1) Interacting systems of molecules enclosed in compartments called __________ evolved 3.8 billion years ago in living organisms.
   a) brains
   b) organs
   c) circulatory systems
   d) mitochondria
   e) cells

2) Which of the following is found in both prokaryotic and eukaryotic cells?
   a) Golgi apparatus
   b) ribosome
   c) centriole
   d) lysosome
   e) peroxisome

3) Prokaryotic organisms lack:
   a) replicator molecules (DNA or RNA).
   b) cell membranes.
   c) metabolism.
   d) organelles.
   e) All of the above.

4) Which of the following is a cellular characteristic of ALL eukaryotes?
   a) a nuclear membrane
   b) few to no organelles in the cytoplasm
   c) a cell wall
   d) a nucleoid
   e) few to no proteins associated with the DNA

5) Eukaryotic cells may contain all of the following EXCEPT:
   a) a membrane-bound nucleus.
   b) a peptidoglycan cell wall.
   c) flagella.
   d) photosynthetic pigments.
   e) ribosomes.

6) According to the theory of endosymbiosis, the origin of chloroplasts probably involved:
   a) the formation of cell walls around the photosynthetic pigments.
   b) the formation of colonies of cyanobacteria.
   c) the engulfing of small photosynthetic prokaryotes by larger cells.
   d) the accumulation of free oxygen in ocean waters.
   e) All of the above are correct.
7) The object depicted in the figure:

a) is a bacterial cell.
b) could be either a plant or an animal cell.
c) is a plant cell.
d) is an animal cell.
e) is a ribosome.

8) The lipids within the fluid mosaic of the plasma membranes are held in place by:

a) covalent bonds.
b) hydrophobic interactions.
c) hydrogen bonds.
d) disulfide bridges.
e) ionic bonds.

9) What are the two distinct “faces” of the phospholipids that make up the surface membrane of a cell?

a) a hydrophilic head and a hydrophobic tail
b) a hydrophobic head and a hydrophilic tail
c) a phosphate group head and two fatty acid tails
d) Both a) and c) are correct.
e) Both b) and c) are correct.

10) Which of the following is the outermost feature on the surface of a plant cell?

a) lipid bilayer
b) cholesterol
c) cell wall
d) glycoproteins
e) sugar molecules

11) The figure shows the action of beta-blockers in reducing anxiety. In this diagram, the triangular wedges represent ____________, the figures with rectangular tops and triangular bottoms represent ____________, and the ovals represent ____________.

a) beta-blocker chemicals; adrenaline; beta-receptors
b) adrenaline; beta-blocker chemicals; beta-receptors
c) adrenaline; beta-receptors; beta-blocker chemicals
d) beta-blocker chemicals; mucus; beta-receptors
e) mucus; beta-blocker chemicals; beta-receptors
12) Which of the following is the most important factor governing a cell’s particular type of interaction with other cells?

a) the type of animal the cell came from
b) the location of the cell within an organism
c) whether the cell is either an animal cell or a plant cell
d) the pattern of proteins on the cell’s surface
e) whether the cell is either eukaryotic or prokaryotic

13) The net movement of molecules from locally concentrated regions to uniform distributions is best described as:

a) active transport.
b) passive transport.
c) diffusion.
d) enthalpy.
e) concentration gradient.

14) Sugar and CO$_2$ are dissolved in water to make carbonated soft drinks. Which of the following is the solute?

a) the water and the sugar
b) the water and the CO$_2$
c) the CO$_2$ only
d) the sugar and the CO$_2$
e) the sugar only

15) The passive transport of water across a membrane from a solution of lower-solute concentration to a solution of higher-solute concentration is best described as:

a) active transport.
b) general diffusion.
c) osmosis.
d) passive transport.
e) facilitated diffusion.

16) If the solution surrounding a cell contains less solute than the cytoplasm does, the osmotic condition is said to be:

a) hypotonic.
b) adiabatic.
c) isobaric.
d) hypertonic.
e) isotonic.

