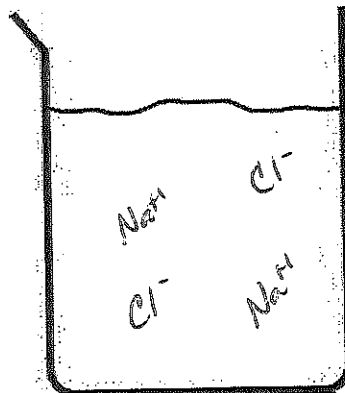$$M = \frac{mol}{L}$$
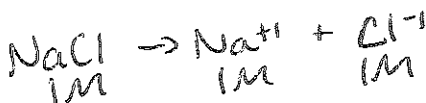
1. 5 Moles NaCl in 5 liters; what is the molarity of the Solution?
    a. Draw a picture NaCl dissolving.

    $\frac{5 mol}{5 L} = 1 M$ NaCl solution

    b. Determine molarity of NaCl.

    $NaCl \rightarrow Na^{+1} + Cl^{-1}$
      $1M$ $1M$ $1M$

    c. Molarity of Na^{+1} ions
        $1M$ Na^{+1}
    d. Molarity of Cl^{-1} ions
        $1M$ Cl^{-1}
    e. Molarity of ions
        $2M$

2. 5 moles of $LiNO_3$ dissolved in 2 liters what is the final molarity of the solution?

    $\frac{5 mol}{2 L} = 2.5 M$ $LiNO_3$ solution

3. How many moles of CO_2 must be added to ½ liter to create a 2 molar solution.

    $2M = \frac{X mol}{0.5L}$ $X = 1 mol$ CO_2

4. 5 moles of Ca and you want to make a 3.2 molar solution. How much H_2O do you need?

    $3.2 M = \frac{5 mol}{X L}$ $(3.2M)X = 5 mol$ $\frac{(3.2M)X}{3.2} = \frac{5 mol}{3.2}$ $X = 1.6 L$ 1.56

5. Need 1.5M solution of NaCl with a volume of 500mL. How much NaCl would you need to weigh out?

    $23.0 + 35.5 = 58.5$ g/mol $0.5L$ $44.$

    $1.5M = \frac{X mol}{0.5L}$ $X = 0.75 mol$ NaCl $\frac{0.75 mol}{1} \frac{58.5 g}{1 mol} = 43.9 g$ NaCl

6. Need a 2.5 M solution of $Ca(NO_3)_2$ which is 2.0L in volume. What is the moles and mass needed for this solution?

    $2.5M = \frac{X}{2L}$ $X = 5 mol$ $Ca(NO_3)_2$

    molar mass = 40.1
    Ca 40.1 = 40.1
    N   14.0 x 2 = 28.0 $\}$ 164.1 g/mol
    O   16.0 x 6 = 96.0

    $\frac{5 mol}{1} \frac{164.1 g}{1 mol} = 821 g$ CaN

7. In a 250 mL solution of 1.5 M $NaOH_{(aq)}$ how many moles of NaOH are present?

    $\rightarrow 0.250L$
    $1.5M = \frac{X}{0.250L}$ $X = 3.75 mol$ NaOH

8. 2.0 molar solution of H_2SO_4. If you have 10 moles in your solution what is the volume?

    $2M = \frac{10 mol}{X L}$ $\frac{2X}{2} = \frac{10}{2}$ $X = 5 mol$ H_2SO_4

9. 1.5 M solution of HCl. In this solution you have 15 grams of HCl what is the volume?

