

Name: KEY

Chem 121, Fall 2009
Test 2B

Multiple Choice (24 pts): Clearly indicate the correct answer in the space provided.

- D 1. Which statement below states a true fact?
- A) All acids are strong electrolytes and ionize completely when dissolved in water.
 - B) All bases are weak electrolytes and ionize completely when dissolved in water.
 - C) All bases are strong electrolytes and ionize completely when dissolved in water.
 - D) All salts are strong electrolytes and dissociate completely when dissolved in water.
 - E) All salts are weak electrolytes and ionize partially when dissolved in water.
- A 2. In the reaction, $\text{Na}_2\text{CO}_3 + \text{NiCl}_2 \rightarrow \text{NiCO}_3 + 2 \text{NaCl}$, which ions are the spectator ions?
- A) Na^+ and Cl^-
 - B) Na^+ and CO_3^{2-}
 - C) Ni^{2+} and CO_3^{2-}
 - D) Ni^{2+} and Cl^-
 - E) Na^+ and Ni^{2+}
- D 3. Which is the net ionic equation for the reaction which takes place when HNO_3 is added to $\text{Mg}(\text{OH})_2$?
- A) $\text{HNO}_3(\text{aq}) + \text{Mg}(\text{OH})_2(\text{s}) \rightarrow \text{Mg}(\text{NO}_3)_2(\text{aq}) + \text{H}_2\text{O}(\text{l})$
 - B) $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
 - C) $\text{HNO}_3(\text{aq}) + \text{OH}^-(\text{s}) \rightarrow \text{NO}_3^-(\text{aq}) + \text{H}_2\text{O}(\text{l})$
 - D) $\text{H}^+(\text{aq}) + \text{Mg}(\text{OH})_2(\text{s}) \rightarrow \text{Mg}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
 - E) $\text{HNO}_3(\text{aq}) + \text{Mg}^{2+}(\text{aq}) \rightarrow \text{Mg}(\text{NO}_3)_2(\text{aq}) + \text{H}^+(\text{aq})$
- E 4. Which is NOT a strong base?
- A) $\text{Ca}(\text{OH})_2$
 - B) $\text{Ba}(\text{OH})_2$
 - C) KOH
 - D) NaOH
 - E) NH_3
- C 5. Which compound is insoluble in water?
- A) Na_2CO_3
 - B) NH_4NO_3
 - C) CaCO_3
 - D) CaCl_2
 - E) LiClO_4
- D 6. Which set of compounds are all insoluble in water?
- A) BaCO_3 , NaBrO_3 , $\text{Ca}(\text{OH})_2$, and PbCl_2
 - B) NaCl , BaCl_2 , NH_4NO_3 , and LiClO_4
 - C) NaCl , AgBr , Na_2CO_3 , and $\text{Hg}_2(\text{NO}_3)_2$
 - D) NiCO_3 , PbSO_4 , AgCl , and $\text{Mg}(\text{OH})_2$
 - E) PbCl_2 , $\text{Pb}(\text{NO}_3)_2$, AgClO_4 , and HgCl_2

Calculations (76 pts): Clearly show all work for full credit.

7. (5 pts) How many chromium atoms are there in a 5.44 g sample of chromium?

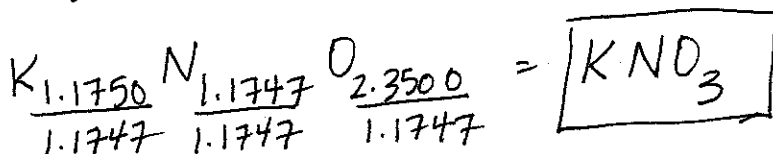
$$5.44 \text{ g Cr} \times \frac{1 \text{ mol Cr}}{52.00 \text{ g Cr}} \times \frac{6.02 \times 10^{23} \text{ atoms Cr}}{1 \text{ mol Cr}} = 6.30 \times 10^{22} \text{ atoms Cr}$$

8. (10 pts) A compound contains potassium, nitrogen, and oxygen. An experimental analysis gave values of 45.942% potassium and 16.458% nitrogen, by weight; the remainder is oxygen. What is the empirical formula of the compound? Assume exactly 100 g

$$45.942 \text{ g K} \times \frac{1 \text{ mol K}}{39.10 \text{ g K}} = 1.1750 \text{ mol K}$$

$$16.458 \text{ g N} \times \frac{1 \text{ mol N}}{14.01 \text{ g N}} = 1.1747 \text{ mol N}$$

