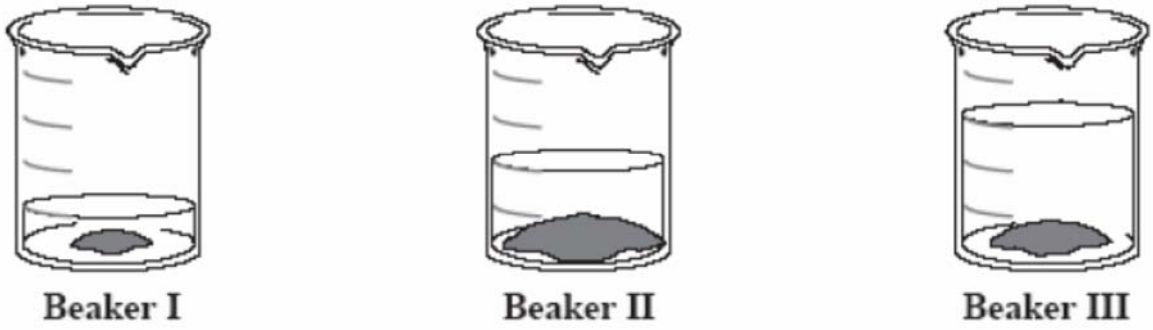
III.1 Solubility Review – Ion Concentrations and Conductivity

1. Which of the solutes below can form an ionic solution with the highest conductivity? Explain.
    a. PbS
    b. CH_3Cl
    c. $NaNO_3$
    d. CH_3COOH

2. The following three beakers each contain different volumes of a saturated solution of PbI_2 and different masses of PbI_2:



What is the relationship for the $[Pb^{2+}]$ in the solution in the three beakers?

III.2 Calculating Solubility

3. The following data was collected to determine the solubility of a substance:

Mass of solute dissolved:	5.00 g
Volume of solvent:	250.0 mL
Molar mass of solute:	100.0 g/mol
Molar mass of solvent:	20.0 g/mol

What is the molar solubility of the substance?

4. When 100.0 mL of a saturated solution of BaF_2 is heated and all the water is evaporated, 3.6×10^{-4} mol of solute remains.
    a. Calculate the molar solubility.
    b. What is the solubility in g/L?

III.3 Predicting the Solubility of Salts

5. Is $FeCO_{3(s)}$ soluble? How do you know?

6. Will a precipitate form when (equal volumes) 0.2 M solutions of CaS and Na_2SO_4 are mixed?

7. Which of the solutes below is both ionic and most soluble? Explain.
   a. RbOH
   b. CH_3OH
   c. $Ca(OH)_2$
   d. $Fe(OH)_3$

8. Which of the following will produce a solution with the highest [OH-]? How do you know? Explain.
   a. AgOH
   b. $Sr(OH)_2$
   c. $Fe(OH)_3$
   d. $Mg(OH)_2$

9. What happens when 10.0 mL of 0.2 M KOH is added to 10.0 mL of 0.2 $CuSO_4$?

10. Consider the following anions present in different solutions:
    i. 10.0 mL solution containing 0.20 M Cl^-
    ii. 10.0 mL solution containing 0.20 M OH^-
    iii. 10 mL solution containing 0.20 M SO_3^{2-}

    When 10.0 mL of 0.20 M $Pb(NO_3)_2$ are added to each of the above solutions, how many precipitates will form? Write the net ionic equations for any of the precipitation reactions that would occur.

III.4 Writing Formula, Complete & Net Ionic Equations

11. Write the net ionic reaction resulting from mixing equal volumes of 0.2 M $Ca(NO_3)_2$ and 0.2 M NaOH.

12. Write the complete ionic equation for the reaction between MgS and $Sr(OH)_2$.

III.1 Solubility Review – Ion Concentrations and Conductivity

1. $NaNO_3$ will form an ionic solution with the highest conductivity

    a. PbS – Ionic, but salt has low solubility and ion concentrations will be 0.1 M or less in solution.
    b. CH_3Cl – Covalent, forms a molecular solution. No electrolytes present, will not conduct electricity
    c. $NaNO_3$ – Soluble salt, dissociates 100% in water, electrolytes formed will conduct electricity
    d. CH_3COOH – Weak Acid, only a small amount will dissociate

2. I = II = III
   The concentration of Pb^{2+} ions in each beaker are the same because all beakers contain a saturated solution.

III.2 Calculating Solubility

3. 20.0 g/L or 0.200 M

The solubility of a substance is the equilibrium concentration of the substance in solution at a given temperature. It can be calculated as g/L or mol/L.

Solubility of substance X = 5.00 g / 0.250 L = 20.0 g/L or (20.0 g/L) / (100.0 g/mol) = 0.200 M

4. Molar solubility: 3.6×10^{-4} mol / 0.1000 L = 3.6×10^{-3} M

   Solubility in grams per litre: $(3.6 \times 10^{-3}$ mol/L)(175.3 g/mol) = 0.63 g/L

III.3 Predicting the Solubility of Salts

5. Yes! $CaSO_{4(s)}$
   Balanced formula equation: $CaS_{(aq)} + Na_2SO_{4(aq)} \rightleftharpoons CaSO_{4(s)} + Na_2S_{(aq)}$
   Net Ionic equation: $Ca^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightleftharpoons CaSO_{4(s)}$

6. Yes!
   Balanced formula equation: $CaS_{(aq)} + Na_2SO_{4(aq)} \rightleftharpoons CaSO_{4(s)} + Na_2S_{(aq)}$
   Net Ionic equation: $Ca^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightleftharpoons CaSO_{4(s)}$

7. RbOH is ionic and will be most soluble.

   Even though RbOH, $Ca(OH)_2$ and $Fe(OH)_3$ are all ionic, only RbOH is soluble, the other two compounds have low solubility (The rubidium ion (Rb^+) is an alkali metal ion which is soluble with any anion and the hydroxide ion (OH^-) has low solubility with Fe^{3+} and Ca^{2+}).

   CH_3OH is the chemical formula for methanol, which is a covalent compound.

8. Of the compounds listed, only $Sr(OH)_2$ is a soluble compound therefore having the greatest concentration of OH- ions in solution.

III.3 Predicting Solubilities

9. A precipitate of $Cu(OH)_2$ will form

10. Three precipitates will form:

$Pb^{2+} + 2\ Cl^- \rightarrow PbCl_{2\,(s)}$
$Pb^{2+} + 2\ OH^- \rightarrow Pb(OH)_{2\,(s)}$
$Pb^{2+} + SO_3^{-2} \rightarrow PbSO_{3\,(s)}$

III.4 Writing Formula, Complete & Net Ionic Equations

11. Before you can write the net ionic equation, you should write the balanced formula equation:

$Ca(NO_3)_{2\,(aq)} + 2\ NaOH_{\,(aq)} \rightarrow Ca(OH)_{2(s)} + 2\ NaNO_{3\,(aq)}$

Net ionic equation:

$Ca^{2+}{}_{(aq)} + 2\ OH^-{}_{(aq)} \rightarrow Ca(OH)_{2\,(s)}$

12. $Mg^{2+}{}_{(aq)} + S^{2-}(aq) + Sr^{2+}{}_{(aq)} + 2\ OH^-{}_{(aq)} \rightarrow Mg(OH)_{2(s)} + Sr^{2+}{}_{(aq)} + S^{2-}{}_{(aq)}$