17) Active transport, the moving of molecules from areas of low concentration to those of high concentration across the membrane, is usually coupled to processes that:

a) counteract osmotic stress.
b) establish a dynamic equilibrium with no net gain or loss in energy for the cell.
c) gain energy for the cell.
d) amplify cellular response to signal molecules.
e) cost energy.
18) Which of the following is a correct description of how exocytosis functions in transporting molecules across the cellular membrane?

a) Vesicles are filled with molecules in the interior of the cell and then fuse with the membrane to deposit the molecules outside of the cell.
b) A receptor protein on the outside of the cell binds to a particular biochemical, causing the membrane to form an indentation and bring the biochemical into the cell.
c) Protein molecules on the interior of the cellular membrane trap molecules attached on the exterior side and bring them into the cell.
d) Nutrients are moved within the cell from one tightly woven network to another.
e) None of the above is correct.

19) Which of the following statements about the cytoskeleton is FALSE?

a) It is responsible for some cellular movement.
b) It is a three-dimensional structure that fills the cytoplasm.
c) It is made from proteins that act as a scaffolding.
d) It is present in both prokaryotic and eukaryotic cells.
e) All of the above are false.

20) Seventy to 90 percent of the genetic material in a gamete made in your body could be inherited from your mother. How could this be?

a) You receive many mitochondria, which have their own genome, from your mother, but not from your father.
b) Your maternal genes kill off your paternal genes at a greater rate than your paternal genes kill off your maternal genes.
c) The X chromosome is substantially larger than the Y chromosome.
d) You receive maternal genes through the placenta and through breast milk.
e) The above statement is incorrect. Fifty percent of the genetic material in your gametes comes from your father.

21) Why does a red blood cell burst when placed in a hypotonic solution such as distilled water, while a plant cell can survive in this environment?

Answer: Since there is a higher concentration of water outside of the cells than inside the cells, there is an overall flow of water into the cells, which causes the red blood cell to swell and burst. However, although the plant cell swells slightly, the cell wall outside of the plasma membrane prevents the cell from swelling enough to burst.

22) Life gains most of its energy from:

a) water.
b) sunlight.
c) sugar molecules.
d) oxygen.
e) carbohydrate molecules.

23) Which of the following statements best represents the relationship between respiration and photosynthesis?

a) Respiration occurs only in animals and photosynthesis occurs only in plants.
b) Photosynthesis occurs only in the day and respiration occurs only at night.
c) Photosynthesis stores energy in complex organic molecules, while respiration releases it.
d) Respiration stores energy in complex organic molecules, while photosynthesis releases it.
e) Photosynthesis reverses the biochemical pathways of respiration.
24) Different steps in cellular respiration occur in different locations in the mitochondria. Which of the following does NOT properly match a step of respiration to its proper location?

   a) a gradient of hydrogen ions phosphorylates ATP: inner mitochondrial membrane  
   b) molecule of CO₂ released: matrix  
   c) energy transferred from NADH and FADH₂ to ATP: inner mitochondrial membrane  
   d) two carbons manipulated through the Krebs cycle: matrix  
   e) All of the above are correct matches between function and location.

25) The phosphate groups in ATP:

   a) are covalently bonded to each other.  
   b) represent a significant source of stored energy.  
   c) are negatively charged.  
   d) release energy when separated from the rest of the molecule.  
   e) All of the above are correct.

26) Which by-product of photosynthesis was important in altering the atmosphere of the earth so that aerobic organisms could evolve?

   a) air  
   b) methane gas  
   c) nitrogen  
   d) carbon dioxide  
   e) oxygen

27) If a thylakoid were punctured so that its interior was no longer separated from the stroma, which of the following processes would be most directly affected?

   a) the absorption of energy by chlorophyll  
   b) the flow of electrons from photosystem I to photosystem II  
   c) the synthesis of ATP  
   d) the oxidation of NADPH  
   e) the splitting of water

28) During photosynthesis, visible light has enough energy to directly:

   a) excite electrons.  
   b) synthesize NADPH.  
   c) convert ADP into ATP.  
   d) reflect light in the red spectrum.  
   e) split a water molecule into hydrogen and oxygen.

