PBIO 375 First Midterm-KEY **Wednesday, Oct 21st, 2020**

Correct answers are in **bold, red type**.

1. Which of the following statements about polar bonds is TRUE?
    a. Molecules with polar bonds are not present in the plasma membrane.
    b. Polar bonds are only found in hydrophobic molecules.
    c. Polar bonds are not found in amphipathic molecules
    d. Polar bonds may be found in hydrophilic molecules.
    e. Polar bonds are charge carriers in ion channels.

2. Water molecules (H_2O)
    a. form hydrogen bonds with each other.
    b. are covalently bonded to each other.
    c. are too large to be affected by thermal energy.
    d. are in low concentration in a liter of pure water.
    e. are amphipathic ions.

3. Salts, such as sodium chloride, when dissolved in water
    a. are small crystals.
    b. repel water dipoles by the hydrophobic effect.
    c. ionize into anions and cations.
    d. break apart into neutral molecules.
    e. form a solution with a net positive charge.

4. A lipid bilayer membrane
    a. is impermeable to small hydrophobic molecules and large hydrophilic molecules.
    b. is permeable to large hydrophobic molecules and small hydrophilic molecules.
    c. is freely permeable to ions.
    d. binds amphipathic gases.
    e. has a core composed of polar head groups.

5. Which of the statements about ion concentration gradient across the cell membrane is TRUE?
    a. The concentration gradient for Cl^- is greater than for Ca^{++}.
    b. The concentration of both Na^+ and K^+ is higher in the extracellular fluid than in the intracellular fluid.
    c. The concentration of both Na^+ and K^+ is lower in the extracellular fluid than in the intracellular fluid.
    d. The concentration of Na^+ is higher in the extracellular fluid than in the intracellular fluid.
    e. The concentration of K^+ is higher in the extracellular fluid than in the intracellular fluid.

6. Which of the following three conditions must exist in order for a cell to have a membrane potential?
    a. ion concentration gradient, membrane capacitance, and non-selective cation channels.
    b. membrane capacitance, osmotic gradient, and ion-selective leak channels.
    c. non-selective leak channels, ion concentration gradient, and a hydrogen bonded network.
    d. ion concentration gradient, glucose transporter, and ion-selective leak channels.
    e. ion concentration gradient, membrane capacitance, and ion-selective leak channels.

7. Diffusion is:
    a. an effective way to send chemical signals over long distances.
    b. too random to be useful in living systems.
    c. insensitive to concentration gradients.
    d. an effective way to send chemical signals over short distances.
    e. driven by ATP hydrolysis.

8. A cell placed in a hypotonic bathing solution will
    a. shrink because of water flow through aquaporin channels.
    b. swell because water moves down a transmembrane osmotic gradient.
    c. swell because water moves up a transmembrane osmotic gradient.
    d. shrink because water is drawn out of the cell to increase bath tonicity.
    e. neither swell nor shrink.

9. Osmosis (choose BEST answer)
    - **a. refers to the flow of water through water-filled pores in the presence of an osmotic gradient.**
    - b. is the movement of solute particles across a solute-permeable barrier.
    - c. is driven by diffusion of water down a water concentration gradient.
    - d. decreases with increasing solute concentration.
    - e. takes place across a water-impermeable membrane.

10. Which of the following statements about ion channels is FALSE?
    - a. Ion channels play an important role in electrical signaling.
    - **b. Ion channels are membrane proteins with a central pore that is permeable to small non-polar molecules.**
    - c. Ion channels are assembled from 3 to 6 subunits.
    - d. Some types of ion channels are open all the time.
    - e. There is a large number of different kinds of ion channels.

11. The resting membrane potential of all types of cells:
    - a. is close to the Na^+ equilibrium potential.
    - b. is close to the Ca^{++} equilibrium potential.
    - **c. is set by the relative numbers of open Na^+ and K^+ leak channels in the membrane.**
    - d. is more negative than the K^+ equilibrium potential.
    - e. depends on the number of open water channels.

12. The sodium-potassium pump
    - a. is only present in nerve cells.
    - **b. uses the energy provided by the hydrolysis of ATP to pump K^+ into the cell.**
    - c. transports large polar molecules across the membrane in exchange for Na^+ and K^+
    - d. is required for the recovery of hyperpolarizing potential changes
    - e. is a gated ion channel that is opened by binding ATP

13. The membrane potential of a cell sitting at -70 mV will
    - a. depolarize if a ligand opened a K^+-selective, ligand-gated channel.
    - b. depolarize if an applied force closed a Na^+-selective, mechanically-gated ion channel.
    - c. depolarize if a ligand opened a Cl^--selective, ligand-gated ion channel.
    - **d. hyperpolarize if a ligand opened a K^+-selective, ligand-gated ion channel.**
    - e. hyperpolarize if an applied force closed a K^+-selective, mechanically-gated ion channel.

14. Which of the following is most responsible for the recovery of the membrane potential following either a hyperpolarizing or depolarizing graded potential change?
    a. the inactivation of voltage-gated Na^+ channels
    b. Ca^{++} activation of a second-messenger cascade
    c. Na^+ and K^+ leak channels
    d. a balance between voltage-gated K^+ channels and Cl^- channels
    e. the summed entry of anions and cations

15. Voltage-gated ion channels
    a. are typically opened by a hyperpolarizing change.
    b. are only found in epithelial cells.
    c. may be selectively permeable to Na^+, K^+, Ca^{++} or Cl^-.
    d. typically close when the membrane depolarizes.
    e. require ATP to be opened by a voltage change.

