

# MEDICAL PHYSIOLOGY I

## Select the letter corresponding to the best response

- (1) Which of the following statements concerning cross bridges is not correct? Cross bridges (a) cross bridges bind to actin during muscle contraction. (b) cross bridges are formed by the globular heads of the myosin molecules. (c) cross bridges consist of troponin and tropomyosin protruding from the actin helix. (d) cross bridges bend during muscle contraction. (e) cross bridges protrude from the thick filaments.
- (2) Which of the following characteristics are shared by all three types of muscle tissues? (a) each one contains myosin and actin. (b) each one is neurogenic. (c) each one is striated. (d) each one is considered to be under voluntary control. (e) None of these answers.
- (3) Troponin (a) binds with calcium to prevent sarcomere shortening. (b) breaks down actin. (c) breaks down myosin. (d) forms the boundaries of a sarcomere. (e) is an enzyme in the sarcomere.
- (4) A function of tropomyosin is (a) bind  $\text{Ca}^{2+}$ . (b) form attachments with myosin cross bridges. (c) prevent myosin cross bridges from attaching to the thin filaments. (d) serve as an ATPase. (e) None of these answers.
- (5) According to the sliding-filament mechanism of muscle contraction, the (a) A bands slide in closer between the I bands. (b) thin filaments slide inward toward the center of the A band. (c) Z lines slide in between the T tubules. (d) contractile proteins contract, thus shortening the sarcomere. (e) filaments slide into the lateral sacs of the sarcoplasmic reticulum.
- (6) During excitation-contraction coupling, (a) the action potential travels down the transverse tubules. (b)  $\text{Ca}^{2+}$  is released from the sarcoplasmic reticulum. (c)  $\text{Ca}^{2+}$  is taken up by the sarcoplasmic reticulum. (d) Both (a) and (b) above are correct. (e) All of these answers.
- (7) Of the step in excitation-contraction below, which occurs before the others? (a) exposed actin sites bind with myosin cross bridges. (b) sodium channels open in the fiber's membrane. (c) calcium is released from the sarcoplasmic reticulum. (d) troponin binds calcium. (e) attachment of ATP allows for cross bridge detachment.
- (8) Which is not characteristic of cross bridges? (a) they are a component of thin filaments. (b) they are comprised of myosin. (c) they have an actin binding site. (d) they have an ATPase binding site. (e) they provide power stroking.
- (9) Which of the following statements concerning cross bridges is incorrect? Cross bridges (a) are formed by the globular heads of the myosin molecules as they protrude from the thick filaments. (b) bend during muscle contraction. (c) bind to actin during muscle contraction. (d) are not found in the I band. (e) bind with troponin and tropomyosin during muscle contraction to pull them away from the actin helical chain.
- (10) During a cross-bridge cycle in skeletal muscle, the (a) cross bridge is energized as myosin ATPase activity hydrolyzes ATP. (b) myosin cross bridge is able to bind with an actin molecule when  $\text{Ca}^{2+}$  pulls the troponin-tropomyosin complex aside. (c) linkage between actin and the myosin cross bridge is broken at the end of the cross-bridge cycle as  $\text{Mg}^{2+}$  binds to the cross bridge. (d) Both (a) and (b) above. (e) All of these answers.
- (11) Which of the following is not involved in the relaxation of muscle? (a) when acetylcholine is destroyed by acetylcholinesterase. (b) when there is no longer a local action potential. (c) when the T tubules actively take up the  $\text{Ca}^{2+}$  that had been released. (d) when the actin and myosin molecules are no longer bound together. (e) when the troponin-tropomyosin complex slips back into its blocking position.
- (12) What would happen if ATP supplies became very low in a muscle cell? (a) tension development would decrease. (b) cross bridges would not detach from actin. (c) possibly contractures. (d) in death, rigor mortis. (e) All these answers.

