Unit 2: Basic Chemistry Study Guide

CONCEPTS OF MATTER AND ENERGY Chapter 2

A. Select all phrases that apply to each of the following statements and insert the letters in the answer blanks.

1. The energy located in the bonds of food molecules:
   A. is called thermal energy
   B. is a form of potential energy
   C. causes molecular movement
   D. can be transformed to the bonds of ATP

2. Heat is:
   A. thermal energy
   B. infrared radiation
   C. kinetic energy
   D. molecular movement

3. Whenever energy is transformed:
   A. the amount of useful energy decreases
   B. some energy is lost as heat
   C. some energy is created
   D. some energy is destroyed

Use choices from the key to identify the energy form in use in each or the following examples.

Key Choices
A. Chemical  B. Electrical  C. Mechanical  D. Radiant

1. Chewing food  C - MECHANICAL
2. Vision (two types, please—think!)  B - ELECTRICAL & D - RADIANT
3. Bending your fingers to make a fist  C - MECHANICAL
4. Breaking the bonds of ATP molecules to energize your muscle cells to make that fist  A - CHEMICAL
5. Lying under a sunlamp  D - RADIANT
## COMPOSITION OF MATTER

### B
Complete the following table by inserting the missing words.

<table>
<thead>
<tr>
<th>Particle</th>
<th>Location</th>
<th>Electrical charge</th>
<th>Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proton</td>
<td>Nucleus</td>
<td>+1</td>
<td>1 Amu</td>
</tr>
<tr>
<td>Neutron</td>
<td>Nucleus</td>
<td>Ø</td>
<td>1 Amu</td>
</tr>
<tr>
<td>Electron</td>
<td>Orbitals</td>
<td>-1</td>
<td>Ø Amu</td>
</tr>
</tbody>
</table>

Insert the chemical symbol (the chemist’s shorthand) in the answer blank for each of the following elements.

1. Oxygen  
2. Carbon  
3. Potassium
4. Iodine  
5. Hydrogen  
6. Nitrogen  
7. Calcium  
8. Sodium  
9. Phosphorus  
10. Magnesium  
11. Chlorine  
12. Iron

### C
Using the key choices, select the correct responses to the following descriptive statements. Insert the appropriate answers in the answer blanks.

**Key Choices**

A. Atom  
B. Electrons  
C. Element  
D. Energy  
E. Ion  
F. Matter  
G. Molecule  
H. Neutrons  
I. Protons  
J. Valence

1. An electrically charged atom or group of atoms
2. Anything that takes up space and has mass
3. A unique substance composed of atoms having the same atomic number
4. Negatively charged particles, forming part of an atom
5. Subatomic particles that determine an atom’s chemical behavior, or bonding ability
6. The ability to do work
7. The smallest particle of an element that retains the properties of the element
8. The smallest particle of a compound, formed when atoms combine chemically
9. Positively charged particles forming part of an atom
10. Name given to the electron shell that contains the most reactive electrons
11. Proton
12. Subatomic particles responsible for most of an atom’s mass
For each of the following statements that is true, insert \( T \) in the answer blank. If any of the statements are false, correct the underlined term by inserting your correction in the answer blank.

1. \( \text{Na}^+ \) and \( \text{K}^+ \) are **needed** for nerve cells to conduct electrical impulses.

2. The atomic number of oxygen is 8. Therefore, oxygen atoms always contain 8 **neutrons**.

3. The greater the distance of an electron from the nucleus, the less energy it has.

4. Electrons are located in more or less designated areas of space around the nucleus called **orbitals**.

5. An unstable atom that decomposes and emits energy is called **radioactive**.

6. Iron is necessary for oxygen transport in red blood cells.

7. The most abundant negative ion in extracellular fluid is **calcium**.

8. The element essential for the production of thyroid hormones is **magnesium**.

9. Calcium is found as a salt in bones and teeth.

**MOLECULES, CHEMICAL BONDS, AND CHEMICAL REACTIONS**

**E**

Match the terms in Column B to the chemical equations listed in Column A. Enter the correct letter or term in the answer blanks. **Write all answers that apply.**

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Decomposition</strong></td>
<td>1. ( \text{A} + \text{B} \rightarrow \text{AB} )</td>
</tr>
<tr>
<td><strong>B. Exchange</strong></td>
<td>2. ( \text{AB} + \text{CD} \rightarrow \text{AD} + \text{CB} )</td>
</tr>
<tr>
<td><strong>C. Synthesis</strong></td>
<td>( \text{XY} \rightarrow \text{X} + \text{Y} )</td>
</tr>
<tr>
<td><strong>D. Anabolic</strong></td>
<td><strong>E. Catabolic</strong></td>
</tr>
</tbody>
</table>
Figure 2-1 is a diagram of an atom. Select two different colors and use them to color the coding circles and corresponding structures on the figure. Complete this exercise by responding to the questions that follow, referring to the atom in this figure. Insert your answers in the answer blanks provided.

