

Cell Physiology
Second practice Exam
November 2006

1. The parasympathetic preganglionic fibers synapse with parasympathetic postganglionic neurons:
 - A. in the sympathetic chain
 - B. partly in the adrenal medulla
 - C. only within the spinal cord
 - D. in the Superior Mesenteric Ganglion
 - E. in ganglia very near, or within, the effector organ

2. Muscarinic m2 and m4 receptor differ from m1, m3, and m5 receptors
 - A. Since even numbers are ion channels and odd are 2nd messenger coupled.
 - B. Since even have 6 subunits, odd 7 subunits
 - C. Since odd numbers are found in the heart
 - D. In the G-protein to which they are coupled
 - E. Since even relax smooth muscle, odd contract it.

3. Nicotinic AChRs and muscarinic AChRs share the property that
 - A. both are linked to G-proteins.
 - B. both always produce an excitatory response in the postsynaptic cell.
 - C. both are receptor ion channel complexes.

 - D. both are involved in neurotransmission between motoneurons and skeletal muscle.
 - E. both function in the parasympathetic nervous system.

4. The baroreceptor can respond to changes in blood pressure and blood flow because:
 - A. It is coupled to a K⁺ channel
 - B. It is a mechanoreceptor that is activated by stretch
 - C. It is a voltage sensitive channel
 - D. It is coupled to a G inhibitory protein
 - E. It is coupled to a Gq protein

5. The transmitter liberated by sympathetic postganglionic fibers innervating sweat glands is:
 - A. epinephrine
 - B. norepinephrine
 - C. acetylcholine
 - D. Bradykinin
 - E. 5-HT

6. Which of the following would be the most effective way to block hormone release by the adrenal medulla?

- A. alpha-receptor blocking drugs
- B. beta-receptor blocking drugs
- C. muscarinic receptor blocking drugs
- D. nicotinic receptor blocking drugs
- E. dopaminergic receptor blocking drugs

7. In a particular disease, a patient's skeletal muscle myosin molecules are modified, displaying a higher ATPase activity/molecule than normal. You would also expect to see in that patient's muscles:

- A. contraction but no relaxation
- B. no contraction
- C. more ATP
- D. more rapid contractions
- E. more summation

8. Binding of Calcium by Troponin induces:

- A. conformational change of myosin head so it can bind to actin
- B. changes in the Z line of the sarcomere so the filaments can slide
- C. depolarization of the cell
- D. changes in tropomyosin so myosin and actin can interact
- E. release of actin by myosin

9. The cardiac muscle cells with the highest rate of spontaneous generation of action potential are:

- A. fibers in the sinoatrial node
- B. atrial fibers near the ventricle
- C. fibers in the atrioventricular node
- D. Purkinje fibers
- E. ventricular fibers

10. If the interaction between actin and myosin in mammalian skeletal muscle were modified such that the bond could be made but not broken, the muscle would:
- A. be stiff and inextensible
 - B. when stimulated, contract and relax normally
 - C. be nonstriated
 - D. when stimulated to contract, hydrolyze ATP at a high rate
 - E. contract with an increased speed of shortening
11. In the Ca^{2+} activation of smooth muscle, a drug that decreases the binding of Ca^{2+} to calmodulin would be expected to
- A. not affect contraction.
 - B. block Ca^{2+} binding to the thick filament.
 - C. decrease myosin light chain phosphorylation.
 - D. produce activation independent of Ca^{2+} .
 - E. block relaxation but not contraction.
12. Release of calcium from the SR in cardiac muscle occurs by the following mechanism:
- A. Calcium induced calcium release
 - B. Direct coupling between channels in the T-tubules and the SR membranes
 - C. Activation of the SR Ca^{2+} ATPase
 - D. Repolarization of the cell
 - E. All of the above
13. If the cells of the Purkinjee fibers are treated with tetrodotoxin (TTX, inhibitor of the TTX sensitive Na^+ channels) the expected result is:
- A. Slower depolarization
 - B. No depolarization
 - C. Faster depolarization
 - D. No effect on depolarization rate
 - E. None of the above
14. In the normally functioning heart, an increase in contractile strength occurs when:
- a) Diastolic filling decreases
 - b) Baroreceptors are stimulated
 - c) Contractions sum
 - d) More muscle units are brought into action
 - e) There is an increase in contraction frequency

