

THE 13TH HONG KONG DIPLOMA OF SECONDARY EDUCATION MOCK EXAMINATION 2024
第十三屆全港 DSE 模擬試 2024

BIOLOGY
生物

Paper 1

卷一

Section A

甲部

1	C	11	A	21	D	31	C
2	B	12	D	22	D	32	C
3	D	13	D	23	B	33	B
4	A	14	A	24	B	34	C
5	D	15	A	25	C	35	A
6	B	16	D	26	B	36	C
7	B	17	C	27	D		
8	C	18	B	28	A		
9	B	19	B	29	D		
10	A	20	D	30	D		

Section B

乙部

1. (a) C (1)
(b) B (1)
(c) A (1)

2. (a) Mutualism (1)

Azolla provides shelter for *Anabaena* while *Anabaena* converts atmospheric nitrogen into ammonium compounds that can be used by *Azolla*. (1)

- (b) The yield of rice increased with the amount of *Azolla* added. (1)

More *Anabaena* was present as the amount of *Azolla* increased. (1)

Therefore, more ammonium compounds were produced by *Anabaena*. (1)

When *Azolla* and *Anabaena* died and decomposed, the ammonium compounds were released into the soil. Hence, the fertility of the soil increased. The rice plant grew better and the yield increased. (1)

3. (a)

<i>Description</i>	<i>Stage of meiosis</i>	<i>Division</i>
Spindle fibres contract, pulling homologous chromosomes to opposite poles of the cell	Anaphase (1)	I (1)
A single line of chromosomes align along the cell equator	Metaphase (1)	II (1)
Crossing over occurs between chromosomes	Prophase (1)	I (1)

- (b) Any *two* of the following: (2)

- two divisions / four daughter cells produced / crossing over occurs in meiosis (1)
- daughter cells are genetically different to parent cells / each other in meiosis (1)
- half the amount of DNA present in daughter cells / diploid cells divide into haploid cells in meiosis (1)

4. (a) The air pressure at a higher altitude is lower. (1)
 When travelling upward on a high speed elevator, the air pressure outside structure W decreases quickly and becomes lower than that in the middle ear. (1)
 Structure W bulges outward, causing pain. (1)
- (b) During swallowing, structure Z opens. (1)
 This allows air to enter the middle ear. (1)
 The air pressure on either side of structure W becomes equalized. (1)
5. (a) The heart rate decreased when nerve X was inhibited. Therefore, nerve Y decreases the heart rate. (1)
 The heart rate increased when nerve Y was inhibited. Therefore, nerve X increases the heart rate. (1)
- (b) Nerve Y has a greater effect on the heart rate at rest. (1)
 The change in heart rate when nerve Y was inhibited was larger than the change when nerve X was inhibited. /
 After nerve X is inhibited, the heart rate is similar to the heart rate at rest. This indicates that nerve Y is dominant over nerve X at rest. (1)
6. (a) In people with alcohol sensitivity, the ADH may be more active than ALDH. (1)
 Therefore, acetaldehyde is accumulated in the body. (1)
 In people without alcohol sensitivity, the ALDH may be more active than ADH. (1)
 Therefore, the acetaldehyde produced is converted to acetate quickly. There is no accumulation of acetaldehyde in the body. (1)
- (b) The ALDH inhibitor will cause the accumulation of acetaldehyde in the body. (1)
 Since the accumulation of acetaldehyde will cause dizziness and vomiting, the ALDH inhibitor can reduce people's desire for drinking alcohol. (1)
 The ADH inhibitor will cause the accumulation of alcohol, which may cause damage to body cells and organs. (1)
7. (a) P is a sensory neurone (1)
 because it has a long dendron and short axons. (1)
 R is a motor neurone (1)
 because it has short dendrons and a long axon / it is connected to muscle fibres. (1)
- (b) Myelin sheath (1)
 It insulates nerve fibres. (1)
 It speeds up the transmission of nerve impulses. (1)
- (c) (i) Y (1)
 (ii) It relays nerve impulses between the brain and other parts of the body. (1)
 It serves as the reflex centre for many reflex actions involving the trunk and limbs. (1)

8. (a) The acidic environment in the stomach may not be favourable for the growth of *H.pylori*. (1)
Ammonia can neutralize the acidic hydrochloric acid present in the stomach. This creates a suitable environment for the growth of *H. pylori*. (1)
- (b) Person X is infected with *H. pylori*. (1)
There is a larger change in the concentration of $^{13}\text{CO}_2$ in person X's breath. (1)
Since the digestive glands in the human body do not produce urease, the increase in the concentration of $^{13}\text{CO}_2$ in a person's breath will only be due to urease produced from *H.pylori*. (1)
- (c) When urease breaks down urea, some of the $^{13}\text{CO}_2$ produced is absorbed into the blood. (1)
The blood transports the $^{13}\text{CO}_2$ to the lungs and the $^{13}\text{CO}_2$ diffuses from the blood into the air sacs. (1)
- (d) It will not cause any pain to the person since it is non-invasive. (1)
(or other reasonable answers)
9. (a) The tying of the pancreatic duct resulted in the backflow of pancreatic juice to the pancreatic tissues that secrete the juice. (1)
Digestive enzymes (e.g. proteases) in the pancreatic juice broke down the pancreatic tissues. (1)
It can be deduced that the islets of Langerhans did not degenerate as the dog did not develop diabetes. (1)
- (b) The pancreatic extract contained insulin. (1)
Since Banting and Best were not diabetics / their pancreas could secrete insulin normally, the injection caused their blood insulin level to reach a higher than normal level. (1)
As insulin stimulates the conversion of more blood glucose into glycogen by the liver / uptake of more blood glucose by body cells, the extra insulin would reduce the blood glucose to a low level. (1)
As a result of insufficient blood glucose supply to the brain, Banting and Best felt dizzy. (1)

