Key

AP CHEMISTRY

Chapter 1 Problems

1. How many significant figures are in each of the following?
   a. 0.0030 2
   b. 1.86×10^5 3
   c. 13800 3
   d. 1060 3
2. Use scientific notation to express the number 480 to:
   a. one significant figure 5×10^2
   b. two significant figures 4.8×10^2
   c. three significant figures 4.80×10^2
   d. four significant figures 4.800×10^2
3. Round each of the following numbers to two significant figures.
   a. 86569 87000
   b. 0.020304 0.020
   c. 1.476×10^6 1.5×10^6
   d. 1.9999999 2.0
4. Perform the following conversions. Make sure you show your work using conversion factors and the answer has the correct number of significant figures.
   a. How many milligrams of aluminum nitrate are in 17.6 kilograms?

$$17.6\ \text{Kg}\left(\frac{1000\ \text{g}}{1\ \text{Kg}}\right)\left(\frac{1000\ \text{mg}}{1\ \text{g}}\right) = 17600000\ \text{mg} \text{ or } 1.76 \times 10^7\ \text{mg}$$

   b. How many cubic centimeters (1 cm^3 = 1mL.) of carbon dioxide gas are in 1.4 liters?

$$1.4\ \text{L}\left(\frac{1000\ \text{mL}}{1\ \text{L}}\right)\left(\frac{1\ \text{cm}^3}{1\ \text{mL}}\right) = 1400\ \text{cm}^3$$

Keep SIG Your FIGS!

   c. How many atoms of oxygen are in 1.03 moles of glucose ($C_6H_{12}O_6$)?

$$1.03\ \text{mol}\left(\frac{6.02 \times 10^{23}\ \text{molecules}}{1\ \text{mol}}\right)\left(\frac{6\ \text{oxygen}}{1\ \text{molecule}}\right) = 3.72 \times 10^{24}\ \text{oxygen atoms}$$

   d. How much would 4.201×10^{24} molecules of sodium acetate weigh?

$$4.201 \times 10^{24}\ \text{molecules}\left(\frac{1\ \text{mol}}{6.02 \times 10^{23}\ \text{molecules}}\right)\left(\frac{82.03\ \text{g}}{1\ \text{mol}}\right) = 572.4\ \text{g}$$

e. The volume of a diamond is found to be 2.8 mL. What is the mass of the diamond in carats? The density of a diamond is 3.51 g/cm^3 and 1 carat = 0.200 grams.

$$2.8\ mL\left(\frac{1\ cm^3}{1\ mL}\right)\left(\frac{3.51\ g}{1\ cm^3}\right)\left(\frac{1\ ct.}{0.200}\right) = 49.14\ ct$$
$$= 49\ ct$$

f. The density of pure silver is 10.5 g/cm^3 at 20°C. If 5.25 g of pure silver pellets is added to a graduated cylinder containing 11.2 mL of water, to what volume level will the water in the cylinder rise?

$$5.25\ g\ Ag\left(\frac{1\ cm^3}{10.5\ g}\right)\left(\frac{1\ mL}{1\ cm^3}\right) = 0.5\ mL\ of\ Hg$$

Final Volume = 11.2 mL H_2O + 0.5 mL Ag
= 11.7 mL

5. Classify each of the following as an element, compound or mixture.

a. aluminum foil Mixture (homogeneous)
g. blueberry muffins Mixture (heterogeneous)
h. hot tea without any tea leaves in it Mixture (homogeneous)
i. salt Compound
j. carbon dioxide Compound
k. water Compound
l. soda Mixture (homo if unopened, hetero if opened)
m. blood Mixture (heterogeneous)

6. In the above problem identify any mixtures as heterogeneous or homogenous.

See Above

7. Identify the proper separation technique to use for the following mixtures and explain why/how it would work.

a) Isolate the sodium nitrate from a homogeneous $NaNO_3$ (aq) solution.

Evaporation: The very large difference in BP between an ionic salt ($NaNO_3$) and a covalent compound (H_2O) allows for separation. Distillation is not required since you are not interested in the low BP (water) compound.

b) Isolate the calcium hydroxide from a heterogeneous KBr (aq) solution containing a $Ca(OH)_2$ precipitate.

