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## Action Potentials, Neurons & Neurotransmission

Exam — Action Potentials

High-school/pre-med level questions on neuron structure, resting potential, action potentials, synapses, neurotransmitters, and myelination.

32 items — Printable Exam

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**1** Which structure typically carries action potentials AWAY from the cell body of a neuron?



- A Dendrite
- B Axon
- C Nucleus
- D Ribosome
- E Myelin sheath

**2** The small gaps between segments of myelin along a myelinated axon are called:



- A Synaptic clefts
- B Nodes of Ranvier
- C Dendritic spines
- D Axon hillocks
- E Boutons

**3** At rest, the membrane potential of a typical neuron is approximately:



- A +70 mV (inside positive)
- B -70 mV (inside negative)
- C 0 mV (no difference)
- D +30 mV (inside positive)
- E -120 mV (inside very negative)





4 Which statement correctly compares ion concentrations **INSIDE** and **OUT-SIDE** a typical resting neuron?



- A  $\text{Na}^+$  is higher inside;  $\text{K}^+$  is higher outside
- B  $\text{Na}^+$  is higher outside;  $\text{K}^+$  is higher inside
- C Both  $\text{Na}^+$  and  $\text{K}^+$  are higher outside
- D Both  $\text{Na}^+$  and  $\text{K}^+$  are higher inside
- E There is no difference in ion concentrations

5 The  $\text{Na}^+/\text{K}^+$  pump (sodium–potassium ATPase) in neurons moves ions in which directions per ATP hydrolysed?



- A 3  $\text{Na}^+$  in, 2  $\text{K}^+$  out
- B 3  $\text{Na}^+$  out, 2  $\text{K}^+$  in
- C 2  $\text{Na}^+$  out, 3  $\text{K}^+$  in
- D  $\text{Na}^+$  and  $\text{K}^+$  both out
- E  $\text{Na}^+$  and  $\text{K}^+$  both in

6 During the rising phase (depolarisation) of a typical action potential, which main event occurs?



- A Voltage-gated  $\text{K}^+$  channels open and  $\text{K}^+$  rushes out
- B Voltage-gated  $\text{Na}^+$  channels open and  $\text{Na}^+$  rushes in
- C  $\text{Na}^+/\text{K}^+$  pumps shut down completely
- D  $\text{Cl}^-$  channels open and  $\text{Cl}^-$  rushes in





- E Myelin sheaths are destroyed

7 Which best describes REPOLARISATION during an action potential?



- A Opening of  $\text{Na}^+$  channels and closing of  $\text{K}^+$  channels
- B Opening of voltage-gated  $\text{K}^+$  channels, allowing  $\text{K}^+$  to leave the cell
- C Massive entry of  $\text{Ca}^{2+}$  into the cell body
- D Sudden shutting of all ion channels
- E Inactivation of all  $\text{Na}^+/\text{K}^+$  pumps

8 The 'all-or-nothing' principle of the action potential means that:



- A The neuron can only fire once in its lifetime
- B If threshold is reached, an action potential of fixed amplitude occurs; if not, there is no action potential
- C Stronger stimuli produce larger amplitude action potentials
- D Neurons never have graded potentials
- E Action potentials can be half-size when threshold is barely reached

9 The threshold potential at which a neuron usually fires an action potential is typically around:



- A 0 mV
- B -90 mV





- C -55 mV
- D +30 mV
- E -10 mV

10 The refractory period of a neuron is important because it:



- A Prevents any further action potentials ever from occurring
- B Allows action potentials to travel in only one direction along the axon
- C Increases the amplitude of action potentials
- D Is when neurotransmitter is synthesised
- E Stops the  $\text{Na}^+/\text{K}^+$  pump permanently

11 Which statement about MYELINATION is TRUE?



- A Myelin increases the amplitude of each action potential
- B Myelin prevents action potentials from occurring at all
- C Myelin increases the speed of conduction along the axon
- D Myelin is mainly found on dendrites
- E Myelin changes the direction of action potentials

12 Saltatory conduction refers to:



- A Action potentials that are continuously regenerated along every nanometer of the axon





- B Action potentials that appear to 'jump' from node of Ranvier to node of Ranvier along a myelinated axon
- C Action potentials that move equally in both directions
- D The failure of action potentials in myelinated axons
- E The opening of chemical synapses

**13** Which of the following would generally **INCREASE** the speed of action potential conduction along an axon?



- A Decreasing axon diameter and removing myelin
- B Increasing axon diameter and adding myelin
- C Increasing membrane resistance by blocking all ion channels
- D Reducing the number of nodes of Ranvier to zero
- E Making the resting potential more positive without myelin

**14** Multiple sclerosis (MS) is an example of a disease where myelin in the central nervous system is damaged. Which effect would you expect?



- A Faster conduction of nerve impulses
- B Slowed or blocked conduction along affected axons
- C Larger action potential amplitude
- D No change in neuronal function
- E Increased neurotransmitter synthesis





**15** At a chemical synapse, which ion's entry into the presynaptic terminal directly triggers vesicle fusion and neurotransmitter release?



- A**  $\text{Na}^+$
- B**  $\text{K}^+$
- C**  $\text{Ca}^{2+}$
- D**  $\text{Cl}^-$
- E**  $\text{Mg}^{2+}$

**16** The small gap between a presynaptic neuron and a postsynaptic cell at a chemical synapse is the:



- A** Axon hillock
- B** Node of Ranvier
- C** Synaptic cleft
- D** Myelin gap
- E** Voltage gap

**17** Which neurotransmitter is released at the neuromuscular junction in vertebrates and stimulates skeletal muscle contraction?