16. The selectivity filter of voltage-gated ion channels
    a. detects a change in the membrane electric field and displaces a blocking particle.
    b. prevents the ion channel from being endocytosed.
    c. closes during inactivation.
    d. excludes ions that don't have a specific set of properties.
    e. is only present in Na^+-selective ion channels.

17. Voltage-gated $\underline{Na^+}$ channels
    a. have four states: closed, open, partly open, and partly closed.
    b. have three states: closed, open, and inactivated.
    c. have two states: closed and not open.
    d. have one state: open.
    e. have one state: closed.

18. Neurotransmitter receptors
    a. are exclusively permeable to Ca^{++}.
    b. are not expressed in neurons with gap junctions.
    c. may be channels opened by binding a ligand.
    d. are always channels opened by ligand dissociation.
    e. are only present in muscle cells.

19. Which of the following statements about inactivation is TRUE?
    a. **The inactivation of voltage-gated ion channels involves a "gate" that blocks the open pore.**
    b. Inactivation is only a property of aquaporin channels.
    c. Inactivation plays an essential role in neurotransmitter reuptake.
    d. Inactivation refers to a conformation change in the Na^+-K^+ ATPase.
    e. Inactivation precedes G-protein activation by GDP-GTP exchange.

20. Which of the following statements about changes in membrane potential is TRUE?
    a. During a depolarizing potential change the membrane becomes impermeable to water.
    b. Hyperpolarization refers to an increase in hydrogen bonding in an aqueous solution.
    c. **During a depolarizing potential change, the membrane potential becomes more positive.**
    d. During a hyperpolarizing potential change, the membrane potential becomes less negative.
    e. Depolarizing and hyperpolarizing potential changes are only produced by voltage-gated ion channels.

21. Which of the following statements about graded potential changes is FALSE?
    a. Graded potential changes decay in amplitude as they spread from their site of generation.
    b. The amplitude of a graded potential produced by binding a ligand increases with the number of open ligand-gated channels.
    c. **Graded potential changes are only produced by ligand-gated channels.**
    d. Graded potential changes can be either depolarizing or hyperpolarizing.
    e. The end-plate potential is an example of a graded potential change.

22. The sole purpose of an electrical signal is to
    a. trigger exocytosis.
    b. generate an action potential.
    c. prevent cell death.
    d. **produce a change in intracellular Ca^{++}.**
    e. inactivate voltage-gated Na^+ channels.

23. The rising phase of the action potential
    a. depends on the strength of the stimulus that evoked it.
    b. depends on the delayed activation of voltage-gated K^+ channels.
    c. is caused by regenerative Na^+ entry.
    d. involves the repetitive activation of a specific type of ligand-gated ion channel.
    e. raises the intracellular concentration of K^+.

24. The repolarizing phase of the action potential
    a. requires the activation of voltage-gated Ca^{++} channels.
    b. is caused by regenerative K^+ entry.
    c. depends on the inactivation of voltage-gated K^+ channels.
    d. only happens in the absence of closed Na^+ channels.
    e. involves the inactivation of some channels and the voltage activation of other channels.

25. Cocaine and other local anesthetics
    a. block voltage-gated Na^+ channels.
    b. block inactivation of K^+ channels.
    c. activate leak channels.
    d. block ligand-gated ion channels.
    e. only act on unmyelinated ion channels.

26. G-protein coupled receptors
    a. are ligand-gated ion channels.
    b. are activated by depolarization.
    c. are phospholipids that are activated by binding a ligand.
    d. are 7-transmembrane proteins that are activated by binding an extracellular ligand.
    e. are activated by binding to a G protein.

27. Release of Ca^{++} from intracellular stores
    a. requires the phosphorylation of the IP_3 receptor.
    b. may be triggered by activation of G protein-coupled receptor.
    c. generates voltage changes that may evoke action potentials.
    d. is the only way that a Ca^{++} signal is produced in neurons.
    e. is blocked by ligand-gated ion channels.

28. The myelin sheath
    a. is a layer of connective tissue that protects the axon from mechanical injury
    b. is many layers of glial cell membrane.
    c. is only found in the somatic nervous system.
    d. is a continuous sheet of insulation that increase conduction velocity.
    e. is attacked by oligodendrocytes.

29. Synaptic transmission in the central nervous system
    a. is like neuromuscular transmission in every way.
    b. is exclusively mediated by the release of glutamate.
    c. depends upon metabolic coupling via gap junctions.
    d. may be either excitatory or inhibitory.
    e. always leads to an action potential in the postsynaptic cell.

30. In the central nervous system, when GABA binds to its receptor to cause an inhibitory postsynaptic potential,
    a. Cl^- ions leave the postsynaptic cell.
    b. Cl^- ions enter the postsynaptic cell.
    c. a non-selective cation channel opens.
    d. Ca^{++} ions enter the postsynaptic cell.
    e. Ca^{++} ions leave the postsynaptic cell.