Filtration: As there is only one solid present in the heterogeneous mixture, it can be isolated from the KBr solution by filtration. Evap/Distillation would result in 2 salts left over in a mixture.

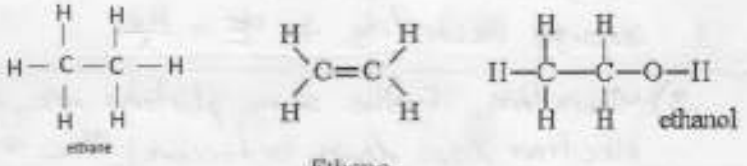
c) Isolate p53 protein from a mixture of p53 (53kD, polar), p21 (21kD, polar), and p36 (36kD, polar) proteins in water.

SEC: Multiple solids in a heterogeneous mixture would need to be separated by size (53 kD, 21 kD, 36 kD) as filtration would leave a mixture of solids.

d) Isolate hexane from a homogeneous mixture of non-polar hydrocarbons; hexane and octane.

Distillation: A homogeneous mixture of compounds with similar polarities cannot likely be separated by HPLC/GC/TLC, so a difference in BP would be the only way to separate the liquids.

e) Isolate ethanol from a mixture of ethane (non-polar), ethene (non-polar), and ethanol (polar).



GC: The difference in polarity would allow for HPLC/GC/TLC separation. Upon researching BP's, you would find they are similar & therefore difficult to distill. Also due to all having low BP's (evaporate easily @ room temp), it would be best to analyze them as gases (GC).

8. A researcher is attempting to make 100mL of a 2.5M K_2SO_4 solution. What would be the appropriate glassware to use to make this volume of solution?

100 mL volumetric flask

9. A lab procedure directs you to deliver 50.0 mL of water to a 100 mL Erlenmeyer flask. What would be the appropriate glassware to use to deliver this volume of solution?

50 mL volumetric pipette

AP CHEMISTRY

Chapter 2 Problems

1. Describe Rutherford's gold foil experiment and the results that were determined. A picture may help. Positively charged alpha particles experienced deflection & reflection when directed at a sheet of gold foil.

1) Reflection shows a dense core to the atom (nucleus)
2) Deflection shows electrostatic repulsion (nucleus is +)
3) Most particles pass through shows most of atom is a low density region (electron cloud)
4) If nucleus is +, - particles must be elsewhere (positive nucleus surrounded by electron cloud)

2. Describe Bohr's observations and the effect they had on atomic theory. A picture may help. Pure elements emit a unique, repeatable spectrum of light waves when excited by an energy source.

1) Light of the same color (if visible) is light of the same wavelength.
2) Light of the same wavelength represents light of equal energy according to $E = \frac{hc}{\lambda}$
3) Therefore, if the same photons are emitted every time an electron drops down between the same ~~atom~~ energy levels, it must require a quantized amount of energy to travel between them (electrons occupy quantized energy levels)

3. Give the *name* and *symbol* of the elements characterized by the following description. There may be more than one possible answer.
   a. Element in the 4th group and 5th period. Zirconium, Zr
   b. Alkali metal with lowest atomic number. Lithium, Li
   c. Halogen that is a liquid at room temperature. Bromine, Br
   d. Transition metal(s) with a fixed charge. Ag (Silver), Zn (Zinc), Cd (Cadmium)
   e. The 3rd period element that has a fixed charge of +2. Magnesium, Mg

4. Identify the following as a metal, nonmetal or semimetal.
   a. Aluminum Metal
   b. Silicon Semimetal
   c. Phosphorus Non-Metal
   d. Magnesium Metal

5. Write the isotopic symbol (${}^{A}_{Z}X$) for each of the isotopes described below.
   a. Z=8, number of neutrons = 9

      ${}^{17}_{8}O$

   b. the isotope of chlorine in which the mass number is 37.

      ${}^{37}_{17}Cl$

   c. the isotope of I which has gained an electron and has a mass number of 131.

