Chapter Four

① Which picture best describes an aqueous solution of Li_2SO_4?
<u>picture c</u>. Since Li_2SO_4 is <u>ionic</u>, it doesn't have molecules; it should be shown as Li^{+1} and SO_4^{-2} ions in solution.
There should be twice as many ⊕1 ions in solution as ⊖2 ions since it has 2 Li^{+1} ions per 1 SO_4^{-2} ion.
only picture c has these features.

② AX is a <u>non</u>electrolyte. The picture shows ⒶⓍ molecules; <u>none</u> of the molecules have dissociated into positive and negative ions, so the solution will not conduct.

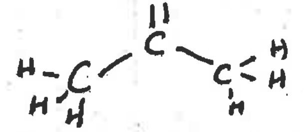
AY is a <u>weak</u> electrolyte. Some of the ⒶⓎ molecules have split into positive and negative ions, but most remain together as molecules. It will weakly conduct.

AZ is a strong electrolyte. The compound is 100% dissociated into A^{+1} and Z^{-1} ions, so it will be a good conductor of electricity.

⑱ Consider: acetone, CH_3COCH_3, a <u>non</u>electrolyte
NH_4Cl, ammonium chloride, a strong electrolyte
$HClO$, hypochlorous acid, a weak electrolyte

(a) Which solute particles are present in each case?
(b) If 0.1 mole of compound dissolves in solution, how many moles of solute particles?

<u>Acetone</u>, CH_3COCH_3, a nonelectrolyte



(a) The only solute particles present will be CH_3COCH_3. It does not dissociate into ions.
(b) Since it doesn't dissociate, <u>only 0.1 mole solute particles</u> will be present.

<u>NH_4Cl</u>, a strong electrolyte
(a) the solute particles present will be NH_4^{+1} and Cl^{-1} it dissociates 100% into ions.
(b) 0.1 mole NH_4Cl will cause 0.1 mole NH_4^{+1} <u>plus</u> 0.1 mole Cl^{-1}, so <u>0.2 moles solute particles total</u>.

HClO, a weak electrolyte (a weak acid)
(a) Since it partially dissociates, three types of solute particles will be present: H^{+1}, ClO^{-1}, and $HClO$.
(b) so <u>between 0.1 and 0.2 moles solute particles</u> will be present.

(61) a) Find molarity: 0.175 mole $ZnCl_2$ in 150 mL soln

$$\text{Molarity} = \frac{\text{moles solute}}{\text{L solution}} = \frac{0.175\text{ mole}}{(150\text{mL})(\frac{1\text{L}}{1000\text{mL}})} = \boxed{1.17\text{ M}}$$

b)

$$(35.0\text{ mL})\left(\frac{1\text{ L}}{1000\text{ mL}}\right)\left(\frac{4.50\text{ mole}}{\text{L}}\right) = 0.1575 \rightarrow \boxed{0.158\text{ moles acid}}$$

c)

$$(0.325\text{ moles})\left(\frac{1\text{ L}}{6.00\text{ moles}}\right)\left(\frac{1000\text{ mL}}{1\text{ L}}\right) = \boxed{54.2\text{ mL}}$$

(63) Avg adult male has 5.0 L total blood volume
Avg $[Na^+]$ = 0.135 M. Q: what mass of sodium ion in blood?

$$(5.0\text{ L})\left(\frac{0.135\text{ mole}}{\text{L}}\right)\left(\frac{22.9898\text{ g}}{\text{mole}}\right) = 15.518 \rightarrow \boxed{16\text{ g sodium ion}}$$

actually this last SF is incorrect...why?

(65) "Blood Alcohol Concentration" = grams alcohol per 100 mL blood (ethanol, C_2H_6O)

Legal intoxication level in Oregon and lots of other states is 0.08. Find molarity of ethanol.

$$\left(\frac{0.08\text{ grams ethanol}}{100\text{ mL solution}}\right)\left(\frac{1000\text{ mL}}{1\text{ L}}\right)\left(\frac{1\text{ mole}}{46.0688\text{ g}}\right) = 0.017365 \rightarrow \boxed{0.02\text{ M}}$$

(#69 is on next page)

(73) a) How many mL of 14.8 M NH_3 are needed to make 1000.0 mL of 0.250 M NH_3?

$M_1V_1 = M_2V_2$ $\quad (14.8\text{M})V_1 = (0.250\text{M})(1000.0\text{mL})$

$$\boxed{V_1 = 16.9\text{ mL}}$$

b) Find new $[NH_3]$ if 10.0 mL of 14.8 M diluted to 0.500 L

$M_1V_1 = M_2V_2$

$(14.8\text{ M})(10.0\text{ mL}) = M_2(500.\text{ mL})$

$$\boxed{M_2 = 0.296\text{ M}}$$

Ⓟ69 (a) 0.20 M KCl vs 0.15 M K_2CrO_4 vs 0.080 M K_3PO_4
Which has the highest $[K^{+1}]$?

$$0.20\text{ M KCl} \begin{cases} \rightarrow 0.20\text{ M } K^{+1} \\ \rightarrow 0.20\text{ M } Cl^{-1} \end{cases}$$

$$0.15\text{ M } K_2CrO_4 \begin{cases} \rightarrow 0.30\text{ M } K^{+1} \\ \rightarrow 0.15\text{ M } CrO_4^{-2} \end{cases} \leftarrow \boxed{\text{highest } [K^{+1}] \text{ is in the } 0.15\text{ M } K_2CrO_4}$$

$$0.080\text{ M } K_3PO_4 \begin{cases} \rightarrow 0.24\text{ M } K^{+1} \\ \rightarrow 0.080\text{ M } PO_4^{-3} \end{cases}$$