(c)

Nature of science	Elaboration
Science is affected by the technology and the types of equipment available at the time.	The development of microscope allowed Langerhans to discover the islets of Langerhans.
Scientists build on the work of other scientists.	Banting and Best knew that the removal of pancreas from a dog can make it diabetic.

(1)

(1)

10. (a) ATP (1)
- (b) In the duodenum, lipase from the pancreatic juice catalyses the breakdown of lipids into fatty acids and glycerol. (1)
Fatty acids and glycerol diffuse into the epithelial cells of the villi. Inside the cells, the fatty acids and glycerol recombine to form small lipid droplets, which then enter the lacteal. (1)
The lipid droplets are carried by the lymph in the lymphatic system, and are eventually passed into the bloodstream. (1)
- (c) NAD is the hydrogen carrier. NAD picks up hydrogen in the Krebs cycle to form NADH (1)
which then transfer hydrogen to oxygen in oxidative phosphorylation to generate ATP. (1)
- (d) Any *one*: (1)
- The energy yield from one gram of fats is approximately 9 kcal, higher than that of carbohydrates (4 kcal).
 - Stored fat is anhydrous and occupies less space than carbohydrates. This allows the body to be lighter and smaller when storing fats, as compared to storing carbohydrates.

11. How gases are exchanged in the placenta:

- Oxygen diffuses from the maternal blood to the embryo's blood. (1)
- Carbon dioxide diffuses from the embryo's blood to the maternal blood. (1)

Adaptations of lung and placenta to gas exchange:

- Numerous air sacs in the lungs and the large number of finger-like embryonic villi in the placenta (1),
provide a large surface area for diffusion of gases. (1)
- The epithelia making up the walls of the air sacs are only one-celled thick. The walls of the embryo's capillaries and the embryonic villi are also very thin. (1)
These features provide a short distance for the diffusion of gases. (1)
- There are numerous capillaries surrounding the air sacs. In the placenta, there are a lot of blood vessels. (1)
The blood in these blood vessels transports the gases away readily. A steep concentration gradient can be maintained for efficient diffusion of gases. (1)
Communication (3)

Paper 2

卷二

SECTION A Human Physiology: Regulation and Control

- 1 a i** The core temperature (temperature deep within the body) is maintained within the normal range of body temperature (at about 37 °C). 1m
The temperature decreases as it nears the peripheral and surface of the body. 1m
The temperature difference is due to vasoconstriction of the peripheral blood vessels to reduce heat loss. 1m
Blood carries heat as it travels along the body. Vasoconstriction which results in a reduction in blood flow will thus reduce the amount of heat transported. 1m
- ii** The region deep within the body contains organs like the heart and the brain. 1m
Maintaining temperature within the normal range is important for these vital organs to function properly. 1m
- iii** Their skin may turn red again due to vasodilation of the blood vessels. 1m
This is to prevent tissue damage due to a prolonged period of nutrient and oxygen shortage. 1m
- iv** The core temperature will remain at 37 °C, 1m
while the temperature near the peripheral and surface of the body will increase. 1m
- b i** The FSH injections promote the development of a number of follicles. 1m
Therefore, more ova can be obtained for IVF to increase the chance of pregnancy. 1m
- ii** Progesterone 1m
It can maintain the thickness of the uterine lining. 1m
- iii** In a normal menstrual cycle, a higher level of LH will stimulate ovulation. 1m
If this LH surge is allowed to occur during the process of IVF, the ova cannot be obtained from the ovaries and hence IVF cannot be carried out. 1m
- iv** r-FSH injections can help obtain more mature ova because a higher level of oestrogen is found in the blood. 1m
Oestrogen is secreted by follicles. Hence, a higher level of oestrogen implies that more follicles have developed. 1m
- v** No follicles are available for development in the ovaries of postmenopausal women. Therefore, the level of oestrogen in the blood of postmenopausal women will decrease. 1m
Without the inhibition by oestrogen, the levels of FSH and LH will increase. 1m

SECTION B Applied Ecology

- 2 a i (1) The number of algae first increases 1m
because the high concentration of nitrates provides nutrients for algal growth. 1m
The number of algae then decreases 1m
because of a decreased nutrient supply / built up of waste / competition between algae. 1m
- (2) The large number of algae consumes a lot of oxygen for respiration at night, leading to suffocation of other aquatic organisms. /
The thick layer of algae on the water surface prevents sunlight from penetrating deep into the water. Aquatic plants growing below the water surface cannot receive enough sunlight for photosynthesis and may die. /
The algae may produce toxins. Other aquatic organisms may get poisoned and die. /
When the algae die, they are decomposed by bacteria. The bacteria consume oxygen in the water, leading to suffocation of other aquatic organisms.
(any 3 or other reasonable answers) 1m × 3
- ii (1) The reeds absorb nitrates for making proteins / amino acids. 1m
Denitrifying bacteria in the soil convert nitrates into nitrogen gas under anaerobic conditions. 1m
- (2) Methane is a greenhouse gas. 1m
It enhances the greenhouse effect / leads to global warming. 1m
- b i When the atmospheric carbon dioxide concentration increases, the ocean pH decreases. 1m
When carbon dioxide dissolves in water, a slightly acidic solution is formed. 1m
With an increase in atmospheric carbon dioxide concentration, more carbon dioxide dissolves into the ocean water. This decreases the ocean pH. 1m
- ii (1) The results do not agree with the suggestion. 1m
The results show that sea snails living at the site with higher carbon dioxide concentration have thicker shells. 1m
- (2) At the site with higher carbon dioxide concentration, the algae population size is larger. 1m
More food is available for the sea snails. 1m
The sea snails have more raw materials 1m
to build thicker shells. 1m

SECTION C Microorganisms and humans

- 3 a i** All the three metals could reduce the growth of *E. coli*. 1m
The number of *E. coli* decreased the fastest in silver-containing solution. This indicates that silver probably has the greatest antibacterial effect. 1m
The number of *E. coli* decreased the slowest in iron-containing solution and a large proportion of bacteria still survived in the solution after 6 hours. This indicates that iron probably has the least antibacterial effect. 1m
The number of *E. coli* in zinc-containing solution decreased slower than in silver-containing solution but faster than in iron-containing solution. This indicates that the antibacterial effect of zinc is probably lower than silver but higher than iron. 1m
- ii (1)** Wash the hands thoroughly with liquid soap and water before working. / Clean all work surfaces with disinfectant. / Sterilize the Petri dish. / Sterilize the agar. / Sterilize the apparatus used to transfer bacteria. / Work near a Bunsen flame. (or other reasonable answers) 1m
This ensures the agar plate does not become contaminated with other bacteria. 1m
- (2)** Copper is most effective against *E. coli* 1m
because the clear zone around the copper disc is the largest. 1m
- (3)** Advantage:
No need to be replaced. / Some bacteria are resistant to disinfectant. / Slow down the development of resistance in bacteria due to reduced use of disinfectant. (or other reasonable answers) 1m
Disadvantage:
Copper is not effective against certain bacteria. /
Compared with disinfectant, it takes a longer time for copper to kill bacteria. /
Copper is much more expensive than disinfectant. 1m
(or other reasonable answers)
- b i** To kill pre-existing microorganisms except the salt-tolerant lactic acid bacteria on the cabbages which may affect the quality of the kimchi. 1m
To weaken the cell structure of the cabbage by removing water from the cells (by osmosis), making the cabbage ready for the subsequent steps in the preparation of kimchi. 1m
- ii** To provide an anaerobic condition for lactic acid bacteria to carry out fermentation. 1m
- iii** Under anaerobic condition, lactic acid bacteria carry out lactic acid fermentation. 1m
During the process, sugars in the cabbages are broken down into lactic acid. 1m
- iv** The storage temperature affects the enzyme activity of the lactic acid bacteria. 1m
This in turns affects the growth rate of the bacteria. 1m
Thus the amount of lactic acid produced by the bacteria in a fixed period of time is altered, affecting the flavour of the kimchi. 1m
- v** The lactic acid produced by lactic acid bacteria lowers the pH of the kimchi. 1m
At low pH, enzymes of many microorganisms that can cause food spoilage are denatured. As a result, the growth of these microorganisms is inhibited, and food spoilage is less likely to occur. 1m

SECTION D Biotechnology

- 4 a i The virus is used as a vector to transfer the gene of interest into target cells. 1m
- ii Retrovirus cannot infect non-dividing cells. Therefore, the application of retrovirus in gene therapy may be restricted. 1m
- iii The insertion of the gene may disrupt the base sequence of an existing gene. 1m
Hence, a functional polypeptide cannot be produced. 1m
The insertion of the gene may affect the expression of an existing gene. 1m
This may lead to diseases such as cancer. 1m
- iv Since adenovirus will not integrate the gene into the genome of target cells, the gene will be lost gradually when the cells divide or die. 1m
Therefore, repeated injections of adenovirus are required to sustain the effect. 1m
The first injection of adenovirus may trigger the B cells to differentiate into plasma cells and memory B cells. 1m
When adenovirus is injected into the body again, the memory B cells will produce a larger amount of antibodies against adenovirus. This lowers the effectiveness of the gene therapy. 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