- A** GABA
- B** Glutamate
- C** Acetylcholine (ACh)
- D** Dopamine
- E** Serotonin





**18** Which is the main inhibitory neurotransmitter in the BRAIN of most vertebrates?



- A** Glutamate
- B** Acetylcholine
- C** GABA
- D** Dopamine
- E** Noradrenaline

**19** Which is the main excitatory neurotransmitter in the BRAIN?



- A** Glutamate
- B** GABA
- C** Glycine
- D** Dopamine
- E** Serotonin

**20** Dopamine, serotonin and noradrenaline are examples of:



- A** Peptide hormones only
- B** Steroid hormones
- C** Monoamine neurotransmitters
- D** Gaseous neurotransmitters
- E** Purine nucleotides





21 An excitatory postsynaptic potential (EPSP) typically:



- A Hyperpolarises the postsynaptic membrane, making action potentials less likely
- B Depolarises the postsynaptic membrane, bringing it closer to threshold
- C Has no effect on membrane potential
- D Blocks voltage-gated  $\text{Na}^+$  channels
- E Occurs only in motor neurons

22 An inhibitory postsynaptic potential (IPSP) usually results from:



- A Opening channels that allow  $\text{Na}^+$  influx
- B Opening channels that allow  $\text{K}^+$  efflux or  $\text{Cl}^-$  influx, hyperpolarising the cell
- C Closing all ion channels
- D Activation of voltage-gated  $\text{Ca}^{2+}$  channels at the terminal
- E Random changes unrelated to neurotransmitters

23 Which statement about GRADED potentials vs ACTION potentials is TRUE?



- A Graded potentials are all-or-nothing, action potentials are graded
- B Graded potentials decrease with distance; action potentials are regenerated and maintain size
- C Only graded potentials use ion channels
- D Action potentials cannot travel along axons
- E Graded potentials occur only in muscles





24 Where are action potentials usually initiated in a multipolar neuron?



- A Dendritic tips
- B Axon terminals
- C Axon hillock / initial segment
- D Nucleus
- E Myelin sheath

25 Which of the following is NOT part of a typical neuron?



- A Cell body (soma)
- B Dendrites
- C Axon
- D Synaptic terminals
- E Sarcomeres

26 Which best describes the role of SCHWANN cells?



- A Form myelin around axons in the peripheral nervous system
- B Form myelin around axons in the central nervous system
- C Produce cerebrospinal fluid
- D Act as sensory receptors in the skin
- E Generate action potentials in skeletal muscle





27 Which glial cell type forms myelin in the central nervous system?



- A Schwann cells
- B Oligodendrocytes
- C Astrocytes
- D Microglia
- E Ependymal cells

28 In an UNMYELINATED axon, action potentials propagate because:



- A Only one  $\text{Na}^+$  channel is present at the terminal
- B The depolarisation at one patch of membrane brings adjacent patches to threshold
- C Ions move only inside the cell and not across the membrane
- D The axon contains many sarcomeres
- E The  $\text{Na}^+/\text{K}^+$  pump carries the action potential forward

29 Which of the following is TRUE regarding the effect of myelination on the ENERGY USE of neurons?



- A Myelination greatly increases the amount of  $\text{Na}^+$  and  $\text{K}^+$  crossing the membrane, increasing ATP use
- B Myelination reduces ion leakage and therefore can reduce ATP required by the  $\text{Na}^+/\text{K}^+$  pump
- C Myelination stops the  $\text{Na}^+/\text{K}^+$  pump from working
- D Myelination has no effect on energy use





- E Myelination stores ATP for later use

30 Which statement correctly describes the DIRECTION of action potential propagation in a normal neuron?



- A From dendrites to cell body to axon terminal
- B From axon terminal to cell body to dendrites
- C Randomly in both directions at the same time
- D Only within the cell body
- E Only from the terminal back to the cell body

31 Which statement about the SYNAPTIC delay at a CHEMICAL synapse is TRUE?



- A Chemical synapses are faster than action potential conduction along the axon
- B Chemical synapses are slightly slower than electrical conduction due to steps of vesicle release and diffusion
- C Chemical synapses have zero delay
- D Synaptic delay is caused only by  $\text{Na}^+/\text{K}^+$  pumps
- E Synaptic delay is unique to myelinated axons

32 Which of the following is a CORRECT pairing of neurotransmitter with a function or association?



- A Serotonin – mainly neuromuscular junction contraction





- B** Dopamine – reward pathways and motor control
- C** Acetylcholine – main inhibitory neurotransmitter in the brain
- D** Glutamate – main inhibitory neurotransmitter in the spinal cord
- E** GABA – main excitatory neurotransmitter in the cortex





#	Ans	Answer Text
	B	
2	B	Nodes of Ranvier
	B	
4	B	Na <sup>+</sup> is higher outside; K <sup>+</sup> is higher inside
	B	
6	B	Voltage-gated Na <sup>+</sup> channels open and Na <sup>+</sup> rushes in
	B	
8	B	If threshold is reached, an action potential of fixed amplitude occurs; ...
	C	
10	B	Allows action potentials to travel in only one direction along the axon
	C	
12	B	Action potentials that appear to 'jump' from node of Ranvier to node of ...
	B	
14	B	Slowed or blocked conduction along affected axons
	C	
16	C	Synaptic cleft
	C	
18	C	GABA
	A	
20	C	Monoamine neurotransmitters
	B	
22	B	Opening channels that allow K <sup>+</sup> efflux or Cl <sup>-</sup> influx, hyperpolarising the...
	B	
24	C	Axon hillock / initial segment
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26	A	Form myelin around axons in the peripheral nervous system
	B	
28	B	The depolarisation at one patch of membrane brings adjacent patches to t...
	B	
30	A	From dendrites to cell body to axon terminal
	B	
32	B	Dopamine – reward pathways and motor control

