

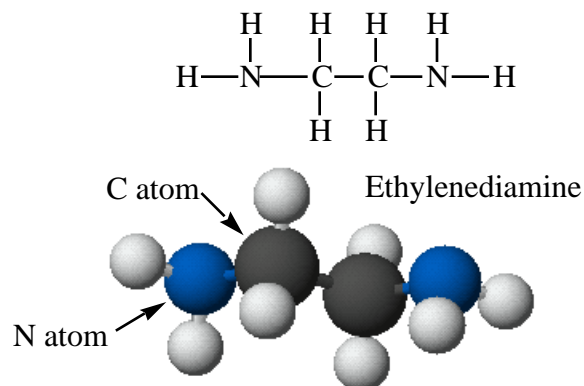
MOLECULAR FORMULAS

1. (6 points) Ethylenediamine reacts with transition metal ions to form many colorful compounds.

(a) Molecular formula = _____

(b) Molar mass = _____ g/mol

(c) Empirical formula = _____



2. (3 points) CFCs or chlorofluorocarbons are composed of chlorine, fluorine, and carbon. They are being phased out of our economy because of the damage they have caused to the earth's ozone layer.

CFC-12 has 9.93% C and 58.64% Cl. The remainder is fluorine. The formula of CFC-12 is

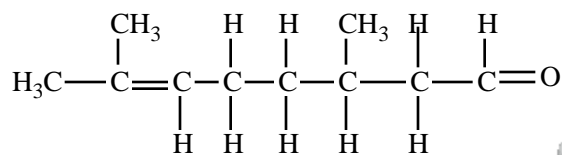
- (a) CCl_3F
 (b) CCl_2F_2
 (c) CClF_3
 (d) C_2ClF_5
3. (3 points) When 2.34 g of pure iron is allowed to react with an excess of chlorine, 6.78 g of an iron-chlorine containing compound is obtained.



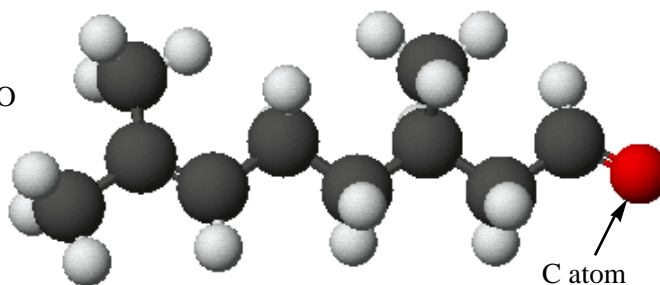
What is the formula of the compound, Fe_xCl_y ?

- (a) Fe_2Cl_3
 (b) FeCl
 (c) FeCl_2
 (d) FeCl_3
 (e) FeCl_4

4. (16 points) The compound citronellal is the chief component of citronella oil (found in lemon and lemon grass).



citronellal



The formula of citronellal is _____ and its molar mass (to three significant figures) is _____ g/mol.

- (a) What is the weight percent carbon in the compound? (*Show your work*)
- (b) If you have 1.03 g of citronellal, how many moles of the compound do you have? (*Show your work*)
- (c) How many molecules of citronellal are there in 1.03 g? (*Show your work*)
- (d) How many H atoms are there in 1.03 g of citronellal? (*Show your work*)

5. (3 points) Suppose you heat 1.056 g of a metal carbonate, MCO_3 , which contains the unknown metal M. The products of heating are the metal oxide, MO, and 0.376 g of CO_2 .

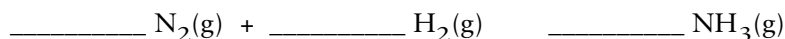


What is the identity of the metal M?

- (a) M = Ni
- (b) M = Cu
- (c) M = Zn
- (d) M = Ba
- (e) None of the above?

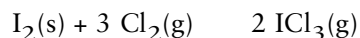
STOICHIOMETRY

1. (7 points) Nitrogen and hydrogen react to give ammonia. Balance the equation for the reaction.



Is the following statement true or false: If you wish to prepare 20 moles of NH_3 , you must mix 10 moles of N_2 with 10 moles of H_2 . _____

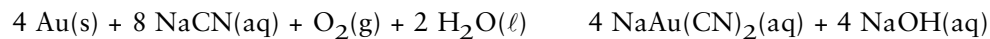
2. (10 points) The balanced equation for the reaction of iodine and chlorine is



Suppose you mix 2.0 mol of I_2 with an excess of Cl_2 and obtain 3.6 mol of ICl_3 . Complete each of the following statements:

- (a) The theoretical yield for ICl_3 is _____ mol.
- (b) The actual yield for ICl_3 is _____ mol.
- (c) The percent yield for the reaction is _____ %.
- (d) The mass of Cl_2 used in the reaction is _____ g
- (e) *True or false:* The theoretical yield cannot be determined unless the exact amount of Cl_2 used is known. _____

4. (9 points) Gold, Au, is dissolved from rock by treating the rock with NaCN in the presence of oxygen.



