

13.1 Excretion in humans

Name: _____ Class: _____ Date: _____

Total: 30 marks

KEY WORDS urea 尿素 • nephron 肾单位 • ions 离子 • amino acids 氨基酸 • liver 肝脏

Objective

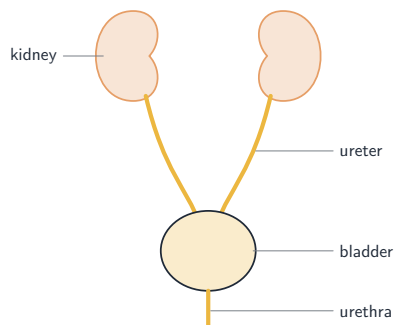
Build the skills to answer exam questions on **excretion in humans** 人体排泄 — the wastes removed, the **urinary system** 泌尿系统, the **nephron** 肾单位, and **urea** 尿素 from the liver.

You must be able to:

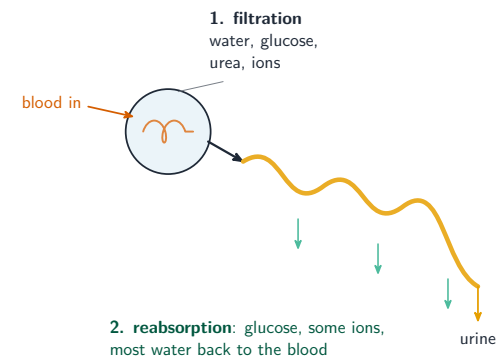
- define excretion and name the main wastes
- state the urine pathway and the role of the kidney
- describe filtration and reabsorption in a nephron; explain how urea is made

1 Worked examples

■ Kidney and nephron



Urine path: kidney → ureter → bladder → urethra



Glomerulus filters; the nephron reabsorbs all glucose, some ions and most water — what's left is urine

- urea** is made in the **liver** from excess amino acids (deamination); it is toxic.

■ Homeostasis: the loop, and the two examples

Homeostasis 稳态 is the maintenance of a constant internal environment. Every example follows the same **negative feedback** 负反馈 loop:

a change from the norm → receptor detects it → coordinator → effector acts → the change is reversed

Temperature control. The skin and the hypothalamus detect the change; the effectors are in the skin and the muscles.

Too HOT	Too COLD
sweat glands release more sweat; its water evaporates , taking heat from the skin	little sweat produced
vasodilation 血管舒张 — arterioles near the surface widen, so more blood flows near the surface and more heat is lost by radiation	vasoconstriction 血管收缩 — arterioles narrow, so less blood flows near the surface and less heat is lost
hairs lie flat	hairs stand up, trapping an insulating layer of air; shivering — muscles contract rapidly, and respiration in them releases heat

△ Blood vessels **do not move up and down** in the skin. It is the arterioles that widen or narrow — saying the capillaries “rise to the surface” is a specific, commonly penalised error.

Blood glucose control. Both hormones come from the **pancreas** 胰腺.

- Glucose **too high** → the pancreas releases **insulin** 胰岛素 → the liver converts glucose to **glycogen** 糖原 for storage, and cells take up more glucose → the level falls.
- Glucose **too low** → the pancreas releases **glucagon** 胰高血糖素 → the liver converts glycogen back to glucose → the level rises.

Type 1 diabetes 糖尿病 is caused by the pancreas not producing enough insulin, so blood glucose stays high; it is treated with insulin injections and by controlling diet and exercise.

Worked example. Explain what happens after a large sugary meal. Blood glucose rises above the norm; the pancreas detects this and releases insulin; insulin makes the liver convert glucose into glycogen and makes body cells take up more glucose; blood glucose falls back towards the norm; insulin release then decreases — which is what makes the loop negative feedback.

2 Practice

2.1 Name the two main waste products removed by excretion. [2]

2.2 State the pathway of urine from the kidney to outside the body. [2]

2.3 Name the organ that releases insulin, and state the effect of insulin on the liver. [2]

2.4 Explain how sweating cools the body. [2]

2.5 State what is meant by negative feedback. [2]

3 Exam-style questions

3.1 Urea is made in the: [1]

- **A** kidney
- **B** liver
- **C** bladder
- **D** lungs

3.2 A nephron cleans the blood.

(a) Name the two main processes in a nephron. [2]

(b) State which substances are reabsorbed into the blood. [2]

3.3 Explain why urea must be excreted from the body. [1]

3.4 A person exercises hard on a hot day, then rests and eats a large meal.

(a) Describe two ways the skin responds while the person is too hot, and explain how each reduces body temperature. [4]

(b) Explain why shivering raises body temperature when the person cools down afterwards. [2]

(c) After the meal, blood glucose rises. Describe the response that returns it to normal, naming the organ, the hormone and the storage compound. [4]

(d) State the hormone released when blood glucose falls too low, and describe its effect. [2]

(e) Explain why this control system is described as negative feedback. [2]

Solutions

2.1 carbon dioxide; urea.

2.2 kidney → ureter → bladder → urethra.

2.3 The pancreas; insulin makes the liver convert glucose into glycogen for storage.

2.4 Sweat is released onto the skin surface; the water in it evaporates, and the energy needed to do so is taken from the skin, cooling the body.

2.5 A change away from the norm is detected, and the response acts to reverse that change and return the level to the norm.

3.1 B. Urea is made in the liver.

3.2 (a) filtration; reabsorption.

(b) all the glucose; some ions; most of the water.

3.3 because urea is toxic (poisonous) if it builds up in the blood.

3.4 (a) Any two, two marks each: more sweat is released, and its evaporation takes heat energy from the skin; vasodilation — the arterioles near the surface widen, so more blood flows close to the surface and more heat is lost by radiation; hairs lie flat, so no insulating layer of air is trapped and more heat escapes.

(b) The muscles contract and relax rapidly; this increases respiration in them, which releases heat and warms the body.

(c) The pancreas detects the rise in blood glucose; it releases insulin; insulin makes the liver convert glucose into glycogen for storage; body cells also take up more glucose, so the blood glucose level falls back to normal.

(d) Glucagon; it makes the liver convert stored glycogen back into glucose, raising the blood glucose level.

(e) The response is triggered by a change away from the norm, and it acts in the opposite direction, reversing that change and restoring the norm.