

Friday, October 22nd, 2022

Following directions on the mark-sense form, write your **name, and student number** in the blanks and fill in the bubbles. In addition, write your **name** on this exam.

When finished with the test, turn in both the mark-sense form and the exam at the front of the room.

PLACE ALL ANSWERS ON THE MARK-SENSE FORM

KEY: Correct answers are given in **red bold-face**.

MULTIPLE CHOICE: Always choose the **BEST, most complete answer. (2 points each)**

1. Which of the following is an amphipathic molecule?
 - a) water
 - b) glucose
 - c) phospholipid**
 - d) Na⁺
 - e) CO₂

2. What happens to red blood cells bathed in a hypotonic solution? (A hypotonic solution has a lower concentration of solutes than the intracellular fluid).
 - a) There is no movement of water or solute because of the barrier provided by the cell membrane.
 - b) Water moves into the cells.**
 - c) Water moves out of the cells.

3. Osmosis
 - a) requires ATP.
 - b) is the movement of water up an osmotic gradient.**
 - c) is the diffusion of water down an osmotic gradient.
 - d) depends upon carrier proteins that specifically bind to water.
 - e) occurs when water moves through ion channels.

4. Which of the following proteins is NOT a channel?
 - a) aquaporin
 - b) protein that causes depolarization in response to membrane stretch
 - c) nicotinic acetylcholine receptor
 - d) protein that allows K⁺ ions to leak out of a resting cell
 - e) Na⁺/K⁺-ATPase**

5. In what way does membrane transport by a carrier protein differ from membrane transport by a channel?
- ions only cross the membrane via channels
 - only channels are transmembrane proteins
 - the transported substance binds to a specific binding site on the carrier protein**
 - only transport by a carrier protein is affected by concentration gradient
 - only transport by a channel is affected by concentration gradient
6. Fill in the blank. Active transport ensures that the concentration of _____ is always much higher inside the cell than outside.
- Na⁺
 - K⁺**
 - Cl⁻
 - water
 - glucose
7. The equilibrium potential for an ion is
- the membrane potential that would occur if there were equal concentrations of ions in the intracellular and extracellular fluid.
 - the membrane potential at which ions flow out of the cell.
 - the same as the resting membrane potential.
 - The membrane potential at which the force due to the concentration gradient is balanced by the force due to the electrical gradient.**
8. Take a cell with typical physiological gradients. At a membrane potential of 0mV, which way will Na⁺ ions flow if you open some Na⁺ channels?
- into the cell**
 - out of the cell
 - there is no net movement of Na⁺ at 0mV
9. The membrane potential is a weighted average of the equilibrium potentials of all the ions contributing to the membrane potential. Which of the following is the “weighting” factor?
- sign of charge (whether ion is positive or negative)
 - valence (the number of charges on the ion)
 - concentration of the ion inside the cell
 - concentration of the ion outside the cell
 - relative membrane permeability for each ion**
10. In a typical neuron, which of the following has the most leak channels that are selectively permeable to it?
- Ca⁺⁺
 - Cl⁻
 - glucose
 - K⁺**
 - Na⁺

11. Which of the following best describes the action of the receptor for estrogen, a steroid hormone?
- a) acts as a second messenger to increase intracellular Ca^{++}
 - b) inactivates a G protein
 - c) opens a ligand-gated ion channel
 - d) acts as a protein kinase
 - e) **acts as a transcription factor to change gene expression**
12. Which of the following is TRUE about signaling involving a G protein coupled receptor (GPCR)?
- a) it is involved in fast synaptic transmission
 - b) the G protein is activated by binding GDP
 - c) the G protein is inactivated when the G-alpha dissociates from the beta-gamma subunits
 - d) the receptor forms a stable association with an intracellular kinase
 - e) **the receptor is a 7-transmembrane domain protein**
13. Which of the following is a Ca^{++} binding protein?
- a) NMDA receptor
 - b) voltage-gated Ca^{++} channel
 - c) **calmodulin**
 - d) IP_3
 - e) G-alpha subunit
14. Albuterol is a drug that acts as a beta-2 adrenergic agonist. This means it
- a) directly binds to a ligand-gated ion channel.
 - b) **activates a G protein coupled receptor.**
 - c) competes for binding with acetylcholine.
 - d) stimulates a receptor that acts as a transcription factor.
 - e) stimulates a catalytic receptor.
15. What is an important step in the signal transduction for the cytokine interferon-gamma? (Cytokines are signals that affect immune cells.)
- a) increase in cAMP
 - b) increase in intracellular Ca^{++}
 - c) **activation of JAK kinase**
 - d) degradation of intracellular STAT proteins
 - e) activation of protein kinase A
16. Which of the following is part of the sequence whereby signaling from the hormone oxytocin leads to Ca^{++} release from intracellular stores?
- a) **G_q activates phospholipase C to cleave a membrane phospholipid and form IP_3**
 - b) membrane depolarization opens voltage-gated Ca^{++} channels
 - c) protein kinase A is activated
 - d) G_s activates adenylyl cyclase
 - e) G_i inhibits adenylyl cyclase