- (a) If you have 0.050 mol of gold, the number of moles of NaCN required is _____ mol and the number of moles of O₂ required is _____ mol.
- (b) If you begin with 0.025 mol of Au and 0.100 mol of NaCN (but unlimited O₂), the limiting reactant is _____.
- (c) Suppose you react 1.00 g of Au with unlimited NaCN and O₂. The theoretical yield of NaAu(CN)₂ (molar mass = 272 g/mol) is
- (i) 0.354 g NaAu(CN)₂
 - (ii) 1.38 g NaAu(CN)₂
 - (iii) 2.72 g NaAu(CN)₂
 - (iv) 272 g NaAu(CN)₂

5. (6 points) Cisplatin, Pt(NH₃)₂Cl₂, is used in cancer chemotherapy. It is produced by the reaction



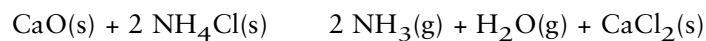
Suppose you wish to produce 25.0 g of cisplatin (molar mass = 300. g/mol). The mass of K₂PtCl₄ (molar mass = 415.1 g/mol) required is

- (a) 2.83 g
- (b) 3.46 g
- (c) 6.02 g
- (d) 34.6 g
- (e) 41.5 g

If the theoretical yield of cisplatin is 25.0 g, but only 12.3 g was produced, the percent yield of cisplatin is

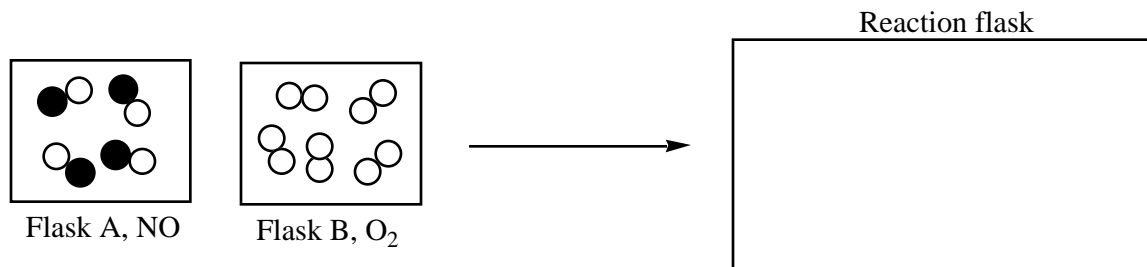
- (a) 12.3%
- (b) 20.3%
- (c) 49.2%
- (d) 98.6%

6. (3 points) Ammonia gas, NH_3 , can be prepared by the reaction of a basic oxide like calcium oxide with ammonium chloride, an acidic salt.



If 16.1 g of CaO (molar mass = 56.1 g/mol) and 32.2 g of NH_4Cl (molar mass = 53.5 g/mol) are mixed, what is the maximum possible yield of NH_3 (molar mass = 17.03 g/mol)?

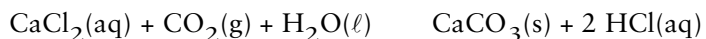
- (a) 2.44 g NH_3
 (b) 4.87 g NH_3
 (c) 9.77 g NH_3
 (d) 10.2 g NH_3
 (e) None of the above
7. (4 points) Nitrogen monoxide, NO , and O_2 react to give NO_2 .
- (a) Write the balanced equation for the reaction of NO and O_2 to give NO_2 .
- (b) Suppose the flasks A (contains NO) and B (contains O_2) are mixed in a reaction flask. *Using dark and light circles for atoms, show the situation in the reaction flask after reaction has occurred.*



Nitrogen atom = dark circle (●) Oxygen atom = open circle (○)

The product NO_2 would be represented by ○●○

8. (6 points) The following reaction can occur in the environment.



(a) Name the following compounds involved in the reaction:

$\text{CaCl}_2 =$ _____

$\text{CaCO}_3 =$ _____

$\text{HCl}(\text{aq}) =$ _____

(b) If you begin with 6.75 g of CaCl_2 (molar mass = 111.0 g/mol), the mass of HCl (molar mass = 36.47 g/mol) produced is

(i) 1.11 g

(ii) 2.22 g

(iii) 4.44 g

(iv) 40.8 g

AQUEOUS SOLUTIONS

1. (4 points) In each pair of compounds below, predict which is more soluble in water.

Silver nitrate, AgNO_3 or silver chloride, AgCl _____

$(\text{NH}_4)_2\text{CO}_3$ or CaCO_3 _____

$\text{Zn}_3(\text{PO}_4)_2$ or Na_3PO_4 _____

Barium sulfate or copper(II) sulfate _____

2. (4 points) Name the following acids and bases or give their formula:

H_2SO_4 _____

Phosphoric acid _____

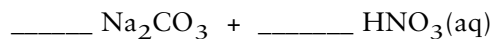
HNO_3 _____

Potassium hydroxide _____

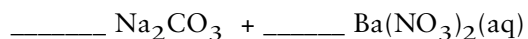
WRITING REACTIONS

1. (12 points) *Complete and balance* the equations a-c. Describe each of the equations as an *acid-base* reaction, a *precipitation*, or a *gas-forming* reaction:

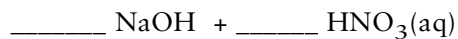
(a) Reaction type: _____



(b) Reaction type: _____



(c) Reaction type: _____



2. (4 points) Balance the following equation and then write the *net ionic equation*:



Net ionic equation: