

Advanced Physiology – Synapses and Neural Circuits

40 Multiple Choice Questions (Last 5 are True/False)

1. Electrical synapses allow faster communication primarily because:
A) They depend on neurotransmitter diffusion
B) They have fewer receptors
C) Impulses pass directly through gap junctions
D) They generate stronger action potentials
2. The direct cytoplasmic continuity between neurons in electrical synapses is achieved via:
A) Ionotropic receptors
B) Connexons
C) Neurotransmitters
D) G proteins
3. Which of the following best explains synchronization in electrical synapses?
A) Sequential activation of adjacent neurons
B) Rapid destruction of neurotransmitters
C) Simultaneous depolarization of many connected neurons
D) Alternating hyperpolarization and depolarization cycles
4. At chemical synapses, the signal transmission involves:
A) Electrical impulses crossing the cleft directly
B) Conversion of an electrical signal into a chemical one
C) Ion exchange through connexons
D) Direct cytoplasmic contact
5. The synaptic delay at chemical synapses mainly results from:
A) Rapid ion diffusion
B) Enzymatic degradation of neurotransmitters
C) Time taken for neurotransmitter release and binding
D) Delay in impulse initiation in the presynaptic neuron
6. An excitatory postsynaptic potential (EPSP) occurs when:
A) The postsynaptic membrane hyperpolarizes
B) The postsynaptic membrane depolarizes toward threshold
C) The synaptic cleft widens
D) Ca^{2+} channels open
7. Opening of K^{+} channels in the postsynaptic neuron typically results in:
A) Depolarization
B) Hyperpolarization
C) Increased excitability
D) Synaptic delay
8. Inhibitory postsynaptic potentials (IPSPs) make action potential generation:
A) Easier
B) Faster
C) More difficult
D) Automatic
9. Which of the following receptor types directly contains an ion channel?
A) Ionotropic
B) Metabotropic
C) Adrenergic
D) Dopaminergic
10. Metabotropic receptors differ from ionotropic receptors in that they:
A) Lack neurotransmitter binding sites
B) Operate only in electrical synapses

- C) Use G proteins to influence ion channels
- D) Are faster in action

11. The role of the G protein in metabotropic receptors is to:

- A) Bind neurotransmitters
- B) Act as a second messenger itself
- C) Open or close ion channels directly or indirectly
- D) Degrade neurotransmitters

12. Neurotransmitter removal by diffusion occurs when molecules:

- A) Re-enter the presynaptic neuron
- B) Move away from the synaptic cleft
- C) Are broken down by enzymes
- D) Bind to glial cells

13. The enzyme acetylcholinesterase functions to:

- A) Synthesize acetylcholine
- B) Degrade acetylcholine in the cleft
- C) Transport ACh into vesicles
- D) Block receptor binding

14. Which small-molecule neurotransmitter is always inhibitory in one-third of brain synapses?

- A) Glutamate
- B) GABA
- C) Dopamine
- D) Histamine

15. The neurotransmitter glutamate is primarily:

- A) Inhibitory
- B) Excitatory
- C) Neutral
- D) Reabsorptive

16. Biogenic amines such as dopamine and serotonin are produced by:

- A) Adding amino groups to carbohydrates
- B) Dehydrating amino acids
- C) Removing the carboxyl group from amino acids
- D) Direct synthesis from glucose

17. Whether a biogenic amine causes excitation or inhibition depends mainly on:

- A) The neurotransmitter concentration
- B) The type of receptor it binds to
- C) The synaptic cleft size
- D) The direction of ion flow

18. The function of reuptake in synaptic transmission is to:

- A) Prolong neurotransmitter effects
- B) Recycle neurotransmitters into the presynaptic cell
- C) Prevent neurotransmitter degradation
- D) Increase synaptic delay

19. Spatial summation involves:

- A) Stimuli from one synapse occurring at different times
- B) Multiple presynaptic neurons stimulating one postsynaptic cell simultaneously
- C) Repeated firing of the same presynaptic neuron
- D) Temporal overlap of IPSPs only

