Chapter 02: Chemical Basis for Life
Colville: Clinical Anatomy and Physiology for Veterinary Technicians, 3rd Edition

MULTIPLE CHOICE

1. Which four elements make up 96% of the matter found in all living organisms?
   a. calcium, oxygen, hydrogen, carbon
   b. carbon, oxygen, calcium, nitrogen
   c. hydrogen, carbon, sodium, chloride
   d. hydrogen, oxygen, carbon, nitrogen

   ANS: D
   Calcium and sodium are found in smaller amounts and aren't included in the list of major elements.

2. The smallest unit of an element that retains the unique properties of the element is a/an
   a. atom.
   b. electron.
   c. neutron.
   d. proton.

   ANS: A
   Electrons, neutrons, and protons are smaller, subatomic particles that make up an atom.

3. A/An __ is formed when an atom gains or loses an electron.
   a. ion
   b. isotope
   c. molecule
   d. neutron

   ANS: A
   An isotope of an element is an atom that has a different number of neutrons from the typical element structure. A molecule is the smallest physical unit of an element or compound. A neutron is an elementary subparticle that has no charge and is found in the atomic nucleus.

4. The smallest unit of a compound that retains the properties of that compound is a/an
   a. atom.
   b. ion.
   c. isotope.
   d. molecule.

   ANS: D
   An atom is smallest unit of an element that retains the unique properties of the element. An ion is formed when an atom gains or loses an electron. An isotope of an element is an atom that has a different number of neutrons from the typical element structure.

5. The most abundant organic molecules in the body are
   a. carbohydrates.
   b. lipids.
   c. proteins.

d. water.

ANS: C
Carbohydrates and lipids are organic molecules found in the body, but in lesser amounts than protein. Water is not an organic molecule.

6. Sol-gel transformation is an ability of __ to transform from a fluid to a solid and back again.
   a. atoms
   b. colloids
   c. solutions
   d. suspensions

   ANS: B
   Atoms are not mixtures so are incapable of changing their physical state. Solutions and suspensions are mixtures but neither is capable of sol-gel transformation, a characteristic that defines a colloid.

7. In a mixture the component that is present in the greatest amount is the
   a. solute.
   b. solution.
   c. solvent.
   d. suspension.

   ANS: C
   A solvent has the ability to dissolve something. A solute is what is dissolved or suspended in the solvent. A solution is a solvent with a solute dissolved in it. The solute doesn't precipitate from the solvent. A suspension is a mixture that contains large solutes that will precipitate out of solution when the solution is not moved.

8. A covalent bond is formed between two molecules when they share
   a. atoms.
   b. electrons.
   c. neutrons.
   d. protons.

   ANS: B
   Because the electrons are located in the outer shells of atoms, they are the most easily shared. An atom is made up of the subatomic particles electrons, neutrons, and protons.

9. An ion with a positive charge is a/an
   a. anion.
   b. cation.
   c. electron.
   d. proton.

   ANS: B
   An anion has a negative charge. An electron is the negatively charged subatomic particle that inhabits the outer shells of an atom. A proton is a particle that, along with the neutron, makes up the atomic nucleus.

10. Special proteins in living organisms that speed up a chemical reaction but are not destroyed or used up are called

a. albumins.
b. catalysts.
c. enzymes.
d. hormones.

ANS: B
An enzyme may need the help of a catalyst to start the enzymatic reaction that will activate the enzyme. A hormone is secreted in its active form and doesn't need transformation. Albumins are plasma proteins that frequently act as inert carrier proteins.

11. An example of an organic compound is
a. ammonia.
b. carbohydrate.
c. sodium chloride.
d. water.

ANS: B
By definition an organic compound contains carbon. Ammonia, sodium chloride, and water molecules do not contain carbon atoms.

12. Water is the universal
a. solute.
b. solution.
c. solvent.
d. suspension.

ANS: C
A solute is what is dissolved or suspended in a solvent. A solution is a mixture of a solvent and a solute. A suspension is a mixture of particles suspended in a solvent but not dissolved.

13. Water and fats don't mix well because fats are
a. hydrocolloidal.
b. hydrophilic.
c. hydrophobic.
d. hydrostatic.

ANS: C
A hydrocolloidal mixture is one in which the solvent forms a gel when added to water. A hydrophilic substance is "water-loving," and fats are repelled by water, not attracted to it. A hydrostatic mixture is a mixture at rest, meaning no osmosis or diffusion is taking place.

