

14.1 Coordination and response

Name: _____ Class: _____ Date: _____

Total: 28 marks

KEY WORDS synapse 突触 • receptor 感受器 • reflex 反射 • neurones 神经元
• reflex arc 反射弧

Objective

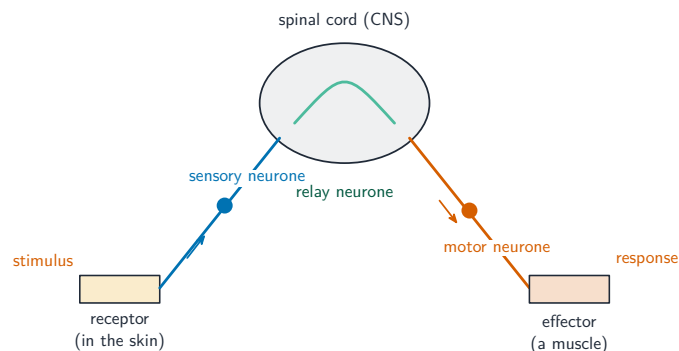
Build the skills to answer exam questions on **coordination and response** 协调与反应 — the **nervous system** 神经系统, the **reflex arc** 反射弧, and **synapses** 突触.

You must be able to:

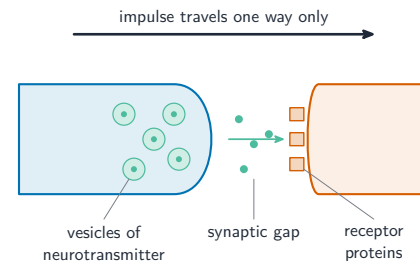
- name the parts of the nervous system and the three neurones
- describe a reflex arc in order
- describe how a synapse works and why impulses go one way

1 Worked examples

■ Reflex arc and synapse



Reflex arc: receptor → sensory neurone → relay neurone → motor neurone → effector



Neurotransmitter diffuses across the gap and binds receptors — impulses go one way only

- **CNS** = brain + spinal cord; **PNS** = the nerves.

■ The reflex arc, named in order, and what a synapse does

The **nervous system** 神经系统 splits into the **central nervous system (CNS)** 中枢神经系统 — the brain and the spinal cord — and the **peripheral nervous system**, the nerves that connect the CNS to the rest of the body.

Three kinds of neurone 神经元, learned as a chain: a **sensory neurone** 感觉神经元 carries the impulse from a receptor to the CNS; a **relay neurone** 中继神经元 passes it across inside the CNS; a **motor neurone** 运动神经元 carries it from the CNS to an effector.

The reflex arc, in the order the marks are given:

stimulus → receptor → sensory neurone → relay neurone → motor neurone → effector → response

A **reflex action** 反射作用 is fast and automatic because the impulse does not travel to the conscious part of the brain — the relay neurone in the spinal cord completes the circuit — which is what protects the body from damage in time.

A **synapse** 突触 is the junction between two neurones, with a tiny gap. The impulse arrives at the end of the first neurone; **neurotransmitter** 神经递质 molecules are released into the gap; they **diffuse** across and bind to **receptor proteins** on the next neurone's membrane; that starts a new impulse in the second neurone. The transmitter is released on one side only, so a synapse makes the impulse travel in **one direction only** — a mark in itself.

Worked example. Describe what happens between touching a hot plate and pulling the hand away. A temperature (pain) receptor in the skin detects the stimulus; a sensory neurone carries the impulse to the spinal cord; a relay neurone passes it to a motor neurone; the motor neurone carries it to the biceps muscle, the effector; the muscle contracts and pulls the hand away. The impulse does not go to the brain first, which is why the response is so fast.

2 Practice

2.1 Name the two parts of the central nervous system. [2]

2.2 State the job of a motor neurone. [1]

2.3 Name the three types of neurone in a reflex arc, in the order the impulse travels. [3]

2.4 Explain why an impulse can travel across a synapse in one direction only. [2]

2.5 State what is meant by an effector, and give one example. [2]

3 Exam-style questions

3.1 The correct order of a reflex arc is: [1]

- A receptor → motor → relay → sensory → effector
- B receptor → sensory → relay → motor → effector
- C effector → motor → relay → sensory → receptor
- D receptor → relay → sensory → motor → effector

3.2 A synapse joins two neurones.

(a) Describe how an impulse crosses a synapse. [3]

(b) Explain why a synapse makes impulses travel in one direction only. [1]

3.3 A person steps on a sharp stone and pulls the foot away before feeling any pain.

(a) Complete the sequence of the reflex arc. [3]

stimulus → **receptor** → _____ → _____ → _____ → effector → response

(b) Name the effector in this reflex and state the response it produces. [2]

(c) Explain why the foot is pulled away before the pain is felt. [2]

(d) Describe how the impulse crosses a synapse. [4]

(e) Explain the advantage of reflex actions to the body. [2]

Solutions

2.1 the brain; the spinal cord.

2.2 to carry impulses from the CNS to an effector.

2.3 Sensory neurone, relay neurone, motor neurone.

2.4 The neurotransmitter is released from one side of the synapse only, and the receptor proteins that it binds to are on the other side, so an impulse cannot start in the reverse direction.

2.5 An effector is a muscle or a gland that carries out the response; for example the biceps muscle, or a gland that secretes a hormone.

3.1 B. receptor → sensory → relay → motor → effector.

3.2 (a) the impulse makes vesicles release neurotransmitter into the gap; the neurotransmitter diffuses across; it binds receptors on the next neurone, starting a new impulse.

(b) only the first neurone releases neurotransmitter and only the second has receptors.

3.3 (a) sensory neurone → relay neurone → motor neurone.

(b) The effector is a muscle in the leg; it contracts and lifts the foot away from the stone.

(c) The reflex is completed through the spinal cord, without the impulse first travelling to the conscious part of the brain; that pathway is much shorter, so the response happens before the brain has processed the pain.

(d) The impulse arrives at the end of the first neurone; neurotransmitter molecules are released into the gap; they diffuse across the synapse; they bind to receptor proteins on the next neurone's membrane and start a new impulse in it.

(e) They are fast and automatic, so the body is protected from damage before conscious thought could act.