*Nucleus* **YELLOW**

*Electrons* **BLUE**

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1. What is the atomic number of this atom? **6**

2. What is its atomic mass? **12 AMU**

3. What atom is this? **CARBON**

4. If this atom had one additional neutron but the other subatomic particles remained the same as shown, this slightly different atom (of the same element) would be called a(n) **ISOTOPE**

5. Is this atom chemically active or inert? **ACTIVE**

6. How many electrons would be needed to fill its outer (valence) shell? **4**

7. Would this atom most likely take part in forming ionic or covalent bonds? **COVALENT** why **EASIER TO SHARE ELECTRONS**; **DIFFICULT TO ACCEPT OR DONATE** 4 **ELECTRONS**.

Both H₂O₂ and 2OH⁻ are chemical species with two hydrogen atoms and two oxygen atoms. Briefly explain how these species are different:

**H₂O₂**: ONE COMPOUND

**2OH⁻**: TWO COMPOUNDS
Two types of chemical bonding are shown in Figure 2-2. In the figure, identify each type as a(n) ionic or covalent bond. In the case of the ionic bond, indicate which atom has lost an electron by adding a colored arrow to show the direction of electron transfer. For the covalent bond, indicate the shared electrons.

Type of bond: ionic

Type of bond: covalent

Figure 2-2
Figure 2–3 illustrates five water molecules held together by hydrogen bonds. First, correctly identify the oxygen and hydrogen atoms both by color and by inserting their atomic symbols on the appropriate circles (atoms). Then label the following structures in the figure:

- **Oxygen** - **GREEN**
- **Hydrogen** - **RED**
- **Positive pole (end)** - **BLUE**
- **Negative pole (end)** - **ORANGE**
- **Hydrogen bonds** - **YELLOW**

Figure 2–3

Respond to the instructions following the equation:

\[ \text{H}_2\text{CO}_3 \rightarrow \text{H}^+ + \text{HCO}_3^- \]

1. In the space provided, list the chemical formula(s) of compounds. \[ \text{H}_2\text{CO}_3, \text{HCO}_3^- \]
2. In the space provided, list the chemical formula(s) of ions. \[ \text{H}^+, \text{HCO}_3^- \]
3. Circle the product(s) of the reaction.
4. Modify the equation by adding a colored arrow in the proper place to indicate that the reaction is reversible.
BIOCHEMISTRY:
THE COMPOSITION OF LIVING MATTER

Use the key choices to identify the substances described in the following statements. Insert the appropriate letter(s) or corresponding term(s) in the answer blanks.

Key Choices
A. Acid(s)    B. Base(s)    C. Buffer    D. Salt(s)

A. Acid  1. B. Base  2. D. Salt  3. Substances that ionize in water; good electrolytes

B. Base

A. Acid

D. Salt

D. Salt

A. Acid

C. Buffer

9. Prevents rapid/large swings in pH

Complete the following statements concerning the properties and biological importance of water.

Heat Capacity

H₂O

60-80%

Hydrogen

Hydrolysis

Condensation / Dehydration

Polarity

Lubricants / Fluids

The ability of water to maintain a relatively constant temperature and thus prevent sudden changes is because of its high (1). Biochemical reactions in the body must occur in (2). About (3) % of the volume of a living cell is water. Water molecules are bonded to other water molecules because of the presence of (4) bonds. Water, as H⁺ and OH⁻ ions, is essential in biochemical reactions such as (5) and (6) reactions. Because of its (7), water is an excellent solvent and forms the basis of mucus and other body (8).

Use an X to designate which of the following are organic compounds.

Carbon dioxide    X    Fats    X    Proteins

Oxygen

KCl    X    Glucose    X    DNA

H₂O
Using the key choices, fully characterize weak and strong acids.

Key Choices
A. Ionize completely in water
B. Ionize incompletely in water
C. Act as part of a buffer system
D. When placed in water, always act to change the pH

