Exercise walk-through

13.1

Neurons, synapses and brain systems: evidence and transfer

GRE · GRE Subject Test · GRE Psychology

Neurons, synapses and brain systems

- Explain the **action potential** and the **all-or-none principle** .
- Describe the steps of chemical transmission at a **synapse** , including **reuptake** .
- Classify drugs as **agonists** or **antagonists** .
- Link major brain structures and transmitters to functions.

The action potential

- At rest, the inside of a neuron is about -70 mV compared with the outside.
- Inputs from other cells cause small graded potentials that add up at the axon hillock. If the total reaches threshold (about -55 mV), sodium channels open and the neuron fires.
- All or none: every spike has the same size. A stronger stimulus raises the firing rate and the number of neurons that fire, not the spike height.

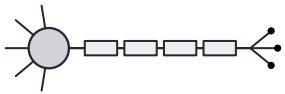
Transmitters

- Acetylcholine: muscle movement and memory; it is lost early in Alzheimer's disease.
- Dopamine: movement and reward. Loss of dopamine neurons causes Parkinson's disease; too much dopamine activity is linked to the hallucinations and delusions of schizophrenia, and many antipsychotic drugs block D2 dopamine receptors.
- Serotonin: mood, sleep and appetite. GABA is the main inhibitory transmitter, glutamate the main excitatory one.
- One transmitter serves many systems, so a drug's effect depends on the pathway and receptor type.

Exercises 2.1–2.2

2.1 The action potential is triggered at which part of the neuron? [1]

A. dendrite B. cell body C. axon hillock D. terminal button E. dendritic spine



2.2 The myelin sheath around an axon serves to: [1]

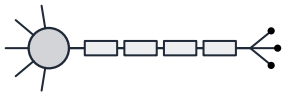
A. protect the axon from overheating B. supply the axon with nutrients C. increase the speed of impulse conduction D. store neurotransmitter vesicles E. generate new action potentials



Exercises 2.1·2.2

2.1 The action potential is triggered at which part of the neuron? [1]

A. dendrite B. cell body C. axon hillock D. terminal button E. dendritic spine



2.1 Answer: C. Graded potentials sum at the axon hillock; crossing threshold there launches the spike. The other options do not satisfy the stated defining conditions.

2.2 The myelin sheath around an axon serves to: [1]

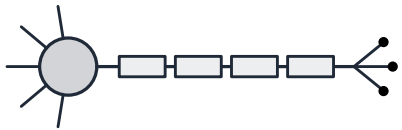
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2.2 Answer: C. Myelin enables saltatory conduction between nodes of Ranvier, speeding the impulse. Compare the exact process, design or evidence, rather than an associated keyword.

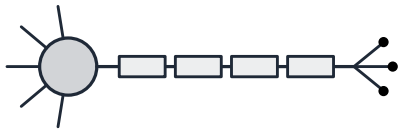
Exercise 2.3

2.3 Revisit the worked case. State one conclusion its evidence supports and one stronger conclusion it does not support. Explain the difference. [2]



Exercise 2.3

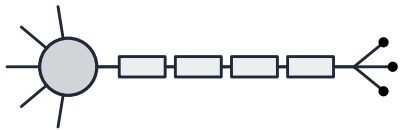
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2.3 Use the worked case evidence to support a bounded claim and explain why a causal, universal or stronger claim needs additional evidence. The claim must fit the specific design and observed process.

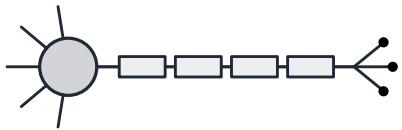
Exercise 3.1

3.1 A stronger stimulus produces more spikes of unchanged height. A pupil calls this evidence against all-or-none firing. Correct the inference. Give the interpretation, supporting reasoning, a relevant alternative or limitation, and an appropriate check. [4]



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3.1 Unchanged spike amplitude fits all-or-none action potentials. Firing rate can carry information about input strength, and more neurons may also be recruited. Separate spike amplitude from number of spikes per second and population activity. A diagram must label which quantity is plotted before being interpreted. Award B1 each (authored) for the interpretation, its reasoning, a relevant limitation/alternative and an appropriate check, up to four points. Accept a different justified answer satisfying these demands.