

A 3D molecular model of a DNA double helix and a protein structure. The DNA is shown as a blue and purple double helix. The protein is a large, complex structure with blue spheres representing atoms and green and orange rods representing bonds. The model is set against a white background with a green border on the left and top.

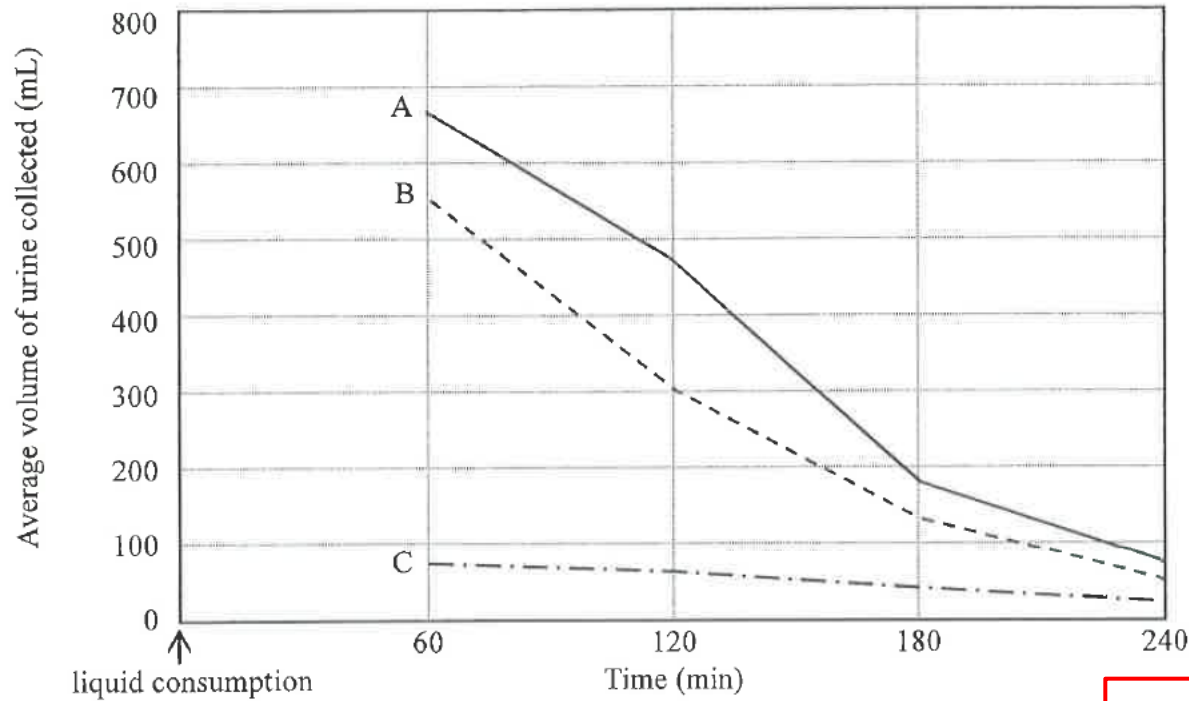
HKDSE Biology 2018

Paper 2A & C

Paper 2A – 1(a)(i)

- 1(a) In a study of the effect of consuming different liquids on urine production, three groups of healthy persons were asked to follow the same pattern of physical activity and dietary intake. After that, Group A consumed a 1500 mL alcoholic beverage, Group B consumed 1500 mL water and Group C did not consume any liquid. Their urine was collected and its volume measured at 60-minute intervals over a period of 240 minutes. The results are shown in the graph below:

Key: — Group A: each person consumed a 1500 mL alcoholic beverage
- - - Group B: each person consumed 1500 mL water
- · - · Group C: did not consume any liquid



Comparison

- (i) With reference to the hormonal control of osmoregulation, explain why Group C had a much lower average volume of urine produced than Group A and Group B. (5 marks)

Paper 2A – 1(a)(i)

- Water potential of blood in group C lower than that of A and B (compare to A & B, not compare to normal, not just low)
- Detected by osmoreceptors / hypothalamus
- Stimulate pituitary to release more ADH
- Increase permeability of collecting duct to water
- More (larger proportion of) water reabsorbed

A and B both consumed 1500 mL liquid while C did not consume any liquid.

