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Reflex Arcs, Synapses & Peripheral Nerve Anatomy

Exam — Reflexes & Spinal Cord

High-school/Pre-med/IB questions on reflex arc components, synapses, nerve structure, and factors affecting speed of nervous transmission.

30 items — Printable Exam

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1 **Which sequence correctly represents the basic pathway of a spinal reflex arc from stimulus to response?**

A Receptor → motor neuron → effector → sensory neuron → spinal cord

B Receptor → sensory (afferent) neuron → CNS integration → motor (efferent) neuron → effector

C Effector → motor neuron → spinal cord → sensory neuron → receptor

D Receptor → interneuron → sensory neuron → motor neuron → effector

E Receptor → blood → brain → muscle → spinal cord

2 **Which statement correctly defines afferent vs efferent nerve pathways?**

A Afferent nerves carry signals from the CNS to muscles; efferent nerves carry signals to the CNS

B Afferent nerves carry sensory information to the CNS; efferent nerves carry commands from the CNS to effectors

C Afferent nerves are only autonomic; efferent nerves are only somatic

D Afferent and efferent both carry signals away from the CNS

E Afferent nerves always contain motor neurons, while efferent nerves never do

3 **In the spinal cord, sensory fibers enter and motor fibers exit via which structures?**

A Sensory enter via ventral roots; motor exit via dorsal roots

B Sensory enter via dorsal roots; motor exit via ventral roots

C Both sensory and motor enter via dorsal roots

D Both sensory and motor exit via ventral roots

E Sensory and motor both enter and exit via the same root only

4 **Where are the cell bodies of most sensory neurons supplying the spinal cord located?**

A Ventral horn of the spinal cord

B Dorsal root ganglion

C Motor end plate

D Inside skeletal muscle fibers

E Cerebral cortex

5 **Which statement about the patellar (knee-jerk) reflex is MOST accurate at Pre-med/IB level?**

A It is a voluntary movement controlled by the motor cortex

B It is a monosynaptic reflex with a direct sensory-to-motor synapse in the spinal cord

C It requires multiple interneurons and is therefore the slowest reflex

D It occurs only if the brain first interprets pain

E It uses only autonomic nerves and glands as effectors

6 **Which change would MOST directly increase the speed of action potential conduction along an axon (all else equal)?**

A Increasing the length of the axon

B Adding more chemical synapses along the pathway

C Increasing myelination of the axon

D Decreasing the axon diameter

E Reducing the number of nodes of Ranvier to zero while keeping myelin

7 **Compared with electrical synapses, chemical synapses are generally slower mainly because chemical synapses:**

A Require diffusion of neurotransmitter and receptor activation steps

B Use myelin to transmit signals

C Allow ions to flow directly through gap junctions

D Are always bidirectional

E Do not involve ion channels in the postsynaptic cell

8 **Which feature is MOST characteristic of an electrical synapse?**

A Uses neurotransmitter vesicles and receptors across a synaptic cleft

B Allows direct ionic current flow through gap junctions

C Has a large synaptic delay due to diffusion

D Is always slower than chemical synapses

E Always produces inhibition and never excitation

9 **Saltatory conduction occurs because action potentials are regenerated mainly at:**

A The myelin sheath itself

B Nodes of Ranvier

C The nucleus of the neuron

D The dendrites

E The synaptic cleft

10 **Damage to myelin around a peripheral axon would most likely cause which effect on nervous transmission?**

A Action potentials become larger in amplitude

B Transmission becomes faster because ions leak out more easily

C Transmission slows and may fail because current leaks and the next node may not reach threshold

D Signals reverse direction along the axon

E Chemical synapses stop using neurotransmitters

11 **A 'nerve' in the peripheral nervous system is best defined as:**

A A single neuron cell body

B A bundle of axons in the PNS surrounded by connective tissue

C A bundle of axons in the CNS (brain or spinal cord)

D A bundle of dendrites only

E A cluster of cell bodies in the CNS

12 **Which connective tissue layer surrounds a FASCICLE (a bundle of axons) within a peripheral nerve?**

A Endoneurium

B Perineurium

C Epineurium

D Sarcolemma

E Periosteum

13 **In peripheral nerve anatomy, a 'fascicle' refers to:**

A A cluster of neuron cell bodies in the spinal cord

B A bundle of axons grouped together within a nerve

C A synapse between two neurons

D The gap between myelin segments

E A bundle of dendrites only

14 **A typical spinal nerve (after dorsal and ventral roots merge) is classified as:**

A Purely sensory

B Purely motor

C Mixed (contains sensory and motor fibers)

D Purely autonomic only

E Neither sensory nor motor

15 **Monosynaptic reflexes are generally faster than polysynaptic reflexes mainly because monosynaptic reflexes:**

A Use electrical synapses only

B Have fewer synapses and therefore less synaptic delay

C Use thicker bones to transmit signals

D Do not require any neurons

E Occur only in the brain cortex

16 **A person withdraws their hand from a hot object before consciously feeling pain. Which explanation best accounts for this?**

A The signal never reaches the brain

B The reflex is integrated in the spinal cord, allowing a rapid motor response before conscious perception

C Heat directly contracts skeletal muscle without nerves

D The motor cortex always reacts faster than the spinal cord

E Chemical synapses are faster than electrical synapses

17 **When stepping on a sharp object, the withdrawal reflex causes the injured leg to flex. Often, the opposite leg extends at the same time. This opposite-leg extension mainly helps to:**

A Stop neurotransmitter release at the synapse

B Maintain balance by supporting body weight on the opposite leg

C Decrease oxygen delivery to muscles

D Increase the pain signal reaching the brain

E Convert the reflex into a voluntary action

18 **An inhibitory postsynaptic potential (IPSP) is most commonly produced when a neurotransmitter causes:**