14. Electrolytes are __
a. anabolic compounds.
b. catalysts.
c. ionized salts.
d. organic compounds.

ANS: C
Anabolic compounds are complex compounds that are built from simpler compounds. For example, joining two monosaccharide sugars together to form a disaccharide sugar requires an anabolic reaction. Catalysts speed up a chemical reaction but are not destroyed or used up by it. Organic compounds contain carbon atoms.

15. A substance that ionizes when added to water and releases a hydroxyl ion (OH^-) is a/an
    a. acid.
    b. base.
    c. electrolyte.
    d. solute.

    ANS: B
    An acid will release a hydrogen ion. An electrolyte is the substance that ionizes when added to water. A solute is a substance that is dissolved or suspended in water.

16. Of the pH values below, which is considered "neutral" pH?
    a. 5.4
    b. 7
    c. 7.4
    d. 9

    ANS: B
    A pH of 5.4 is acidic. A pH of 7.4 or 9 is basic.

17. To buffer a solution means to
    a. change the pH from acidic to basic.
    b. change the pH from basic to acidic.
    c. keep the solution in a 0 (zero) pH range.
    d. keep the solution in a neutral pH range.

    ANS: D
    Changing the pH from acid to basic or from basic to acid is just exchanging one set of homeostatic problems for another. The body must keep the pH around 7.4 to function at full capacity. Taking the pH to zero would take it to extreme acidity not compatible with life.

18. A monosaccharide contains which three atoms?
    a. calcium, hydrogen, oxygen
    b. carbon, oxygen, hydrogen
    c. hydrogen, carbon, phosphorous
    d. phosphorous, calcium, carbon

    ANS: B
    Carbon, hydrogen, and oxygen are the building blocks of all simple sugars. Calcium and phosphorus are the building blocks for bone.

19. When two monosaccharides join together they form a
    a. disaccharide.
    b. hexose sugar.
    c. pentose sugar.
    d. polysaccharide.

    ANS: A
    Di means "two," so two single (mono) saccharides joined together would produce a di (two) saccharide. Hexose sugar is six sugars joined together. Pentose sugar is five sugars joined together. By definition a polysaccharide has three or more sugars joined together. Hexose sugar and pentose sugar are polysaccharides.

20. Glycogen, the storage form of glucose, is a
    a. disaccharide.
    b. monosaccharide.
    c. oligosaccharide.
    d. polysaccharide.

    ANS: D
    Glycogen can contain over 100 glucose residues, which puts it in the category of a polysaccharide. A disaccharide has two sugar molecules. A monosaccharide is one sugar molecule. An oligosaccharide has scant or few (usually less than 10) sugar molecules.

21. Triglycerides are
    a. eicosanoids.
    b. neutral fats.
    c. phospholipids.
    d. steroids.

    ANS: B
    An eicosanoid is a lipid formed from a 20-carbon fatty acid and ring structure. A phospholipid has a phosphate group and two fatty acids instead of three fatty acids attached to the glycerol backbone. A steroid is a lipid with four interlocking hydrocarbon rings.

22. A saturated fatty acid is defined as
    a. a chain of carbon atoms with one or two hydrogen atoms attached to each carbon atom by a single bond.
    b. a chain of carbon atoms with one or two hydrogen atoms attached to each carbon atom by double or single bonds.
    c. a chain of hydrogen atoms with one or two carbon atoms attached to each hydrogen atom by a single bond.
    d. a chain of hydrogen atoms with one or two carbon atoms attached to each hydrogen atom by single or double bonds.

    ANS: A
    A saturated fatty acid is a chain of carbon atoms with one or two hydrogen atoms attached to each carbon atom by a single bond. The other three answers (B, C, and D) are combinations of carbon and hydrogen atoms that are hypothetical and don't define a fatty acid.

23. Which group of lipids has a hydrophilic end and a hydrophobic end that causes them to line up in two layers when placed in water?
    a. eicosanoids
    b. neutral fats
    c. phospholipids
    d. steroids

    ANS: C
    Eicosanoids, neutral fats, and steroids have different molecular makeups that prevent them from forming a lipid bilayer.

