Chapter 3: Matter and Energy – Study Guide

*Do not forget about the extra resources available to help you study and prepare for this test!
  - Textbook pages 81-93 (answers to odd questions in the back of the book)
  - Mastering Chemistry Study Area: http://www.pearsonmylabandmastering.com/northamerica/
  - Miss Marnik’s Website: http://www.northallegheny.org/Page/16665
  - Labs, problem packets, and homework assignments

Section 1 – Classifying Matter: (text pages 57-62)

Need to be able to:
  - Define matter, atoms, molecules, element, compound, and mixture.
  - Classify matter as and distinguish between solid, liquid, or gas.
  - Classify matter as element, compound, or mixture.

Practice Problems:
1. Match the following terms with the phrases below:

   6. a. State of matter in which atoms or molecules pack close to each other in fixed locations
   3. b. State of matter in which atoms or molecules are packed close together but are free to move around and by each other
   5. c. Substance composed of only one type of atom or molecule
   4. d. Matter composed of two or more different types of atoms or molecules combined in variable proportions
   1. e. Mixture that has two or more regions with different compositions
   2. f. Mixture that has the same composition throughout

2. Which of the following can be classified as matter?
   - a. atoms
   - b. gas
   - c. wind
   - d. liquids
   - e. potential energy
   - f. temperature
   - g. carbon
   - h. light

3. Classify each type of matter as a pure substance or a mixture. If it is a pure substance, classify it as an element or a compound. If it is a mixture, classify it as homogeneous or heterogeneous.
   - a. limestone (CaCO₃) pure - compound
   - b. orange juice with pulp mixture heterogeneous
   - c. helium pure - element
   - d. Pacific ocean mixture heterogeneous
   - e. Cheex mix mixture heterogeneous
   - f. Table salt pure compound
   - g. Brass mixture homogeneous
   - h. oxygen pure element
4. Distinguish between a crystalline solid and an amorphous solid.

Crystalline solids have long range order of their molecules with repeating patterns. (ex: diamonds, salt)
Amorphous solids have no repeating patterns. (ex: glass, rubber)

5. Would the following pictures be classified as pure substances or as mixtures?

![Pure](image1)
![Pure](image2)
![Mixture](image3)
![Pure](image4)

6. Describe the differences between solutions, suspensions, colloids, and alloys.

**Solutions** homogenous mixtures in which one substance is dissolved in another. Molecules NEVER settle out.

**Suspension**: heterogeneous mixture in which particles settle eventually evenly. Scatters light.

**Colloid**: homogenous mixture in which large particles are distributed evenly. Scatters light.

**Alloy**: homogeneous mixture of at least one metal and another metal/nonmetal

Section 2 – Changes in Matter: (text pages 63-68)

Need to be able to:
- Distinguish between physical and chemical properties.
- Distinguish between physical and chemical changes.

Practice Problems

7. Match the following terms with the phrases below:

| a. Property that a substance displays without changing its composition | 1. chemical change |
| b. Property that a substance displays only through changing its composition | 2. chemical property |
| c. Change in matter with no change in composition | 3. chemical reaction |
| d. Change in composition of matter | 4. decanting |
| e. Substance present in a chemical reaction before the chemical change | 5. distillation |
| f. Substance present in a chemical reaction after the chemical change | 6. filtration |
| g. Process by which one or more substances transform into different substances via a chemical change | 7. physical change |
| h. Separation technique that involves pouring off a liquid from a solid | 8. physical property |
| i. Separation technique that separates liquid mixtures by heating them to their boiling points. | 9. product |
| j. Separation process in which a liquid and solid mixture is poured through filter paper | 10. reactant |
8. Decide if each of the following is a physical or chemical property:
   a. the explosiveness of hydrogen gas
      chemical
   b. the bronze color of copper
      physical
   c. the shiny appearance of silver
      physical
   d. the ability of dry ice to sublime
      physical

9. Decide if each of the following is a physical or chemical change:
   a. Ice melting
      physical
   b. Silver tarnishing to a dull finish
      chemical
   c. A candle burning
      Chemical
   d. Puddles evaporating in the sun
      physical

10. List four observations that would be evidence that a chemical reaction has taken place.
    ① color change  ② gas released
    ③ Energy change  ④ precipitation (solid formed)

11. Would the following picture represent a physical or a chemical change? Explain your answer.

   Physical. The molecules do not change composition, they are only farther apart.

12. Explain how paper chromatography separates mixtures:
    A sample of the mixture is placed on the paper. The paper (stationary phase) is placed into a liquid solvent (mobile phase). The solvent travels up the paper and dissolves the mixture. Different components of the mixture separate and travel at different rates with the solvent.

13. Potassium iodide reacts with chlorine to form potassium chloride and iodine. If 7.16 g of potassium iodide reacts with 1.53 g of chlorine to form 3.22 g of potassium chloride, how many grams of iodine form?

   Potassium Iodide + Chlorine → Potassium Chloride + Iodine
   7.169 g + 1.53 g → 3.22 g + x

   \[8.699 g \rightarrow 3.22 g + x\]

   x = 5.47 g of I
Section 3 – Energy: (text pages 68-72)

Need to be able to:

- Recognize the different forms of energy.
- Identify and convert among energy units.
- Distinguish between exothermic and endothermic reactions.

