14.1 Homeostasis in mammals

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS glucose • kidney • glucagon • hormone • cell signalling

Objective

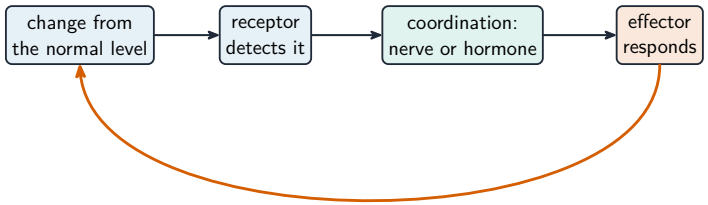
Build the skills to answer exam questions on **homeostasis in mammals** – **negative feedback**, the **kidney** and urine formation, **osmoregulation**, and **cell signalling** in blood-glucose control.

You must be able to:

- explain homeostasis and the principle of negative feedback
- describe ultrafiltration and selective reabsorption in the nephron
- explain osmoregulation by ADH and the glucagon signalling cascade

1 Key knowledge and worked examples

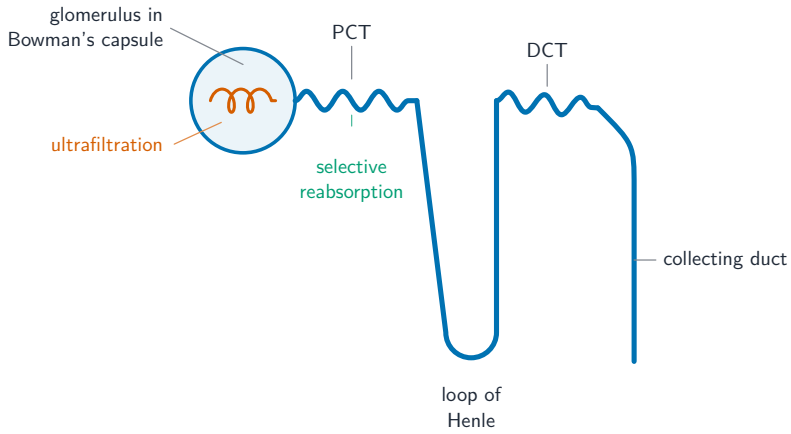
■ Homeostasis and negative feedback



Negative feedback: a receptor detects a change; an effector corrects it, returning to normal

Homeostasis keeps internal conditions steady. A **stimulus** is detected by a **receptor**; a coordination system (nervous or endocrine) signals an **effector** that corrects the change.

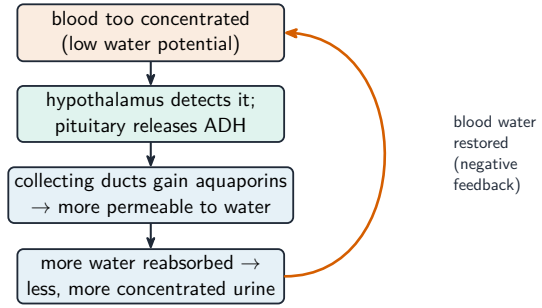
■ The nephron: making urine



Ultrafiltration in the Bowman's capsule; selective reabsorption in the proximal convoluted tubule

- **ultrafiltration** (Bowman's capsule): high glomerular pressure forces water and small molecules (glucose, ions, urea) out; cells and proteins stay in the blood.
- **selective reabsorption** (proximal convoluted tubule): glucose and much water/ions are taken back; the cells have **microvilli** and many **mitochondria** for active transport.

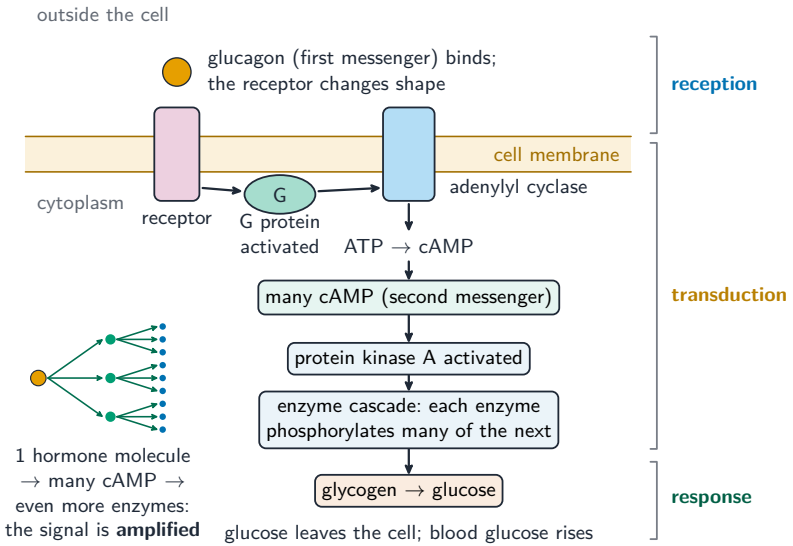
■ Osmoregulation by ADH



When blood is too concentrated, ADH makes the collecting ducts reabsorb more water

The **hypothalamus** detects low water potential; the **pituitary** releases **ADH**; the collecting ducts gain **aquaporins**, so more water is reabsorbed → less, more concentrated urine.

■ **Cell signalling: glucagon**



A second messenger (cAMP) and an enzyme cascade amplify the signal – each step activates many

2 Practice

2.1 Name the coordination system that uses (a) nerve signals and (b) hormones. [2]

2.2 State **two** substances reabsorbed in the proximal convoluted tubule. [1]

3 Exam-style questions

3.1 Which substance does **not** normally pass into the glomerular filtrate during ultrafiltration? [1]

- **A** glucose
- **B** urea
- **C** plasma protein
- **D** water

3.2 When the blood is too concentrated, ADH causes: [1]

- **A** less water to be reabsorbed
- **B** the collecting ducts to become more permeable to water
- **C** more dilute urine to be produced
- **D** glycogen to break down

3.3 (a) Explain how the proximal convoluted tubule is adapted for selective reabsorption. [3]

(b) Explain how ADH restores the water potential of the blood when it is too low. [3]

3.4 Glucagon controls blood glucose by an enzyme cascade.

(a) Name the second messenger formed inside the liver cell. [1]

(b) Explain why the use of an enzyme cascade amplifies the signal. [2]