

Name: KEY

**Chem 121
Test 2
Version A**

You have 75 minutes to complete this 100 point test. Show all work for full credit. You may use a non-graphing, scientific calculator.

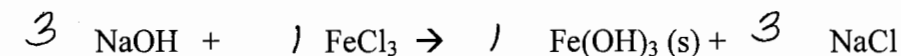
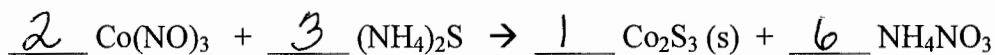
1. (5 pts) Fill-in the blank with an appropriate chemical formula

- a. NH₃ is an example of a weak base.
- b. KOH is an example of a strong base.
- c. HC₂H₃O₂ is an example of a weak acid.
- d. HNO₃ is an example of a strong acid.
- e. H₂O and a salt are formed in a reaction of a strong acid and a strong base.

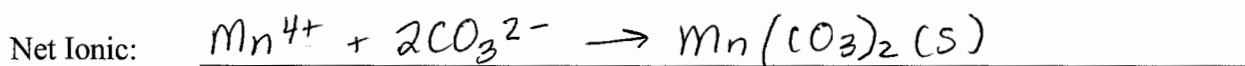
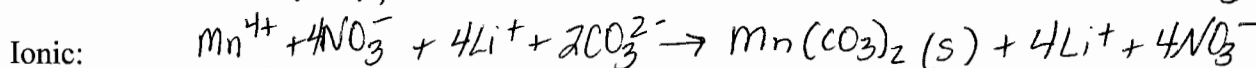
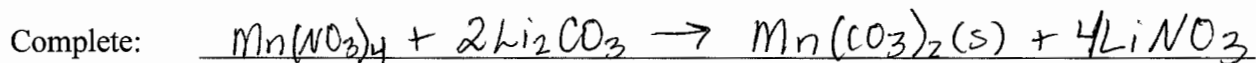
2. (10 pts) Identify each compound below as soluble (S) or insoluble (IS) in water. If the compound is soluble in water, write the dissociation reaction.

Compound	S or IS	Dissociation Reaction
CaSO ₄	IS	_____
(NH ₄) ₂ CO ₃	S	$(\text{NH}_4)_2\text{CO}_3 \rightarrow 2\text{NH}_4^+ + \text{CO}_3^{2-}$
Fe(NO ₃) ₂	S	$\text{Fe}(\text{NO}_3)_2 \rightarrow \text{Fe}^{2+} + 2\text{NO}_3^-$
Cr ₂ O ₃	IS	_____
Al(C ₂ H ₃ O ₂) ₃	S	$\text{Al}(\text{C}_2\text{H}_3\text{O}_2)_3 \rightarrow \text{Al}^{3+} + 3\text{C}_2\text{H}_3\text{O}_2^-$

3. (10 pts) Balance the reactions below



4. (15 pts) Write the complete, ionic and net ionic balanced equations for the reaction of manganese(IV) nitrate with lithium carbonate. Don't forget to indicate the precipitate.



5. (10 pts) Sucrose has a formula of $\text{C}_{12}\text{H}_{22}\text{O}_{11}$.

- a. Calculate the molar mass of sucrose

$$\begin{array}{r} 12\text{C} = 12(12.01\text{ g/mol}) = 144.1\text{ g/mol} \\ 22\text{H} = 22(1.008\text{ g/mol}) = 22.18\text{ g/mol} \\ 11\text{O} = 11(16.00\text{ g/mol}) = 176.0\text{ g/mol} \\ \hline 342.3\text{ g/mol} \end{array}$$

- b. There is 3.10×10^4 mg of sucrose in a Snicker's bar. How many molecules of sucrose is this?

$$3.10 \times 10^4 \text{ mg} \times \frac{1\text{ g}}{1000\text{ mg}} \times \frac{1\text{ mol } \text{C}_{12}\text{H}_{22}\text{O}_{11}}{342.3\text{ g } \text{C}_{12}\text{H}_{22}\text{O}_{11}} \times \frac{6.02 \times 10^{23}\text{ molecules}}{1\text{ mol } \text{C}_{12}\text{H}_{22}\text{O}_{11}} = 5.45 \times 10^{22}\text{ molecules } \text{C}_{12}\text{H}_{22}\text{O}_{11}$$

6. (10 pts) Doctors recommend soaking sore feet in a solution of Epsom salt, also known as MgSO_4 .

- a. If you want to prepare 2.00 L of the soaking solution with a concentration of 0.500M, how many grams of MgSO_4 should you dissolve in water? (MM of $\text{MgSO}_4 = 120.37$ g/mol)

$$2.00\text{ L} \times \frac{0.500\text{ mol}}{\text{L}} \times \frac{120.37\text{ g } \text{MgSO}_4}{1\text{ mol } \text{MgSO}_4} = 120.\text{ g } \text{MgSO}_4$$

- b. What volume of the 0.500M Epsom salt would be needed to make a 2.50L solution with a concentration of 0.300M? (hint: you do not need anything from 6a do complete 6b)

$$\begin{aligned} V_{\text{dil}} M_{\text{dil}} &= V_{\text{conc}} M_{\text{conc}} \\ (2.50\text{ L})(0.300\text{ M}) &= V_{\text{conc}} (0.500\text{ M}) \\ 1.50\text{ L} &= V_{\text{conc}} \end{aligned}$$

7. (15 pts) Estradiol is a female sexual hormone that causes maturation and maintenance of the female reproductive system. Elemental analysis of estradiol gave the following percent composition: 79.37% C, 8.88% H and 11.75% O. Assume 100.0g

a. Determine the empirical formula of estradiol.