Practice Problems:

14. Match the following terms with the phrases below:

- Energy can be neither created nor destroyed 1. Calorie
- Energy associated with motion 2. chemical energy
- Energy associated with position 3. electrical energy
- Energy associated with the flow of electrical charge 4. endothermic
- Energy associated with potential chemical changes 5. exothermic
- Energy associated with random motions of atoms and molecules in matter 6. kilowatt-hour (kWh)
- Unit of energy equal to 1000 calories 7. kinetic energy
- Unit of energy that appears on electricity bills 8. law of conservation of energy
- Process that absorbs energy from the surroundings 9. potential energy
- Process that emits energy to the surroundings 10. thermal energy

15. Distinguish between potential and kinetic energy.

**Kinetic energy** is associated with movement or motion.

**Potential energy** is stored energy due to height or position.

16. Classify each as having either kinetic energy or potential energy.

a. batteries in a package  **potential**

b. a person that has climbed to the top of a tree  **potential**

c. a roller coaster in motion at the bottom of a hill  **kinetic**

d. air molecules in a balloon  **kinetic**

e. an arrow pulled back, ready to shoot  **potential**

f. a firework exploding  **kinetic**
17. How many joules are in one calorie? How many calories are in one Calorie?

\[
1 \text{ calorie} = 4.184 \text{ J} \\
1000 \text{ cal} = 1 \text{ Cal}
\]

18. Convert \(3.16 \times 10^2\) cal to joules.

\[
3.16 \times 10^2 \text{ cal} \times \frac{4.184 \text{ J}}{1 \text{ cal}} = 1322.144 \text{ J} = 1320 \text{ J}
\]

19. If you were counting Calories, and consumed 2160 Calories in one day, what would this be in Joules?

\[
2160 \text{ Cal} \times \frac{1000 \text{ cal}}{1 \text{ Cal}} \times \frac{4.184 \text{ J}}{1 \text{ cal}} = 9037440 \text{ J} = 9,040,000 \text{ J}
\]

20. Classify each of the following as either exothermic or endothermic changes:

a. Freezing water **Exothermic**

b. Boiling water **Endothermic**

c. Cooking an egg **Endothermic**

d. Burning of propane **Exothermic**

Section 4 – Thermal Energy: (text pages 72-80)

Need to be able to:

- Convert between Fahrenheit, Celsius, and Kelvin temperature scales.
- Relate energy, temperature change, and heat capacity.
- Explain specific heat capacity.
- Apply calorimetry when solving specific heat problems.

Practice Problems:

21. Match the following terms with the phrases below:

<table>
<thead>
<tr>
<th>Term</th>
<th>Phrase</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 a. Temperature scale commonly used in the United States</td>
<td>11. calorimeter</td>
</tr>
<tr>
<td>12 b. Temperature scale used by scientists that contains negative values</td>
<td>12. Celsius scale</td>
</tr>
<tr>
<td>15 c. Temperature scale used by scientists that contains no negative values</td>
<td>13. Fahrenheit scale</td>
</tr>
<tr>
<td>14 d. Quantity of heat energy required to raise the temperature of a given amount of substance by 1°C</td>
<td>14. heat capacity</td>
</tr>
<tr>
<td>16 e. Amount of energy required to raise the temperature of 1 g of a substance by 1°C</td>
<td>15. Kelvin scale</td>
</tr>
<tr>
<td>11 f. A tool used to determine the amount of heat an object contains by transferring that heat to water</td>
<td>16. specific heat capacity</td>
</tr>
</tbody>
</table>
22. Explain the energy of a sample of matter at absolute zero.

At absolute zero, matter would have no energy because its molecules would have no motion.

23. Convert 68°F to K.

\[ ^\circ C = \frac{68^\circ F - 32}{1.8} = 20.\,^\circ C + 273.15 = 293.15\, K = 293\, K \]

24. Convert 36 K to °C.

\[ ^\circ C = 36\, K - 273.15 = -237.15\, ^\circ C = -237\, ^\circ C \]

25. The amount of energy needed to heat 2.00 g of carbon from 50.0°C to 80.0°C is 42.6 J. What is the specific heat capacity of this sample of carbon?

\[ 42.6\, J = 2.00g\, (C)(80.0^\circ C - 50.0^\circ C) \]
\[ 42.6\, J = 2.00g\, (C)(30.0^\circ C) \]
\[ 0.71 = C \]

26. The specific heat capacity of silver is 0.235 J/g °C. How many joules of energy are needed to warm 0.500 g of silver from 25.0°C to 27.5°C?

\[ q = 0.500g\, (0.235\, J/\, g\, °C)(27.5^\circ C - 25.0^\circ C) \]
\[ q = 0.1175 \, (2.5^\circ C) \]
\[ q = 0.29375 \]

27. A 6.75 g sample of gold (specific heat capacity = 0.130 J/g °C) is heated using 50.6 J of energy. If the original temperature of the gold is 25.0°C, what is its final temperature?

\[ 50.6\, J = 6.75\, g\, (0.130\, J/\, g\, °C)\, (T_F - 25.0^\circ C) \]
\[ 50.6\, J = 0.8775\, (T_F - 25.0^\circ C) \]
\[ 50.6\, J = 0.8775\, T_F - 21.9375 \]
\[ 72.5375 = 0.8775\, T_F \]
\[ T_F = 82.1638^\circ C \]

28. A 2.50 g sample of zinc is heated and then placed in a calorimeter containing 65.0 g of water. Temperature of water increases from 20.00 °C to 22.50 °C. The specific heat of zinc is 0.390 J/g°C. What was the initial temperature of the zinc metal sample?

\[ 2.50\, g \, (4.184\, J/\, g\, °C)(22.50 - 20.00) = -1(2.50\, g\, (0.390\, J/\, g\, °C)(22.50 - T_i)) \]
\[ 679.9 = 0.975\, (-22.50 + T_i) \]
\[ 679.9 = -21.9375 + 0.975\, T_i \]
\[ 720.9 = 0.975\, T_i \]
\[ 719.833 = T_i \]