- (13) Why are you able to repeatedly contract and relax your muscles of respiration, allowing you to breathe in and breathe out? (a) As soon as all of the  $\text{Ca}^{2+}$  stored in the lateral sacs of the sarcoplasmic reticulum is used up, muscle relaxation occurs. (b) After the muscle cell becomes excited, acetylcholinesterase rapidly destroys acetylcholine. (c) When there is no longer a local action potential in the muscle cell,  $\text{Ca}^{2+}$  is actively transported back into the lateral sacs of the sarcoplasmic reticulum, and muscle relaxation occurs. (d) Both (b) and (c) above. (e) All of these answers.
- (14) Which of the following is not a determinant of whole muscle tension? (a) the number of muscle fibers contracting. (b) the tension produced by each contracting fiber. (c) the extent of motor-unit recruitment. (d) the frequency of stimulation. (e) the proportion of each motor unit that is contracting at any given time.
- (15) During an isotonic contraction of a muscle in the arm (a) filaments do not shorten in the muscle. (b) movement does not occur. (c) the muscle does not change length. (d) the tension in the muscle does not overcome a load. (e) the tension in the muscle remains constant.
- (16) The following statement about dopamine is incorrect (a) inhibitory neurotransmitter (b) excitatory neurotransmitter (c) prolactin-inhibiting hormone (d) secreted by the nerve endings of basal ganglia (e) none of the above.
- (17) Gap junctions are: (a) zona occludens (b) junctions between gaps (c) attachments between cells (d) components of cell membrane (e) none of the above
- (18) Carrier mediated transport is characterized by (a) stereospecificity (b) saturation (c) competition (d) a, b and c (e) none of the above
- (19). A red blood cell initially contains 200 mOsm of impermeant solute. It is dropped into a large bath containing 200 mOsm of permeant solute and 100 mOsm of impermeant solute. The steady-state cell volume will: (a) remain constant (b) increase by  $\frac{3}{2}$  (c) decrease by  $\frac{2}{3}$  (d) increase by 2 (e) decrease by  $\frac{1}{2}$ .
- (20) The value of osmotic pressure can be measured using (a) Nernst Equation (b) Van't Hoff's law (c) reflection coefficient (d) diffusion potential (e) action potential.
- (21). A toxin attacks a cell by inserting a nonselective channel in the membrane, causing the cell's voltage to depolarize to near 0 mV. As a result, what will happen to cell volume? (a) remain constant (b) increase (c) decrease (d) decrease then increase (e) cannot be determined
- (22) Voltage-gated channels are opened or closed by (a) changes in membrane potential (b) hormones (c) neurotransmitters (d) second messenger (e) sodium ions.
- (23) The value of diffusion potential can be measured using (a) Nernst Equation (b) Van't Hoff's law (c) reflection coefficient (d) diffusion potential (e) action potential.
- (24) Typical value of equilibrium potentials in the nerve for sodium ion is (a) -85 mV (b) +120 mV (c) +40 mV (d) -65 mV (e) +65 mV
- (25). Which of the following is not true about the way  $\text{Na}^+$  crosses cell membranes? (a) by diffusion through lipid (b) by active transport through a protein (c) by diffusion through protein channels (d) by exchange for  $\text{Ca}^{2+}$  via a protein (e) by exchange for  $\text{H}^+$  via a protein
- (26). A Nernst or equilibrium potential: (a) is always negative to the resting voltage (b) is due to diffusion (c) is equal to the resting voltage (d) is always positive to the resting voltage (e) depends on the membrane capacitance.
- (27) Which of the following would not change the  $\text{K}^+$  current crossing a cell membrane? (a) a change in intracellular voltage (b) a change in extracellular  $\text{K}^+$  concentration (c) a change in the open probability of the membrane's  $\text{K}^+$  channels (d) a change in the number of the membrane's  $\text{K}^+$  channels (e) a change in the membrane's capacitance

