MEDICAL PHYSIOLOGY. "MUSCLE WEAKNESS" MODULE

Directions: Each of the numbered items or incomplete statements in this section is followed by answers or by completions of the statement. Select the ONE lettered answer or completion that is BEST in each case.

1.) Each of the following statements concerning facilitated diffusion is true EXCEPT:
   a.) exhibits saturation kinetics  
   b.) exhibits selectivity in what is transported  
   c.) competitive inhibition  
   d.) requires ATP hydrolysis  
   e.) can only carry out transport down a concentration gradient.

2.) Consider a cell containing 160 mM KCl and 10 mM NaCl, which is bathed in a solution containing 100 mM NaCl and 10 mM KCl. If the membrane is equally permeable to Na⁺ and K⁺, the membrane potential will be.
   a.) -100 mV  
   b.) -60 mV  
   c.) 0 mV  
   d.) +60 mV  
   e.) +100 mV

\[ V_m = \frac{100 \text{mM NaCl} \times 10 + 10 \text{mM KCl} \times 10}{200} \times 25 \frac{\text{mV}}{10^{-4} \text{F} \cdot \text{m}^2} = 0 \]

3.) In skeletal muscle, the maximal velocity of shortening \( V_{max} \) in an isotonic contraction is determined by
   a.) the preload  
   b.) the afterload  
   c.) the length at which the muscle is stretched  
   d.) the number of active crossbridges  
   e.) the myosin ATPase isoform present in the muscle

4.) Which of the following is true?
   a.) contraction in cardiac muscle does not require extracellular Ca²⁺, while skeletal muscle does.  
   b.) contraction in skeletal muscle does not require extracellular Ca²⁺, while cardiac muscle does.  
   c.) myosin light chain kinase is involved in skeletal muscle, while it is not in cardiac muscle.  
   d.) myosin-light chain kinase is involved in cardiac muscle contraction, while it is not in skeletal muscle.  
   e.) cardiac muscle does not contain well-defined sarcomeres, while skeletal muscle does.
5) The force of contraction of a whole skeletal muscle can be physiologically graded (varied in amplitude) by:

- the frequency of muscle action potentials in the muscle.
- recruitment of different numbers of motor units.
- changes in muscle-tendon length.
- all of the above.
- none of the above.

6) The Na⁺-dependent glucose transporter is the major pathway for glucose transport in enterocytes. What effect would depolarization of the membrane from -50 mV to 0 mV have on glucose uptake by the enterocytes?

- it would increase.
- it would decrease.
- it would be unchanged.

7) During the fast cardiac action potential, which of the following best describes the K⁺ permeability during phase 2?

- \( P_K \) (phase 2) > \( P_K \) (at rest).
- \( P_K \) (phase 2) = \( P_K \) (at rest).
- \( P_K \) (phase 2) < \( P_K \) (at rest).

8) Movement of myofibrils with respect to each other occurs when

- myosin binds ATP.
- myosin binds with myosin-ADP-Pi complex.
- when the myosin-ADP-Pi complex dissociates from actin.
- when the ADP and Pi dissociate from the actin-myosin complex.
- during rigor.

9) The major inward current in the plateau phase (phase 2) of the fast cardiac action potential is carried primarily by which ion:

- \( K^+ \)
- \( Na^+ \)
- \( Ca^{2+} \)
- \( Cl^- \)
- none of the above.
10.) An increase in the membrane permeability to potassium of the cells of the SA node during phase 4 will result in:
   (a) a decrease in the heart rate
   (b) an increase in the heart rate
   (c) no change in heart rate

   ![Graph: K⁺ will go out, leading to a more neg. inside.]

11.) An example of a secondary active transport system is:
   (a) Na⁺, K⁺ ATPase
   (b) Ca²⁺ ATPase
   (c) Na⁺/Ca²⁺ exchange
   (d) Na⁺ Channel
   (e) H⁺/K⁺ ATPase

12.) If the reflection coefficient of substance X is 0.99, it means:
   (a) This substance will cross the biological membrane easily
   (b) This substance is slightly permeable
   (c) The substance is impermeable
   (d) This substance will bind to the outside of the membrane
   (e) This substance will bind to DNA

13.) In the neuronal axon Na⁺ current inactivation is responsible for:
   (a) falling phase of the action potential
   (b) rising phase of the action potential
   (c) depolarization of the membrane
   (d) release of acetylcholine from the cell
   (e) maintenance of a prolonged depolarized state

14.) In skeletal muscle, the myosin heads interact with:
   (a) globular actin
   (b) troponin-C
   (c) caldesmon
   (d) filamentous actin
   (e) tropomyosin
15. Calcium is released from the sarcoplasmic reticulum of skeletal muscle by way of the
   a.ryanodine receptor
   b. CaATPase
   c. T-tubule
   d. Troponin C
   e. Filamentous actin