    $H = 1.0$
    $Cl = 35.5$
    36.5

    $\frac{15 g HCl}{1} \frac{1 mol}{36.5 g} = 0.41 mol$ HCl $1.5M = \frac{0.41}{X L}$ $\frac{1.5X}{1.5} = \frac{0.41}{1.5}$ $X = 0.27 mol$ HCl

10. You have 25 grams of a chemical known as Crystal violet. The molecular weight is 407.0 grams/mol. Your lab calls for a liter of .005M solution. Do you have enough CV? How much solution can actually be made.

    yes

    $\frac{25 g CV}{1} \frac{1 mol}{407 g} = 0.061 mol$ CV $0.005M = \frac{0.061}{X L}$ $\frac{0.005X}{0.005} = \frac{0.061}{0.005}$

    $X = 12.3 L$

Modeling Solutions – Practice   Name_____ hr___

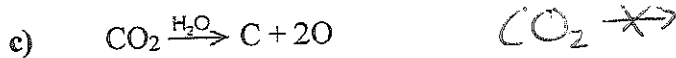1. **What is wrong** with each of the following equations of electrolytic dissociation?
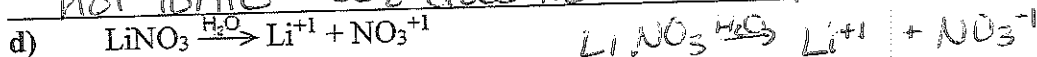   a. Explain what is incorrect.   b. Re-write the equations correctly.

a) $MgO \xrightarrow{H_2O} Mg^{1+} + O^{1-}$ $MgO \xrightarrow{H_2O} Mg^{+2} + O^{-2}$

Charges are not correct

b) $CaBr_2 \xrightarrow{H_2O} Ca^{2+} + Br^{-1}$ $CaBr_2 \xrightarrow{H_2O} Ca^{+2} + \underline{2}Br^{-1}$

Not balanced

c) $CO_2 \xrightarrow{H_2O} C + 2O$ $CO_2 \xrightarrow{X}$

not ionic – CO_2 does not break apart at Covalent Bonds

d) $LiNO_3 \xrightarrow{H_2O} Li^{+1} + NO_3^{+1}$ $LiNO_3 \xrightarrow{H_2O} Li^{+1} + NO_3^{-1}$

Charges are not correct

e) $Al(OH)_3 \xrightarrow{H_2O} Al^{1+} + 3OH^{3-}$ $Al(OH)_3 \xrightarrow{H_2O} Al^{+3} + 3OH^{-1}$

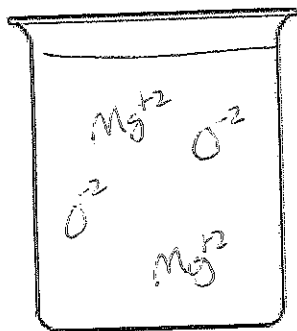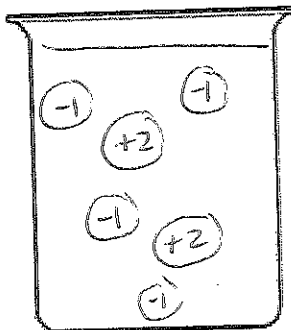*Charges are not correct*

2. a. Show/draw the dissolution of 2 particles of each substance in a beaker.
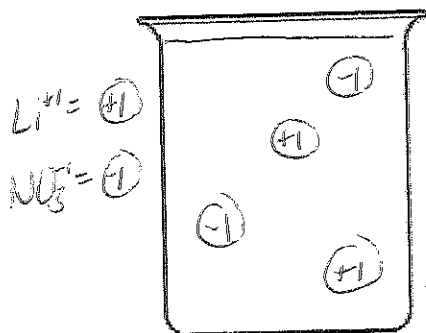   b. Use the Molarity to determine the concentration of each ion.

Mg^{+2} O^{-2}
O^{-2}
Mg^{+2}

0.1 M MgO $MgO \rightarrow Mg^{+2} + O^{-2}$
                 0.1   0.1   0.1
Ion conc:
$Mg^{+2}=$ _0.1 M_
$O^{-2}=$ _0.1 M_

(-1)   (-1)
   (+2)
(-1)   (+2)
   (-1)

$Ca^{+2} = (+2)$
$Br^{-1} = (-1)$

0.2 M CaBr₂ $\rightarrow Ca^{+2} + 2Br^{-1}$
                      0.2   0.4
Ion conc:
$Ca^{+2}=$ _0.2 M_
$Br^{-1}=$ _0.4 M_