Because C didn't consume any liquid, the water potential is below ~~the~~ normal. ~~The~~ hypothalamus detected the changes and released more ADH. Therefore, the collecting duct will be less permeable to water, a larger proportion of water reabsorbed and small amount of urine released.

Paper 2A - 1(a)(i)

For Group A and Group B, each person consumed a 1500 ml alcoholic beverage or water. The absorption of these beverages will trigger a rise in water potential of blood. The rise in water potential of blood is detected by osmoreceptors in hypothalamus, stimulating less ADH release from pituitary. The permeability of collecting duct to water is thus lower, leading to less proportion of water to be reabsorbed. A larger volume of diluted urine is produced. For Group C, they do not consume any liquid, there is no change in water potential and thus the normal ADH release, leading to the huge difference in average urine volume produced.

由于C组人士没有饮用任何液体，他们的血液水势较正常的血液的低，使下丘脑的渗透压感受器刺激垂体释放较少的抗利尿激素，令集尿管壁对水的渗透性增加，被重吸收的水的比例较少，产生少量浓缩的尿液。

Paper 2A – 1(a)(ii)(1)(2)

- (ii) (1) With reference to the results of Group A and Group B, what is the overall effect of consuming alcoholic beverages on urine production? (1 mark)
- (2) Based on (ii) (1), deduce *one* possible effect of alcohol on the **hormonal control** of osmoregulation. (1 mark)
- (1) **Increase** urine production
 - (2) **Inhibit** release/production of ADH

Alcohol increase the rate of ultrafiltration so that the rate of glomerular filtrate formation increase and lead to more urine production. as same proportion of water is reabsorbed as group B.

(ii)(1) 飲用含酒精飲品會產生更多的尿液 ✓
(2) 集尿管的透性下降

Paper 2A – 1(a)(iii)

(iii) Explain why the participants should avoid doing vigorous physical activity during the study.

(2 marks)

- Prevent water loss by sweating
- May reduce urine production (not only "may affect the result")

Doing vigorous physical activity produces a large amount of heat. More sweat is produced to lose heat through evaporation of heat. Water potential of blood is affected and thus the average volume of urine may be affected.

因为参与者在研究期间会进行大量排尿、进行4次尿液收集，使身体的水分缺少。而进行剧烈活动使要进行呼吸作用产生能量，使身体变热、排汗增加。如参与者进行剧烈活动可能使身体的水分大量流失，可能出现脱水情况，或有生命危险。

Paper 2A – 1(b)(i)

1(b) Nowadays, many weather forecast apps list ‘real feel’ temperature in addition to air temperature. The real feel temperature is the temperature which takes into account multiple factors influencing the effectiveness of heat loss from the human body. The higher the effectiveness, the lower is the real feel temperature. The table below shows the real feel temperatures at different air temperatures and relative humidities (other environmental conditions remain the same):

		<i>Air temperature (°C)</i>			
		<i>24</i>	<i>28</i>	<i>32</i>	<i>36</i>
<i>Relative humidity (%)</i>	<i>40</i>	24	29	34	39
	<i>50</i>	24	29	35	41
	<i>60</i>	25	30	36	41
	<i>70</i>	26	31	37	42
	<i>80</i>	26	32	37	44
	<i>90</i>	27	32	38	45
	<i>100</i>	27	33	39	46

Note: Real feel temperatures are highlighted in grey.

