Concentration

Name____Section_____________

DCI13.1. Write the chemical formula(s) of the product(s) and balance the following reactions. Identify all products phases as either (g)as, (l)iquid, (s)olid or (aq)ueous.

a) Na_3PO_4*(aq)* + $Pb(NO_3)_2$*(aq)* → **$Pb_3(PO_4)_2$*(s)*** + **$6NaNO_3$*(aq)***

b) $Mg(OH)_2$*(aq)* + **2**$HClO_4$*(aq)* → **$Mg(ClO_4)_2$*(aq)*** + **$2H_2O$*(l)***

c) $HC_2H_3O_2$*(aq)* + NaOH*(aq)* → **$NaC_2H_3O_2$*(aq)*** + **H_2O*(l)***

d) H_2SO_4*(aq)* + $2NH_3$*(aq)* → **$(NH_4)_2SO_4$*(aq)***

DCI13.2. Write the ionic and net ionic chemical equations for DCI13.2a) and DCI13.2b).

Ionic equation:

$$6Na^{+}(aq) + 2PO_4^{3-}(aq) + 3Pb^{2+}(aq) + 6NO_3^{-}(aq) \rightarrow Pb_3(PO_4)_2(s) + 6Na^{+}(aq) + 6NO_3^{-}(aq)$$

Net Ionic equation:

$$2PO_4^{3-}(aq) + 3Pb^{2+}(aq) \rightarrow Pb_3(PO_4)_2(s)$$

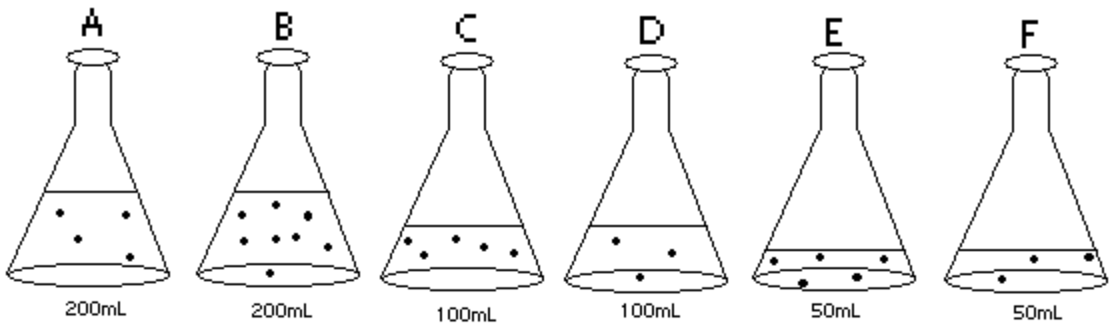
Ionic equation:

$$Mg^{2+}(aq) + 2OH^{-}(aq) + 2ClO_4^{-}(aq) + 2H^{+}(aq) \rightarrow Mg(ClO_4)_2(aq) + 2H_2O(l)$$

Net Ionic equation:

$$OH^{-}(aq) + H^{+}(aq) \rightarrow H_2O(l)$$

DCI13.3

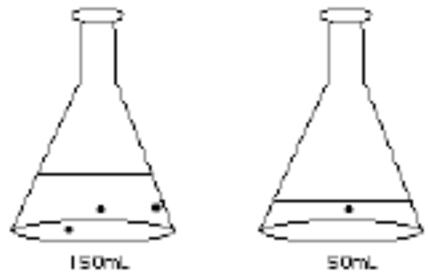


a) Which container has the highest concentration? **E**

b) Which container has the lowest concentration? **A**

c) If you pour 1/2 of A out the concentration will... double? halve? **Stay the same**? Not enough info

d) If the contents of container A are distributed in the following way into two new empty containers: 50 mL in one container and 150 mLs in the other. Draw a picture of the two containers.



e) If you double the amount of water in E the concentration will be the same as container **C.**

DCI13.3a. How many grams of magnesium sulfate are required to prepare 250.0 mLs of 0.0250 M $MgSO_4$?

$$\mathbf{.250\ L\left(\frac{0.025\ mol\ MgSO_4}{1\ L}\right) = 0.00625\ mol\ MgSO_4}$$

$$\mathbf{0.\ 00625\ mol\ MgSO_4\left(\frac{120.3\ g\ MgSO_4}{1\ mol\ MgSO_4}\right) = 0.752\ g\ MgSO_4}$$

b) Describe how you would prepare this solution?

