Name: _____ Class: _____ Date: _____

Chapter 2

1. Covalent bonds between which of the following pairs of atoms are nonpolar?
   a. C–C
   b. C–H
   c. O–H
   d. A and B

ANSWER: d

2. Which of the following is a noncovalent interaction?
   a. hydrophobic effect
   b. ionic interactions
   c. van der Waals interactions
   d. all of the above

ANSWER: d

3. Which of the following is the strongest interaction?
   a. hydrogen bond
   b. ionic bond
   c. phosphoanhydride bond
   d. van der Waals interaction

ANSWER: c

4. Which of the following is the weakest interaction?
   a. hydrogen bond
   b. ionic bond
   c. phosphoanhydride bond
   d. van der Waals interaction

ANSWER: d

5. When two atoms differing in electronegativity are joined in a covalent bond, then the:
   a. electrons are shared equally between the atoms.
   b. bond is nonpolar.
   c. resulting compound is devoid of any dipole moment.
   d. atom with the greater electronegativity attracts the bonded electrons more strongly.

ANSWER: d

6. Which of the following is a negatively charged amino acid?
   a. alanine
   b. aspartate
   c. glutamine
   d. histidine

Chapter 2

ANSWER: b

7. Which of the following is/are a hydrophilic amino acid?
   a. alanine
   b. leucine
   c. tryptophan
   d. serine

ANSWER: d

8. Adenosine is a:
   a. component of RN
   b. nucleoside.
   c. pyrimidine.
   d. a and b

ANSWER: d

9. Based on what you know about hydrophobic interactions, which of the following is/are composed of a bilayer?
   a. a cell's membrane
   b. spontaneously aggregated phospholipids surrounding an aqueous interior
   c. lipid vesicles that have budded off the cell's membrane
   d. all of the above

ANSWER: d

10. A nucleotide can vary in _____.
   a. the base
   b. the sugar
   c. the phosphate group
   d. the sugar and the base

ANSWER: d

11. Which of the following is NOT one of the ways RNA differs from DNA?
   a. Ribonucleotides have a hydroxyl group on the 2 carbon of their sugar subunit.
   b. Ribonucleotides can have enzymatic activity.
   c. Ribonucleotides contain a phosphate group.
   d. Ribonucleotides can contain the base uracil.

ANSWER: c

12. How do phospholipids interact with water molecules?
   a. The polar heads interact with water; the nonpolar tails do not.
   b. Phospholipids don't interact with water because water is polar and lipids are nonpolar.

Chapter 2

c. The polar heads avoid water; the nonpolar tails attract water (because water is polar and opposites attract).

d. Phospholipids dissolve in water.

ANSWER: a

13. Which of the following is the BEST explanation for why vegetable oil is a liquid at room temperature while animal fats are solid?

a. Vegetable oil has fewer double bonds than animal fats.
b. Animal fats have no amphipathic character.
c. Vegetable oil has longer fatty-acid tails than do animal fats.
d. Vegetable oil has more double bonds than do animal fats.

ANSWER: a

14. A 1-mL solution of 0.05 M H_2SO_4 is diluted to 100 mL at 25°C. What is the pH of the resulting solution?

a. 1
b. 2
c. 3
d. 4

ANSWER: c

15. An Archaea cell living in an abandoned mine is found to contain a very high concentration of protons. It is likely that this cell:

a. has a high ph and is acidic
b. has a high ph and is alkaline.
c. has low ph and is acidic
d. has a low pH and is alkaline.

ANSWER: c

16. A 1-mL solution of 0.1 M NaOH is diluted to 1 L at 25°C. What is the pH of the resulting solution?

a. 1
b. 7
c. 10
d. 13

ANSWER: c

17. The p*Ka* of the weak base NH_3 is 9.25. When present in lysosomes, a subcellular organelle—ammonia—is almost totally protonateD) Which of the pH values listed below is most likely to be that of the lysosome lumen?

a. 1
b. 5
c. 8

Chapter 2

d. 14

ANSWER: b

18. If the equilibrium constant for the reaction A→B is 0.5 and the initial concentration of A is 25 mM and of B is 12.5 mM, then the reaction:

a. will proceed in the direction it is written, producing a net increase in the concentration of B.
b. will produce energy, which can be used to drive ATP synthesis.
c. will proceed in the reverse direction, producing a net increase in the concentration of A.
d. is at equilibrium.

