UNIVERSITY OF
ROCHESTER

COLLEGE OF ARTS AND SCIENCE

DEPARTMENT OF CHEMISTRY

CHEM131 HOMEWORK #4 KEY

4-13. a) 2.00 L x (0.250 mol NaOH/L) x (40.00g NaOH/mol) = 20.0 g NaOH
Place the 20.0 g NaOH into a 2 L volumetric flask; add water and fill to the mark.

b) 2.00 L x (0.250 mol NaOH/L) x (1 L stock sln)/(1.00 mol NaOH) = 0.500 L
Add 500 mL of 1.00 M NaOH stock sln to a 2 L volumetric flask, add water and fill to the mark

c) 2.00 L x (0.100 mol K_2CrO_4/L) x 194.20 g K_2CrO_4/mol K_2CrO_4 = 38.8 g K_2CrO_4.
Mix up solution as in part (a).

d) 2.00 L x (0.100 mol K_2CrO_4/L) x (1 L stock sln)/(1.75 mol K_2CrO_4) = 0.114 L
Mix up solution as in part (b) using 114 mL of stock.

4-16. You can do this in two different ways. One route calculates the molarity of the original solution and then calculates the molarity of the diluted solution.

[25.0 g $(NH_4)_2SO_4$]/[132.2 g $(NH_4)_2SO_4$)/mol $(NH_4)_2SO_4$] = 0.189 mol $(NH_4)_2SO_4$

[0.189 mol $(NH_4)_2SO_4$]/(0.100 L solution) = 1.89 M $(NH_4)_2SO_4$ (original solution)

(1.89 mol/L)(0.01 L) = 0.0189 mol; M = 0.0189/(0.010 + 0.050) = 0.315 M (final solution)

A more direct route is to recognize that 10 mL of the original 100 mL solution contains 0.100 of the original number of moles. Then you can skip the intermediate step.

The molarity of SO_4^{2-} ions is also 0.315 M, but the molarity of NH_4^+ ions is 0.630 M.

4-19. (1.584 g Mo^{2+})/(54.94 g Mo^+/mol Mo^+) = 2.883×10^{-2} mol Mo^+; molarity = 2.883×10^{-2} mol Mo^+/1 L = 2.883×10^{-2} M

Solution A: (2.883×10^{-2} mol/L)(0.050 L)/1.000 L = 1.442×10^{-3} M

Solution B: (1.442×10^{-3} mol/L)(0.01000 L)/0.2500 L = 5.768×10^{-5} M

Solution C: (5.768×10^{-5} mol/L)(0.01000 L)/0.5000 L = 1.154×10^{-6} M

4-25. Balanced molecular equation is first, complete ionic equation is second, net ionic equation is last

a) $(NH_4)_2SO_4$ (aq) + $Ba(NO_3)_2$ (aq) → 2 NH_4NO_3 (aq) + $BaSO_4$ (s)
$2NH_4^+$(aq) + SO_4^{2-} (aq) + Ba^{2+}(aq) + $2NO_3^-$(aq) → $2NH_4^+$(aq) + $2NO_3^-$(aq) + $BaSO_4$ (s)
SO_4^{2-} (aq) + Ba^{2+}(aq) → $BaSO_4$ (s)

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b) $Pb(NO_3)_2$ (aq) + 2NaCl (aq) → $PbCl_2$(s) + 2 $NaNO_3$(aq)
Pb^{2+}(aq) + 2NO_3^-(aq) + 2 Na^+(aq) + 2 Cl^-(aq) → $PbCl_2$(s) + 2 Na^+(aq) + 2NO_3^-(aq)
Pb^{2+}(aq) + 2 Cl^-(aq) → $PbCl_2$(s)

4-29. The lack of an Hg_2Cl_2 ppt. eliminates Hg_2^{2+}; the lack of a $BaSO_4$ ppt. eliminates Ba^{2+}; so the culprit is in $Mn(OH)_2$.

4-30. $2Na_3PO_4 + 3Pb(NO_3)_2 \mapsto Pb_3(PO_4)_2 + 6NaNO_3$ is the necessary place to start.

150 mL of 0.250 M lead nitrate contains 0.150*0.250 = 0.0375 M lead.

We need 2 mol of sodium phosphate for each 3 mol of lead so we need fewer moles of Na_3PO_4, specifically 2*.0375/3 = 0.0250 mole Na_3PO_4.

Since a liter of your Na_3PO_4 solution contains 0.100 mol, you need 0.0250/0.100 = 0.250 L = 250 mL of Na_3PO_4 solution.

You can do this kind of problem in a single step of ratios: (0.150*0.250)(2/3)(1/0.100) = 0.250 L, but supplying more details also gives more understanding and confidence.

4-35. First, what mass percentage of saccharin is S? 32.07/183.19 = 0.1751 or 17.51% S in saccharin.

Similarly, 32.07/233.4 = 0.1374 or 13.74% S in $BaSO_4$.

(0.5032 g $BaSO_4$)(0.1374 g S/g $BaSO_4$) = 0.0691 g S

(0.0691 g S)/(0.1751 g S/g saccharin) = 0.3949 g saccharin in 10 tablets or 0.03949 g 0r 39.49 mg/tablet.

39.49/58.94 = 0.6700 or 67.00% saccharin. (58.94 mg is the mass of 1 tablet and the other 33% is an inert filler used to make the tablet a convenient size to handle.)

4-86 $Pb^{2+} + 2Cl^- \rightarrow PbCl_2$. We recover 3.407 g $PbCl_2$ from the concentrated solution.
3.407 g $PbCl_2$ x (1 mol $PbCl_2$)/(278.1 g $PbCl_2$) x (1 mol Pb^{2+})/(1 mol $PbCl_2$) = 0.01225 mol Pb^{2+} in the concentrated solution.
0.01225 mol Pb^{2+}/(2.00 x 10^{-3} L) = 6.13 *M* Pb^{2+} (evaporated concentration)
original concentration = (0.0800 L x 6.13 mol/L)/(0.1 L) = 4.90 *M*.

Next H.W. assignment: 4: 40, 42, 44, 49