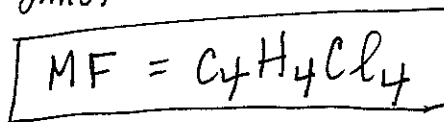
$$100 \text{ g} - 45.942 \text{ g} - 16.458 \text{ g} = 37.600 \text{ g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 2.3500 \text{ mol O}$$



9. (5 pts) A compound has an empirical formula of CHCl. An independent analysis gave a value of 194 g for its molar mass. What is the molecular formula of the compound?

$$\text{CHCl} \quad 1\text{C} + 1\text{H} + 1\text{Cl} = 12.01 \text{ g/mol} + 1.008 \text{ g/mol} + 35.45 \text{ g/mol} \\ = 48.47 \text{ g/mol}$$

$$\frac{\text{MM of MF}}{\text{MM of EF}} = \frac{194 \text{ g/mol}}{48.47 \text{ g/mol}} = 4$$



10. (6 pts) How many grams of iron are there in a sample of Fe_2O_3 , which weighs 28.95 grams? (MM of $\text{Fe}_2\text{O}_3 = 159.70 \text{ g/mol}$)

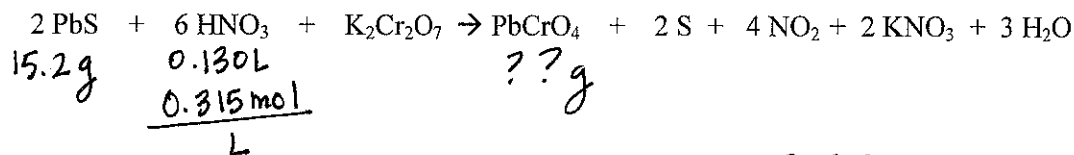
$$28.95 \text{ g Fe}_2\text{O}_3 \times \frac{1 \text{ mol Fe}_2\text{O}_3}{159.70 \text{ g Fe}_2\text{O}_3} \times \frac{2 \text{ mol Fe}}{1 \text{ mol Fe}_2\text{O}_3} \times \frac{55.85 \text{ g Fe}}{1 \text{ mol Fe}} \\ = 20.25 \text{ g Fe}$$

11. (10 pts) Calculate the molar mass of $(\text{NH}_4)_3\text{PO}_4$ and determine the percent by mass of phosphorus in the compound.

$$\begin{aligned}
 3\text{N} &= 3(14.01\text{g/mol}) = 42.03\text{g/mol} \\
 12\text{H} &= 12(1.008\text{g/mol}) = 12.10\text{g/mol} \\
 1\text{P} &= 1(30.97\text{g/mol}) = 30.97\text{g/mol} \\
 4\text{O} &= 4(16.00\text{g/mol}) = 64.00\text{g/mol} \\
 \hline
 &149.10\text{g/mol}
 \end{aligned}$$

$$\% \text{P} = \frac{30.97}{149.10} \times 100 = 20.77\% \text{P}$$

12. (15 pts) Lead sulfide, in ores, can be assayed by the reaction below. How much PbCrO_4 is produced when 15.2 g PbS is reacted with 0.130L of 0.315 M HNO_3 ? (MM of PbS = 239.3g/mol, MM of PbCrO_4 = 323.2 g/mol)



$$15.2\text{g PbS} \times \frac{1\text{mol PbS}}{239.3\text{g PbS}} \times \frac{1\text{mol PbCrO}_4}{2\text{mol PbS}} \times \frac{323.2\text{g PbCrO}_4}{1\text{mol PbCrO}_4} = 10.3\text{g PbCrO}_4$$