      ${}^{131}_{53}I^{1-}$

   d. an atom with 58 protons and 83 neutrons in its nucleus and 56 electrons.

      ${}^{141}_{58}Ce^{2+}$

6. Complete the following table.

Symbol	# of Protons	# of Neutrons	# of Electrons	Net Charge
${}^{89}_{39}Y$	39	50	39	0
${}^{79}_{35}Br^{1-}$	35	44	36	1-
${}^{31}_{15}P^{3-}$	15	16	18	-3
${}^{195}_{78}Pt^{+3}$	78	117	75	3+

7. List the transition metals and p-block metals that have a single oxidation state and identify the fixed charge they take on.

Transition { Ag - +1, Zn - +2, Cd - +2 } p-block { Al - +3, Ga - +3 }

8. Name the following ions.

a. PO_4^{-3} Phosphate

b. NO_2^{-1} Nitrite

c. SO_4^{-2} Sulfate

d. Br^{-1} Bromide

e. NH_4^{+1} Ammonium

f. N^{-3} Nitride

8. Write the symbol and charge of the following ions. And identify if they are a cation or anion.

a. Sulfite ion SO_3^{2-}

b. Chromate ion CrO_4^{2-}

c. Sodium ion Na^+

d. Iron (III) ion Fe^{3+}

e. Chloride ion Cl^-

f. Carbonate ion CO_3^{2-}

9. Name the following ionic compounds.

a. $TiCl_2$ Titanium (II) Chloride

b. $(NH_4)_2S$ Ammonium Sulfide

c. $Mg_3(PO_4)_2$ Magnesium Phosphate

d. Fe_2O_3 Iron (III) Oxide

10. Write the formulas for the following ionic compounds.

a. Potassium Cyanide KCN

b. Aluminum Chlorite $Al(ClO_2)_3$

c. Tin (IV) Nitride Sn_3N_4

d. Lithium Iodate $LiIO_3$

11. Name the following molecular compounds.

a. SiF_4 Silicon Tetrafluoride

b. NO Nitrogen Monoxide

c. N_2F_7 Dinitrogen Heptafluoride

d. PCl_3 Phosphorus Trichloride

13. Write the formula of the following molecular compounds.

a. Nitrogen Dioxide NO_2

b. Triclorine Pentafluoride Cl_3F_5

c. Sulfur Hexafluoride SF_6

d. Octaphosphorus Pentoxide P_8O_5

14. Name the following compounds.

a. HCN in H_2O Cyanic Acid

b. HI in H_2O Hydroiodic Acid

c. $H_2C_2O_4$ in water Oxalic Acid

d. $MgHPO_4$ Magnesium Hydrogen Phosphate

e. Cl_3O_9 Trichlorine Nonoxide

f. MnO_2 Manganese (II) Peroxide

g. $CaCr_2O_7$ Calcium Dichromate

h. $HClO_2$ in water Chlorous Acid

i. $AuCl_3$ Gold (III) Chloride

j. $Ni_2(CO_3)_3$ Nickel (III) Carbonate

k. $NaKSO_4$ Sodium Potassium Sulfate

l. H_2SO_4 in water Sulfuric Acid

m. CS_2 Carbon Disulfide

n. P_2O_5 Diphosphorus Pentoxide

15. Write formulas for the following compounds.

a. Hydrofluoric Acid HF

b. Strontium Nitrite $Sr(NO_2)_2$

c. Lead (IV) Oxide PbO_2

d. Sulfurous Acid H_2SO_3

e. Dihydrogen Monoxide H_2O

f. Aluminum Acetate $Al(C_2H_3O_2)_3$

g. Rubidium Hydrogen Sulfate $RbHSO_4$

h. Potassium Sulfide K_2S

i. Tetraphosphorus Hexahydride P_4H_6

j. Carbonic Acid H_2CO_3

k. Ammonium Phosphate $(NH_4)_3PO_4$

l. Iron(II) Nitride Fe_3N_2

m. Copper (I) Sulfate Cu_2SO_4

*****Expected memorization for first test*****

First 3 periods of element names/symbols, fixed charge metals, group names, roman prefixes 1-10, and circled polyatomic ion names/formulas/charges