KEY

Solutions Part 2

Name - _____

1.) State whether each of the following substances is expected to form an ionic or molecular (covalent) solution.

a.) $RbBr_{(s)}$ I c.) $CsNO_{3\,(s)}$ I e.) $S_{8\,(s)}$ C g.) $NaCH_3COO_{(s)}$ I i.) $HNO_{3\,(l)}$ I

b.) $CHCl_{3\,(l)}$ C d.) $CuSO_{4\,(s)}$ I f.) $CrCl_{3\,(s)}$ I h.) $ICl_{(s)}$ C j.) $CH_{4\,(g)}$ C

2.) Write equations to show the dissolving of the following substances in water.

a.) $(NH_4)_2SO_{4\,(s)}$ →

$2\ NH_4^{+}{}_{(aq)} + SO_4^{-2}{}_{(aq)}$

b.) $CH_3CH_2OH_{(l)} + H_2O_{(l)}$ →

$CH_3CH_2OH_{(l)} + H_2O_{(l)}$

c.) $K_2CO_{3\,(s)}$ →

$2\ K^{+}{}_{(aq)} + CO_3^{-2}{}_{(aq)}$

d.) $CaCl_{2\,(s)}$ →

$Ca^{+2}{}_{(aq)} + 2\ Cl^{-}{}_{(aq)}$

3.) Calculate the concentrations of all the ions in each of the following solutions.

a.) $0.25\ M$ $FeCl_3$ $FeCl_3 \rightarrow Fe^{+3} + 3\ Cl^{-}$

Answer - $\frac{0.25\ mol\ FeCl_3}{1\ L\ FeCl_3} \times \frac{1\ mol\ Fe^{+3}}{1\ mol\ FeCl_3} = 0.25\ M\ Fe^{+3}$ $\frac{0.25\ mol\ FeCl_3}{1\ L\ FeCl_3} \times \frac{3\ mol\ Cl^{-}}{1\ mol\ FeCl_3} = 0.75\ M\ Cl^{-}$

b.) $1.5 \times 10^{-3}\ M$ $Al_2(SO_4)_3$ $Al_2(SO_4)_3 \rightarrow 2\ Al^{+3} + 3\ SO_4^{-2}$

Answer - $\frac{0.0015\ mol\ Al_2(SO_4)_3}{1\ L\ Al_2(SO_4)_3} \times \frac{2\ mol\ Al^{+3}}{1\ mol\ Al_2(SO_4)_3} = 3.0 \times 10^{-3}\ M\ Al^{+3}$

$\frac{0.0015 mol\ Al_2(SO_4)_3}{1\ L\ Al_2(SO_4)_3} \times \frac{3\ mol\ SO_4{}^{-2}}{1\ mol\ Al_2(SO_4)_3} = 4.5 \times 10^{-3}\ M\ SO_4{}^{-2}$

c.) $12.0\ g$ of $(NH_4)_2CO_3$ in $2.50\ L$ $(NH_4)_2CO_3 \rightarrow 2\ NH_4^{+} + CO_3^{-2}$

Answer - $12.0\ g\ (NH_4)_2CO_3 \times \frac{1\ mol\ (NH_4)_2CO_3}{96.11\ g\ (NH_4)_2CO_3} \times \frac{2\ mol\ NH_4{}^{+}}{1\ mol\ (NH_4)_2CO_3} \times \frac{1}{2.50\ L} = 0.100\ M\ NH_4{}^{+}$

$12.0\ g\ (NH_4)_2CO_3 \times \frac{1\ mol\ (NH_4)_2CO_3}{96.11\ g\ (NH_4)_2CO_3} \times \frac{1\ mol\ CO_3{}^{2-}}{1\ mol\ (NH_4)_2CO_3} \times \frac{1}{2.50\ L} = 0.050\ M\ CO_3{}^{2-}$

d.) $0.41\ g$ of $Ca(OH)_2$ in $500\ mL$ of aqueous solution $Ca(OH)_2 \rightarrow Ca^{+2} + 2\ OH^{-}$

Answer - $0.41\ g\ Ca(OH)_2 \times \frac{1\ mol\ Ca(OH)_2}{74.1\ g\ Ca(OH)_2} \times \frac{1\ mol\ Ca^{+2}}{1\ mol\ Ca(OH)_2} \times \frac{1}{0.500\ L} = 0.011\ M\ Ca^{+2}$

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$$0.41\ g\ Ca(OH)_2 \times \frac{1\ mol\ Ca(OH)_2}{74.1\ g\ Ca(OH)_2} \times \frac{2\ mol\ OH^-}{1\ mol\ Ca(OH)_2} \times \frac{1}{0.500\ L} = 0.022\ M\ OH^-$$

e.) $2.50\ g$ of KBr in $150\ mL$ of aqueous solution KBr → K^+ + Br^-

Answer - $$2.50\ g\ KBr \times \frac{1\ mol\ KBr}{119\ g\ KBr} \times \frac{1\ mol\ K^+}{1\ mol\ KBr} \times \frac{1}{0.150\ L} = 0.140\ M\ K^+$$

$$2.50\ g\ KBr \times \frac{1\ mol\ KBr}{119\ g\ KBr} \times \frac{1\ mol\ Br^-}{1\ mol\ KBr} \times \frac{1}{0.150\ L} = 0.140\ M\ Br^-$$

4a.) Write an equation showing the equilibrium in a saturated solution of lead (II) bromide.

