Chapter 3: Cell Structure and Function
Test Bank

MULTIPLE CHOICE

1. Glycolysis is the metabolic process of breaking down a glucose molecule to form
   a. CO_2 and H_2O.
   b. 2 ATP and 2 pyruvate.
   c. 30 ATP.
   d. oxygen.

   ANS: B
   Glycolysis produces a net gain of 2 ATP molecules and breaks down glucose modules to produce two pyruvate molecules. Oxidative phosphorylation produces CO_2 and H_2O. Oxidative phosphorylation produces 30 ATP molecules. Oxygen is not produced by glycolysis, but it is necessary for oxidative phosphorylation.

   REF: Pg. 34

2. The benefit of glycolysis is that this phase supplies
   a. ATP to meet energy needs of the body.
   b. pyruvate to the citric acid cycle.
   c. energy for oxidative phosphorylation
   d. lactate during anaerobic conditions.

   ANS: B
   The benefit of glycolysis is to supply pyruvate to the citric acid cycle of cellular metabolism, which then produces much ATP. Glycolysis only produces 2 ATP modules, which is insufficient for energy needs. Glycolysis does not supply energy for oxidative phosphorylation. Lactate produced during prolonged anaerobic conditions builds up and can lead to lactic acidosis, which is an undesirable outcome.

   REF: Pg. 34

3. Repolarization of a neuron after a depolarizing action potential is due to
   a. activation of the Na^+-K^+ pump.
   b. influx of calcium.
   c. efflux of potassium.
   d. influx of sodium.

   ANS: C
   Repolarization is due to efflux of potassium from the cell. The Na^+-K^+ pump maintains cellular volume via osmotic pressure and helps to maintain resting membrane potential. Calcium influx prolongs the action potential. Influx of sodium initiates depolarization.

   REF: Pg. 45

4. Excitable cells are able to conduct action potentials because they have
   a. receptors for neurotransmitters.
   b. tight junctions.

c. ligand-gated channels.
d. voltage-gated channels.

ANS: D
Voltage-gated channels respond to changes in membrane potential and are responsible for conducting action potentials. Receptors for neurotransmitters allow neurotransmitters to bind to the cell membrane but are not directly responsible for action potentials in excitable cells. Tight junctions are intercellular connections that help segregate proteins on the cell membrane and are not involved in conducting action potentials. Ligand-gated channels respond to binding of a signaling molecule such as a neurotransmitter, but are not directly responsible for action potentials in excitable cells.

REF: Pgs. 42-44

5. The resting membrane potential in nerve and skeletal muscle is determined primarily by
   a. extracellular sodium ion concentration.
   b. the ratio of intracellular to extracellular potassium ions.
   c. activation of voltage-gated sodium channels.
   d. activity of energy-dependent membrane pumps.

   ANS: B
   The major determinant of the resting membrane potential is the difference in potassium ion concentration across the membrane. Extracellular sodium helps to maintain cell volume and resting membrane potential but it is not the primary determinant. Activation of voltage-gated sodium channels help to initiate an action potential. Channels are not linked to an energy source; ions flow passively across the cell membrane.

   REF: Pgs. 42-43

6. An increase in extracellular potassium ion from 4.0 to 6.0 mEq/L would
   a. hyperpolarize the resting membrane potential.
   b. make it more difficult to reach threshold and produce an action potential.
   c. hypopolarize the resting membrane potential.
   d. alter the threshold potential.

   ANS: C
   An increase in extracellular potassium hypopolarizes the cell (makes it less negative) because more K^+ ions stay inside the cell owing to the reduced concentration gradient. Hyperpolarization of the resting membrane potential (makes it more negative) is caused by a decrease in extracellular potassium. Hyperpolarization due to a decrease in extracellular potassium makes it more difficult to reach threshold and produce an action potential. The threshold for action potential does not change with a change in extracellular potassium.

   REF: Pg. 43

7. GTP-binding proteins (G proteins) function to
   a. activate receptors on the extracellular surface.
   b. degrade second-messenger molecules.
   c. activate intracellular enzyme systems.
   d. synthesize ATP.

   ANS: C

G-proteins activate specific target enzymes within the cell and these enzymes then produce second messenger molecules that trigger specific intracellular function. Membrane-bound G-protein channels are a component of the cell membrane; they do not activate other receptors on the extracellular surface. G-proteins do not degrade second messengers, but instead produce these. G-proteins do not synthesize ATP.

REF: Pg. 49

8. Phospholipids spontaneously form lipid bilayers, because they are
   a. polar.
   b. charged.
   c. insoluble.
   d. amphipathic.

