**Random Stuff:**

What is the difference between a chemical change and a physical change?
Distinguish between accuracy and precision.

**Atomic Structure**

An atom is made up of protons and neutrons (both found in the nucleus) and electrons (in the surrounding electron cloud). The atomic number is equal to the number of protons. The mass number is equal to the number of protons plus neutrons. In a neutral atom, the number of protons equals the number of electrons. The charge on an ion indicates an imbalance between protons and electrons. Too many electrons produce a negative charge, too few, a positive charge.

This structure can be written as part of a chemical symbol.

![Atomic Structure Diagram]

Complete the following chart.

<table>
<thead>
<tr>
<th>Element/Ion</th>
<th>Atomic Number</th>
<th>Atomic Mass</th>
<th>Mass Number</th>
<th>Protons</th>
<th>Neutrons</th>
<th>Electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>H+</td>
<td></td>
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<tr>
<td>¹³C</td>
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<td></td>
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<tr>
<td>⁶³Li</td>
<td></td>
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<td></td>
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<tr>
<td>¹⁷Cl</td>
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<td></td>
</tr>
</tbody>
</table>

**Isotopes and Average Atomic Mass**

Elements come in a variety of isotopes, meaning they are made up of atoms with the same atomic number but different atomic masses. These atoms differ in the number of neutrons.

The average atomic mass is the weighted average of all the isotopes of an element.

**Example:** A sample of cesium is 75% ¹²³Cs, 20% ¹²⁴Cs and 5% ¹²⁵Cs. What is its average atomic mass?

Answer: .75 x 133 = 99.75
        .20 x 132 = 26.4
        .05 x 134 = 6.7

Total = 132.85 amu = average atomic mass

Determine the average atomic mass of the following mixtures of isotopes.

1. 80% ¹²⁷I, 17% ¹²⁹I, 3% ¹³¹I
Nomenclature Review:

<table>
<thead>
<tr>
<th>Formula</th>
<th>Ions (if needed)</th>
<th>Name</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mg(ClO₄)₂</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIO₃</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF₆</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>NaCl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P₂O₁₀</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CoBr₂</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>ICl</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>CuO</td>
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<tr>
<td>NO₂</td>
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<tr>
<td>K₂O</td>
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</tr>
<tr>
<td>MnO₂</td>
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<td></td>
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</tr>
<tr>
<td>N₂O₃</td>
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</tr>
<tr>
<td>MgBr₂</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FeCl₃</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Zr(C₂H₃O₂)₄</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BaCl₂</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Ions (if needed)</th>
<th>Formula</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon monoxide</td>
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</tr>
<tr>
<td>Manganese (II) chloride</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dinitrogen trioxide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium sulfide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barium phosphate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium hydroxide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitric acid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonium acetate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrosulfuric acid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver chloride</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper (II) bromide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium sulfate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum sulfate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver sulfite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnesium oxalate</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Periodic Table:

The letters inside the table have no significance here. They are from another worksheet.

Write the location on of each of the following families or classifications of elements on a periodic table:
metals, nonmetals, metalloids, alkali metals, alkaline earth metals, halogens, noble gases, transition metals, & diatomic elements.

1. Horizontal rows are called ______________
2. Columns are called ___________ or ____________
3. Name group 1___________, 2 ________________, 3-12______________, 17______________, 18______________.
4. Elements are arranged according to their ______________
5. Elements within a group have the same number of ______________
6. Name the groups with the following ionic charges: +1____, +2____, +3____, -3____, -2____, -1____.
7. Label Zn and Ag with their charges.
8. As you go across the periodic table, the elements go from ( metals / nonmetals ) to ( metal / nonmetals ).
10. Where are the s, p, d and f sublevels?
11. Where are the most active metals?
12. Where are the most active nonmentals.
13. As you go across a period, the atomic size (decreases / increases).
14. As you go down a group, the atomic size (decreases / increases).
15. A negative ion is called a ___________ and is (larger / smaller) than its atom.
16. A positive ion is called a ___________ and is (larger / smaller) than its atom.
17. As you go down a group, the ionization energy generally (decreases / increases).
18. Where is the highest electronegativity found? Which element. Why?
19. Where is the lowest electronegativity found?
20. A colored ion generally indicates a ____________________.

