Chemistry 11

Solution Chemistry II Worksheet

✓ **Ions in Solutions**

Name: Key
Date:
Block:

1. Write the balanced ionization equation for the following solutes in water:

   a. $CaCO_3$

   $CaCO_{3(aq)} \rightarrow Ca^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)}$

   b. Cesium phosphate

   $Cs_3PO_{4(aq)} \rightarrow 3Cs^{+}_{(aq)} + PO_4^{3-}{}_{(aq)}$

2. Calculate the number of moles of aqueous ions in the following solutions. Assume that each dissolved substance complete dissociates.

   a. 0.60 L of 0.20 M K_2SO_4

   $0.60\,L \times \frac{0.20\,mol}{L} = 0.12\,mol\,K_2SO_4$

   $K_2SO_{4\,(aq)} \rightarrow 2K^{+}_{(aq)} + SO_4^{2-}{}_{(aq)}$

   0.12 mol ×2 0.24 mol; 0.12 mol

   b. 75.0 mL of 0.150 M $MnCl_2$

   $0.075\,L \times \frac{0.150\,mol}{L} = 0.0113\,mol\,MnCl_2$

   $MnCl_{2\,(aq)} \rightarrow Mn^{2+}_{(aq)} + 2Cl^{-}_{(aq)}$

   0.0113 mol; 0.0113 mol; ×2; 0.0226 mol

3. What is the concentration of SO_4^{2-} present in 0.135 M $Al_2(SO_4)_3$?

   $Al_2(SO_4)_3 \rightarrow 2Al^{3+} + 3SO_4^{2-}$

   0.135 M; ×3; **0.405 M**

4. What is the $[Cl^-]$ formed when 10.0 g of $BaCl_{2(s)}$ is dissolved and diluted to 0.600 L?

   $\frac{10.0\,g\,BaCl_2}{0.600\,L} \times \frac{1\,mol\,BaCl_2}{208.23\,g} = 0.0800\,M\,BaCl_2$

   $BaCl_{2\,(aq)} \rightarrow Ba^{2+}_{(aq)} + 2Cl^{-}_{(aq)}$

   0.0800 M; **0.160 M**

5. When 350.0 mL of 0.250 M $MgCl_2$ is boiled down to a final volume of 275.0 mL, what is the $[Cl^-]$ in the resulting solution?

   $[MgCl_2]$

   $C_1V_1 = C_2V_2$

   $(0.250\,M)(350.0\,mL) = C_2(275.0\,mL)$

   $C_2 = 0.318\,M\,MgCl_2$

   $MgCl_{2\,(aq)} \rightarrow Mg^{2+}_{(aq)} + 2Cl^{-}_{(aq)}$

   0.318 M; **0.636 M**

$V_2 = 250.0\ mL$

6. A solution is made by mixing 100.0 mL of 0.200 M $MgSO_4$ and 150.0 mL of 0.400 M Na_2SO_4. What is the concentration of each ionic species in the final solution?

[$MgSO_4$]

$C_1V_1 = C_2V_2$

$(0.200\ M)(100.0\ mL) = C_2(250.0\ mL)$

$C_2 = 0.0800\ M\ MgSO_4$

$MgSO_4(aq) \rightarrow Mg^{2+}(aq) + SO_4^{2-}(aq)$

$0.0800\ M \quad 0.0800\ M \quad 0.0800\ M$

+

[Na_2SO_4]

$(0.400\ M)(150.0\ mL) = C_2(250.0\ mL)$

$C_2 = 0.240\ M\ Na_2SO_4$

$Na_2SO_4(aq) \rightarrow 2Na^+(aq) + SO_4^{2-}(aq)$

$0.240\ M \quad 0.480\ M \quad 0.240\ M$

$[SO_4^{2-}] = 0.320\ M$

7. A chemistry student dissolves 3.25 g of K_2CrO_4 and 1.75 g of $K_2Cr_2O_7$ in water and dilutes the mixture to a total volume of 100.0 mL. What is the concentration of all the ions in the solution?

[K_2CrO_4]

$\frac{3.25\ g}{100.0\ mL} \times \frac{1000\ mL}{1\ L} \times \frac{1\ mol}{194.20\ g}$

$= 0.167\ M\ K_2CrO_4$

$K_2CrO_4(aq) \rightarrow 2K^+(aq) + CrO_4^{2-}(aq)$

$0.167\ M \quad 0.334\ M \quad 0.167\ M$

+

[$K_2Cr_2O_7$]

$\frac{1.75\ g}{100.0\ mL} \times \frac{1000\ mL}{1\ L} \times \frac{1\ mol}{294.20\ g}$

$= 0.0595\ M\ K_2Cr_2O_7$

$K_2Cr_2O_7(aq) \rightarrow 2K^+(aq) + Cr_2O_7^{2-}(aq)$

$0.0595\ M \quad 0.119\ M \quad 0.0595\ M$

$[K^+] = 0.453\ M$

8. What is the concentration of all ions in a solution given that 15.0 mL of 0.325 M Na_3PO_4 was mixed with 35.0 mL of 0.225 M K_2SO_4?

[Na_3PO_4]

$C_1V_1 = C_2V_2$

$(0.325\ M)(15.0\ mL) = C_2(50.0\ mL)$

$C_2 = 0.0975\ M\ Na_3PO_4$

$Na_3PO_4(aq) \rightarrow 3Na^+(aq) + PO_4^{3-}(aq)$

$0.0975\ M \quad 0.293\ M \quad 0.0975\ M$

[K_2SO_4]

$C_1V_1 = C_2V_2$

$(0.225\ M)(35.0\ mL) = C_2(50.0\ mL)$

$C_2 = 0.158\ M\ K_2SO_4$

$K_2SO_4(aq) \rightarrow 2K^+(aq) + SO_4^{2-}(aq)$

$0.158\ M \quad 0.316\ M \quad 0.158\ M$

1. see website 2a. 0.24 mol, 0.12 mol 2b. 0.0113 mol, 0.0225 mol 3. 0.405 M 4. 0.160 M 5. 0.636 M 6. $[Mg^{2+}]=0.0800$ M, $[Na^+]=0.480$ M, $[SO_4^{2-}]=0.320$ M 7. $[K^+]=0.453$ M, $[CrO_4^{2-}]=0.167$ M, $[Cr_2O_7^{2-}]=0.0595$ M 8. $[Na^+]=0.293$ M, $[PO_4^{3-}]=0.0975$ M, $[K^+]=0.315$ M, $[SO_4^{2-}]=0.158$ M