20. Temporal summation refers to:

- A) Rapid repeated signals from a single synapse
- B) Simultaneous activation from different synapses
- C) Inhibition of EPSPs

D) Summation across multiple neurons

21. When the sum of EPSPs exceeds threshold:

- A) Hyperpolarization occurs
- B) The postsynaptic neuron fires an action potential
- C) The synapse resets
- D) Neurotransmitter release stops

22. Which statement best describes neural convergence?

- A) One neuron influencing many postsynaptic neurons
- B) Many presynaptic neurons synapsing with one postsynaptic neuron
- C) Recurring impulses within the same neuron
- D) Multiple neurons connected in parallel

23. Divergence in neural circuits ensures:

- A) A single neuron affects multiple targets
- B) Multiple neurons affect one target
- C) Delay in information transfer
- D) Reduction of signal strength

24. In a reverberating circuit, impulses:

- A) Stop after one transmission
- B) Loop back to re-stimulate the same pathway
- C) Are blocked by inhibitory neurons
- D) Occur only in the spinal cord

25. A parallel after-discharge circuit allows:

- A) Equal signal arrival times
- B) Prolonged output after input ends
- C) One-way inhibition
- D) Faster synaptic delay

26. Which neurotransmitter acts as both excitatory and inhibitory depending on receptor type?

- A) Glutamate
- B) GABA
- C) Acetylcholine
- D) Dopamine

27. In electrical synapses, connexons are mainly responsible for:

- A) Neurotransmitter synthesis
- B) Ion flow between neurons
- C) Receptor activation
- D) Vesicle release

28. Which of the following processes would increase synaptic delay?

- A) Direct gap junction communication
- B) Increased neurotransmitter diffusion distance
- C) Faster receptor binding
- D) Higher synaptic vesicle release rate

29. When Cl^- channels open in a postsynaptic membrane, the effect is:

- A) EPSP
- B) IPSP
- C) Action potential generation
- D) Membrane depolarization

30. GABA agonists like diazepam enhance inhibition by:

- A) Increasing GABA degradation
- B) Blocking GABA receptors
- C) Strengthening GABA's inhibitory effect
- D) Reducing GABA reuptake

31. A neuron receiving inputs from 10,000 synapses demonstrates:
- A) Neural isolation
 - B) Extensive synaptic integration
 - C) Refractory summation
 - D) Reduced signal transmission
32. The main reason neurotransmitters must be removed from the cleft is to:
- A) Maintain indefinite excitation
 - B) Prevent continuous stimulation of the postsynaptic cell
 - C) Strengthen signal duration
 - D) Delay impulse propagation
33. The second messenger in metabotropic receptor activity functions to:
- A) Transport neurotransmitters
 - B) Act as an enzyme
 - C) Mediate channel opening indirectly
 - D) Block receptor binding
34. Which of the following would most likely produce a stronger postsynaptic response:
- A) Temporal summation of subthreshold EPSPs
 - B) A single IPSP
 - C) A hyperpolarizing potential
 - D) Removal of all neurotransmitters
35. The CNS differs from the PNS mainly because it:
- A) Contains nerves and ganglia
 - B) Is limited to brain and spinal cord
 - C) Has no synaptic communication
 - D) Lacks integration centers
36. Electrical synapses involve neurotransmitter release. (T/F)
37. EPSPs always lead directly to an action potential. (T/F)
38. Metabotropic receptors can influence ion channels via G proteins. (T/F)
39. Diffusion, enzymatic degradation, and uptake are all methods of neurotransmitter removal. (T/F)
40. Spatial summation occurs when signals arrive from multiple neurons at once. (T/F)

Answer Key

1-C 2-B 3-C 4-B 5-C 6-B 7-B 8-C 9-A 10-C 11-C 12-B 13-B 14-B 15-B 16-C 17-B 18-B 19-B 20-A 21-B 22-B 23-A 24-B 25-B 26-C 27-B 28-B 29-B 30-C 31-B 32-B 33-C 34-A 35-B 36-F 37-F 38-T 39-T 40-T