(i) Describe the effect of relative humidity on the real feel temperature. Explain this phenomenon with reference to the effectiveness of heat loss from the body. (3 marks)

- Higher relative humidity increases real feel temperature
- Hinder sweat evaporation
- Heat lost to surrounding is not/less effective

Paper 2A – 1(b)(i)

相对湿度愈高，体感温度亦愈高，双方呈正比关系。由于人体排汗需要~~透过后~~需要透过后蒸发作用，才能把汗水中的代谢废物带走。若相对湿度愈高，表示空气中的水汽浓度也愈高，这导致与人体所排出的水汽汗的水汽浓度相同，双方之间没有差距，难以发生蒸发作用，故此汗水有且不能排走，令身体温度上升。

Paper 2A – 1(b)(ii)

1(b) Nowadays, many weather forecast apps list ‘real feel’ temperature in addition to air temperature. The real feel temperature is the temperature which takes into account multiple factors influencing the effectiveness of heat loss from the human body. The higher the effectiveness, the lower is the real feel temperature. The table below shows the real feel temperatures at different air temperatures and relative humidities (other environmental conditions remain the same):

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Note: Real feel temperatures are highlighted in grey.

(ii) How does the effect described in (i) change at higher air temperatures? Explain this phenomenon with reference to the effectiveness of heat loss from the body. (3 marks)

- The effect intensifies / is stronger / is more serious
- Narrower temperature gradient
- Heat lost through conduction / convection / radiation is not/less effective

Paper 2A - 1(b)(ii)

(i) The effect described in (i) increase ✓ at higher air temperature. When the temperature increase, the thermoreceptor on skin produce nerve impulse to stimulate vasodilation. The blood flow in capillary increase. The temperature in skin increase, The people will feel hotter when the skin temperature increase.

ii) In higher temperature, heat feel temperature increase more rapidly as relative humidity increase ✓. Since evaporation rate of sweat is low, the effectiveness of losing heat by evaporation of sweat is low. While air temperature is higher, heat gain of body by conduction, convection, radiation ^{more} is greater. When heat gain is ^{more} greater than heat loss, there's ^{more} net heat gain, internal body temperature increase, thus, heat feeling temperature increase more.

在較高空气溫度時，相對濕度增加會使體感溫度變得更高，相比起較低溫度時 ✓。因為空气溫度較高時，空气儲存了較多的熱能，皮膚會接觸到較多熱，所以會使體感溫度更進一步提高。

Paper 2A – 1(b)(iii)

Only first two sets of answers

- (iii) Other than relative humidity and air temperature, suggest *two* environmental factors that may affect the real feel temperature. Explain your answer. (4 marks)

(Any two sets)

- Wind speed / air movement, increases evaporation of sweat
- Sunshine / light intensity / sunny / cloudiness, absorb more heat
- Precipitation, wetted skin loses heat faster through conduction and evaporation

① 風速：風速愈高，表示風力愈強，會使人體體感溫度下降，因此會感冷。

② 陽光：陽光愈烈，表示天氣的溫度愈酷熱，會使人體體感溫度上升，因此會感熱。

另一个是空气的二氧化碳浓度，由于二氧化碳是温室气体，会困住空气中的热能，如空气中二氧化碳浓度上升会困住更多的热能，使环境有更多热度，体感温度会上升。

Paper 2A – 1(b)(iv)

(iv) People who are engaged in outdoor work or activities are advised to drink plenty of water when the Hong Kong Observatory issues the Very Hot Weather Warning. Based on your biological knowledge, suggest an explanation for this advice. (1 mark)

- Compensate / replenish water loss due to sweating
- Insufficient water → sweating may be cut down → heat stroke

