MULTIPLE CHOICE (3pts each): Write the ONE letter corresponding to the correct answer on the line next to each question. The LETTER ASSOCIATED WITH THE CORRECT ANSWER MUST BE WRITTEN ON THE LINE NEXT TO THE QUESTION in order to receive full credit.

1.) Which of the following compounds would be the most soluble in water? 1.) A

(a.) CH_3OH b.) $PbCl_2$ c.) C_2H_4 d.) $FeCO_3$

2.) The largest component of a solution is referred to as the 2.) D

a.) solute b.) precipitate c.) spectator ion (d.) solvent

3.) Which of the following solutions would have the largest number of dissolved ions? 3.) B

a.) 2.0M NaCl (b.) 2.0M Na_2SO_4 c.) 3.0M Ag_2CO_3 d.) 3.0M PbS

4M 6M insol insol

4.) What is the oxidation number on chromium in $V_2O_6^{2-}$? 4.) A

(a.) +5 b.) +6 c.) +10 d.) +12

$6x - 12 = -12 + 2V = -2$ $2V = 10$ $V = +5$

5.) What is the correct formula for the precipitate formed from the following reactants? NaOH (aq) + $CaBr_2$ 5.) C

a.) $NaBr_2$ b.) NaBr (c.) $Ca(OH)_2$ d.) CaOH

6.) What is the oxidizing agent in the reaction: $\overset{0}{Fe} + \overset{+2}{SnCl_2} \rightarrow \overset{0}{Sn} + \overset{+2}{FeCl_2}$ 6.) D

a.) Fe b.) Sn c.) Fe^{2+} (d.) Sn^{2+}

7.) What are the products of the reaction between H_2SO_4 and KOH? 7.) C

a.) H_2SO_4 and KOH b.) H_2S & K_2O (c.) H_2O & K_2SO_4 d.) H_2, O_2, & K_2S

8.) If you start with 6.0 moles of H_2 and 6.0 moles of N_2, how many moles of NH_3 can be produced in the reaction $3H_2 + N_2 \rightarrow 2NH_3$? 8.) B

a.) 2.0mol (b.) 4.0mol c.) 6.0mol d.) 12.0mol

$6\left(\frac{2}{3}\right) = 4$ $6\left(\frac{2}{7}\right) = 12$

9.) What is the concemtraton of a 500.0mL solution containing 5.00g MgF_2? 9.) A

(a.) 0.161M b.) 10.0M c.) 1.61×10^{-4}M d.) 0.0100M

$24.305\ g/mol + 2(18.9984\ g/mol) = 62.3018\ g/mol$ $5.00g\left(\frac{1mol}{62.3018g}\right) = 0.0803mol / 0.5L$

10.) What volume of a 0.136M stock solution would be needed to make 250mL of a 0.0500M solution? 10.) C

a.) 680.mL b.) 1.70mL (c.) 91.9mL d.) 27.2mL

$(0.136M)(x) = (0.0500M)(250mL)$

$x = 91.9mL$

SHORT ANSWER (10 pts each): Completely answer all of the following questions. Read all questions carefully!!! ALL WORK MUST BE SHOWN TO RECEIVE FULL CREDIT. If your work is in a different location, you must make a note of this in the given work area for the problem in order for the work to be considered for partial credit. Make sure to include units and report all mathematical answers to the correct number of significant figures. Write final answers in designated locations when indicated.

1.) Given the reaction $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$,

a.) if 15.2g of iron (III) oxide (159.6882g/mol) is combined with 25.5g carbon monoxide (28.0104g/mol), what is the limiting reagent?

Answer: Fe_2O_3

$15.2g\left(\frac{1mol}{159.6882g}\right) = 0.0951855\ mol\ Fe_2O_3\left(\frac{2\ mol\ Fe}{1\ mol\ Fe_2O_3}\right) = 0.190371\ mol\ Fe$ ← Less so

$25.5g\left(\frac{1mol}{28.0104g}\right) = 0.910376\ mol\ CO\left(\frac{2\ mol\ Fe}{3\ mol\ CO}\right) = 0.606917\ mol\ Fe$ Fe_2O_3 is LR

b.) What mass of iron would be produced?

Answer: 10.6 g

$0.190371\ mol\ Fe\left(\frac{55.845g}{mol}\right) = 10.6312g$

2.) A 0.599g sample of an unknown compound containing carbon, hydrogen, and oxygen was burned to produce 1.20g CO_2 (44.0098g/mol) and 0.490g H_2O (18.01528g/mol). What was the empirical formula of the unknown compound?