   ANS: D
   Phospholipids have a hydrophilic (water-loving) polar end and a hydrophobic (water-fearing) polar end. This amphipathic nature causes the lipids to form bilayers. It is the water-loving and water-fearing nature of the end rather than simply being polar, charged, or insoluble that forms the bilayers.

   REF: Pg. 27

9. Cell-to-cell communication through secretion of chemical signals into the bloodstream to target cells throughout the body is called _____ signaling.
   a. synaptic
   b. paracrine
   c. endocrine
   d. autocrine

   ANS: C
   Endocrine signaling is accomplished by specialized endocrine cells that secrete hormones that travel via the bloodstream to target cells throughout the body. Synaptic signaling occurs at specialized junctions between the nerve cell and its target cell; the neuron secretes a chemical neurotransmitter into a small space between the nerve and target cell. In paracrine signaling chemicals are secreted into a localized area, and only those cells in the immediate area are affected. Autocrine signaling occurs when cells respond to signaling molecules that they secrete and provides feedback to that cell rather than other cells.

   REF: Pg. 47

10. Ribosomes are very important organelles within the cell that have the function of
    a. detoxifying substances.
    b. synthesizing proteins.
    c. converting energy to forms that can be used.
    d. coding for protein synthesis.

    ANS: B
    Ribosomes primary function is the synthesis of proteins. Lysosomes and peroxisomes detoxify substances. Mitochondria convert energy to forms that can be used to drive cell reactions. The nucleus contains genomic DNA that codes for protein synthesis.

REF: Pg. 31

11. The cardiac drug digitalis enhances myocardial contraction, because it
    a. increases intracellular calcium level in cardiac cells.
    b. inhibits sodium from entering cardiac cells.
    c. enhances the sodium-potassium pump.
    d. increases the sodium gradient across the cell membrane.

    ANS: A
    Digitalis inhibits the sodium-potassium pump and allows the accumulation of intracellular sodium, decreasing the sodium gradient across the cell membrane. This leads to less efficient calcium removal by the sodium-dependent calcium pump. Increased calcium inside the cardiac cell leads to more forceful cardiac muscle contraction to treat congestive heart failure due to cardiac muscle weakness.

    REF: Pg. 41

12. The organelle that contains enzymes necessary for oxidative phosphorylation to produce ATP is the
    a. mitochondria.
    b. ribosome.
    c. lysosome.
    d. nucleus.

    ANS: A
    The inner membrane of the mitochondria contains many enzymes that promote oxidative phosphorylation which produces ATP. Ribosomes synthesize proteins. Lysosomes and peroxisomes detoxify substances. The nucleus contains genomic DNA that codes for protein synthesis.

    REF: Pg. 32

13. Ion channels open and close in response to all the following *except*
    a. mechanical pressure.
    b. ligand binding.
    c. voltage changes.
    d. temperature changes.

    ANS: D
    No temperature change channels are present on the cell membrane. Mechanically gated channels respond to mechanical deformation. Ligand-gated channels respond to the binding of a signaling molecule (neurotransmitter or hormone). Voltage-gated channels respond to a change in membrane potential.

    REF: Pg. 42

14. Gap junctions are connecting channels that allow passage of small molecules from one cell to the next and are especially important for
    a. distance signaling.
    b. tissues requiring synchronized function.
    c. communication within a cell.

d. passage of large molecules.

ANS: B
Gap junctions are especially important in tissues in which synchronized functions are required such as in cardiac muscle contraction. Gap junctions are channels between adjacent cells, not distant cells. Gap junctions function to promote communication not within a cell, but between adjacent cells. Gap junctions allow passage of small molecules, but not large molecules.

REF: Pg. 45

COMPLETION

15. During conditions of prolonged insufficient oxygen availability (e.g., respiratory or cardiovascular disease) anaerobic glycolysis accumulated pyruvate can lead to _____ acidosis.

ANS:
lactic
Pyruvate is converted to lactate and released into the blood stream, resulting in lactic acidosis.

REF: Pg. 34

16. The phase of cellular metabolism in which energy is released during breakdown of nutrient sources is _____.

ANS:
catabolism
Catabolism involves energy release via breakdown of nutrient sources such as glucose to provide ATP to the cell. In contrast, anabolism refers to energy-using processes that result in complex molecules such as fats.

REF: Pg. 34

17. Some individuals inherit a gene that results in dangerously high blood cholesterol due to impaired _____ of low-density lipoproteins (LDLs).

ANS:
endocytosis
The defective gene inhibits the synthesis of LDL protein receptors on the cell membrane. This impairs endocytosis of LDL. High levels of LDL in the blood predispose to atherosclerosis.

REF: Pg. 38