Answer - $PbBr_{2\ (s)} + H_2O_{\ (l)} \leftrightarrow Pb^{+2}{}_{(aq)} + 2\ Br^-{}_{(aq)} + H_2O$

b.) The solubility of $PbBr_2$ is $0.844\frac{g}{100\ mL}$. What is its Molarity?

Answer - $$\frac{0.844\ g\ PbBr_2}{0.100\ L\ PbBr_2} \times \frac{1\ mol\ PbBr_2}{367\ g\ PbBr_2} = 0.023\ M\ PbBr_2$$

c.) Calculate the concentrations of $Pb^{+2}{}_{(aq)}$ and $Br^-{}_{(aq)}$ in a saturated solution of $PbBr_2$?

Answer - $$\frac{0.023\ M\ PbBr_2}{1\ L} \times \frac{1\ mol\ Pb^{+2}}{1\ mol\ PbBr_2} = 0.023\ M\ Pb^{+2}$$

$$\frac{0.023\ M\ PbBr_2}{1\ L} \times \frac{2\ mol\ Br^-}{1\ mol\ PbBr_2} = 0.046\ M\ Br^-$$

5.) Calculate the concentration of all the ions present when

a.) $25.0\ mL$ of water is added to $20.0\ mL$ of $0.35\ M$ Fe^{+3}.

Answer - $$\frac{(0.35)(0.020)}{0.045} = 0.156\ M\ Fe^{+3}$$

b.) $15.0\ mL$ of $6.5 \times 10^{-5}\ M$ Cu^{+2} is mixed with $40.0\ mL$ of $3.2 \times 10^{-3}\ M$ Cl^- 1:1 ratio

Answer - $$\frac{(6.5\times10^{-5})(0.015)}{0.055} = 1.8 \times 10^{-5}\ M\ Cu^{+2} \qquad \frac{(3.2\times10^{-3})(0.040)}{0.055\ L} = 2.3 \times 10^{-3}\ M\ Cl^-$$

c.) $95.0\ mL$ of $8.65 \times 10^{-4}\ M$ $Al(NO_3)_3$ is mixed with $15.0\ mL$ of $7.50 \times 10^{-6}\ M$ Ag_2SO_4.

Answer - $Al(NO_3)_3$ → Al^{+3} + $3\ NO_3^-$ $$\frac{(8.65\times10^{-4})(0.095)}{0.110} = 7.47 \times 10^{-4}\ M\ Al(NO_3)_3$$

$$7.47 \times 10^{-4}\ M\ Al(NO_3)_3 \times \frac{1\ mol\ Al^{+3}}{1\ mol\ Al(NO_3)_3} = 7.47 \times 10^{-4}\ M\ Al^{+3}$$

$$7.47 \times 10^{-4}\ M\ Al(NO_3)_3 \times \frac{3\ mol\ NO_3^-}{1\ mol\ Al(NO_3)_3} = 2.24 \times 10^{-3}\ M\ NO_3^-$$

Ag_2SO_4 → $2\ Ag^+$ + SO_4^{-2} $$\frac{(7.50\times10^{-6})(0.015)}{0.110} = 1.02 \times 10^{-6}\ M\ Ag_2SO_4$$

KEY

$$1.02 \times 10^{-6}\ M\ Ag_2SO_4 \times \frac{2\ mol\ Ag^+}{1\ mol\ Ag_2SO_4} = 2.04 \times 10^{-6}\ M\ Ag^+$$

$$1.02 \times 10^{-6}\ M\ Ag_2SO_4 \times \frac{1\ mol\ SO_4^{-2}}{1\ mol\ Ag_2SO_4} = 1.02 \times 10^{-6}\ M\ SO_4^{-2}$$

d.) $25.0\ mL$ of $0.360\ M$ NH_4Br is mixed with $75.0\ mL$ of $0.160\ M$ $(NH_4)_2SO_4$.

Answer - $NH_4Br \rightarrow NH_4^+ + Br^-$ $\quad \frac{(0.360)(0.025)}{0.100} = 0.090\ M\ NH_4Br$

$$0.090\ M\ NH_4Br \times \frac{1\ mol\ NH_4^+}{1\ mol\ NH_4Br} = 0.090\ MNH_4^+ \longrightarrow 0.090 + 0.240 = 0.330\ MNH_4^+$$

$$0.090\ M\ NH_4Br \times \frac{1\ mol\ Br^-}{1\ mol\ NH_4Br} = 0.090\ M\ Br^-$$

$Ag_2SO_4 \rightarrow 2\ NH_4^+ + SO_4^{-2}$ $\quad \frac{(0.160)(0.075)}{0.100} = 0.120\ M\ (NH_4)_2SO_4$

$$0.120\ M\ (NH_4)_2SO_4 \times \frac{2\ mol\ NH_4^+}{1\ mol\ (NH_4)_2SO_4} = 0.240\ M\ NH_4^+$$

$$0.120\ M\ (NH_4)_2SO_4 \times \frac{1\ mol\ SO_4^{-2}}{1\ mol\ (NH_4)_2SO_4} = 0.120\ M\ SO_4^{-2}$$