CHM151 Q6a 25 Pts FALL 2005 Name: Key

SHOW ALL WORK TO RECEIVE CREDIT. Due 7:30 a.m. Tuesday Oct. 11.

****Honor System: You are to Work Alone on this Quiz.

1. (3 Pts) What volume of 12.0 *M* HNO_3 is required to prepare 900 mL of 2.0 *M* HNO_3 solution?

Dilution Problem $M_1 V_1 = M_2 V_2$

$(12.0\,M)(V_1) = (2.0\,M)(900\,mL)$

$V_1 = 150\,mL$

2. (3 Pts) What is the molarity of 1600 mL of a solution that contains 3.25 g of H_3PO_4?

$$\frac{3.25\,g\,H_3PO_4 \mid 1\,mol}{97.994\,g \mid 1600\times10^{-3}\,L} = 0.0207\,\frac{mol\,H_3PO_4}{L}$$

3. (3 Pts) If 75.0 mL of 0.250 *M* HNO_3 and 75.0 mL of 0.250 *M* KOH are mixed, what is the molarity of the salt in the resulting solution?

$HNO_3(aq)$ + $KOH(aq)$ → $H_2O(l)$ + $KNO_3(aq)$

75.0 mL, 0.250 mol/L; 75.0 mL, 0.250 mol/L; ? mol/L

Since the reaction has a 1:1 ratio and there are stoichiometric amounts (same volumes & concentrations), we can work with either reactant.

$$\frac{75.0\,mL\,HNO_3 \mid 0.250\,mol\,HNO_3 \mid 1\,mol\,KNO_3}{1000\,mL\,HNO_3 \mid 1\,mol\,HNO_3 \mid 0.150\,L_{solution}} = 0.125\,\frac{mol\,KNO_3}{L_{solution}}$$

4. (3 Pts) If 400 mL of 0.20 *M* HCl solution is added to 800 mL of 0.050 *M* $Ba(OH)_2$ solution, the resulting solution will be ? *M* in $BaCl_2$.

$2HCl(aq)$ + $Ba(OH)_2$ → $2H_2O(l)$ + $BaCl_2(aq)$

400 mL, 0.20 mol/L; 800 mL, 0.050 mol/L; ? mol/L

either one

Based on HCl:
$$\frac{400\,mL\,HCl \mid 0.20\,mol\,HCl \mid 1\,mol\,BaCl_2}{1000\,mL\,HCl \mid 2\,mol\,HCl \mid 1.2\,L_{solution}} = 0.033\,\frac{mol\,BaCl_2}{L_{solution}}$$

Based on $Ba(OH)_2$:
$$\frac{800\,mL\,Ba(OH)_2 \mid 0.050\,mol\,Ba(OH)_2 \mid 1\,mol\,BaCl_2}{1000\,mL\,Ba(OH)_2 \mid 1\,mol\,Ba(OH)_2 \mid 1.2\,L_{solution}} = 0.033\,\frac{mol\,BaCl_2}{L_{solution}}$$

5. (3 pts) What is the molarity of the calcium chloride in the solution resulting from the addition of 100 mL of 0.0500 *M* $Ca(OH)_2$ to 200 mL of 0.0500 *M* HCl?

$Ca(OH)_2(aq)$ + $2HCl(aq)$ → $2H_2O(l)$ + $CaCl_2(aq)$

100 mL, 0.0500 mol/L; 200 mL, 0.0500 mol/L; ? mol/L

either one

Based on $Ca(OH)_2$:
$$\frac{100\,mL\,Ca(OH)_2 \mid 0.0500\,mol\,Ca(OH)_2 \mid 1\,mol\,CaCl_2}{1000\,mL\,Ca(OH)_2 \mid 1\,mol\,Ca(OH)_2 \mid 0.300\,L_{solution}} = 0.017\,\frac{mol\,CaCl_2}{L_{solution}}$$

Based on HCl:
$$\frac{200\,mL\,HCl \mid 0.0500\,mol\,HCl \mid 1\,mol\,CaCl_2}{1000\,mL\,HCl \mid 2\,mol\,HCl \mid 0.300\,L_{solution}} = 0.017\,\frac{mol\,CaCl_2}{L_{solution}}$$

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6. (3 Pts) If 50.0 mL of 0.0400 *M* HBr is added to 100 mL of 0.0300 *M* $Ba(OH)_2$, what is the molarity of the acid or base that remains unreacted?