Complete the following table:

<table>
<thead>
<tr>
<th>Property</th>
<th>Trend → Period</th>
<th>Trend ↓ Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic Radius</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electron Affinity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronegativity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ionization Energy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Arrange the following atoms from largest to smallest atomic radius, and from highest to lowest ionization energy.

a. Cs, K, Li
b. Ba, Sr, Ca
c. I, Br, Cl
d. Mg, Si, S

Electron Configuration

Electrons are distributed in the electron cloud into principal energy levels (1, 2, 3, ...), sublevels (s, p, d, f), orbitals (s has 1, p has 3, d has 5, f has 7), and spin (two electrons allowed per orbital).

Example: Draw the electron configuration of sodium (atomic #11).
Answer: 1s² 2s² 2p⁶ 3s¹

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Draw the orbital notation, electron configuration and noble gas configuration for the following (and in the table to the right).

Don’t forget HUND’S RULE, HUND’S RULE, HUND’S RULE!!!

1. Cl
2. O

Exceptions are:

1.  
2.  

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Don’t forget HUND’S RULE, HUND’S RULE, HUND’S RULE!!!

1. Cl
2. O

Exceptions are:

1.  
2.  
Lewis dot diagrams

Lewis diagrams are a way to indicate the number of valence electrons around an atom.

1. Calcium
2. Potassium
3. Argon
4. Aluminum
5. e
6. Carbon
7. Oxygen
8. Helium

Atomic Theory
A. Dalton’s Theory
1. All matter is composed of _________.
2. Atoms of the same element are the same and are _________ from atoms of other elements.
3. Atoms cannot be subdivided, _______, nor _________.
4. Atoms combine in whole number _________.
5. Atoms in chemical reactions are combined, separated, or _________.

B. Thompson and Millikan had negative attitudes. Thompson discovered the ____________ and Millikan said it had very little ___________.

C. Rutherford said the nucleus is ____________ and ________________.

D. Bohr proposed the p ____________ emission spectrum.

E. When an electron goes from n-

Electromagnetic Spectrum:
Use the electromagnetic spectrum to relate wavelength and energy.
\[ c = \lambda \nu \]
\[ E = h \nu \]
What is the energy of a photon with a wavelength of \( 9.0 \times 10^{-9} \) nm?
Explain what is meant by the wave-particle nature of light.
Are the colors of flame tests due to taking in energy or releasing energy? Explain
What does it mean when we say energy levels are quantized?
What are the essential points of Bohr’s theory of the structure of the hydrogen atom?

Chemical bonding
Classify the following as ionic (metal/cation + nonmetal/anion), covalent (nonmetal and nonmetal).
1. CaCl₂ 5. NH₄Cl
2. CO₂  6. KI
3. BaSO₄ 7. NO₂

Shapes of molecules
The VSEPR theory helps us predict the shape of molecules. The unshared pairs of electrons will push the shared pairs away and change the shape of the molecule.

Determine the shapes of the following by first drawing the lewis dot structures for them and drawing the dipole moments on each polar covalent bond. This will allow you to determine the shape and molecular polarity: N₂, H₂O, CO₂, NH₃, CH₄, SO₃, H₂S, CH₃Cl (Linear, Bent, Trigonal Planar, Pyramidal, Tetrahedral)

Polarity
In polar covalent bonds the electrons are not shared equally. When the electronegativity difference is great enough (above 0.3) and the shape is asymmetrical, the molecule will be polar.

Determine if the examples from above are polar or nonpolar.

Metallic Bonding:
Describe the properties of metals and how their mobile electrons contribute to these properties.
What is an alloy (Explain and given an example)?

The MOLE
1. Determine the number of moles of 25 g of NaCl.
2. Determine the number of grams of 2.5 mol NaCl.
3. What volume will 3.2 moles of O₃ occupy at STP?
4. How many moles of hydrogen are needed to completely react with two moles of nitrogen?
\[ N_2 + 3H_2 \leftrightarrow 2NH_3 + 88kJ \]

5. What volume of hydrogen is necessary to react with five liters of nitrogen to produce ammonia? (Assume constant temperature, pressure and they are all gases.)