O=C=O

O=C=O

0.00001 M CO₂
C̶=
O̶=

$Li^{+1} = (+1)$
$NO_3^- = (-1)$

(-1)
   (+1)
(-1)
   (+1)
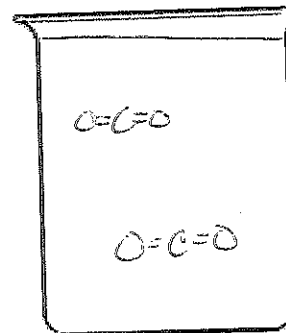
0.5M LiNO₃
Ion conc:
$Li^{+1}=$ _0.5 M_
$NO_3^{-1}=$ 0.5 M

$LiNO_3 \rightarrow Li^{+1} + NO_3^{-1}$
  0.5   0.5   0.5

(-1)   (-1)
   (+3)
(-1)   (-1)
(-1)   (-1)
   (+3)
(-1)
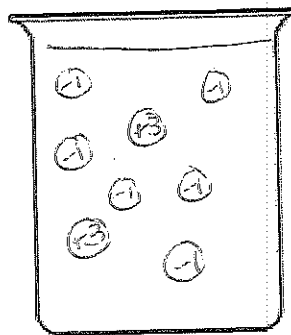
0.03 M Al(OH)₃
Ion conc:
$Al^{+3}=$ _0.03 M_
$OH^{-1}=$ 0.09 M

$Al(OH)_3 \rightarrow Al^{+3} + 3OH^{-1}$
  0.03   0.03   0.09

DILUTION:

MOLARITY$_1$ * VOLUME$_1$ = MOLARITY$_2$ * VOLUME $_2$ ($M_1V_1 = M_2V_2$)

1 = before   2 = after

- NOTE:
  - Make sure you are consistent with the units used in your equation.
  - V_2 = equals total volume. Starting volume plus added volume.

$$M_1V_1 = M_2V_2$$

PRACTICE PROBLEMS:

1. 6M STOCK SOLUTION OF HCl. Your experiment calls for 750mL of 2M HCl. How much 6M HCl is need in this dilution?

$$\frac{(2M)(750mL)}{6M} = \frac{(6M)V_2}{6M}$$

$$V_2 = \boxed{250\,mL\ HCl}$$

2. In an acid spill, 15L of Concentrated Sulfuric acid (16M) needs to be diluted. If all this acid is diluted down to 2.0 M. What is the ending volume?

$$\frac{(15L)(16M)}{2M} = \frac{(2M)V_2}{2M}$$

$$V_2 = \boxed{120\,L}$$

3. 10 mL of 2.0M NaCl is added to 1 liter of H_2O. What is the new concentration?

$$1000 + 10\,mL = 1010\,mL$$

$$\frac{(10mL)(2M)}{1010mL} = \frac{(1010mL)M_2}{1010mL}$$

$$M_2 = \boxed{0.02\,M\ NaCl} \quad 0.0198$$

4. A solution is diluted down from 100 mL to 1L and the ending concentration is .1M. What is the original concentration?   1000 mL

$$\frac{(100mL)M_1}{100mL} = \frac{(1000mL)(0.1M)}{100mL}$$

$$M_1 = \boxed{1\,M}$$

5. How much water is added to a solution that is 50 mL of 5M if it needs to be diluted down to 2 M.

answer this question

$$\frac{(50mL)(5M)}{2M} = \frac{(2M)V_2}{2M} \quad V_2 = 125\,mL \leftarrow ending\ volume$$