A Na^+ influx that depolarizes the postsynaptic membrane

B Ca^{2+} influx into the postsynaptic membrane to trigger vesicle release

C Cl^- influx or K^+ efflux that hyperpolarizes the postsynaptic membrane

D Closure of all ion channels so the membrane potential becomes 0 mV

E Direct ATP production at the synapse

19 **A neuron receives several weak excitatory inputs that are each insufficient alone to reach threshold. The neuron fires only when MANY different presynaptic neurons activate at the SAME time. This is best described as:**

A Temporal summation

B Spatial summation

C Refractory period

D Saltatory conduction

E Osmosis

20 **Where are the cell bodies of somatic motor neurons that innervate skeletal muscle typically located?**

A Dorsal root ganglion

B Ventral horn of the spinal cord

C Synaptic cleft

D White matter tracts only

E Inside the muscle fiber

21 A lesion cuts the DORSAL root of a spinal nerve but leaves the ventral root intact. Which outcome is most expected for that spinal segment?

A Loss of motor output with normal sensation

B Loss of sensation and loss of the reflex response, but motor pathways can still carry signals out if directly activated

C Normal sensation but exaggerated reflexes

D Loss of all autonomic functions only

E Improved conduction speed due to reduced sensory load

22 A lesion cuts the VENTRAL root of a spinal nerve but leaves the dorsal root intact. Which outcome is most expected?

A Loss of motor output (weakness/paralysis) with preserved sensation; reflex response is absent because the efferent limb is broken

B Loss of sensation with preserved motor output

C Normal reflexes and normal movement

D Only pain sensation is lost; touch and pressure remain

E Only brain function changes; spinal cord function is unaffected

23 **A local anesthetic blocks voltage-gated Na^+ channels in the skin near a painful stimulus. Which immediate effect is MOST likely on the reflex withdrawal response?**

A The reflex becomes stronger because inhibition is blocked

B The reflex is reduced or absent because sensory action potentials cannot propagate to the spinal cord

C The reflex is unchanged because reflexes do not use action potentials

D Only motor neurons are affected; sensory neurons are not

E Only neurotransmitter diffusion in the synapse is blocked, not conduction

24 **Which reflex is MOST likely to require one or more interneurons and therefore be polysynaptic?**

A Knee-jerk (stretch) reflex

B Withdrawal reflex from pain

C A single action potential traveling along an axon

D Passive recoil of the lungs

E Diffusion of oxygen in alveoli

25 **Which pairing of myelinating cell type and nervous system location is correct?**

A Schwann cell – CNS

B Oligodendrocyte – PNS

C Schwann cell – PNS; oligodendrocyte – CNS

D Astrocyte – PNS; microglia – CNS

E Neurons myelinate themselves in both PNS and CNS

26 **Which statement best distinguishes gray matter from white matter in the nervous system?**

A Gray matter is mostly myelinated axons; white matter is mostly cell bodies

B Gray matter contains many cell bodies and synapses; white matter contains many myelinated axons

C Gray matter exists only in the PNS; white matter only in the CNS

D White matter is where neurotransmitters are stored; gray matter is where oxygen is stored

E There is no structural difference; the colors are only artistic labels

27 **In a stretch reflex, what structure most directly detects muscle stretch and initiates the afferent signal?**

A Muscle spindle (stretch receptor)

B Golgi tendon organ (tension receptor) only

C Myelin sheath

D Neuromuscular junction

E Ribosomes in the muscle fiber

28 **At the neuromuscular junction, what MOST directly terminates the signal so the muscle does not contract continuously?**

A Diffusion of acetylcholine into the bloodstream

B Breakdown of acetylcholine by acetylcholinesterase in the synaptic cleft

C Closure of the dorsal root ganglion

D Conversion of acetylcholine into glucose inside the muscle

E Immediate reuptake of acetylcholine into the nucleus of the neuron

29 Which axon type would generally conduct action potentials the FASTEST?

A Small-diameter unmyelinated axon

B Small-diameter myelinated axon

C Large-diameter unmyelinated axon

D Large-diameter myelinated axon

E Any axon conducts at the same speed regardless of diameter or myelination

30 During repeated rapid stimulation of a reflex pathway, the response may weaken over time even if the axons are intact. This 'fatigue' most directly suggests that:

A Axons cannot conduct more than one action potential

B Synapses can become temporarily less effective due to neurotransmitter depletion or receptor changes

C Myelin is destroyed by repeated use within seconds

D The action potential amplitude gradually decreases along the axon

E The dorsal root ganglion stops producing neurons during stimulation

Answer Key

#	Ans	Answer Text
	B	
2	B	Afferent nerves carry sensory information to the CNS; efferent nerves ca...
	B	
4	B	Dorsal root ganglion
	B	
6	C	Increasing myelination of the axon
	A	
8	B	Allows direct ionic current flow through gap junctions
	B	
10	C	Transmission slows and may fail because current leaks and the next node ...
	B	
12	B	Perineurium
	B	
14	C	Mixed (contains sensory and motor fibers)
	B	
16	B	The reflex is integrated in the spinal cord, allowing a rapid motor resp...
	B	
18	C	Cl^- influx or K^+ efflux that hyperpolarizes the postsynaptic membrane
	B	
20	B	Ventral horn of the spinal cord
	B	
22	A	Loss of motor output (weakness/paralysis) with preserved sensation; refl...
	B	
24	B	Withdrawal reflex from pain
	C	
26	B	Gray matter contains many cell bodies and synapses; white matter contain...
	A	
28	B	Breakdown of acetylcholine by acetylcholinesterase in the synaptic cleft
	D	
30	B	Synapses can become temporarily less effective due to neurotransmitter d...