Weak acid: B, C, E
Strong acid: A, D, E, F, G

Match the terms in Column B to the descriptions provided in Column A. Enter the correct letter(s) or term(s) in the answer blanks.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-MONOSACCHARIDES</td>
<td>1. Building blocks of carbohydrates</td>
</tr>
<tr>
<td>D-FATTY ACID</td>
<td>2. Building blocks of fat</td>
</tr>
<tr>
<td>A-AMINO ACID</td>
<td>3. Building blocks of protein</td>
</tr>
<tr>
<td>F-NUCLEOTIDES</td>
<td>4. Building blocks of nucleic acids</td>
</tr>
<tr>
<td>H-PROTEINS</td>
<td>5. Cellular cytoplasm is primarily composed of this substance</td>
</tr>
<tr>
<td>G-MONO or B-CARBS</td>
<td>6. The single most important fuel source for body cells</td>
</tr>
<tr>
<td>C-LIPOS</td>
<td>7. Not soluble in water</td>
</tr>
<tr>
<td>B-CARBS or G-MONOSACCHARIDES</td>
<td>8. Contain C, H, and O in the ratio CH₂O</td>
</tr>
<tr>
<td>C-LIPOS</td>
<td>9. Contain C, H, and O, but have relatively small amounts of oxygen</td>
</tr>
<tr>
<td>F-NUCLEOTIDES</td>
<td>10. A-AMINO ACIDS</td>
</tr>
<tr>
<td>11. These building blocks contain N in addition to C, H, and O</td>
<td></td>
</tr>
<tr>
<td>F-NUCLEOTIDES</td>
<td>12. Contain P in addition to C, H, O, and N</td>
</tr>
<tr>
<td>C-LIPOS</td>
<td>13. Used to insulate the body and found in all cell membranes</td>
</tr>
<tr>
<td>H-PROTEINS</td>
<td>14. Primary components of meat and cheese</td>
</tr>
<tr>
<td>B-CARBS</td>
<td>15. Primary components of bread and lollipops</td>
</tr>
<tr>
<td>C-LIPOS</td>
<td>16. Primary components of egg yolk and peanut oil</td>
</tr>
<tr>
<td>H-PROTEINS</td>
<td>17. Include collagen and hemoglobin</td>
</tr>
<tr>
<td>C-LIPOS</td>
<td>18. Class that usually includes cholesterol</td>
</tr>
</tbody>
</table>
Using the key choices, correctly select all terms that correspond to the following descriptions. Insert the correct letter(s) or their corresponding term(s) in the answer blanks.

Key Choices
A. Cholesterol  D. Enzyme  G. Hormones  J. Maltose
B. Collagen  E. Glycogen  H. Keratin  K. RNA
C. DNA  F. Hemoglobin  I. Lactose  L. Starch

1. Example(s) of fibrous (structural) proteins
2. Example(s) of globular (functional) proteins
3. Biologic catalyst
4. Plant storage carbohydrate
5. Animal storage carbohydrate
6. The "stuff" of the genes
7. A steroid
8. Double sugars, or disaccharides

Five simplified diagrams of biological molecules are depicted in Figure 2-4. First, identify the molecules and insert the correct names in the answer blanks on the figure. Then select a different color for each molecule listed below and use them to color the coding circles and the corresponding molecules on the illustration.
For each true statement, insert T in the answer blank. If any are false, correct the underlined term and insert your correction in the answer blank.

1. Phospholipids are polarized molecules.  
2. Steroids are the major form in which body fat is stored.  
3. Water is the most abundant compound in the body.  
4. Nonpolar molecules are generally soluble in water.  
5. The bases of RNA are A, G, C, and U.  
6. The universal energy currency of living cells is RNA.  
7. RNA is single stranded.  
8. The four elements that make up more than 90% of living matter are C, H, N, and Na.

The biochemical reaction shown in Figure 2–6 represents the complete digestion of a polymer (a large molecule as consumed in food) down to its constituent monomers, or building blocks. Select two colors and color the coding circles and the structures. Then, select the one correct answer for each statement below and insert your answer in the answer blank.

**Figure 2–6**

1. If starch is the polymer, the monomer is:
   A. glycogen  B. amino acid  C. glucose  D. maltose
2. During polymer digestion, water as H⁺ and OH⁻ ions would:
   A. be a product of the reaction.
   B. act as a catalyst.
   C. enter between monomers, bond to them, and keep them separated.
   D. not be involved in this reaction.
3. Another name for the chemical digestion of polymers is:
   A. dehydration  B. hydrolysis  C. synthesis  D. displacement
4. If the monomers are amino acids, they may differ from each other by their:
   A. R group  B. amino group  C. acid group  D. peptide bond
Various types of foods are ingested in the diet and broken down to their building blocks. Use the key choices to complete the following statements according to these understandings. Insert the correct term or letter in the answer blanks. In some cases, more than one choice applies.

**Key Choices**

A. Amino acids  
B. Fatty acids  
C. Fructose  
D. Galactose  
E. Glucose  
F. Lactose  
G. Maltose  
H. Starch  
I. Sucrose

1. The building blocks of carbohydrates are monosaccharides, or simple sugars. The three common simple sugars in our diet are ____, ____ , and ____.

2. Disaccharides include ____, ____ , and ____.

3. Protein foods must be digested to ____ before they can be absorbed.

4. Fats are broken down to two types of building blocks, ____ and glycerol.

5. Of the simple sugars, ____ is most important because it is the sugar referred to as “blood sugar.”

**NUTRITION AND METABOLISM**

*Nutrients Used by Body Cells*  
*Chapter 24*

Using the key choices, identify the foodstuffs used by cells in the cellular functions described below. Insert the correct term or key letter in the answer blanks.

**Key Choices**

A. Amino acids  
B. Carbohydrates  
C. Lipids

B. - CARBS  
C. - FATS  
A. - AMINO ACIDS

1. The most used substance for producing the energy-rich ATP

2. Important in building myelin sheaths and cell membranes

3. Tend to be conserved by cells

4. The second most important food source for making cellular energy

5. Form insulating deposits around body organs and beneath the skin

6. Used to make the bulk of cell structure and functional substances such as enzymes