(b) which has more moles of K^{+1} ion?
30.0 mL of 0.15 M K_2CrO_4 or 25.0 mL of 0.080 M K_3PO_4 ?

$$(.0300\text{ L})\left(\frac{.15\text{ mole } K_2CrO_4}{L}\right)\left(\frac{2\text{ moles } K^{+1}}{1\text{ mole } K_2CrO_4}\right) = 0.0090\text{ moles } K^{+1}$$

$$(.0250\text{ L})\left(\frac{.080\text{ mole } K_3PO_4}{L}\right)\left(\frac{3\text{ moles } K^{+1}}{1\text{ mole } K_3PO_4}\right) = 0.0060\text{ moles } K^{+1}$$

0.0090 > 0.0060, so $\boxed{\text{the } K_2CrO_4 \text{ soln has more } K^{+1} \text{ ions.}}$

(75) a) How to prepare 250 mL of 0.250 M sucrose ($C_{12}H_{22}O_{11}$).

$$(0.250\ L)\left(0.250\ \frac{mole}{L}\right)\left(\frac{342.2992g}{mole}\right) = 21.4\ g\ \text{Sucrose.}$$

Fill a 250 mL volumetric flask about halfway with distilled water. Add 21.4 g sucrose to the flask. Stir or shake until it dissolves. Add distilled water to the line on the neck of the flask (the bottom of the meniscus should sit on the line. Stir. add more H_2O to reach the line if necessary afterstirring.

(60) (a)[15] After preparing 500 mL of 0.10 M salt, you spill some of the solution. The solution left in the container should still be 0.10 M. since it was a solution, it was homogeneously mixed, so each portion of the solution (the spilled part, or the part still in the bottle) should have the same amount of salt per volume of solution.

(b) If you prepare this solution but then allow it to sit out for a long time, so that H_2O evaporates, the concentration of the remaining solution will increase (assuming the 0.10 M solution was not saturated.) The same mass of salt will be dissolved in a smaller solution volume, so the concentration of salt will increase.

(c) a certain volume of a 0.50 M solution contains 4.5 g salt. what mass of the salt would be present in the same volume of a 2.50 M solution?

$$4.50g\left(\frac{2.50\ M}{0.50\ M}\right) = \boxed{22.5\ g\ \text{Salt}}$$

(83) $$2\,NaHCO_{3(s)} + H_2SO_{4(aq)} \rightarrow Na_2SO_{4(aq)} + 2\,H_2O_{(l)} + 2\,CO_{2(g)}$$

what mass needed to neutralize acid?

27 mL 6.0 M spilled!

$$(0.027\ L)\left(\frac{6.0\ mole\ H_2SO_4}{L}\right)\left(\frac{2\ mole\ NaHCO_3}{1mole\ H_2SO_4}\right)\left(\frac{84.0071\ g}{1mole}\right)$$

$$= 27.22\ g \rightarrow \boxed{27\ g\ \text{baking soda needed}}$$

(81) a) $HClO_4 + NaOH \rightarrow H_2O + NaClO_4$

$HClO_4$: 0.115 M, V = ?

$NaOH$: 50.00 mL, 0.0875 M

↑ What volume needed to neutralize the NaOH?

$$(0.05000\,L)\left(0.0875\,\frac{\overset{NaOH}{mole}}{L}\right)\left(\frac{1\,mole\,HClO_4}{1\,mole\,NaOH}\right)\left(\frac{1\,L\,HClO_4}{0.115\,moles}\right) = 0.0380\,L$$

or $\boxed{38.0\,mL}$

or, since stoichiometry is 1:1,
do $M_aV_a = M_bV_b$

$(0.115\,M)\,V_a = (.0875\,M)(50.00\,mL)$ $\quad V_a = 38.0\,mL$!

b) $Mg(OH)_2 + 2HCl \rightarrow 2\,H_2O + MgCl_2$

$Mg(OH)_2$: 2.87 g

HCl: .128 M

↑ what volume needed to neutralize $Mg(OH)_2$?

$$(2.87\,g\,Mg(OH)_2)\left(\frac{1\,mole}{58.3196\,g}\right)\left(\frac{2\,mole\,HCl}{\underset{1\,mole}{Mg(OH)_2}}\right)\left(\frac{1\,liter\,HCl}{0.128\,mole}\right) = 0.769\,L$$

or $\boxed{769\,mL}$

$AgNO_3 + KCl \rightarrow AgCl_{(s)} + KNO_3$

c) 25.8 mL $AgNO_3$ needed to precipitate all Cl^- ions in a 785 mg sample of KCl.. What was $[AgNO_3]$?

$$\frac{(0.785\,g\,KCl)\left(\frac{1\,mole}{74.5513\,g}\right)\left(\frac{1\,mole\,AgNO_3}{1\,mole\,KCl}\right)}{0.0258\,L\,AgNO_3\,soln} = \boxed{0.408\,mole\,AgNO_3/L}$$

(or 0.408 M)

(99) Mixing 35.0 mL 1.00 M KBr with 60.0 mL of 0.600 M KBr. Final soln is heated to evaporate H_2O until volume is 50.0 mL. Find [KBr].

$$[KBr] = \frac{\text{total moles KBr}}{\text{volume solution (L)}}$$

$$= \frac{(.0350\,L)(1.00\,\frac{mole}{L}) + (.0600\,L)(.600\,\frac{mole}{L})}{0.0500\,L}$$

$$= \frac{0.0710\,moles}{0.0500\,L} = \boxed{1.42\,M}$$