Answer: C_2H_4O

$1.20g\ CO_2\left(\frac{1mol}{44.0098g}\right) = 0.0272671\ mol\ CO_2\left(\frac{1\ mol\ C}{1\ mol\ CO_2}\right)$

$= \frac{0.0272671}{0.01354} \rightarrow 2\ mol\ C\left(\frac{12.011g}{mol}\right) = 0.3275g\ C$

$0.490g\ H_2O\left(\frac{1mol}{18.01528g}\right) = 0.027199\ mol\ H_2O\left(\frac{2\ mol\ H}{1\ mol\ H_2O}\right)$

$= \frac{0.054398}{0.01354} \rightarrow 4\ H\ mol\left(\frac{1.00794g}{mol}\right) = 0.05483g\ H$

$0.599g - 0.3275g - 0.05483g = 0.216687g\ O\left(\frac{1mol}{15.9994g}\right) = 0.01354\ mol\ O$

$\frac{0.01354}{0.01354} = 1$

3.) Balance the following equations:

a.) $2F_2 + 2H_2O \rightarrow 4HF + O_2$

b.) $\left[C_4H_6 + \frac{11}{2}O_2 \rightarrow 4CO_2 + 3H_2O\right] \times 2$

$80 + 30 = 110$

$2C_4H_6 + 11O_2 \rightarrow 8CO_2 + 6H_2O$

Use the charges to balance the following equation:

c.) $Mn^{4+} + 2Cu \rightarrow 2Cu^{+} + Mn^{2+}$

$Mn^{4+} + 2e^- \rightarrow Mn^{2+}$

$(Cu \rightarrow Cu^{+} + 1e^-)2 = 2Cu \rightarrow 2Cu^{+} + 2e^-$

Write the total ionic and net ionic equations for the following reaction:

$$Pb(NO_3)_2\,(aq) + Na_2S\,(aq) \rightarrow PbS\,(s) + 2\,NaNO_3\,(aq)$$

d.) Total ionic equation (you do not need to include phases):

$Pb^{2+} + 2NO_3^- + 2Na^+ + S^{2-} \rightarrow PbS + 2Na^+ + 2NO_3^-$

e.) Net ionic equation (you do need to include phases):

$Pb^{2+}(aq) + S^{2-}(aq) \rightarrow PbS(s)$

4.) If 38.76mL of 0.250M barium hydroxide is needed to fully titrate 35.00mL of hydrochloric acid, what is the concentration of the hydrochloric acid solution?

$$Ba(OH)_2\,(aq) + 2\,HCl\,(aq) \rightarrow 2\,H_2O\,(l) + BaCl_2\,(aq)$$

Answer: 0.537 M

$0.03876\,L \left(\frac{0.250\,mol}{L}\right)$

$= 0.0094\,mol\,Ba(OH)_2 \left(\frac{2\,mol\,HCl}{1\,mol\,Ba(OH)_2}\right)$

$= \frac{0.0188\,mol\,HCl}{0.03500\,L}$

$= 0.53714\,M$

5.) For each of the following reactions, write the oxidation and reduction half reaction, then indicate the oxidizing agent for each. Write the symbol for the oxidizing agent, not the name.

a.) $3Mg + 2FeBr_3 \rightarrow 2Fe + 3MgCl_2$

Oxidation ½ reaction: $Mg \rightarrow Mg^{2+} + 2e^-$

Reduction ½ reaction: $Fe^{3+} + 3e^- \rightarrow Fe$

Oxidizing Agent: Fe^{3+}

b.) $F_2 + CaCl_2 \rightarrow Cl_2 + CaF_2$

Oxidation ½ reaction: $2Cl^- \rightarrow Cl_2 + 2e^-$

Reduction ½ reaction: $F_2 + 2e^- \rightarrow 2F^-$

Oxidizing Agent: F_2

6.) Complete and balance the following equations. If no reaction will occur, write no rxn.

a.) $Sn + AlF_3 \rightarrow$ no rxn

b.) $Ca + 2H_2O\ (l) \rightarrow H_2 + Ca(OH)_2$

c.) $2\,Cr + 3Cu(NO_3)_2 \rightarrow 2Cr(NO_3)_3 + 3Cu$

d.) $Ni + H_2O\ (g) \rightarrow$ no rxn

e.) $Mg + 2HCl \rightarrow MgCl_2 + H_2$

7.) Lead (II) nitrate was reacted with 25.00mL of iron (III) iodide to form 0.258g of solid lead (II) iodide (461.008g/mol). What was the concentration of the iron (III) iodide solution?

$2\ FeI_3\ (aq) + 3\ Pb(NO_3)_2\ (aq) \rightarrow 3\ PbI_2\ (s) + 2\ Fe(NO_3)_3$

Answer: 0.0149 M

$$0.258\ g \left(\frac{1\ mol}{461.008\ g}\right)$$

$$= 0.000559643\ mol\ PbI_2 \left(\frac{2\ FeI_3}{3\ PbI_2}\right)$$

$$= \frac{0.000373095\ mol\ FeI_3}{0.02500\ L}$$

$$= 0.014924\ \frac{mol}{L}$$