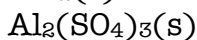
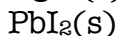


Background Concept Questions

This background information includes the main concepts and definitions covered in high school chemistry nationwide. We are using them as pointers to help guide your reorientation to the study of the chemical world.

1. You should be comfortable using conversion factors and the metric system (SI) to convert between measurements of length, mass, volume and temperature.
 - a. How many seconds are in one year?
 - b. How many millimeters are in 2.5 kilometers?
 - c. How many milligrams are in 57 grams?
 - d. How many milliliters are in 28.3 liters?
 - e. Convert 54°F to °C and K.
2. What is the percent yield if a student recovers .78 grams, in an organic synthesis, of possible 1.20 grams? Identify which mass is the theoretical yield and which is the actual yield.
3. Classify each of the following changes as endothermic or exothermic:
 - a. Ice melts
 - b. Water freezes
 - c. Photosynthesis
 - d. TNT is detonated
4. What does the term *energy of activation* mean? Draw a diagram to support your explanation.
5. Before approaching an experiment in the lab you should understand the difference between different states of matter at the molecular level.
 - a. Are the molecules in a solid/liquid/gas randomly or uniformly spaced?
 - b. Are the molecules in a solid/liquid/gas free to move about in space?
 - c. Describe the difference in average kinetic energy between a solid/liquid/gas.
 - d. Hexane is a volatile liquid, what does this mean?
6. At the surface of a liquid an equilibrium is reached between the liquid phase and the gaseous phase, is this equilibrium static or dynamic? Explain.
 - a. What is meant by the term vapor pressure?
 - b. What is the difference between evaporation and boiling?
7. Write the equation and equilibrium expression for the formation of ammonia from nitrogen and hydrogen.

8. Write the K_{sp} expression for the following slightly soluble solids.



9. What is the difference between a physical property and a chemical property? Identify the type of property listed:

- Water boils at 100°C .
- Water (H_2O) can donate a proton to form hydroxide (OH^-) ions.
- Ice is less dense than liquid water.
- Hydrogen and oxygen can react to form water.
- Steam will expand or contract to fit the volume of a container.

10. Describe the spatial relationship between the proton, neutron and electron in a hydrogen atom.

- If a hydrogen atom has no electron what is it called? What is the charge on this species?
- If a hydrogen atom has one neutron what is it called? What is the charge on this species?
- Hydrogen exists as a diatomic species, what does this mean? What term describes a species made up of two or more atoms?
- Explain the difference between an element, compound and mixture?

11. Describe the difference between a homogeneous and heterogeneous mixture. Identify each of the following mixtures as either homogeneous or heterogeneous.

- Pasteurized milk
- A chocolate chip cookie
- A metal alloy
- Air

12. You need to be familiar with the periodic table of elements.

- The atomic masses of hydrogen and oxygen are 1.0 and 16.0 g/mol respectively, what is the molecular weight of water?
- How many grams of water are needed to obtain 2.6 moles of water?
- The atomic number of argon is 18 and chlorine is 17, how many electrons are in the valence electron shell of argon? How many are in the valence electron shell of chlorine? What is the charge on each?
- What is meant by the term *noble gas configuration*?
- Describe the difference in the number of electrons in the valence shell of a chlorine ion and a potassium ion. What is the charge on a chloride ion? What is the charge on a potassium ion?
- What is the relative difference in the electronegativity of chlorine and potassium? What makes one an anion and one a cation?

13. $\text{Zn (s)} + \text{Cu(NO}_3)_2 \text{(aq)} \rightarrow \text{Zn (NO}_3)_2 \text{(aq)} + \text{Cu (s)}$
- Which species is oxidized in the above reaction?
 - Which species is being reduced?
 - Identify both the oxidizing and reducing agents.
 - Write the half reactions for the anode and the cathode.
14. What is Avogadro's number?
- How many water molecules are in two moles of water?
15. Using a periodic table identify two metals, two metalloids and two non-metals. Describe the properties of each.
16. Metallic bonding is modeled as a 'sea of electrons'. Describe what this means and how this affects the conductive properties of a metal.
17. The reaction between boron trifluoride (BF_3) and ammonia (NH_3) involves the formation of a coordinate (dative covalent) bond. Draw the structure of ammonia, BF_3 and the product. Identify the coordinate (dative covalent) bond.
18. Explain the difference between ionic and covalent bonding and classify each of the following as ionic or covalent compounds.
- Water (H_2O)
 - Methanol (CH_3COOH)
 - Sodium Chloride (NaCl)
 - Nitric Acid (HNO_3)
 - Acetic Acid (CH_3COOH)
 - Copper Sulfate (CuSO_4)
19. Some species are considered polar and other are considered non-polar, explain what is meant by the term *dipole moment*.
- Draw the atomic structure of water (H_2O), oxygen (O_2) and carbon dioxide (CO_2), classify each as either polar or non-polar based on their structure.
20. How many moles of hydrogen are needed to react with one mole of oxygen?
- Write the balanced chemical equation for the reaction of hydrogen and oxygen to form water.
 - Write the balanced chemical equation for the conversion of liquid water to ice.
 - Write the balanced chemical equation for the addition of hydrochloric acid (HCl) to water. How does this change the pH of the solution?

- d. Write the balanced chemical equation for the addition of sodium hydroxide (NaOH) to water. How does this change the pH of the solution?
21. What is the Bronsted definition of an acid? A base?
- What is the product of the dissociation of the acidic proton on acetic acid (CH_3COOH)? Write the complete balanced reaction and identify the acid/base conjugate pairs. Write the K_a expression for this reaction.
 - Write the balance reaction and K_w expression for the auto ionization of water. Explain the relationship between pH and pOH.