea ice melts 1m

(iv) The carbon dioxide released from burning trees was once absorbed by trees from the atmosphere and stored as biomass 1m

There is no net carbon dioxide production as comparing to burning fossil fuels. 1m

Section C

3a **i** The cells with the gene introduced produce the antibody. 1m

The antibody binds to the surface protein of HIV, 1m

preventing HIV from binding to the CCR5 receptor on the cells of the patient. 1m

ii **(1)** A premature stop codon causes a change in the structure of the CCR5 receptor. 1m

Thus, the surface protein on HIV cannot bind to it. 1m

(2) This gene therapy has a longer therapeutic effect 1m

because this gene therapy involves modifying a gene in stem cells, while the one described in **i** involves introducing a gene into somatic cells. 1m

Stem cells carrying the modified gene coding for CCR5 receptor can divide and form more stem cells, which then differentiate into new cells inside the patient's body, 1m

while somatic cells are constantly replaced with new cells. 1m

iii The new gene is inserted randomly into the genome. The insertion of genes may affect the expression of existing genes, leading to diseases such as cancer. /

The new gene may be wrongly carried to non-target cells, resulting in health problems. /

Viral vectors may regain the ability to cause diseases during gene therapy. /

Viral vectors may cause severe immune repsonses. 1m

b **i** BamHI should be used to cut both the plasmid and the gene. 1m

It is because both the start and stop codons of the gene are located between the two BamHI cut sites. 1m

ii The bacteria carrying the plasmid can be identified by growing the bacteria on an agar plate containing an antibiotic. 1m

Since the plasmid contains an antibiotic resistance gene, those bacteria that contain the plasmid will be able to survive on the agar plate and form colonies. On the contrary, those bacteria without the plasmid will be killed by the antibiotic. 1m

iii The bacteria in sample 3 should contain type A plasmid. 1m

When the gene is cut by BamHI and inserted into the plasmid, it should introduce a new EcoRI cut site into the plasmid. Therefore, a recombinant plasmid (type B or C) should contain two EcoRI cut sites. 1m

Therefore, when the recombinant plasmid is cut by EcoRI, it should produce two DNA fragments instead of one. 1m

iv The bacteria in sample 2 should be able to produce functional protein X. 1m

In order to produce functional protein X, the start codon should be next to the ribosome binding site. 1m

One of the DNA fragments in sample 2 is smaller than the two DNA fragments in sample 1. This implies that the two EcoRI cut sites are closer to each other in sample 2. Hence, the start codon instead of the stop codon should be next to the ribosome binding site in sample 2. 1m