ANSWER: d

19. For the binding reaction A + B → AB, the dissociation constant is equal to:

a. [AB]/([A]+[B])
b. ([A] + [B])/[AB].
c. K_{eq}
d. The first and third answers are correct.

ANSWER: b

20. In a biochemical reaction in which $\Delta H < 0$ and $\Delta S > 0$:

a. the reaction is spontaneous.
b. the reaction is endothermic
c. the reaction is endergonic
d. ΔG is positive.

ANSWER: a

21. In the reaction $NAD^+ + H^+ + 2e^- \rightarrow NADH$, NAD^+ becomes:

a. dehydrated
b. hydrolyzed
c. oxidized
d. reduced

ANSWER: d

22. The ultimate source of energy used to make ATP for all cells is:

a. electricity.
b. heat.
c. light.
d. magnetism.

ANSWER: c

23. Hydrolysis of ATP:

Chapter 2

a. is endothermic
b. has a positive ΔG value.
c. must be coupled to an energetically favorable reaction.
d. none of the above

ANSWER: d

24. What is [P]/[R] when $\Delta G = \Delta G^{\circ\prime}$?

a. –1
b. 0
c. 1
d. 2.3

ANSWER: b

25. A reaction with a positive ΔG value can be made energetically favorable by increasing the:

a. $\Delta G^{\circ\prime}$.
b. starting concentration of products.
c. starting concentration of reactants.
d. The first two answers are correct.

ANSWER: c

26. Photosynthesis by plants and certain microbes traps the energy in light and uses it to:

a. Reduce glucose into carbon dioxide.
b. synthesize ATP from ADP and inorganic phosphate.
c. generate ATP from the oxidation of reduced inorganic compounds.
d. none of the above

ANSWER: b

27. NAD+ and FAD are often referred to as:

a. redox proteins.
b. polymers.
c. reduced dinucleotides.
d. electron-carrying coenzymes.

ANSWER: d

28. Which of the following is true about an observed change in free energy (ΔG)?

a. Free energy was created when the Big Bang occurred
b. It can be calculated from the total change in energy, temperature, and change in entropy.
c. If a reaction's free energy is greater than zero, it is likely to happen spontaneously.
d. Free energy is comparable to unusable energy.

ANSWER: b

Name: _____ Class: _____ Date: _____

Chapter 2

29. The interactions between two proteins such as an antibody and an antigen or a hormone and its receptor are quite strong despite the fact that these interactions consist of relatively weak noncovalent bonds. How can this be?

ANSWER: Two proteins can bind tightly because of molecular complementarity, in which multiple noncovalent bonds participate. Although each individual bond is weak, the cumulative effect of many noncovalent bonds is a relatively strong and highly specific interaction.

30. What produces the dipole of a water molecule?

ANSWER: The dipole of a water molecule is caused by the difference in electronegativity between O and H. The oxygen atom has a greater electronegativity than the hydrogen atom. As a result, oxygen attracts the electrons in the O–H bond more strongly, and the oxygen side of the bond has a slight net negative charge. This results in a dipole moment.

31. You discover that you suffer from a deficiency in the amino acid tryptophan. At the pharmacy, you find both tryptophan and L-tryptophan supplements. Which do you purchase? Why?

ANSWER: You should choose L-tryptophan. All amino acids can exist as one of two stereoisomers (D or L) because of asymmetry around the α carbon. Proteins consist of the L form of amino acids, and as these stereoisomers possess distinct biological properties and are not readily interconverted, you should choose the form that is normally utilized by cells.

32. Cysteine often plays an important role in stabilizing protein structure. Explain how this works.

ANSWER: Two adjacent sulfhydryl (SH) groups can oxidize to form a covalent disulfide (S–S) bond. Disulfide bonds can stabilize the structure of folded peptides or sometimes link two separate peptide chains together.

