C-2 To Know for the Final Exam

PART 1: BASIC CHEMISTRY

I. Definition of Concepts: Matter and Energy (pp. 25–27)

A. Matter is anything that occupies space and has mass (p. 25).

B. States of Matter (p. 25)

  1. Matter exists in one of three states: solid, liquid, or gas.

C. Energy (pp. 25–27)

  1. Energy is the capacity to do work, and it exists in two forms.
     a. Kinetic energy is the energy of motion.
     b. Potential energy is stored energy.
  3. Energy is easily converted from one form to another.

II. Composition of Matter: Atoms and Elements (pp. 27–30)

A. Basic Terms (p. 27; Table 2.1)

  2. Four elements: carbon, hydrogen, oxygen, and nitrogen make up roughly 96% of body weight.
  3. Atoms are the smallest particles of an element that retain the characteristics of that element.
  4. Elements are designated by a one- or two-letter abbreviation called the atomic symbol.

B. Atomic Structure (pp. 27–29; Figs. 2.1–2.2)

  1. Each atom has a central nucleus with tightly packed protons and neutrons.
     a. Protons have a positive charge and weigh 1 atomic mass unit (amu).
     b. Neutrons do not have a charge and weigh 1 amu.
  2. Electrons are found moving around the nucleus, have a negative charge, and are almost weightless (0 amu).
  3. Atoms are electrically neutral and the number of electrons is equal to the number of protons.

D. Atomic Number (pp. 28–29)

  1. The atomic number of an element is equal to the number of protons of an element.
  2. Since the number of protons is equal to the number of electrons, the atomic number indirectly tells us the number of electrons.

E. Mass Number and Isotopes (p. 29; Fig. 2.3)

  1. The mass number of an element is equal to the number of protons plus the number of neutrons.
  2. The electron is almost weightless and is ignored in calculating the mass number.
  3. Isotopes are structural variations of an atom. They have the same number of protons and neutrons of all other atoms of the element but differ in the number of neutrons the atom has.

A. Molecules and Compounds (p. 30)

  1. A combination of two or more atoms is called a molecule.
  2. If two or more atoms of the same element combine it is called a molecule of that element.
  3. If two or more atoms of different elements combine it is called a molecule of a compound.

B. Mixtures (pp. 30–31)

  1. Mixtures are substances made of two or more components mixed physically.

2. Solutions are homogeneous mixtures of compounds that may be gases, liquids, or solids.
   a. The substance present in the greatest amounts is called the solvent.
   b. Substances present in smaller amounts are called solutes.
   c. Solutions may be described by their concentrations. These may be expressed as a percent or in terms of its molarity.
3. Colloids or emulsions are heterogeneous mixtures.
4. Suspensions are heterogeneous mixtures with large, often visible solutes that tend to settle out.

C. Distinguishing Mixtures and Compounds (p. 31)
1. The main difference between mixtures and compounds is that no chemical bonding occurs between molecules of a mixture.
2. Mixtures can be separated into their chemical components by physical means; separation of compounds is done by chemical means.
3. Some mixtures are homogeneous, while others are heterogeneous.

IV. *Chemical Bonds (pp. 31–36)*

1. The Role of Electrons in Chemical Bonding (Fig. 2.4)
   a. Electrons occupy regions of space called electron shells that surround the nucleus in layers.
   b. Each electron shell represents a different energy level.

B. Types of Chemical Bonds (pp. 33–36; Figs. 2.5–2.10)
1. Ionic bonds are chemical bonds that form between two atoms that transfer one or more electrons from one atom to the other.
   a. Ions are charged particles.
   b. An anion is an electron acceptor carrying a net negative charge due to the extra electron.
   c. A cation is an electron donor carrying a net positive charge due to the loss of an electron.
   d. Crystals are large structures of cations and anions held together by ionic bonds.
2. Covalent bonds form when electrons are shared between two atoms.
   a. Some atoms are capable of sharing two or three electrons between them, resulting in double covalent or triple covalent bonds.
   b. Nonpolar molecules share their electrons evenly between two atoms.
   c. In polar molecules, electrons spend more time around one atom thus providing that atom with a partial negative charge, while the other atom takes on a partial positive charge.
3. Hydrogen bonds are weak attractions that form between partially charged atoms found in polar molecules.

A. Chemical Reactions (pp. 36–37)
1. Chemical reactions occur whenever bonds are formed, rearranged, or broken.
2. Chemical Equations
   a. A chemical equation describes what happens in a reaction.
   b. Chemical reactions denote the kinds and number of reacting substances, called reactants; the chemical composition of the products; and the relative proportion of each reactant and product, if balanced.

C. Energy Flow in Chemical Reactions (pp. 38–39)

1. Exergonic reactions release energy as a product, while endergonic reactions absorb energy.

E. Factors Influencing the Rate of Chemical Reactions (pp. 39–40)
   2. An increase in temperature increases the rate of a chemical reaction.
   3. Smaller particle size results in a faster rate of reaction.
   4. Higher concentration of reactants results in a faster rate of reaction.
   5. Catalysts increase the rate of a chemical reaction without taking part in the reaction.