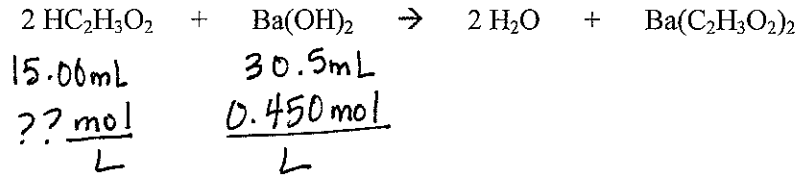
$$0.130\text{L} \times \frac{0.315\text{mol HNO}_3}{\text{L}} \times \frac{1\text{mol PbCrO}_4}{6\text{mol HNO}_3} \times \frac{323.2\text{g PbCrO}_4}{1\text{mol PbCrO}_4} = \boxed{2.21\text{g PbCrO}_4}$$

13. What is the molar concentration of a solution prepared by dissolving 7.58 grams of potassium nitrate in enough water to prepare 250.0 mL of the solution? (MM of KNO_3 = 101.10 g/mol)

$$?? \frac{\text{mol}}{\text{L}}$$

$$\begin{aligned}
 &\frac{7.58\text{g KNO}_3}{250.0\text{mL}} \times \frac{1\text{mol KNO}_3}{101.10\text{g KNO}_3} \times \frac{1000\text{mL}}{1\text{L}} \\
 &= 0.300\text{M KNO}_3
 \end{aligned}$$

14. (15 pts) Vinegar contains acetic acid ($\text{HC}_2\text{H}_3\text{O}_2$), which is responsible for its acidity. In one analysis of a commercial vinegar brand, a 15.00 mL sample was titrated with 0.450 M $\text{Ba}(\text{OH})_2$. It required 30.5 mL of barium hydroxide to neutralize the acid in the vinegar sample. What is the molar concentration of acetic acid in the vinegar?



$$30.5 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{0.450 \text{ mol Ba}(\text{OH})_2}{\text{L}} \times \frac{2 \text{ mol HC}_2\text{H}_3\text{O}_2}{1 \text{ mol Ba}(\text{OH})_2} = 0.0275 \text{ mol HC}_2\text{H}_3\text{O}_2$$

$$\frac{0.0275 \text{ mol HC}_2\text{H}_3\text{O}_2}{15.00 \text{ mL}} \times \frac{1000 \text{ mL}}{\text{L}} = \boxed{1.83 \text{ M HC}_2\text{H}_3\text{O}_2}$$

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2	Li 6.94	Be 9.01											B 10.81	C 12.01	N 14.01	O 16.00	F 19.00	Ne 20.18																																																																																													
3	Na 22.99	Mg 24.31											Al 26.98	Si 28.09	P 30.97	S 32.06	Cl 35.45	Ar 39.95																																																																																													
4	K 39.10	Ca 40.08	Sc 44.96	Ti 47.90	V 50.94	Cr 52.00	Mn 54.94	Fe 55.85	Co 58.93	Ni 58.71	Cu 63.55	Zn 65.37	Ga 69.72	Ge 72.59	As 74.92	Se 78.96	Br 79.90	Kr 83.80																																																																																													
5	Rb 85.47	Sr 87.62	Y 88.91	Zr 91.22	Nb 92.91	Mo 95.94	Tc [98]	Ru 101.1	Rh 102.9	Pd 106.4	Ag 107.9	Cd 112.40	In 114.8	Sn 118.7	Sb 121.8	Te 127.60	I 126.90	Xe 131.30																																																																																													
6	Cs 132.9	Ba 137.3	La 138.9	Ce 140.1	Pr 140.9	Nd 144.2	Pm [145]	Sm 150.4	Eu 152	Gd 157.3	Tb 158.9	Dy 162.5	Ho 164.93	Er 167.3	Tm 168.9	Yb 173	Lu 175	Hf 178.5	Ta 181	W 183.9	Re 186.2	Os 190.2	Ir 192.2	Pt 195.1	Au 197	Hg 200.59	Tl 204.4	Pb 207.2	Bi 209	Po [209]	At [210]	Rn [222]																																																																															
7	Fr [223]	Ra [226]	Ac [227]	Th 232	Pa [231]	U 238	Np [237]	Pu [244]	Am [243]	Cm [247]	Bk [247]	Cf [251]	Es [252]	Fm [257]	Md [258]	No [259]	Lr [262]	Rf [267]	Db [268]	Sg [271]	Bh [272]	Hs [270]	Mt [276]	Ds [281]	Rg [280]	Uub [285]	Uut [284]	Uuq [289]	Uup [288]	Uuh [293]	Uuo [294]																																																																																
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