29) Which of the following sequences accurately represents the flow of electrons during photosynthesis?

   a) NADPH → O₂ → CO₂  
   b) NADPH → chlorophyll → Calvin cycle  
   c) NADPH → electron transport chain → O₂  
   d) H₂O → NADPH → Calvin cycle  
   e) H₂O → ATP → Calvin cycle
30) Photosynthesizing plants rely on water:

   a) to replace electrons that are excited by light energy and passed from molecule to molecule down an electron transport chain.
   b) to serve as a high-energy electron carrier.
   c) to concentrate the beams of light hitting a leaf, focusing them on the reaction center.
   d) to provide the protons necessary to produce chlorophyll.
   e) to replenish oxygen molecules that are lost during photosynthesis.

31) Where does the Calvin cycle take place?

   a) in the stroma of the chloroplast
   b) in the thylakoid membrane
   c) in the Hobbesian membrane
   d) in the cellular cytoplasm
   e) around the chlorophyll molecule

32) During C₄ photosynthesis:

   a) plants are able to continue producing sugars even when they must close their stomata to reduce water loss during hot days.
   b) plants utilize less ATP when producing sugar.
   c) plants are able to produce sugars without any input of carbon dioxide.
   d) plants are able to reduce water loss by producing more rubisco.
   e) plants are able to generate water molecules to cool their leaves.

33) Glycolysis:

   a) is not performed in plants, which get their energy solely through photosynthesis.
   b) occurs in all cells.
   c) is performed solely on the glucose ingested by the organism.
   d) is also referred to as the Krebs cycle.
   e) completely oxidizes glucose to carbon dioxide.

34) Which of the following statements about glycolysis is INCORRECT?

   a) It occurs in the cytoplasm of the cell.
   b) It requires oxygen.
   c) It results in the oxidation of glucose.
   d) It generates ATP.
   e) It leads to the formation of pyruvate.

35) During the Krebs cycle:

   a) the products of glycolysis are further broken down, generating additional ATP and the high-energy electron carrier NADH.
   b) cellular respiration can continue even in the absence of oxygen.
   c) the products of glycolysis are completely converted into ATP.
   d) high-energy electron carriers pass their energy to molecules of sugar which store them as potential energy.
   e) the products of glycolysis are further broken down, generating additional ATP and the high-energy electron carrier NADPH.
36) An inherited disease results from abnormal mitochondria passed from mother to child. Using your knowledge of the function of mitochondria within human cells, which of the following is the most likely description of the symptoms of this disease?

   a) extreme sensitivity to UV light, resulting in skin cancer at a very young age
   b) fragile bones and arthritis
   c) extreme muscle weakness
   d) color blindness
   e) inability to absorb iron, resulting in extreme anemia

37) Fermentation reactions generally occur under conditions of:

   a) low glucose levels.
   b) high oxygen concentrations.
   c) low methane concentrations.
   d) low oxygen concentrations.
   e) high temperatures.

38) Briefly describe the adaptations of C4 and CAM plants that reduce water loss through stomata.

   Answer: Both C4 and CAM plants reduce water loss by keeping their stomata partially or completely closed at times. C4 plants are able to incorporate carbon dioxide even when it is present in very small amounts, which allows carbon fixation to occur with stomata only partially open. CAM plants let carbon dioxide in through open stomata during the night, and use this carbon dioxide during the day while their stomata are closed.

39) Draw a picture of a chloroplast, labeling the outer and thylakoid membranes and the stroma. Where in a chloroplast do the light-harvesting reactions of photosynthesis occur? How about the sugar synthesis reactions?

   Answer: The light-harvesting reactions occur in the thylakoid membrane, and the sugar synthesis reactions occur in the stroma.