$2HBr(aq) + Ba(OH)_2(aq) \rightarrow 2H_2O(l) + BaBr_2(aq) + XS?$

50.0 mL, 0.040 mol/L — 100 mL, 0.0300 mol/L — "pick a product is H_2O"

Based on HBr:

$$\frac{50.0\ mL\ HBr}{1000\ mL\ HBr}\left|\frac{0.0400\ mol\ HBr}{1}\right|\frac{2\ mol\ H_2O}{2\ mol\ HBr} = 0.00200\ mol\ H_2O$$

Based on $Ba(OH)_2$:

$$\frac{100\ mL\ Ba(OH)_2}{1000\ mL\ Ba(OH)_2}\left|\frac{0.0300\ mol\ Ba(OH)_2}{1}\right|\frac{2\ mol\ H_2O}{1\ mol\ Ba(OH)_2} = 0.00600\ mol\ H_2O$$

Difference is related to XS:

$$\frac{0.00400\ mol\ H_2O}{2\ mol\ H_2O}\left|\frac{1\ mol\ Ba(OH)_2}{0.150\ L\ solution}\right. = 0.0133\ \frac{mol\ Ba(OH)_2}{L\ solution}$$

7. (3 Pts) If 200 mL of 2.00 *M* H_3PO_4 solution is added to 600 mL of 2.00 *M* NaOH solution, the resulting solution will be _____ molar in Na_3PO_4.

$H_3PO_4(aq) + 3NaOH(aq) \rightarrow 3H_2O(l) + Na_3PO_4(aq)$

200 mL, 2.00 mol/L — 600 mL, 2.00 mol/L — ? mol/L

Based on H_3PO_4:

$$\frac{200\ mL\ H_3PO_4}{1000\ mL\ H_3PO_4}\left|\frac{2.00\ mol\ H_3PO_4}{1}\right|\frac{1\ mol\ Na_3PO_4}{1\ mol\ H_3PO_4}\left|\frac{}{0.8\ L\ solution}\right. = 0.500\ \frac{mol\ Na_3PO_4}{L\ solution}$$

Based on NaOH:

$$\frac{600\ mL\ NaOH}{1000\ mL\ NaOH}\left|\frac{2.00\ mol\ NaOH}{1}\right|\frac{1\ mol\ Na_3PO_4}{3\ mol\ NaOH}\left|\frac{}{0.8\ L\ solution}\right. = 0.500\ \frac{mol\ Na_3PO_4}{L\ solution}$$

8. (3 Pts) If 20 mL of 0.010 *M* H_3PO_4 solution is completely neutralized by 60.0 mL of $Ca(OH)_2$ solution, what is the molarity of the $Ca(OH)_2$ solution?

$2H_3PO_4(aq) + 3Ca(OH)_2(aq) \rightarrow 6H_2O(l) + Ca_3(PO_4)_2(aq)$

20 mL, 0.010 mol/L — 60.0 mL, ? mol/L

$$\frac{20\ mL\ H_3PO_4}{1000\ mL\ H_3PO_4}\left|\frac{0.010\ mol\ H_3PO_4}{1}\right|\frac{3\ mol\ Ca(OH)_2}{2\ mol\ H_3PO_4}\left|\frac{}{60.0\times10^{-3}\ L\ Ca(OH)_2}\right. = 0.0050\ \frac{mol\ Ca(OH)_2}{L\ Ca(OH)_2}$$