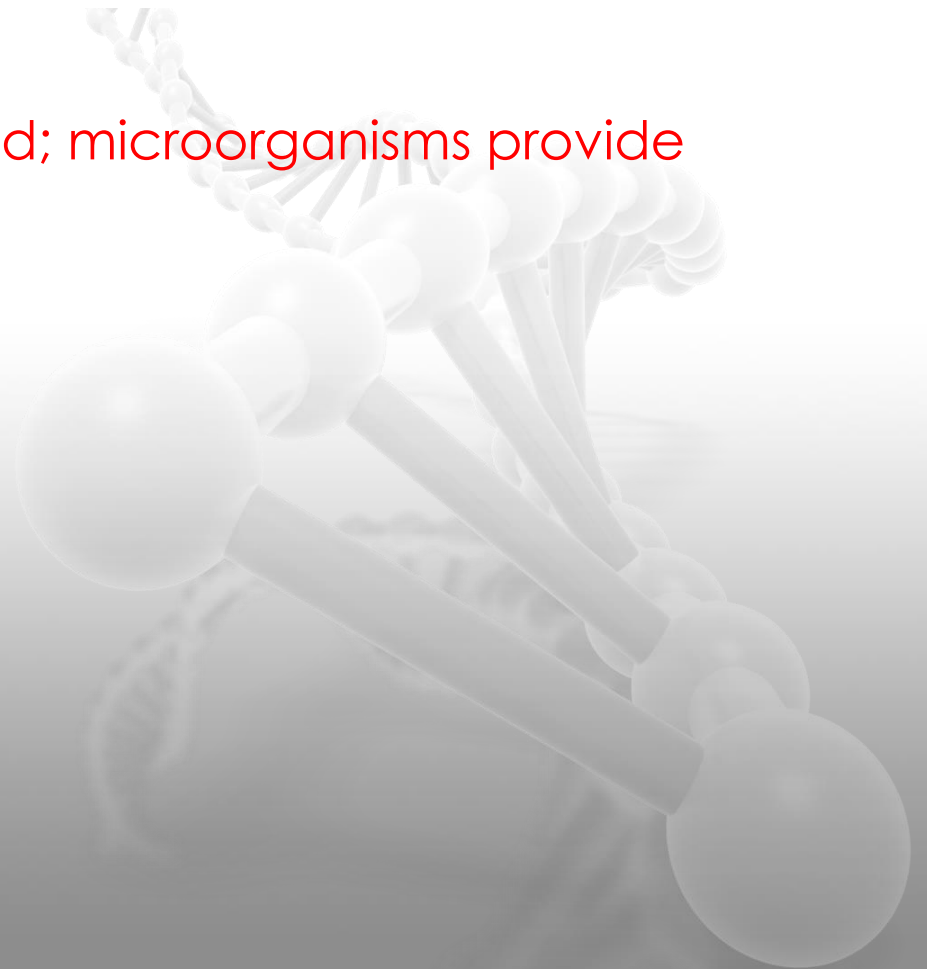
iv) Drinking water increase blood water level, which can produce more ~~heat~~ sweat for losing heat by evaporation and more blood flow through blood capillaries near skin surface to lose heat by convection.

Paper 2C – 3(a)(i)

3(a) Trillions of microorganisms live in the human intestine. Most of them are non-pathogenic and play an important role in many functions in the human body, including food digestion, defence against pathogens and vitamin production.

(i) What is the ecological relationship between humans and these microorganisms in the intestine?
Explain your answer. (2 marks)

- **Mutualism**
- Humans provide habitat / food; microorganisms provide services to humans



Paper 2C – 3(b)(ii)(1)

- (ii) According to the World Health Organization, probiotics are microorganisms that confer health benefits on humans. However, a large amount of probiotics has to be ingested so that a sufficient number can survive gastric digestion and reach the intestine.

Only first two answers

Not controlled variables

- (1) You are given a flask of cultured probiotic bacteria and a 37°C incubator. In order to design an investigation to estimate the number of probiotic bacteria that can survive gastric digestion, suggest *two* other pieces of information that are required to simulate, in a laboratory setting, the physiological conditions in the stomach. (2 marks)

(Any two)

- pH of gastric environment
- Retention period in stomach
- Content / volume of gastric juice
- Churning actions (magnitude, frequency)

Extreme pH value, around pH 2 since hydrochloric acid is in stomach ✓

Stirring of the culture since stomach has churning ✓

Paper 2C – 3(b)(ii)(1)



pH值，人體在不同部份有不同pH值，

pH值會影響~~微生物的~~細菌的生存，例如pH值低會適合嗜酸細菌生存，嗜中細菌適合在pH值在7附近生存，嗜鹼細菌適合在pH值高的環境生存。

氧含量，

良好氧含量高適合專性需氧細菌，缺氧環境適合專性^厭氧細菌。

Paper 2C – 3(a)(ii)(2)

