A-LEVEL BIOLOGY • EXERCISE SHEET

15.1 Control and coordination in mammals

Name: _____ Class: _____ Date: _____ **Total: 13 marks**

Objective

Build the skills to answer exam questions on **control and coordination in mammals** —the **nervous** 神经 and **endocrine** 内分泌 systems, **neurones** 神经元, the **action potential** 动作电位, **saltatory conduction** 跳跃式传导, and the **synapse** 突触.

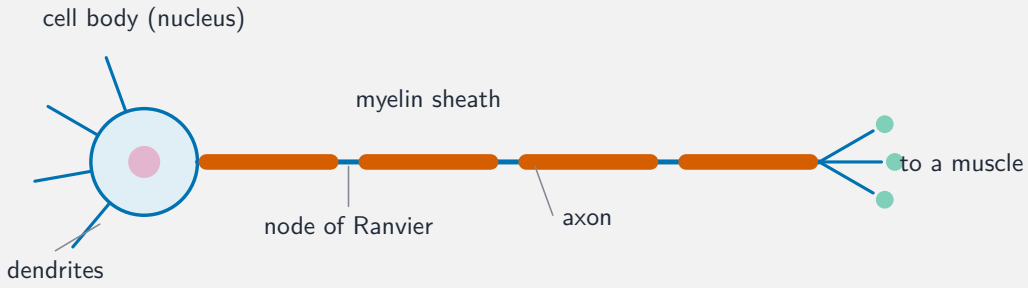
You must be able to:

- 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

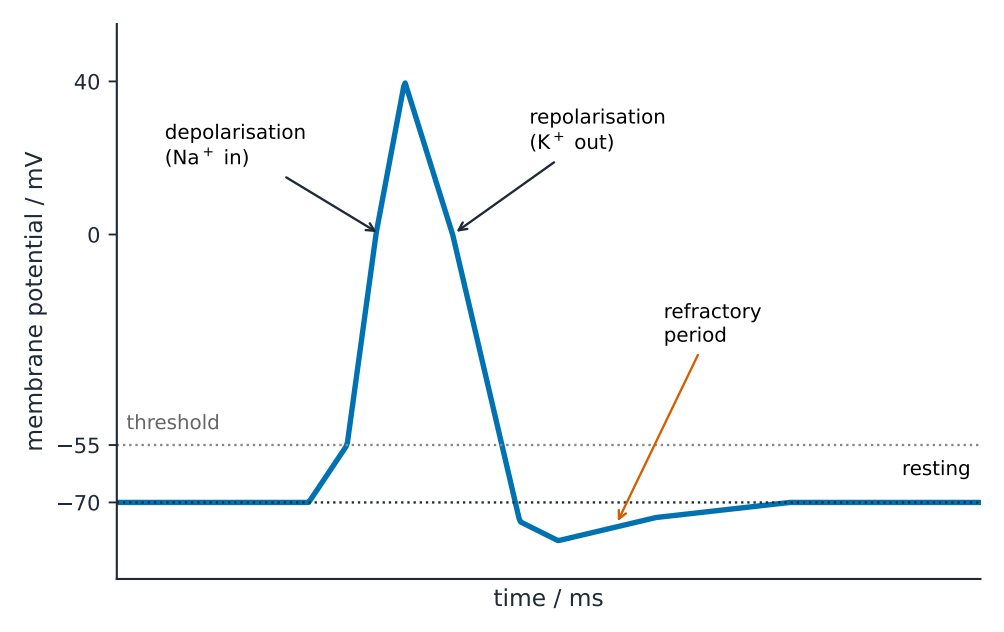
1 Worked examples

■ 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.



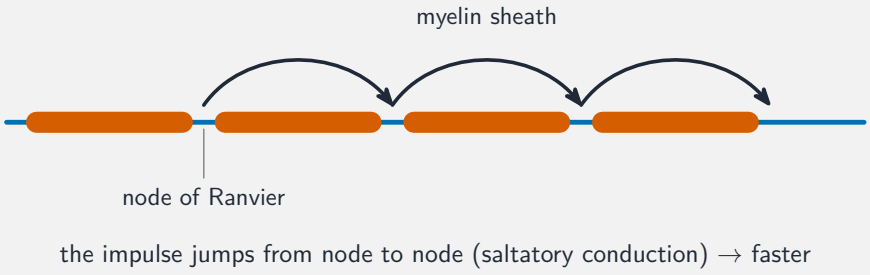
A motor neurone carries impulses to an effector; a sensory neurone carries them from a receptor



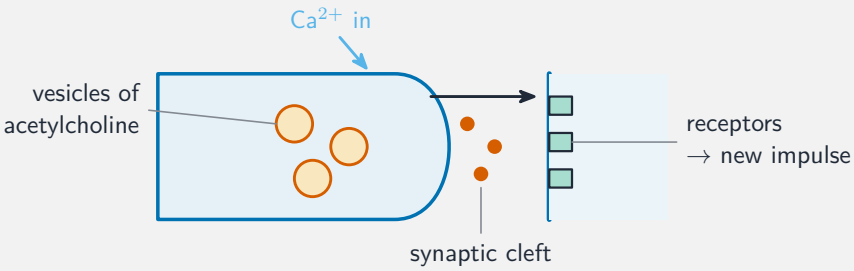
Sodium in → depolarisation; potassium out → repolarisation; then a refractory period

- **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.

Saltatory conduction and the synapse



The impulse jumps between nodes (saltatory conduction), so a myelinated neurone conducts much faster



At a cholinergic synapse, acetylcholine diffuses across the cleft and binds receptors to start a new impulse

2 Practice

2.1 State **two** differences between the nervous and the endocrine systems. [2]

2.2 Name the ion that (a) rushes in during depolarisation and (b) leaves during repolarisation. [2]

3 Exam-style questions

3.1 During the refractory period, a neurone cannot send another impulse because: [1]

- **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

3.2 Why does a myelinated neurone conduct impulses faster than an unmyelinated one? [1]

- **A** it has a larger cell body
- **B** the impulse jumps between nodes of Ranvier
- **C** it has more synapses
- **D** it uses hormones

3.3 (a) Describe how the resting potential is maintained in a neurone. [2]

(b) Describe how an action potential is produced when the neurone is stimulated. [3]

3.4 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}. [2]

4 Go further

You are now ready for the real exam questions on this subtopic. Open the **15.1 Control and coordination in mammals** past-paper sheet in the Library, or try these in **Practice mode**:

- 9700/41 N25 —Q5 (nervous coordination, calculation)
- 9700/42 N25 —Q10 (neurones and impulses)
- 9700/44 N25 —Q1 (synapse)
- 9700/41 J25 —Q10 (action potential, calculation)

Solutions

2.1 any two: nervous uses electrical impulses vs hormones; along neurones vs in the blood; fast vs slow; short-lived vs longer-lasting.

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

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

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

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

3.4 speed $= \dfrac{0.60}{0.012} = 50$ m s^{-1}.