# Exercise walk-through

## Control and coordination in mammals ▪ 15.1

eXercise

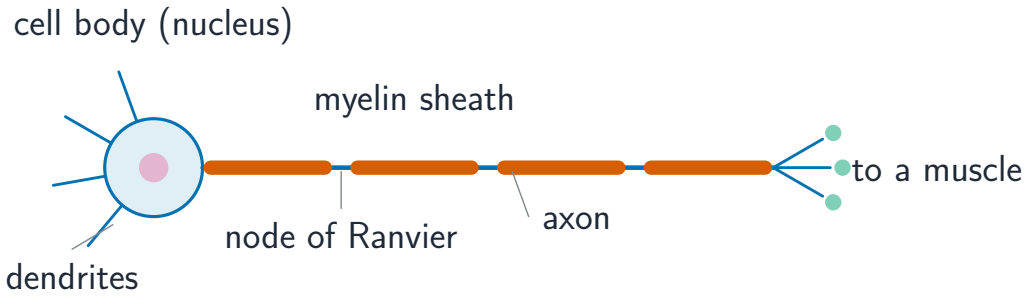
# You must be able to

- compare the nervous and endocrine systems and describe sensory and motor neurones
- describe the events of an action potential and how the resting potential is restored
- explain saltatory conduction and transmission across a cholinergic synapse

# Method — Nervous vs endocrine, and neurones

The **nervous system** sends fast, short-lived electrical **impulses** 冲动 along neurones; the **endocrine system** sends slower, longer-lasting **hormones** 激素 in the blood.

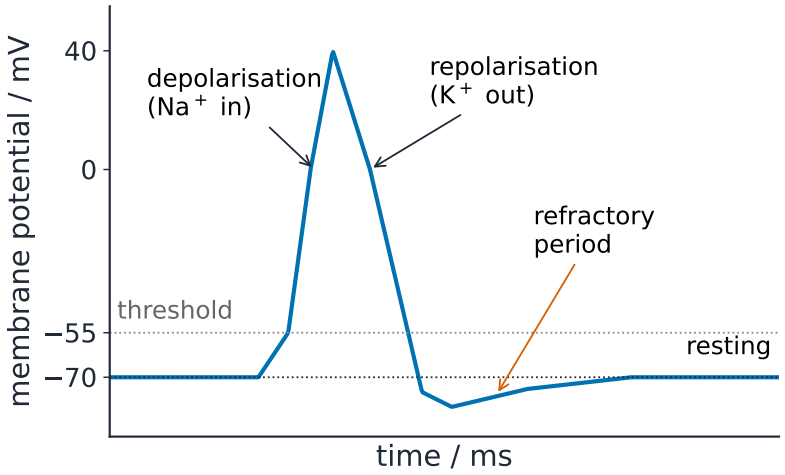
# Method — Nervous vs endocrine, and neurones



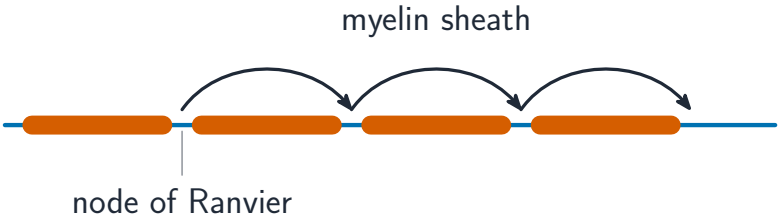
# Method — The action potential

- **resting potential 静息电位** ($-70$ mV): a pump moves Na out and K in; the membrane is more permeable to K .
- **depolarisation**: a stimulus opens Na channels; Na rushes in; inside becomes positive.
- **repolarisation**: K channels open; K leaves; the potential returns to negative.
- **refractory period 不应期**: Na channels cannot reopen for a moment, limiting impulse frequency.

# Method — The action potential



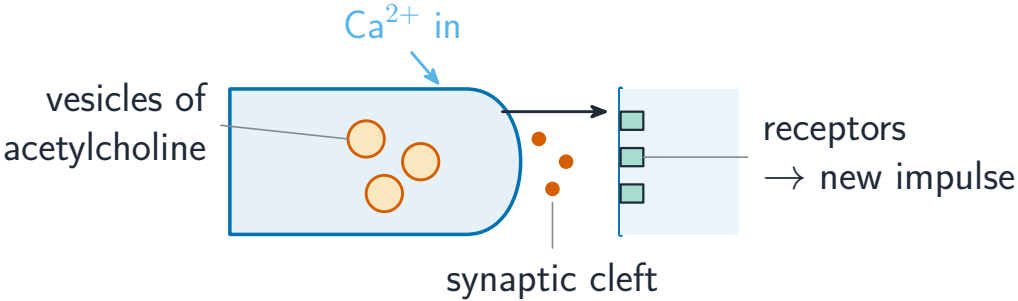
# Method — Saltatory conduction and the synapse




the impulse jumps from node to node (saltatory conduction) $\longrightarrow$ faster

*A myelinated axon where the impulse jumps node to node*

# Method — Saltatory conduction and the synapse



## Practice 2.1 ▪ 2 marks

State **two** differences between the nervous and the endocrine systems.

# Solution 2.1

Method: Nervous vs endocrine, and neurones

**Worked steps**

any two: nervous uses electrical impulses vs hormones; along neurones vs in the blood; fast vs slow; short-lived vs longer-lasting B1 *each, max 2.*

## Practice 2.2 ▪ 2 marks

Name the ion that (a) rushes in during depolarisation and (b) leaves during repolarisation.

# Solution 2.2

Method: The action potential

**Worked steps**

(a) sodium (Na ) B1; (b) potassium (K ) B1.

## Exam-style 3.1 ▪ 1 mark

During the refractory period, a neurone cannot send another impulse because:

**A** there is no stimulus

**B** the sodium channels cannot reopen for a short time

**C** the myelin sheath blocks it

**D** acetylcholine is not made

# Solution 3.1

Method: The action potential

**A** there is no stimulus

**B** the sodium channels cannot reopen for a short time ✓

**C** the myelin sheath blocks it

**D** acetylcholine is not made

## Worked steps

**B**. The sodium channels are temporarily unable to reopen.

## Exam-style 3.2 ▪ 1 mark

Why does a myelinated neurone conduct impulses faster than an unmyelinated one?

**A** it has a larger cell body

**B** the impulse jumps between nodes of Ranvier

**C** it has more synapses

**D** it uses hormones

# Solution 3.2

**A** it has a larger cell body

**B** the impulse jumps between nodes of Ranvier ✓

**C** it has more synapses

**D** it uses hormones

**Worked steps**

**B**. The impulse jumps between nodes of Ranvier (saltatory conduction).

## Exam-style 3.3 ▪ 2 marks

(a) Describe how the resting potential is maintained in a neurone.
(b) Describe how an action potential is produced when the neurone is stimulated.

# Solution 3.3

Method: The action potential

**Worked steps**

(a) a pump moves sodium ions out and potassium ions in M1; the membrane is more permeable to potassium, so the inside is negative A1.
(b) sodium channels open and $Na^+$ rushes in, depolarising the membrane to about $+40$ mV M1 M1; then $K^+$ channels open and $K^+$ leaves, repolarising it A1.

## Exam-style 3.4 ▪ 2 marks

An impulse travels along an axon a distance of $0.60$ m in $0.012$ s. Calculate the speed of conduction, in m s $^{1}$.

# Solution 3.4

Method: Saltatory conduction and the synapse

**Worked steps**

$$\text{speed} = \frac{0.60}{0.012} = 50 \text{ m s}^{-1}$$ M1 A1.