17. Capsaicin (found in chili peppers) is a ligand that opens a
- neurotransmitter receptor.
 - temperature-gated ion channel.**
 - mechanically-gated ion channel.
 - voltage-gated ion channel.
 - leak channel.
18. Which of the following is TRUE about graded potentials?
- The end plate potential is a type of graded potential.**
 - Graded potentials conduct long distances in axons.
 - Regenerative Na^+ entry causes a graded potential.
 - Graded potentials are only produced by voltage-gated channels.
 - Graded potentials can only be depolarizing potentials.
19. Which of the following proteins is responsible for generating a receptor potential?
- ligand-gated ion channel
 - Na^+/K^+ -ATPase
 - mechanically-gated ion channel**
 - Na^+ leak channel
 - K^+ leak channel
20. Which of the following best describes the voltage sensor?
- transmembrane segment with positive charges**
 - flap that closes channel in response to depolarization
 - part of the channel pore that makes it selective for one type of ion
 - intracellular domain that binds to cations
 - requires phosphorylation to be activated
21. The rising phase of the action potential
- peaks at the E_{Na} (the Na^+ equilibrium potential).
 - depends upon a positive feedback loop.**
 - increases the intracellular concentration of K^+ .
 - depends upon the opening of voltage-gated K^+ channels.
 - depends upon the activity of the Na^+/K^+ -ATPase.
22. During the absolute refractory period
- summation of graded potentials can't occur.
 - voltage-gated Na^+ channels are inactivated.**
 - voltage-gated K^+ channels are closed.
 - ligand-gated Cl^- channels are open.
 - depolarization can elicit a second action potential.

23. Which of the following is localized to the cell membrane in the node of Ranvier?
- a) **voltage-gated Na⁺ channels**
 - b) voltage-gated Ca⁺⁺ channels
 - c) myelin
 - d) nicotinic acetylcholine receptors
 - e) mechanically-gated ion channels
24. Multiple sclerosis is an autoimmune disorder that primarily damages
- a) voltage-gated Na⁺ channels.
 - b) nicotinic acetylcholine receptors at the neuromuscular junction.
 - c) docking proteins for synaptic vesicles.
 - d) **myelin.**
 - e) GABA receptors.
25. A neurotransmitter receptor
- a) may be a G protein coupled receptor.
 - b) may be a ligand-gated ion channel.
 - c) may be permeable to Ca⁺⁺.
 - d) **ALL of the above are true.**
 - e) NONE of the above are true.
26. What does it mean to say that the neuromuscular junction has a high safety factor?
- a) The neuron makes multiple synapses onto a muscle fiber to guarantee activation.
 - b) The end plate potential is large enough to conduct throughout the muscle fiber.
 - c) **The end plate potential is always well above the threshold for action potential initiation.**
 - d) Acetylcholinesterase activity prevents over-excitement of the muscle fiber.
 - e) Postsynaptic receptors allow Ca⁺⁺ entry into the cell to ensure that there is enough to trigger contraction.
27. Myasthenia gravis is a disorder of the neuromuscular junction. What type of drug is used to treat myasthenia gravis?
- a) nicotinic agonist
 - b) muscarinic agonist
 - c) nicotinic antagonist
 - d) muscarinic antagonist
 - e) **acetylcholinesterase inhibitor**

28. In what way does the neuromuscular junction differ from every synapse in the central nervous system (CNS)?
- a) Acetylcholinesterase terminates the action of the neurotransmitter.
 - b) Acetylcholine is the neurotransmitter.
 - c) The postsynaptic potential is excitatory.
 - d) The postsynaptic potential always elicits an action potential in the postsynaptic cell.**
 - e) The neuromuscular junction is a chemical synapse.
29. Which part of the brain is most important for consolidation of long-term memories?
- a) frontal cortex
 - b) hippocampus**
 - c) hypothalamus
 - d) medulla
 - e) midbrain
30. Which of the following is required for induction of long-term potentiation?
- a) a high safety factor
 - b) GABA receptors
 - c) acetylcholine release
 - d) stimulation by neuromodulators
 - e) NMDA receptors**

END OF TEST

Turn in your mark-sense form
and your question sheets
at the front of the room.