15. The concentration of acetylcholine (ACh) in nerve terminals is maintained to a major extent by:

- A. uptake of ACh from the circulation
- B. reuptake of ACh from the synaptic area
- C. uptake of choline from the circulation and synaptic area and resynthesis of ACh in the nerve terminal
- D. A and B
- E. B and C

16. Which of the following statements is false in respect to smooth muscle cells:

- A. α -actinin is involved in the arrangement of the thin filaments
- B. Myosin interacts with actin
- C. The thin filaments have troponin but it does not regulate the actin-myosin interaction
- D. IP_3 sensitive Ca^{2+} channels play an important role in SR calcium release
- E. All of the above

17. In visceral (unitary) smooth muscle of the small intestine, slow waves of membrane depolarization can produce oscillatory contractions:

- A. by stimulating phasic release of norepinephrine which produces contraction
- B. by stimulating phasic release of ACh which produces contraction
- C. by opening Ca^{2+} channels allowing Ca^{2+} entry and force production
- D. through a reflex arc involving the spinal cord
- E. by stretching neighboring cells

18. Acetylcholine enhances contractions in circular smooth muscle of the small intestine by:

- A. Inducing SR calcium release
- B. Inhibition of the myosin light chain phosphatase
- C. Phosphorylates the K^+ channel to activate it and repolarize the cell
- D. A and B
- E. A, B and C

19. Actin polymerization is catalyzed by:

- A. Hydrolysis of ATP
- B. Hydrolysis of GTP
- C. Phosphorylation of tubulin dimers
- D. Interaction between tubulin and dynein
- E. Profilin

20. Uncle Lou, sitting across from you at Thanksgiving has a question. "Now that you're a pre-med student, what can you tell me about Motor Units"? You respond that;
- A. an alpha motor neuron innervates only one muscle fiber
 - B. in any movement, the largest motor units are recruited first
 - C. a cross section through a muscle shows fibers of one type completely segregated from another type
 - D. for any motor unit, all muscle fibers are the same type
 - E. if a fast motor neuron is connected to a slowly contracting muscle, muscle contraction becomes slower
21. There are several types of human muscle fibers. Slow oxidative muscle fibers:
- A. are resistant to fatigue
 - B. are rich in capillaries
 - C. are dark in appearance
 - D. are designed for sustained activity
 - E. all of the above
22. Which of the following sensory receptors is used to signal rate of change (velocity) of muscle length.
- A. Primary muscle spindle (nuclear bag)
 - B. Secondary muscle spindle (nuclear chain)
 - C. Golgi tendon organ
 - D. Gamma fiber
 - E. Alpha fiber
23. If a patient displays spasticity in a muscle:
- A. Stretching the muscle slowly results in increased resistance
 - B. Forcibly stretching the muscle can lead to the Clasp Knife Reaction
 - C. The muscle is completely unresponsive and atrophic
 - D. Descending excitation from the cerebral cortex leads to hyperactive reflexes
 - E. None of the above
24. The role of the gamma motoneuron-intrafusal fiber system in movement is
- A. It maintains the sensitivity of muscle spindle receptors
 - B. It is activated along with alpha motor neurons
 - C. It contains both static and dynamic types of motor neurons
 - D. It innervates intrafusal muscle fibers
 - E. All of the above
25. The reflex action in which whenever a particular muscle is activated its antagonist is inhibited is called
- A. Local sign
 - B. Reversal potential
 - C. Reciprocal innervation
 - D. Digressive antagonism
 - E. Dual innervation