PART 2: BIOCHEMISTRY

I. Inorganic Compounds (pp. 40–43)

A. Water (pp. 40–41)
   1. Water is the most important inorganic molecule, and makes up 60–80% of the volume of most living cells.
   2. Water has a high heat capacity, meaning that it absorbs and releases a great deal of heat before it changes temperature.
   3. Water has a high heat of vaporization, meaning that it takes a great deal of energy (heat) to break the bonds between water molecules.
   4. Water is a polar molecule and is called the universal solvent.
   5. Water is an important reactant in many chemical reactions.
   6. Water forms a protective cushion around organs of the body.

B. Salts (p. 41; Fig. 2.12)
   1. Salts are ionic compounds containing cations other than H^+

C. Acids and Bases (pp. 41–43; Fig. 2.13)

   3. The relative concentration of hydrogen ions is measured in concentration units called pH units.
      a. The greater the concentration of hydrogen ions in a solution, the more acidic the solution is.
      b. The greater the concentration of hydroxyl ions, the more basic, or alkaline, the solution is.
      c. The pH scale extends from 0–14. A pH of 7 is neutral; a pH below 7 is acidic; a pH above 7 is basic or alkaline.
   4. Neutralization occurs when an acid and a base are mixed together. They react with each other in displacement reactions to form a salt and water.
   5. Buffers resist large fluctuations in pH that would be damaging to living tissues.

II. Organic Compounds (pp. 43–59)

A. Carbohydrates (pp. 44–46; Fig. 2.14)
   1. Carbohydrates are a group of molecules including sugars and starches.
   2. Carbohydrates contain carbon, hydrogen, and oxygen.
   3. The major function of carbohydrates in the body is to provide cellular fuel.
   4. Monosaccharides are simple sugars that are single-chain or single-ring structures.
   5. Disaccharides are formed when two monosaccharides are joined by a dehydration synthesis.
   6. Polysaccharides are long chains of monosaccharides linked together by dehydration synthesis.

B. Lipids (pp. 46–48; Table 2.2; Fig. 2.15)

    1. Lipids are insoluble in water but dissolve readily in nonpolar solvents.
    2. Triglycerides (neutral fats) are commonly known as fats when solid and oils when liquid.

C. Proteins (pp. 48–54; Table 2.3; Figs. 2.16–2.21)

    1. Proteins compose 10–30% of cell mass.
        a. They are the basic structural material of the body.
        b. They also play vital roles in cell function.
    2. Proteins are long chains of amino acids connected by peptide bonds.
    3. Proteins can be described in terms of four structural levels.
        a. The linear sequence of amino acids is the primary structure.
        b. Proteins twist and turn on themselves to form a more complex secondary structure.
        c. A more complex structure is tertiary structure, resulting from protein folding upon itself to form a ball-like structure.
    4. Fibrous and Globular Proteins
        a. Fibrous proteins are extended and strandlike. They are known as structural proteins and most have only secondary structure.
        b. Globular proteins are compact, spherical structures. They are water soluble, chemically active molecules, and play an important role in vital body functions.
    5. Protein denaturation is a loss of the specific three-dimensional structure of a protein. It may occur when globular proteins are subjected to a variety of chemical and physical changes in their environment.
    7. Enzymes and Enzyme Activity
        a. Enzymes are globular proteins that act as biological catalysts.

D. Nucleic Acids (DNA and RNA) (pp. 54–57; Table 2.4; Fig. 2.22)

    1. Nucleic acids are the largest molecules in the body.
    2. Nucleotides are the structural units of nuleic acids.
    3. Each nucleotide consists of three components: a pentose sugar, phosphate group, and a nitrogen-containing base.
    4. There are five nitrogenous bases used in nucleic acids: Adenine (A), Guanine (G), Cytosine (C), Uracil (U), and Thymine (T).
    5. DNA, or Deoxyribonucleic Acid
        a. DNA is the genetic material of the cell, and is found within the nucleus.
        b. DNA replicates itself before cell division and provides instructions for making all of the proteins found in the body.
        c. The structure of DNA is a double-stranded polymer containing the nitrogenous bases A, T, G, and C, and the sugar deoxyribose.
        d. Bonding of the nitrogenous bases in DNA is very specific; A bonds to T, and G bonds to C.
        e. The bases that always bind together are known as complementary bases.
    6. RNA, or Ribonucleic Acid
        a. RNA is located outside the nucleus, and is used to make proteins using the instructions provided by the DNA.
        b. The structure of RNA is a single-stranded polymer containing the nitrogenous bases A, G, C, and U, and the sugar ribose.
        c. In RNA, G bonds with C, and A bonds with U.

E. ATP, or Adenosine Triphosphate (pp. 57–59; Figs. 2.23–2.24)

1. ATP is the energy currency used by the cell.
2. ATP is an adenine-containing RNA nucleotide that has two additional phosphate groups attached.
3. The additional phosphate groups are connected by high energy bonds.
4. Breaking the high energy bonds releases energy the cell can use to do work.