PRACTICE TEST/AQ CHEM/FREE RESPONSE PROBLEMS/AP CHEMISTRY

In your text book, Chemistry the Central Science, there are three problems that are very similar to problems you will be expected to answer on your Aqueous Chemistry test. These problems are: 20.5, 20.9, and 20.10

ANSWERS TO SUGGESTED BOOK PROBLEMS

20.5: a). $TiCl_4(g) + 2Mg(l) \rightarrow Ti(s) + 2MgCl_2(l)$
b). titanium in $TiCl_4$ is the oxidant, magnesium is the reductant.

20.9: a). $8H^+(aq) + Cr_2O_7^{2-}(aq) + I^-(aq) \rightarrow 2Cr^{3+}(aq) + 4H_2O(l) + IO_3^-(aq)$
b). $12H^+(aq) + 4MnO_4^-(aq) + 5CH_3OH(aq) \rightarrow 4Mn^{2+}(aq) + 11H_2O(l) + 5HCO_2H(aq)$
c). $H_2O(l) + I_2(aq) + 5ClO^-(aq) \rightarrow 2IO_3^-(aq) + 2H^+(aq) + 5Cl^-(aq)$
d). $2H_2O(l) + As_2O_3(s) + H^+(aq) + 2NO_3^-(aq) \rightarrow 2H_3AsO_4(aq) + N_2O_3(aq)$
e). $H_2O(l) + 2MnO_4^-(aq) + Br^-(aq) \rightarrow 2MnO_2(s) + BrO_3^-(aq) + 2OH^-(aq)$
f). $ClO^-(aq) + Pb(OH)_4^{2-}(aq) \rightarrow Cl^-(aq) + H_2O(l) + PbO_2(s) + 2OH^-(aq)$

20.10: a). $3NO_2^-(aq) + 8H^+(aq) + Cr_2O_7^{2-}(aq) \rightarrow 3NO_3^-(aq) + 2Cr^{3+}(aq) + 4H_2O(l)$
b). $6H_2O(l) + 4As(s) + 3H^+(aq) + 3ClO_3^-(aq) \rightarrow 4H_3AsO_3(aq) + 3HClO(aq)$

In addition to the above reaction writing problems, there are some calculation-based problems. These suggested problems are: 4.71, 4.72, and 4.73.

ANSWERS TO ADDITIONAL BOOK PROBLEMS:

4.71:
$2HBr(aq) + Ca(OH)_2 \rightarrow CaBr_2(aq) + 2H_2O(l)$

0.0488 L HBr soln X 5.00×10^{-2} mol HBr/1.0 L soln X 1 mol $Ca(OH)_2$/2 mol HBr

X 1/0.100 L of $Ca(OH)_2$ = 1.220×10^{-2} = 1.22×10^{-2} M $Ca(OH)_2$

From the molarity of the saturated solution, we can calculate gram solubility of $Ca(OH)_2$ in 100 mL of H_2O.

0.100 L soln X 1.220 X 10-2 mol $Ca(OH)_2$/1.0 L soln X 74.10 g $Ca(OH)_2$/1 mol $Ca(OH)_2$ =

0.0904 g $Ca(OH)_2$ in 100 mL of soln.

4.72:
$Sr(NO_3)_2(aq) + Na_2CrO_4(aq) \rightarrow SrCrO_4(s) + 2NaNO_3(aq)$

From a 100 mL sample we can:

0.100 L soln X 7.52 g $Sr(NO_3)_2$/0.750 L soln X 1 mol $Sr(NO_3)_2$/2.11.6 g $Sr(NO_3)_2$ X

1 mol Na_2CrO_4/ 1 mol $Sr(NO_3)_2$ X 1 L soln/0.0425 mol Na_2CrO_4 = 0.111 L Na_2CrO_4 soln

4.73:
a. $NiSO_4(aq) + 2KOH(aq) \rightarrow Ni(OH)_2(s) + K_2SO_4(aq)$

b. The precipitate is $Ni(OH)_2$

c. 0.200 M KOH X 0.1000 L KOH = 0.0200 mol KOH

0.150 M $NiSO_4$ X 0.2000 L KOH = 0.0300 mol $NiSO_4$

1 mol $NiSO_4$ requires 2 mol KOH, so 0.0300 mol $NiSO_4$ requires 0.0600 mol KOH.

Since only 0.0200 mol KOH is available, KOH is the limiting reagent.

d. The amount of the limiting reagent (KOH) determines the amount of product, in this case $Ni(OH)_2$

0.0200 mol KOH X 1 mol $Ni(OH)_2$/2 mol KOH X 92.71 g $Ni(OH)_2$/ 1 mol $Ni(OH)_2$ = 0.927 g $Ni(OH)_2$

e. The limiting reagent is OH^-, no excess OH^- remains in solution.

Excess reactant: Ni^{2+}: M Ni^{2+} remaining = mol Ni^{2+} remaining/liter of solution.

0.0300 mol Ni^{2+} initial – 0.0100 mol Ni^{2+} reacted = 0.0200 mol Ni^{2+} remaining.

0.0200 mol Ni^{2+}/0.3000 L = 0.0667 M Ni^{2+} (aq)

Spectators: SO_4^{2-} and K^+ These ions do not react, so the only change in their M is due to dilution. The final volume is 0.3000 L

Dilution equation says M1V1 = M2V2

So, M2 = M1V1/V2 So, 0.200 M K^+ X 0.1000 L/0.3000 L = 0.0667 M K^+(aq)

0.150 M SO_4^{2-} X 0.2000 L/0.3000 L = 0.100 M SO_4^{2-}(aq)

OH WHAT THE HECK, TRY THIS PROBLEM TOO! HINT, HINT. TRY THIS ONE!!!!!

A titration was performed:
73.2 ml of 0.143 M sulfuric acid solution are titrated with 109.4 mL of 0.317 M sodium hydroxide solution.
A. Show the balanced *ionic* equation.
B. What is the limiting reagent?
C. What are the remaining molarities of *all* of the remaining ions in solution? (There are three)

ANSWERS:

A. $H^+ + HSO4^- + 2Na^+ + 2OH^- \rightarrow 2Na^+ + SO_4^{2-} + 2\,H_2O$
B. H2SO4 is the limit
C. 0.0575 M SO_4^{2-}, 0.190 M Na^+, 0.0750 M OH^-