5.1 Homeostasis and the nervous system

Name: _____ Class: _____ Date: _____ **Total: 21 marks**

KEY WORDS homeostasis • reflex arc • synapse

Objective

Define homeostasis, trace the nervous pathway, explain the reflex arc with synapses, and describe RP7 on reaction time. Original questions for spec statements 4.5.1–4.5.2.1.

1 Key knowledge and worked examples

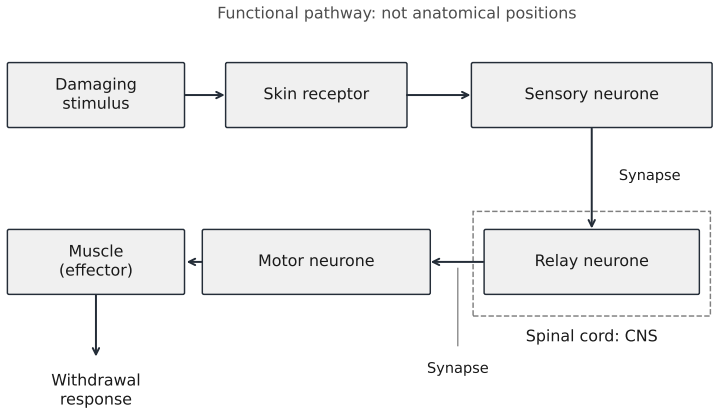
Homeostasis is the regulation of the internal conditions of a cell or organism, to maintain **optimum conditions for enzyme action** and all cell functions.

The body controls: **blood glucose concentration**, **body temperature**, **water levels**.

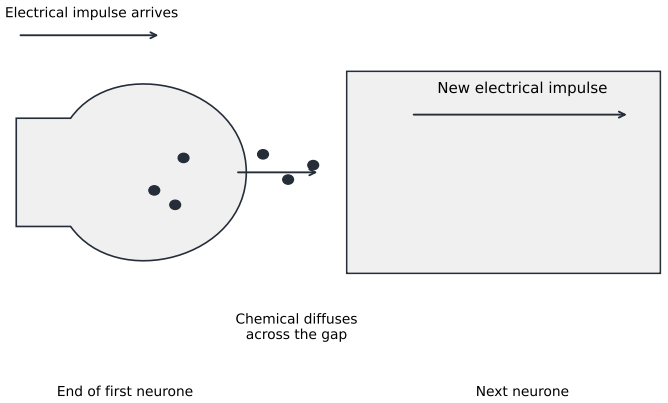
Every automatic control system includes:

- **receptors** – detect **stimuli** (changes in the environment);
- **coordination centres** – brain, spinal cord, pancreas – receive and process information;
- **effectors** – muscles or glands – bring about the response that restores optimum levels.

Nervous pathway: stimulus → receptor → coordinator (CNS = brain + spinal cord) → effector (muscle contracts, gland secretes) → response. Information travels along **neurones** as **electrical impulses**.



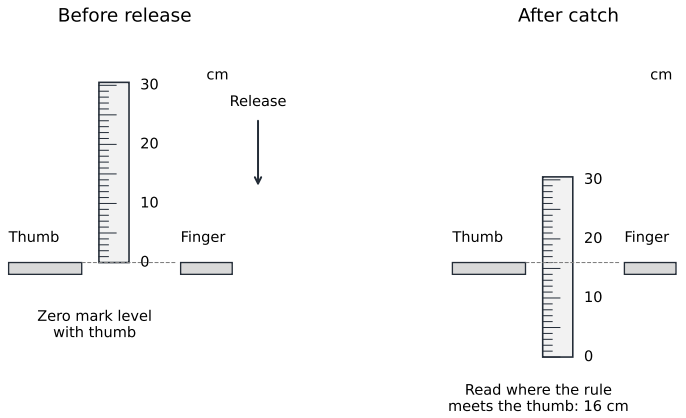
Withdrawal reflex arc (automatic and rapid, without waiting for conscious decision): stimulus → receptor → **sensory neurone** → **synapse** → **relay neurone** in the CNS → synapse → **motor neurone** → effector → response.



At a **synapse** a chemical is released at the end of one neurone, diffuses across the gap, and triggers an impulse in the next neurone.

Worked example (3 marks). Why does pulling your hand off a hot pin not wait for the conscious brain?

This withdrawal response is coordinated by relay neurones in the spinal cord; it does not wait for conscious decision, so the rapid automatic muscle contraction limits further damage. Information can still reach the brain and become conscious afterwards. Not every reflex is coordinated in the spinal cord.



RP7 – reaction time: Use listening to music versus silence as a factor. Support the same person's arm; hold the ruler vertically with its zero mark level with the top of the thumb and the same gap between finger and thumb. Release after a variable delay without a countdown, and record catch distance. Repeat trials, keep the same hand, ruler and starting position, and keep the music condition fixed. Give practice trials first and vary/counterbalance condition order to reduce learning and order effects; these controls do not eliminate them. Convert readings using the supplied table or equation, then process the results as the task directs. For paired conditions, compare mean reaction times and state the limits of the conclusion.

Visual reaction compared with withdrawal: in a ruler-drop test, eye receptors detect movement; impulses travel along the optic nerve to the brain and then along motor neurones to hand muscles. A spinal withdrawal reflex does not wait for conscious decision. Do not give the spinal pathway as the explanation for every response.

Worked data reading (AQA June 2025 Q07.1–07.2): catch distances are 18, 15, 12, 16, 14, 23, 14 cm. Ordered: 12, 14, 14, **15**, 16, 18, 23 cm; the median is 15 cm, while the mean is $\bar{d} = 112/7 = 16$ cm.

The question supplies $t = \sqrt{2d/980}$, with d in cm and t in seconds, and asks you to use the mean distance:

$$t = \sqrt{\frac{2d}{980}} = \sqrt{\frac{2 \times 16}{980}} = 0.18070\ldots \text{ s}$$

$$t_{\text{ms}} = 1000t = 1000 \times 0.18070\ldots = 180.70\ldots \text{ ms}$$

Final answer: **181 ms** to 3 significant figures. Keep unrounded values until the final step. This supplied mean-distance estimate does not imply that all nonlinear conversions commute with averaging.

2 Practice

2.1 Define homeostasis. [2]

2.2 Name the three components every automatic control system includes. [3]

2.3 Give two effectors and the response each brings about. [2]

3 Exam-style questions

3.1 Describe the pathway of a reflex arc from stimulus to response, naming each structure involved. [5]

3.2 Explain how a synapse allows an impulse to pass from one neurone to the next. [3]

3.3 A student investigates whether listening to music affects reaction time, using the ruler-drop method. Describe how she should do this investigation, including the control variables and how results should be processed. [6]