16. When ATP declines at the start of skeletal muscle contraction, the most rapid source of additional ATP is
   a. glycolysis
   b. oxidative phosphorylation
   c. creatine phosphate
   d. isotonic shortening
   e. isometric relaxation

17. In smooth muscle, myosin light chain kinase is activated directly by
   a. IP3
   b. phosphatidic C
   c. cAMP
   d. cGMP
   e. calcium/calmodulin

18. Osmosis will occur from chamber A to chamber B through the semi-permeable membrane separating the tanks when
   a. $\text{C}_A = \text{C}_B$
   b. The osmotic pressure in chamber A is equal to the osmotic pressure in chamber B
   c. Chamber A contains 150 mM sucrose and chamber B contains 75 mM NaCl and the membrane is permeable to water only
   d. Chamber A contains 150 mM sucrose and chamber B contains 75 mM NaCl and the membrane is permeable to solutes
   e. Chamber A contains 150 mM sucrose and chamber B contains 150 mM NaCl and the membrane is permeable to all solutes
19.) The Na⁺-glucose transporter is:
   a.) A primary active transporter that moves glucose against its concentration gradient
   b.) A primary active transporter that moves Na⁺ against its concentration gradient
   c.) A secondary active transporter that moves glucose against its concentration gradient
   d.) A peripheral membrane protein
   e.) A secondary active transporter that moves Na⁺ against its concentration gradient

20.) Solution A of 1000 mM MgCl₂ is separated from Solution B of 10 mM MgCl₂ by a membrane that is permeable to Mg²⁺ only. Assuming solution B is at 0 mV, Mg²⁺ will be at electrochemical equilibrium when:
   a.) Solution A is +50 mV
   b.) Solution A is -50 mV
   c.) Solution A is +250 mV
   d.) Solution A is -250 mV
   e.) Solution A is 0 mV

21.) Smooth muscle contracts:
   a.) by a change in length of filaments
   b.) by a sliding and interdigitating of thick and thin filaments
   c.) without a cross-bridge cycle
   d.) without hydrolysis of ATP
   e.) primarily by a voluntary process

22.) The termination of a contraction of skeletal muscle is initiated by:
   a.) decreased CaATPase activity
   b.) depletion of calmodulin
   c.) increase in myoplasmic Ca²⁺
   d.) dissociation of Ca²⁺ from calmodulin
   e.) decrease in myoplasmic Ca²⁺

23.) Which protein is NOT involved in smooth muscle contraction:
   a.) tropomyosin
   b.) myosin
   c.) actin
   d.) tropomyosin
   e.) caldesmon
24.) Which muscle type has the highest level of ATPase activity:
(a) arterial muscle
(b) cardiac muscle
(c) femotendinous skeletal muscle
(d) soleus skeletal muscle
(e) trapezialis muscle

25.) Which of the following best describes osmolarity:
(a) A colligative property
(b) Movement of water up its concentration gradient
(c) Movement of water down its concentration gradient
(d) An active process
(e) A process dependent on membrane potential

26.) Nerve and fast cardiac action potentials differ in that:
   a.) Nerve action potentials rely on changes in calcium conductance.
   b.) Cardiac action potentials rely on a voltage-dependent calcium conductance.
   c.) Cardiac and not nerve potentials include an increase in potassium conductance.
   d.) Nerve action potentials have a higher metabolic demand.
   e.) Nerve action potentials have a longer refractory period.

27.) The plateau phase of the length-tension relationship is due to:
   a.) Overlapping thick filaments as the sarcomere shortens
   b.) Decrease in number of S1 heads able to interact with actin
   c.) No change in the number of S2 segments of myosin able to interact with actin
   d.) Increase in Troponin C affinity for intracellular calcium
   e.) Shortening across the bare zone of myosin

28.) The latch state in smooth muscle is defined by:
   a.) High levels of shortening velocity supported by low levels of myosin light chain phosphorylation
   b.) High levels of calcium/calmodulin activating the myosin light chain phosphatase
   c.) Low levels of force in response to a decrease in both myosin light chain phosphorylation and calcium
   d.) High levels of force supported by slowly cycling dephosphorylated cross-bridges
   e.) None of the above
29.) Which of the following accurately describes one step in excitation-contraction coupling in skeletal muscle:

a.) Inositol triphosphate induced release of sarcoplasmic reticular calcium is required.
b.) Calcium-induced calcium release is required.
c.) Activation of calmodulin is required.
d.) Voltage sensor in T-tubule controls calcium release.
e.) Action potential and twitch have similar temporal profile.

End of the Physiology questions.