

1.3 The Neuron and Neural Firing

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

KEY WORDS neuron 神经元 • neurotransmitter 神经递质 • axon 轴突 • all-or-none 全或无
• dendrites 树突

Objective

Build the skills to answer exam questions on the **neuron** 神经元 and **neural firing** 神经放电.

You must be able to:

- label the parts of a neuron and state what each does
- explain the **all-or-none** 全或无 principle
- describe what happens at the **synapse** 突触
- match a **neurotransmitter** 神经递质 to a function it influences

1 Worked examples

Study these first. Each one shows the method for a task used later.

■ The parts of a neuron

Dendrites receive signals. The **cell body** integrates them. The **axon** carries the signal away, wrapped in a **myelin sheath** that speeds transmission. **Terminal buttons** release neurotransmitters.

■ All-or-none

A neuron either fires at full strength or does not fire. Increasing the stimulus does not make one action potential larger; it makes the neuron fire **more often**. Intensity is coded by rate, not by size.

■ At the synapse

An action potential reaches the terminal, neurotransmitter is released into the **synaptic gap**, it binds to receptors on the next neuron, and is then reabsorbed (**reuptake**) or broken down. The next neuron becomes more or less likely to fire.

■ Excitatory and inhibitory

An **excitatory** signal pushes the receiving neuron toward firing; an **inhibitory** signal pushes it away. A neuron fires when excitatory input exceeds inhibitory input by enough to reach **threshold**.

2 Practice

2.1 State the function of dendrites and of the axon. [2]

2.2 Explain the all-or-none principle. [2]

2.3 A drug blocks the reuptake of a neurotransmitter.

(a) State what happens to the amount of that neurotransmitter in the synaptic gap. [1]

(b) State the likely effect on the receiving neuron. [1]

3 Exam-style questions

3.1 A more intense stimulus is signalled to the brain mainly by [1]

- **A** larger action potentials
- **B** a faster rate of firing
- **C** slower firing
- **D** thicker myelin

3.2 The myelin sheath principally [1]

- **A** releases neurotransmitters
- **B** speeds conduction along the axon
- **C** receives incoming signals
- **D** stores memories

3.3 A neuron receives both excitatory and inhibitory input.

(a) State the condition under which it fires.

[1]

(b) Explain why inhibitory signals are as important as excitatory ones.

[2]

Solutions

2.1 dendrites receive incoming signals from other neurons; the axon carries the outgoing signal away from the cell body.

2.2 a neuron fires at full strength or not at all; a stronger stimulus produces more frequent firing, not a larger action potential.

2.3 (a) it stays in the gap longer / accumulates. (b) the receiving neuron is stimulated for longer, so its firing is more affected.

3.1 B. intensity is coded by rate because each action potential is the same size.

3.2 B. myelin insulates the axon and speeds conduction.

3.3 (a) when excitatory input exceeds inhibitory input by enough to reach threshold. (b) without inhibition every input would push toward firing, so the nervous system could not select between signals or stop a response.