26. During a tap of the left patellar tendon, which of the following will occur?
- A. The left quadriceps muscle will contract
 - B. The left antagonist (biceps femoris) will be activated
 - C. The left synergist (tensor fascia lata) will be inhibited
 - D. the positive babinski sign will be seen in the left foot
 - E. All of the above
27. A patient presents with reduced serum potassium levels. Recalling what you learned in physiology, the following possibilities come to mind:
- A. Na-Cl and N-K-2Cl epithelial transport could be inhibited
 - B. there could be an increase in serum aldosterone levels
 - C. there could be excess urinary potassium
 - D. the patient would be experiencing muscle weakness
 - E. all of the above
28. An infant is brought to the ER with excessive diarrhea. After stabilizing the patient, you begin to look for causes that could include:
- A. a bacterial toxin that chronically activates adenylyl cyclase
 - B. increased Na-Cl uptake from GI tract
 - C. decreased pH in intestinal and renal tubule lumen
 - D. increased activation of Na-K-ATPase pumps
 - E. all of the above
29. Aldosterone is a powerful steroid hormone synthesized in the adrenal cortex. Characteristics of the aldosterone system include:
- A. its release is increased with decreasing serum sodium
 - B. aldosterone decreases Na leakage into the cell from the lumen
 - C. aldosterone helps to increase serum potassium
 - D. aldosterone helps to decrease blood volume
 - E. all of the above
30. A young child presents with persistent cough, low weight with good appetite. Consistent with your conclusion that the child may suffer from cystic fibrosis would be:
- A. the child's sweat has a high Na Cl content
 - B. her pancreatic acinar cells are not producing sufficient digestive enzymes
 - C. her airways are filled with accumulated DNA
 - D. her breathing rate is faster than normal
 - E. all of the above
31. Glucose uptake into epithelial cells is critical to life. Concerning uptake mechanisms:
- A. potassium is co-transported with glucose
 - B. glucose and fructose use the same transporter
 - C. uptake into epithelial cells can occur against a concentration gradient

- D. aldosterone increases its uptake
 - E. glucose uptake is coupled with hydrogen secretion
32. Some regions of the epithelium such as in the proximal and distal tubules of the kidney have “leaky tight junctions.” Transport processes occurring in this type of epithelial cells include:
- A. the Na-K-ATPase pump is on the luminal surface
 - B. Na influx is coupled with hydrogen efflux
 - C. a block of Na-Cl transporters decreases urination
 - D. salt-secreting cells do not have Na-K-ATPase pumps
 - E. a hyperosmotic condition in the lumen results in increased water absorption
33. A young patient presents in the emergency room with abnormally low serum potassium levels. Consistent with this condition would be:
- A. he has taken a powerful diuretic drug that blocks Na Cl transportation
 - B. his muscle membranes would be depolarized
 - C. Na-K-ATPase pumps must be inhibited
 - D. the adrenal-aldosterone system is not working
 - E. the cyclic AMP chloride channel is not working
34. Epithelial cells in the colon and renal collecting duct have similar physiological properties. For example:
- A. water and electrolytes easily pass between cells from the basolateral surface to the lumen
 - B. the lumen is more negative than the basolateral surface of the cell
 - C. sodium leaks out of the cell into the lumen
 - D. aldosterone inhibits potassium secretion
 - E. it is the one place where chloride secretion is mediated by ATP
35. The anti-cancer drug Taxol works by:
- A. Stabilizing the actin filaments
 - B. Destabilizing the microtubules (tubulin)
 - C. Stabilizing the microtubules (tubulin)
 - D. Inhibiting myosin
 - E. inhibiting dyenin
36. Which among the following would suggest an insufficiency of sympathetic innervation?
- a) Hands cold and sweaty
 - b) A tendency to become dizzy when standing up
 - c) Frequent episodes of abnormally high heart rate
 - d) Dilated pupils
 - e) Droopiness of the eyelid (ptosis)

37. Stretching the wall of the carotid sinus results in:

- a) Less activity in the vagal motor center
- b) More activity in the vasomotor center
- c) Increased stroke volume
- d) Reduced heart rate
- e) Vasoconstriction of arterioles

38. In autonomic effector organs occupation of beta-adrenergic receptors by agonist can lead to a number of related events shown below. Which among these is thought to precede all

- A. opening of ion channels
- B. increase in intracellular $[Ca^{2+}]$
- C. phosphorylation of enzymes and other physiologic effector proteins
- D. a rise in intracellular cAMP
- E. activation of adenylate cyclase (by G-protein)

39. Which of the following changes in the permeability of the cardiac muscle cell membrane

contribute normally to pacemaker activity in SA nodal cells.

- A. Ca channels closing with depolarization
- B. Na channels closing with depolarization
- C. Na channels closing slowly
- D. h channels opening with repolarization
- E. Cl channels closing slowly

Answer Key

1. E
2. D
3. E
4. B
5. C
6. D
7. D
8. D
9. A
10. A

11. C
12. A
13. A
14. E
15. C
16. C
17. C
18. D
19. A
20. D

21. E
22. A
23. B
24. E
25. C
26. A
27. E
28. A
29. A
30. E

31. C
32. B
33. A
34. B
35. C
36. E
37. D
38. E
39. D