Weigh 0.752 g $MgSO_{4(s)}$ using a balance. Add the $MgSO_{4(s)}$ to a 250 mL volumetric flask. Add some water, about 200 mL and mix the solution until all the $MgSO_4$ dissolves. Then add enough water so the final volume is 250 mL.

DCI13.4. Calculate the molarity of a solution prepared by mixing 9.98 g of NaCl in enough water to make 200.0 mLs of solution.

$$\mathbf{9.98\ g\ of\ NaCl\left(\frac{1\ mol\ NaCl}{58.45\ g\ NaCl}\right) = 0.171\ mol\ NaCl}$$

$$\mathbf{\frac{0.171\ mol\ NaCl}{0.200\ L} = 0.854\ M}$$

DCI13.5. What is the concentration of sulfate in a 50.0 mL sample of sodium sulfate if 6.55 mL of 0.0100 M $BaCl_2$ is needed to react with all of the sulfate ion.

$$\mathbf{Na_2SO_{4}\mathit{(aq)} + BaCl_{2}\mathit{(aq)} \rightarrow BaSO_{4}\mathit{(s)} + 2NaCl\mathit{(aq)}}$$

Initial
Change
Final

We must complete the ICE table. We are given a volume and concentration of $BaCl_2$ from which we can determine moles.

$$0.0655\ \text{L BaCl}_2 \left(\frac{0.0100\ \text{mol BaCl}_2}{1\ \text{L}}\right) = 6.55 \times 10^{-4}\ \text{mol BaCl}_2$$

We can add this amount to the ICE table, as the amount of that reacts (the Change row),

	$Na_2SO_4(aq)$ +	$BaCl_2(aq)$ →	$BaSO_4(s)$ +	$2NaCl(aq)$
Initial				
Change		**-6.55 x 10^{-4} mol**		
Final				

Now we can use the coefficients in the balanced equation to determine the ratio of the reactants and products in the Change row.

$$6.55 \times 10^{-4}\ \text{mol BaCl}_2 \left(\frac{1\ \text{mol Na}_2\text{SO}_4}{1\ \text{mol BaCl}_2}\right) = 6.55 \times 10^{-4}\ \text{mol Na}_2\text{SO}_4$$

$$6.55 \times 10^{-4}\ \text{mol BaCl}_2 \left(\frac{1\ \text{mol BaSO}_4}{1\ \text{mol BaCl}_2}\right) = 6.55 \times 10^{-4}\ \text{mol BaSO}_4$$

$$6.55 \times 10^{-4}\ \text{mol BaCl}_2 \left(\frac{2\ \text{mol NaCl}}{1\ \text{mol BaCl}_2}\right) = 1.31 \times 10^{-3}\ \text{mol NaCl}$$

	$Na_2SO_4(aq)$ +	$BaCl_2(aq)$ →	$BaSO_4(s)$ +	$2NaCl(aq)$
Initial				
Change	**-6.55 x 10^{-4} mol**	**-6.55 x 10^{-4} mol**	**6.55 x 10^{-4} mol**	**1.31 x 10^{-3} mol NaCl**
Final				

Since 6.55 x 10^{-4} mol of Na_2SO_4 must react the concentration of sulfate is determined knowing the moles of sulfate and the volume of its solution,

$$6.55 \times 10^{-4}\ \text{mol Na}_2\text{SO}_4 \left(\frac{1\ \text{mol SO}_4^{2-}}{1\ \text{mol Na}_2\text{SO}_4}\right) = 6.55 \times 10^{-4}\ \text{mol SO}_4^{2-}$$

$$\left(\frac{6.55 \times 10^{-4}\ \text{SO}_4^{2-}}{0.050\ \text{L}}\right) = 0.0131\ \text{M SO}_4^{2-}$$

NOTE: This is the same concentration of Na_2SO_4

Solubility Table

Ion	Solubility	Exceptions
NO_3^-	soluble	none
ClO_4^-	soluble	none
Cl^-	soluble	except Ag^+, Hg_2^{2+}, *Pb^{2+}
I^-	soluble	except Ag^+, Hg_2^{2+}, Pb^{2+}
SO_4^{2-}	soluble	except Ca^{2+}, Ba^{2+}, Sr^{2+}, Hg^{2+}, Pb^{2+}, Ag^+
CO_3^{2-}	insoluble	except Group IA and NH_4^+
PO_4^{3-}	insoluble	except Group IA and NH_4^+
^-OH	insoluble	except Group IA, *Ca^{2+}, Ba^{2+}, Sr^{2+}
S^{2-}	insoluble	except Group IA, IIA and NH_4^+
Na^+	soluble	none
NH_4^+	soluble	none
K^+	soluble	none

*slightly soluble