$$125-50 = \boxed{75mL\ water\ was\ added\ to\ 50mL\ to\ get\ 125mL}$$

Solubility and Concentration Practice   Name_____ hour____

Obj: I can determine solubility of a salt or gas on a solubility chart.
Obj: I can calculate Molarity, amount of solute, or amount of solution using M=mol/liter.
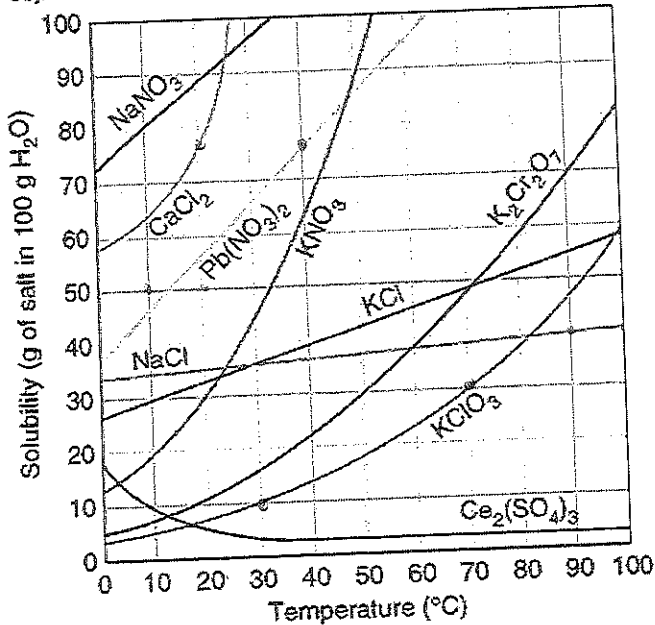
1.   What is the solubility of NaCl at 90°C?   *don't forget units*

   40g NaCl in 100g H_2O

2.   At what temperature will 10 grams of $KClO_3$ dissolve to make a saturated solution?

   30°C

3.   What substance on the graph is most soluble at 10°C? $NaNO_3$ Least soluble? $KClO_3$

4.   A solution becomes saturated when 58 grams of solute is added to water at 80°C. Using the graph to the left, determine the compound that is most likely the solute. $K_2Cr_2O_7$

5. A solution contains 50 g of $CaCl_2$ in 100 mL of water at 20°C. How much more $CaCl_2$ can dissolve at this temperature in this amount of water?

   Solubility of $CaCl_2$ is 75g $CaCl_2$ per 100g H_2O (at 20°C) $\frac{75}{-50}$ 25g $CaCl_2$

6. Calculate the additional amount of solute that could be dissolved in a solution of $KClO_3$ at 70°C compared to a solution of $KClO_3$ at 30°C.

   70°C = 30g
   30°C = 10g
   20g more @ 70°C

7. What is the maximum amount of $Pb(NO_3)_2$ that will dissolve in 100 mL at 40°C?

   76 g $PbNO_3)_2$

8. What is the molarity of a solution with 1.1 moles of NaCl in 3.5 liters of solution? Show your calculation.

   $\frac{1.1 mol}{3.5 L}$ = 0.31 M NaCl

9. How many moles of NaCl are in 620 mL of a 0.5M solution? Show your calculation.

   $0.5M = \frac{X mol}{0.620 L}$ x = 0.31 mol NaCl

10. What is the molarity of a solution if 25 grams of $Pb(NO_3)_2$ are dissolved in 243 mL of solution? Show your calculation.   → 0.243L

   $25g PbNO_3 \frac{1 mol}{331.25} = 0.075 mol$

   Pb 1×207.2 = 207.2
   N 2×14 = 28.0   } 331.2
   O 6×16 = 96.0   g/mol

   $\frac{0.075 mol}{0.243 L}$ = 0.31 M NaCl

11. a. Use the graph to determine the solubility of $Ce_2(SO_4)_3$ at 10°C.

   10 g in 100 g H_2O.

   b. What is the molar mass of $Ce_2(SO_4)_3$? Show your work.
   (#58)

   Ce 2×140.1 = 280.2
   S 3×32.1 = 96.3   } 568.5
   O 12×16.0 = 192.0   g/mol

   c. (Assume that the volume is 0.1 Liter of solution) What is the molarity of the solution in 11a?

   $10g Ce_2(SO_4)_3 \frac{1 mol}{568.5 g} = 0.0176 mol$ $\frac{0.0176 mol}{0.1 L}$ = 0.17 M → 0.2M $Ce_2(SO_4)_3$