- (28). The rapid depolarization and overshoot of the axonal action potential is due to: (a) a rapid increase in  $K^+$  conductance (b) a rapid increase in  $Ca^{2+}$  conductance (c) a rapid reduction in inactivation of  $Na^+$  conductance (d) a rapid inactivation of  $Na^+$  conductance (e) a rapid activation of  $Na^+$  conductance
- (29). The relative refractory period is mostly due to: (a) an elevated  $K^+$  conductance (b) an elevated  $Na^+$  conductance (c) an inactivated  $K^+$  conductance (d) an increase in membrane capacitance (e) an influx of  $Ca^{2+}$
- (30). A reduction in ACh esterase at the NMJ will cause: (a) a higher frequency of MEPPS (b) a lower frequency of MEPPS (c) a block in transmission of action potentials (d) exceptionally large MEPPS with near normal time courses (e) exceptionally long MEPPS with near normal amplitudes
- (31) During cellular respiration, NADH (a) is chemically converted into ATP. (b) is converted to  $NAD^+$  by an enzyme called dehydrogenase. (c) is reduced to form  $NAD^+$ . (d) delivers its electron load to the first electron carrier molecule. (e) None of the choices are correct.
- (32) During cellular respiration, electrons move through a series of electron-carrier molecules. Which of the following is a true statement about this process? (a) Molecular oxygen is eventually oxidized by the electrons to form water. (b) Electrons move from carriers that have more affinity for them to carriers that have less affinity for them. (c) Electrons release large amounts of energy each time they are transferred from one carrier to another. (d) The carrier molecules are found in the cytoplasm of eukaryotic and prokaryotic cells. (e) None of the statements are true.
- (33) Which one of the following is the correct sequence of stages in cellular respiration? (a) glycolysis, oxidative phosphorylation, and the citric acid cycle (b) glycolysis, the citric acid cycle, and oxidative phosphorylation (c) the citric acid cycle, oxidative phosphorylation, and glycolysis (d) oxidative phosphorylation, the citric acid cycle, and glycolysis (e) oxidative phosphorylation, glycolysis, and the citric acid cycle
- (34) A drug is tested in the laboratory and is found to create holes in both mitochondrial membranes. Scientists suspect that the drug will be harmful to human cells because it will inhibit (a) glycolysis. (b) the citric acid cycle. (c) oxidative phosphorylation. (d) the formation of alcohol. (e) the citric acid cycle and oxidative phosphorylation.
- (35) During which phase of cellular respiration does substrate-level phosphorylation take place? (a) the citric acid cycle (b) "grooming" of pyruvic acid (c) glycolysis (d) oxidative phosphorylation (e) glycolysis and the citric acid cycle.
- (36) Which one of the following metabolic pathways is common in aerobic and anaerobic organisms? (a) oxidative phosphorylation (b) chemiosmosis (c) glycolysis (d) the citric acid cycle (e) None of the choices are correct.
- (37) Which of the following is a result of glycolysis? (a) a net loss of two ATPs per glucose molecule (b) conversion of FAD to  $FADH_2$  (c) conversion of glucose to two three-carbon compounds (d) production of  $CO_2$  (e) conversion of NADH to  $NAD^+$
- (38) Glycolysis (a) does not occur in bacterial cells. (b) takes place in virtually all cells. (c) does not occur in yeast cells. (d) does not occur in animal cells (e) does not occur in plant cells.
- (39) Pyruvate (a) is the molecule that starts the citric acid cycle. (b) is the end product of oxidative phosphorylation (c) is a six-carbon molecule. (d) is the end product of chemiosmosis. (e) forms at the end of glycolysis.
- (40) Between glycolysis and the citric acid cycle, (a) pyruvate is oxidized while a molecule of  $NAD^+$  is reduced to NADH. (b) coenzyme A is cleaved off of the four-carbon compound. (c) a carbon atom is added to make a four-carbon compound. (d) More than one of the choices is correct. (e) None of the choices are correct.
- (41) During cellular respiration, glucose is converted into two pyruvic acid molecules. These molecules (a) together contain less chemical energy than was found in the original glucose molecule. (b) are oxidized. (c) each lose a carbon atom, which is released as  $CO_2$  (d) are each converted into a two-carbon molecule joined to a coenzyme A molecule. (e) All of the choices are correct.

- (42) The end products of the citric acid cycle include all of the following except (a) CO<sub>2</sub>. (b) NADH. (c) pyruvic acid. (d) FADH<sub>2</sub>. (e) ATP.
- (43) At the end of the citric acid cycle, most of the energy remaining from the original glucose is stored in a) FADH<sub>2</sub> (b) CO<sub>2</sub>. (c) pyruvic acid. (d) ATP. (e) NADH.
- (44) In the electron transport chain, the final electron acceptor is (a) a molecule of water. (b) a molecule of carbon dioxide. (c) ATP. (d) ADP (e) an oxygen atom.
- (45) Rotenone is a poison commonly added to insecticides. Insects exposed to rotenone will die because (a) high levels of fermentation products will build up. (b) water will not be produced and dehydration will occur. (c) anaerobic respiration can't occur. (d) of inadequate ATP production. (e) None of the choices are correct.
- (46) Cyanide differs from dinitrophenol because cyanide (a) is an electron transport blocker and dinitrophenol is a reaction uncoupler. (b) makes the membrane of mitochondria leaky to H<sup>+</sup> ions and prevents a concentration gradient from building up; dinitrophenol blocks the passage of electrons through electron carriers. (c) inhibits the production of ATP by inhibiting ATP synthase; dinitrophenol causes mitochondrial membranes to become less permeable to H<sup>+</sup> ions. (d) is highly toxic to human cells and dinitrophenol is nontoxic. (e) None of the choices are correct.
- (47) Which of the following statements about the energy yield of aerobic respiration is false? (a) Most of the ATP derived during aerobic respiration results from oxidative phosphorylation (b) Oxidative phosphorylation resulting from one glucose molecule may yield 32-34 ATP molecules. (c) Less than 50% of the chemical energy available in glucose is converted to ATP energy. (d) Glycolysis and the "grooming" of pyruvate together produce more NADH per glucose molecule than does the citric acid cycle. (e) Each FADH<sub>2</sub> molecule yields 2 ATP molecules and each NADH molecule generates 3 ATP molecules.
- (48) The energy yield from the complete aerobic breakdown of a single molecule of glucose (a) is less than the yield from anaerobic respiration. (b) increases as the supply of oxygen increases. (c) is always 38 ATP. (d) can vary with the mechanism used to shuttle NADH electrons into the mitochondrion. (e) is equivalent to the yield from alcoholic fermentation.
- (49) During chemiosmosis (a) a concentration gradient is generated when large numbers of H<sup>+</sup> ions are passively transported from the matrix of the mitochondrion to the mitochondrion's intermembrane space. (b) energy is generated by coupling exergonic reactions with other exergonic reactions (c) ATP is synthesized when H<sup>+</sup> ions move through a protein port provided by ATP synthase. (d) H<sup>+</sup> ions serve as the final electron acceptor. (e) energy is released as H<sup>+</sup> ions move freely across mitochondrial membranes.
- (50) Which of the following processes produces the most ATP per molecule of glucose oxidized? (a) aerobic respiration (b) alcoholic fermentation (c) lactic acid fermentation (d) anaerobic respiration (e) All produce approximately the same amount of ATP per molecule of glucose.
- (51) What is the name for chromosomes that are similar in size, shape, and function but may have different versions of each gene? (a) Sister chromosomes (b) Sister chromatids (c) Replicated chromosomes (d) Homologous chromosomes (e) Homologous chromatids.
- (52) Chromosomes separate during which phase of mitosis? (a) Prophase (b) Metaphase (c) Anaphase (d) Telophase (e) Cytokinesis
- (53) Which checkpoint determines whether a cell will proceed to the S phase or enter a resting phase (G<sub>0</sub>)? (a) G<sub>0</sub> checkpoint (b) G<sub>1</sub> checkpoint (c) G<sub>2</sub> checkpoint (d) M checkpoint (e) S checkpoint
- (54) Bacteria divide using which of the following methods? (a) Binary fission (b) Mitosis (c) Meiosis I (d) Meiosis II (e) Recombination
- (55) In which phase do most cells spend the majority of their life cycle? (a) G<sub>1</sub> (b) G<sub>2</sub> (c) G<sub>3</sub> (d) S (e) M

- (56) Sister chromatids are joined at which of the following? (a) Centrosome (b) Centromere (c) Kinetochore (d) Spindle (e) Cleavage furrow
- (57) DNA synthesis occurs during which of the following phases? (a) Prophase (b) Metaphase (c) G<sub>1</sub> phase (d) G<sub>2</sub> phase (e) S phase
- (58) Which of the following does not play a role in DNA replication? (a) DNA polymerase (b) Helicase (c) Single-stranded binding protein (d) Guanyl transferase (e) none of the above.
- (59) What signals the end of transcription? (a) Stop codon (b) Terminator (c) The end of the DNA chain (d) RNA polymerase runs out (e) none of the above
- (60) Splicing is the process that does which of the following? (a) Remove introns and conserve exons (b) Remove exons and conserve introns (c) Remove mutated regions of primary transcript RNA (d) Add multiple adenosine bases to the end of a primary RNA transcript. (e) none of these answers.