6. How much heat would be produced if 6 moles of hydrogen gas reacted?
\[ N_2 + 3H_2 \leftrightarrow 2NH_3 + 88kJ \]

**Percent Composition**

\[
\text{Percent Composition} = \left( \frac{\text{Mass of element}}{\text{Mass of the compound}} \right) \times 100\%
\]

Determine the percentage of potassium in potassium permanganate.

**Determining Empirical Formulas**

\[-\rightarrow-\rightarrow-\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\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5. The average kinetic energy of gas particles depends on temperature.

A. Which of the above are not completely true but accepted anyway?

An ideal gas will behave like a real gas when the TEMPERATURE IS LOW (slow moving particles are attracted to each other – hey baby) and the PRESSURE IS HIGH (particles can get close enough to bond - let’s become a liquid. 😎).

Gases expand to fill their containers, they are fluid, have low density, are compressible, diffuse and effuse.

**Density**

\[ D = \frac{\text{mass}}{\text{Volume}} \]

**Gas Laws**

In practical terms, it is often difficult to hold any of the variables constant. When there is a change in pressure, volume and temperature, the combined gas law is used.

\[
\frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2} \quad \text{or} \quad P_1 \times V_1 \times T_1 = P_2 \times V_2 \times T_2
\]

Use the Ideal Gas Law below to solve the following problems.

\[ PV = nRT \quad \text{where} \quad P = \text{pressure in atmospheres} \]
\[ V = \text{volume in liters} \]
\[ n = \text{number of moles of gas} \]
\[ R = \text{Universal Gas Constant} \]
\[ 0.0821 \text{ L atm/mol K} \]
\[ T = \text{Kelvin temperature} \]

1. How many moles of oxygen will occupy a volume of 2.5 liters at 1.2 atm and 25°C?

Dalton’s Law says that the sum of the individual pressures of all the gases that make up a mixture is equal to the total pressure or: \( P_t = P_1 + P_2 + P_3 + \ldots \). The partial pressure of each gas is equal to the mole fraction of each gas x total pressure.

\[ P_t = P_1 + P_2 + P_3 + \ldots \]

Solve the following problems.

1. A 250. ml sample of oxygen is collected over water at 25°C and 760.0 torr pressure. What is the pressure of the dry gas alone? (Vapor pressure of water at 25°C = 23.8 torr)

---

**Diagram**

Phase

Pressure (Atmosphere)

- A
- B
- C
- D
- E
- F

Temperature (°C)

- 45° 60°
- 100° 110°
1. What section represents the solid phase? Liquid? Gas?
2. Describe what line d-f represents.
3. Describe what line d-e represents.
4. Describe what line d-g represents.
5. What is the substance’s normal melting point? Boiling Point?
6. When do all three phases exist at once?
7. Would an increase in pressure cause this substance to freeze or melt?

**Heating and Cooling Curves**

![Graph showing heating and cooling curves]

Change the temperatures to make these curves be for water.

1. What is a? b? c? d? e?
2. When does KE change?
3. When does PE change?
4. Which direction in endothermic? Exothermic?
5. Would the $\Delta T$ for an endothermic reaction be positive or negative?
6. What equation would solve for heat during lines a, c, e?
7. What equation would solve for heat during d? b?
8. What does it mean that the specific heat of water is more than the specific heat of ice?
9. What is the difference between temperature and heat?
Changes to a System at Equilibrium

3 ways to apply a stress to a system
   a. Change the concentration
   b. Change the temperature
   c. Change the pressure

Le Chatelier’s Principle states that when a system at equilibrium is subjected to a stress, the system will shift its equilibrium point in order to relieve the stress.

\[
12.6 \text{ kcal} + \text{H}_2(g) + \text{I}_2(g) \rightleftharpoons 2\text{HI}(g)
\]

Which way will the system shift when:
1. Hydrogen is added?
2. Iodine is added?
3. Hydroiodic acid is added?
4. Iodine is removed?
5. Temperature is increased?
6. The pressure is increased?
7. When would pressure affect a system at equilibrium?
8. Write the equilibrium expression for this reaction.
9. What is K if [H$_2$] = 0.2 , [I$_2$] = 0.4 , and [HI] = 0.6

