A3 · The action potential, threshold and all-or-none · Practice key

This is the worked key. Every practice question is worked step by step.

Worked examples

Read these first. There is one for each kind of question in this lesson.

Example 1 · Read an action potential graph

On a graph of an action potential, the line is falling from +40 mV. What is happening?

1. Use the five steps: the fall is step 4, repolarization.
2. Sodium channels have closed and potassium channels are open.
3. Potassium ions are diffusing out of the cell.

Answer: Repolarization: potassium ions are diffusing out.

Example 2 · Use the threshold level

A neuron has a threshold level of 5 units. What happens with a stimulus of 4 units, and of 9 units?

1. Compare each stimulus with the threshold level.
2. 4 is below 5: no action potential.
3. 9 is above 5: a full action potential, peak +40 mV.

Answer: No action potential at 4 units. A full action potential at 9 units.

Practice

Questions 1 to 4 are easy. Questions 5 to 8 are medium. Questions 9 and 10 are harder.

EASY

1. Name the ion that rushes into a neuron during depolarization.

1. Sodium channels open.
2. Sodium ions rush in.

EASY

2. State the membrane potential at the peak of an action potential.

1. The line rises from −70 mV.
2. It peaks at +40 mV.

EASY

3. Name the ion that diffuses out of a neuron during repolarization.

1. Potassium channels open.
2. Potassium ions diffuse out.

EASY

4. State how long the refractory period lasts.

1. It is the time to return to the resting potential.
2. It lasts 1 to 10 ms.

MEDIUM

5. Calculate the total change in membrane potential from rest to the peak of an action potential.

1. Rest is −70 mV. The peak is +40 mV.
2. 40 − (−70) = 110.
3. The change is 110 mV.

MEDIUM

6. Explain what hyperpolarization is.

1. For a moment the inside is more negative than the resting potential.
2. It happens because the potassium channels close slowly.

MEDIUM

7. Explain what "all-or-none response" means.

1. A stimulus below the threshold level gives no action potential.
2. A stimulus at or above it gives a full action potential.
3. Every action potential is the same size.

MEDIUM

8. Explain why an action potential travels faster along an axon with a myelin sheath.

1. The ion channels are only at the nodes of Ranvier.
2. The action potential jumps from node to node.

HARDER

9. Light pressure and hard pressure on the skin give action potentials of the same size. Explain how the brain tells them apart.

1. Hard pressure gives a higher frequency of action potentials.
2. Hard pressure also makes more neurons fire.

HARDER

10. A drug keeps the sodium channels of a neuron closed. Predict the effect on the neuron. Explain.

1. Sodium ions cannot rush in.
2. There is no depolarization.
3. The neuron cannot start an action potential.