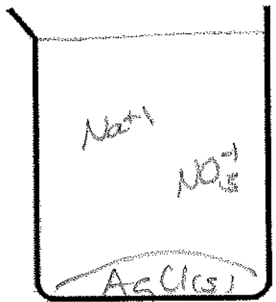
Concentration in M = [ ]

(#7-2d)

Chemistry

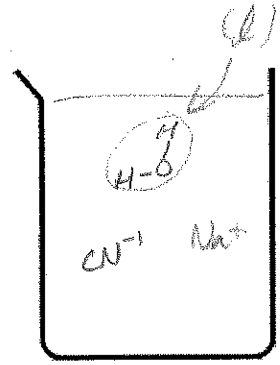
Stoichiometry and concentrations

1. To a beaker, 20.0 ml of .100 M $AgNO_3$ has an aqueous solution of .05M NaCl, added causing a solid to precipitate.
   a. Write the complete balanced equation. $AgNO_3 + NaCl \rightarrow AgCl_{(s)} + NaNO_3$
   b. How many moles of $AgNO_3$ are present before the reaction?
      $0.1M = \frac{X}{0.02L}$ $X = 0.002$ mol $AgNO_3$
   c. What is the solid precipitating?
      $AgCl_{(s)}$
   d. How many mL of NaCl will be needed to reach equivalence?
      $0.05M = \frac{0.002 \text{ mol NaCl}}{X\ L}$ $X = 0.04L$ or 40mL



   e. What is the concentration of each ion in solution at equivalence?
      $\frac{0.002 \text{ mol } Na^{+1}}{(0.02 + 0.04)L} = 0.033M\ Na^+$ $0.033M\ NO_3^{-1}$
   f. Draw a picture of the beaker at equivalence. Show particle proportionality.
      ISE
      $AgNO_3 + NaCl \rightarrow AgCl_{(s)} + NaNO_{3(aq)}$
      I 0.002
      S -0.002 -0.002 +0.002 +0.002
      E 0 0.002 0.002

2. 20.0 mL of .200 M $NaOH_{(aq)}$ is added to 40.0mL of .100M $HCN_{(aq)}$. Answer the following questions from the information provided.
   $0.2M = \frac{X}{0.02L}$ $X = 0.004$ mol $0.1M = \frac{X \text{ mol}}{0.04L}$ $X = 0.004$ mol
   a. Write the complete balanced equation and create an ISE table below
      $NaOH_{(aq)} + HCN_{(aq)} \rightarrow NaCN_{(aq)} + HOH_{(l)}$
      I 0.004 0.004
      S -0.004 -0.004 +0.004 +0.004
      E 0 0
   b. Write the net-ionic equation. Which ion is eliminated causing the reaction to stop?
      $OH^- + H^+ \rightarrow HOH_{(l)}$ neither exact amount
   c. How many moles of water is produced?
      0.004 mol H_2O
   d. Draw a picture of the beaker. Show particle proportionality.



   e. (True/False) The $[Na^+] = [Cl^-]$
      $[Na^+] = [CN^-]$
   f. What is the concentration of each ion in solution at equivalence?
      $\frac{0.004 \text{ mol}}{0.06L} = 0.067M\ Na^{+1}$ $0.067M\ CN^{-1}$
      20+40mL →

3. To a beaker, 50mL of .2M HBr is added to 50 mL of .3M KOH.
   $0.2M = \frac{X \text{ mol}}{0.050L}$ $0.3M = \frac{X \text{ mol}}{0.050L}$
   $X = 0.01$ mol HBr $X = 0.015$ mol KOH

a. Write the complete balanced equation and complete an ISE table below.

$HBr + KOH \rightarrow KBr_{(aq)} + HOH(l)$

I 0.01   0.015

S -0.01   -0.01   +0.01   +0.01

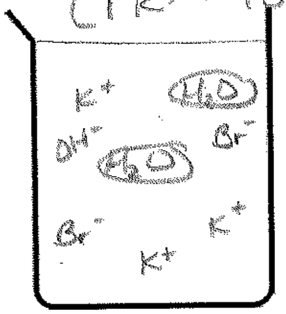
E 0   0.005   0.01   0.01 — Draw → { $2H_2O$; $2K^+ + 2Br^-$; $1K^+ + 1OH^-$ }

b. Which reactant is the limiting reactant?

HBr

c. How much water is produced?

0.01 mol H_2O



100 mL

d. What is the concentration of the HBr after the reaction has ended?

$[H^+] = 0$ $[Br^-] = \frac{0.01}{0.1L} = 0.1M\ Br^{-1}$

e. Draw a picture of the beaker. Show particle proportionality.

conc of K^+? OH^-?

$[K^+] = \frac{(0.005 + 0.01)}{0.1L} = 0.15M\ K^{+1}$

$[OH^-] = \frac{0.005}{0.1L} = 0.05M\ OH^{-1}$

4. To a beaker, 50mL of .2M $CaCl_2$ is added to 50 mL of .4M Na_3PO_4 forming a white solid at the bottom of the solution. $0.2 = \frac{x}{0.05}$ $x = 0.01$ mol $CaCl_2$ $0.4M = \frac{x}{0.05}$ $x = 0.02$ Na_3PO_4

f. Write the complete balanced equation.

$3CaCl_2 + 2Na_3PO_{4(aq)} \rightarrow 6NaCl(aq) + Ca_3(PO_4)_2(s)$

I 0.01   0.02

S -0.01   -0.0067   +0.02   +0.0033

E 0   0.0133   0.02   0.0033

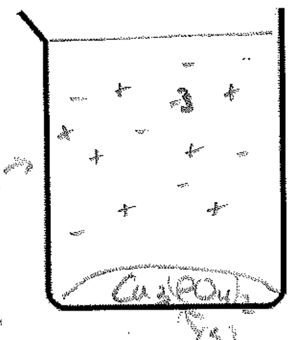
g. Which reactant is the limiting reactant?

$CaCl_2$ (higher rate + less quantity)

h. What is the solid precipitating?

$Ca_3(PO_4)_2(s)$

not perfect →



100mL

i. Draw a picture of the beaker. Show particle proportionality.

$Na_3PO_4 \rightarrow 3Na^+ + PO_4^{-3}$ | $NaCl \rightarrow Na^+ + Cl^-$

0.0133 | 0.02

-0.0133   +0.04   +0.0133 | -0.02   +0.02   +0.02

j. What is the concentration of the PO_4^{-3} ion in solution?

key

+ = Na^{+1} (→ 7)

- = Cl^{-1} (→ 6)

-3 = PO_4^{-3} (→ 1)

$[PO_4^{-3}] = \frac{0.0133 mol}{0.1L} = 0.133M\ PO_4^{-3}$

Na^+ + Cl^-?

$[Na^{+1}] = \frac{0.04 + 0.02}{0.1L} = 0.6M\ Na^{+1}$

$[Cl^-] = \frac{0.02}{0.1L} = 0.2M\ Cl^{-1}$