Viable cell count

(2) Describe how you can estimate the number of living probiotic bacteria at the end of the experiment. (4 marks)

- Serial dilution of culture
- Fixed amount of each, spread on nutrient agar plate
- Choose plate with considerable (30-300) colonies
- Calculate number of viable cells using dilution factor
- Mix culture with stain for dead cell (trypan blue)
- Transfer small amount to cell counter
- Count number of viable (unstained) cells
- Serial dilution and repeat counting until reasonable number

Paper 2C – 3(a)(ii)(2)

It can be estimated through viable cell count. Obtain the culture at the end of the experiment. Inoculate a small fixed amount of the culture to an agar plate. Carry out spread plate method to allow even spreading of culture on the plate. Carry out serial dilution to obtain different concentrations of the culture and inoculate the fixed amount of them to obtain a dish with better observation. Later, incubate the plates in 30°C for 24-48 hours. Take the one with 30-300 colonies on dishes and count the number of colonies formed. Each colony formed corresponds and represents each bacterium in the culture or diluted sample.

Paper 2C – 3(a)(ii)(2)

2) The solution, ^{at the end of experiment} can be serially diluted. The diluted solution can be inoculated and spread onto agar plates. The ^{probiotic bacteria on} agar plates are incubated for 48 hours. The number of colonies are counted and ^{after multiplying the dilution factor} they represent the number of living ^{estimate of the} probiotic bacteria.

By getting the few solution of the flask contained probiotic bacteria, dilute the concentration and put on the cultured gel and put into the incubator. A few days later, there will be colonies of bacterial growth. The more colonies on the gel, the more number of living probiotic bacteria at the end of the experiment.

Paper 2C – 3(a)(ii)(3)

(3) It is believed that patients who have completed a course of antibiotic treatment should consume food that contains probiotics. Suggest why this may protect patients from infection. (3 marks)

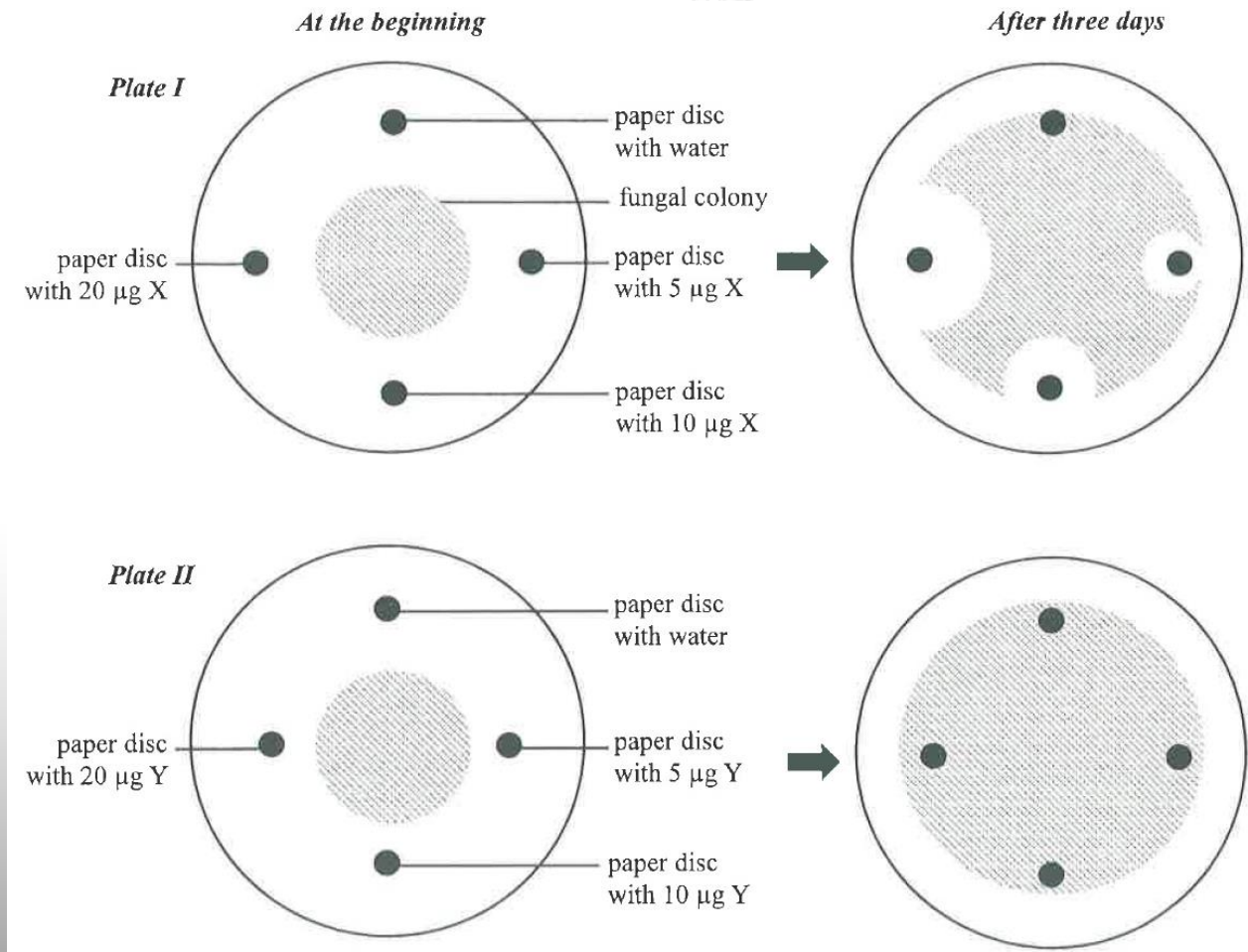
- Antibiotics **kill both** probiotics and pathogens
- Consume probiotics, transfer to gut, **multiply to large number**
- **Outcompete** (not kill) pathogens

Consume food contains probiotics can survive and reach intestine and it promotes the growth of non-pathogenic bacteria ✓ to act against pathogen, preventing infection.

Paper 2C – 3(b)(i)

(i) Describe the effects of compounds X and Y on the growth of this fungus.

(3 marks)



- X inhibits fungal growth
- Effect of X is dose-dependent (more X, stronger inhibition)
- Y has no effect on fungal growth

Paper 2C – 3(b)(i)

3(b)(i) Compound Y pose no effect on the growth of fungus ✓ as no clear zone around it, no matter the concentration. X with 20 µg is more effective to inhibit the growth of fungus than 10 µg and 5 µg. X can^{all} inhibit growth of fungus ✓ under 5 µg, 10 µg and 15 µg concentrations with larger clear zone.

Paper 2C – 3(b)(ii)(1)

(ii) In another experiment, the fungus was incubated for 1 hour with compound X or Y. After that, a green fluorescent dye which cannot pass through cell membranes was added. Green fluorescence stained the nuclei of the fungal cells exposed to compound X while no fluorescence was detected in fungal cells exposed to compound Y.

(1) With reference to the results, suggest the possible action of compound X on the fungus.

(2 marks)

- **Increase permeability** of fungal membrane to green dye
- Green dye went into the nucleus

化合物X可以破壞真菌細胞膜，因為
經化合物X處理的真菌可以使不能穿過細胞
膜的螢光染料穿過。

Paper 2C – 3(b)(ii)(2)

(2) Based on your answer in (1), suggest why clear zones were present in plate I after three days as shown in the diagram above. (2 marks)

- X **diffused** through agar to fungal colony
- Caused **lysis of fungal cells**

(2) 化合物 X 把真菌吞噬，已被消化

Paper 2C – 3(b)(iii)(iv)

- (iii) Aseptic technique should be used during the inoculation of the fungus on the agar plate. Explain the importance of this. (1 mark)
- (iv) This fungus occurs commonly in air and grows on our household goods. Suggest *one* possible daily use of compound X in our household products. (1 mark)

- (iii) **Ensure no contamination** with other microorganisms
- (iv) **Anti-fungal spray / paint** (*not disinfectants*)

iv) 梳打粉

iv) 洗潔精

3b iv) ~~梳打粉~~ 洗手液