### Solutions

**Soluble:** capable of being dissolved

**Insoluble:** obviously not dissolvable

**Saturated:** contains maximum amount of dissolved solute

**Supersaturated:** a solution that contains more dissolved solute than a saturated solution.

**Unsaturated:** a solution that contains less solute than a saturated solution

1. What is the relationship between the solubility of gases and pressure?
2. What is the relationship between the solubility of gases and temperature?
3. Describe the type of solution, if 90 grams of sodium nitrate were dissolved in 100g 40°C water. ________________ What about if the temp dropped to 10C? ________________

If you need help with this chart reference page 462 in you textbook 😊

<table>
<thead>
<tr>
<th>Solution</th>
<th>Colloid</th>
<th>Suspension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>Salt water</td>
<td>Gel</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Homogeneous vs. Heterogeneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle Size</td>
</tr>
<tr>
<td>Settles when standing</td>
</tr>
<tr>
<td>Can be filtered</td>
</tr>
<tr>
<td>Tyndall Effect</td>
</tr>
</tbody>
</table>
Electrolytes
Solute with charges will conduct electricity and are therefore electrolytes. Electrolytes include:
1. Ionic solutes:
2. Strong Acids:
3. Strong Bases:

Molarity

\[ M = \frac{\text{moles of solute}}{\text{Liters of solution}} \]

1. What is the molarity of a solution in which 10 g of silver nitrate (AgNO₃) is dissolved in 500 mL of solution?

Acids and Bases

What are the three different definitions of acids and bases?
Acids: H⁺ / proton donors (electron pair acceptors)
Bases: H⁺ / proton acceptors (electron pair donors)

Explain the significance of these diagrams in relation to pH.

Determine the pH, pOH, [H₃O⁺], and [OH⁻] for each of the following given.
1. [H₃O⁺] = 0.500 M.
2. pOH = 3.59
3. [OH⁻] = 1.50 \times 10^{-5} M.
4. pH = 2.81
5. [OH⁻] = 3.2 \times 10^{-8} M.

Calculate the molarity of an acetic acid solution if 34.57 mL of this solution are needed to neutralize 25.19 mL of 0.1025 M sodium hydroxide.

Reaction Rate
The speed of the reaction OR The change in concentration of reactants over time.

Factors affecting rate;
1. Type of reactants
2. Surface area
3. Temperature
4. Concentration of reactants
5. Catalysts: a substance that lowers the activation energy of a chemical reaction.

\[
\Delta E = \Delta H = \text{ENTHALPY = heat of the reaction} = E_{\text{products}} - E_{\text{reactants}}
\]

Exothermic \( \Delta H \) = is negative
Endothermic \( \Delta H \) = is positive

1. Are the forward reactions endothermic or exothermic?
2. Which has more energy, reactants or products?
3. What does the catalyst do?
4. Is the catalyst part of the rxn?
5. Is \( \Delta H \) for this forward rxn positive or negative? How do you know?

**ENTROPY = ISORDRE (Get it?)**

DISORDERLY = Gases > Solutions > Liquids > Solids = ORDERLY
DISORDERLY = 2 compounds > 1 compound = ORDERLY

**Facts about Reactions**
Indications that a reaction has taken place are 1. 2. 3. 4.

**Nuclear Decay**
Describe the characteristics

<table>
<thead>
<tr>
<th></th>
<th>symbols</th>
<th>masses</th>
<th>Shielding / penetrating ability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gamma</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Predict the products of the nuclear reactions**

Complete the following nuclear reactions and identify the reaction types:

a. \(^{22}^{86}Rn \rightarrow ^{21}^{84}Po + \underline{______}

b. \(^{23}^{92}U \rightarrow ^{\underline{0}}_{-1}e + \underline{______}

c. \(^{105}_{47}Ag + \underline{______} \rightarrow ^{105}_{46}Pd

d. \(^{12}_{6}C \rightarrow ^{\underline{11}}_{5}B + \underline{______}

e. \(^{234}_{90}Th \rightarrow ^{234}_{90}Th + \underline{______}

**Concept of half-life:**

1) Silicon-31 has a half-life of approximately 2.5 hours. If we begin with a sample containing 2000 kg of Silicon-31, what is the approximate amount remaining after 10 hours?

2) Carbon-15 has a half-life of 5.0 seconds. Suppose we have a sample containing 100 grams of Carbon-15. How much will remain after 30 seconds?

Define Fission

Define Fusion

How does a nuclear reactor work?