33. Triacylglycerol and cholesterol esters are nonpolar; in contrast, phospholipids are amphipathic molecules. Biomembranes are based on phospholipids rather than on triacylglycerols. Why?

ANSWER: Biomembranes are based on phospholipids rather than on triacylglycerols because phospholipids as amphipathic molecules can form planar lipid bilayers, whereas the nonamphipathic nonpolar triacylglycerols cannot. Their amphipathic property, the presence of a polar and nonpolar domain at opposite ends of the same molecule, allows phospholipids to form hydrophilic associations with water at the same time as forming hydrophobic associations with each other through their hydrophobic tails. Triacylglycerols are strictly hydrophobic in nature and hence in an aqueous environment tend to associate with one another to form lipid droplets. This minimizes the contact of triacylglycerol with water. Recall the old adage: oil and water do not mix.

34. How do cells maintain a relatively constant pH despite the fact that many metabolic processes produce acids?

ANSWER: All cells contain buffers such as phosphate ions that can absorb or release protons or hydroxyl ions to stabilize pH changes near neutral pH.

35. What is the effect of an enzyme on the end equilibrium concentration of reactants and products?

ANSWER: An enzyme has no effect on the end equilibrium concentration of reactants and products.

Name: _____ Class: _____ Date: _____

Chapter 2

36. The enzyme alcohol dehydrogenase is capable of catalyzing the oxidation of a number of different substances, including ethanol, ethylene glycol, and methanol, to an aldehyde. The metabolic products of both ethylene glycol and methanol are highly toxic to humans. A standard medical treatment for prevention of ethylene glycol or methanol poisoning is the administration of a dose of ethanol. Why is this treatment effective?

ANSWER: The ethanol-like ethylene glycol and methanol are capable of binding to the enzyme, alcohol dehydrogenase, and competing with its other substrates. A sufficient dosage of ethanol can out-compete the other substrates, and hence the ethylene glycol and methanol are not metabolized to toxic products. Gradually the ethylene glycol or methanol will be excreted from the body.

37. A solution of 8 M urea is sometimes used in the isolation of protein molecules. When the solution is prepared by dissolving urea in water at room temperature, it becomes cold. How should the ΔG for this process change if you tried to dissolve urea in the cold room, rather than at room temperature?

ANSWER: Urea will be less soluble at cold temperatures than at room temperature because the decrease in temperature will decrease the term $T\Delta S$, increasing the value of ΔG, because $\Delta G = \Delta H - T\Delta S$. The values of ΔH and ΔS are relatively independent of temperature.

38. Phosphoglucomutase converts glucose 1-phosphate, the product of the reaction catalyzed by glycogen phosphorylase, into glucose 6-phosphate. The K_{eq} for this reaction is 19 under standard conditions. What is the Δ for the reaction?

ANSWER: −1.741 kcal/mol, $\Delta G^{\circ\prime} = -2.3RT \log K_{eq}$, $\Delta G^{\circ\prime} = -2.3\ (1.987)\ (298) \log Keq$

39. Under what conditions is the ΔG for a reaction different from the $\Delta G^{\circ\prime}$?

ANSWER: ΔG°′ is the Gibbs free energy of a reaction under standard conditions: pH 7.0, 1 M initial concentration of all reactants and products except protons and water, 1 atm pressure, 298°K (25°C). Variation of any of these parameters from standard conditions, depending on the reaction, can produce a different ΔG value.

40. Which of the following is a monosaccharide?

a. fructose
b. galactose
c. glucose
d. all of the above

ANSWER: d

41. What is the major structural difference between starch and cellulose?

a. the types of monosaccharide subunits in the molecules
b. the amount of branching that occurs in the molecule
c. that humans can only ingest starch
d. the type of glycosidic linkages in the molecule

ANSWER: d

42. The amount of free energy released when bonds are broken during a reaction is higher when the molecule has more electronegative atoms.

Chapter 2

a. True
b. False

ANSWER: False