24. Which group of lipids is made up of a glycerol molecule and three fatty acids?
    a. eicosanoids

b. neutral fats
c. phospholipids
d. steroids

ANS: B
Neutral fats are also known as *triglycerides*. Eicosanoids, phospholipids, and steroids have different molecular makeups.

25. Which group of lipids is characterized by a lipid bilayer?
a. eicosanoids
b. neutral fats
c. phospholipids
d. steroids

ANS: C
Eicosanoids, neutral fats, and steroids have different molecular makeups that prevent them from forming a lipid bilayer.

26. Which group of lipids contains prostaglandins that help mediate an inflammatory reaction?
a. eicosanoids
b. neutral fats
c. phospholipids
d. steroids

ANS: A
Neutral fats, phospholipids, and steroids do not mediate inflammatory reactions via prostaglandins.

27. Cholesterol is classified as what type of lipid?
a. eicosanoid
b. neutral fat
c. phospholipid
d. steroid

ANS: D
The molecular structure of cholesterol with four interlocking hydrocarbon rings classifies it as a steroid. Because eicosanoids, neutral fats, and phospholipids don't have this molecular structure, they are not classified as steroids.

28. All proteins contain
a. carbon, oxygen, nitrogen, and hydrogen.
b. hydrogen, iron, phosphorous, and carbon.
c. iron, carbon, sulphur, and hydrogen.
d. oxygen, nitrogen, hydrogen, and sulphur.

ANS: A
Not all proteins contain sulphur and/or phosphorous, although some of them do.

29. A polypeptide can be made up of a chain of as many as __ amino acids.
a. 10
b. 100
c. 250

d. 66

ANS: B
After the chain of amino acids exceeds 100, it is called a *protein*.

30. Hair is an example of a __ protein.
    a. catalytic
    b. functional
    c. globular
    d. structural

    ANS: D
    Hair is water insoluble, rigid, and inert. Catalytic proteins are not inert. Functional proteins are water soluble and flexible. Globular proteins are another name for functional proteins.

31. Substances that are catalyzed by enzymes are
    a. antibodies.
    b. hormones.
    c. solutes.
    d. substrates.

    ANS: D
    Antibody and hormone reactions do not require catalysts. Solutes are substances that will dissolve or be suspended in a solvent.

32. Denatured proteins become
    a. a beta-pleated sheet of amino acids.
    b. a group of individual amino acids.
    c. a straight chain of amino acids.
    d. an alpha helix of amino acids.

    ANS: C
    Beta-pleated sheets of amino acids and alpha helix structures of amino acids are secondary protein structures that will be denatured into a straight chain of amino acids. Denaturing reactions are usually not strong enough to break the peptide bond that holds the amino acids together, so they remain together as a chain, not as individual amino acids.

33. Which three nucleotides do both DNA and RNA have in common?
    a. adenine (A), guanine (G), and cytosine (C)
    b. adenine (A), thymine (T), and cytosine (C)
    c. guanine (G), cytosine (C), and uracil (U)
    d. guanine (G), thymine (T), and uracil (U)

    ANS: A
    Thymine is unique to DNA and uracil is unique to RNA.

34. How many nucleotides are needed to create a code for an amino acid?
    a. 2
    b. 3
    c. 4
    d. 5

ANS: B
Three nucleotides are needed to create a code for an amino acid.

35. A sequence of nucleotides that carries information to make one peptide chain is a/an
    a. amino acid.
    b. chromosome.
    c. gene.
    d. ribosome.

    ANS: C
    One nucleotide carries information for one amino acid. A sequence of nucleotides makes the gene for the peptide chain. Ribosomes synthesize proteins from amino acids.

36. The double helix configuration is characteristic of
    a. chromosomes.
    b. DNA.
    c. genes.
    d. RNA.

    ANS: B
    Chromosomes, genes, and RNA each have their own unique structures.

37. The energy source for cells of the body to function properly is stored in and released by
    a. ADA.
    b. ALT.
    c. AST.
    d. ATP.

    ANS: D
    ADA (adenosine deaminase) is an enzyme. ALT (alanine aminotransferase) and AST (aspartate aminotransferase) are liver enzymes with elevated blood levels in certain liver diseases.