$$79.37 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} = 6.609 \text{ mol C}$$

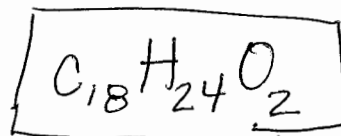
$$8.88 \text{ g H} \times \frac{1 \text{ mol H}}{1.008 \text{ g H}} = 8.81 \text{ mol H}$$

$$11.75 \text{ g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 0.7344 \text{ mol O}$$

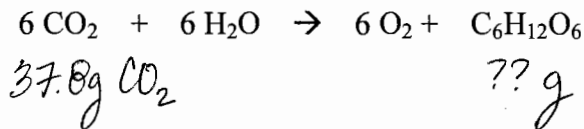
$$\frac{6.609 \text{ H}}{0.7344} \frac{8.81 \text{ O}}{0.7344} \frac{0.7344}{0.7344} = \boxed{\text{C}_9\text{H}_{12}\text{O}}$$

- b. If the molar mass of estradiol is 272.37 g/mol, what is the molecular formula of estradiol? $9(12.01 \text{ g/mol}) + 12(1.008 \text{ g/mol}) + 16.00 \text{ g/mol} = 136.29 \text{ g/mol}$

$$\frac{\text{MM of MF}}{\text{MM of EF}} = \frac{272.37 \text{ g/mol}}{136.29 \text{ g/mol}} = 2$$



8. (10 pts) In photosynthesis, plants convert carbon dioxide and water into glucose, $\text{C}_6\text{H}_{12}\text{O}_6$. If a plant consumes 37.8 g of CO_2 in a week, what mass of glucose is produced? (MM of $\text{CO}_2 = 44.01 \text{ g/mol}$, MM of $\text{C}_6\text{H}_{12}\text{O}_6 = 180.2 \text{ g/mol}$)

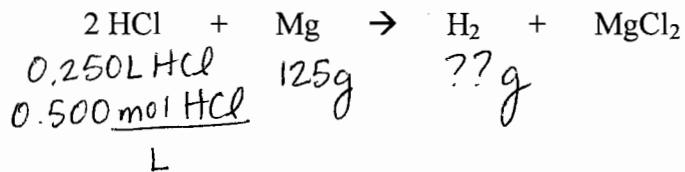


$$37.8 \text{ g CO}_2 \times \frac{1 \text{ mol CO}_2}{44.01 \text{ g CO}_2} \times \frac{1 \text{ mol C}_6\text{H}_{12}\text{O}_6}{6 \text{ mol CO}_2} \times \frac{180.2 \text{ g C}_6\text{H}_{12}\text{O}_6}{1 \text{ mol C}_6\text{H}_{12}\text{O}_6}$$

$$= 25.8 \text{ g C}_6\text{H}_{12}\text{O}_6$$

9. (15 pts) Hydrochloric acid reacts with magnesium metal to form magnesium chloride and hydrogen gas. What mass of hydrogen gas is produced if 0.250L of 0.500M HCl is allowed to react with 125g of Mg? (MM of H₂ = 2.016 g/mol)

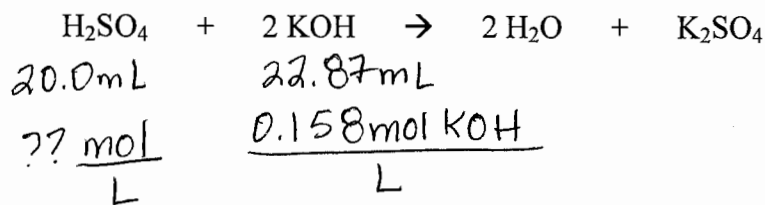
LR problem



$$0.250 \text{L HCl} \times \frac{0.500 \text{mol HCl}}{\text{L}} \times \frac{1 \text{mol H}_2}{2 \text{mol HCl}} \times \frac{2.016 \text{g H}_2}{1 \text{mol H}_2} = \boxed{0.126 \text{g H}_2}$$

$$125 \text{g Mg} \times \frac{1 \text{mol Mg}}{24.31 \text{g Mg}} \times \frac{1 \text{mol H}_2}{1 \text{mol Mg}} \times \frac{2.016 \text{g H}_2}{1 \text{mol H}_2} = 10.4 \text{g H}_2$$

10. (10 pts) The titration of a 20.0mL sample of an H₂SO₄ solution of unknown concentration requires 22.87mL of a 0.158 M KOH solution to reach the end point. What is the concentration of the unknown H₂SO₄?



$$22.87 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{0.158 \text{ mol KOH}}{\text{L}} \times \frac{1 \text{ mol H}_2\text{SO}_4}{2 \text{ mol KOH}}$$

$$= 1.807 \times 10^{-3} \text{ mol H}_2\text{SO}_4$$

$$\frac{1.807 \times 10^{-3} \text{ mol H}_2\text{SO}_4}{20.0 \text{ mL}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = \boxed{0.0904 \text{ M H}_2\text{SO}_4}$$

Name: KEY

**Chem 121
Test 2
Version B**

You have 75 minutes to complete this 100 point test. Show all work for full credit. You may use a non-graphing, scientific calculator.

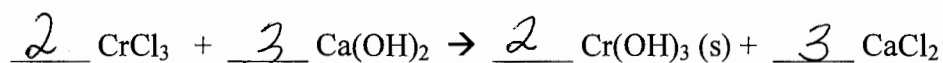
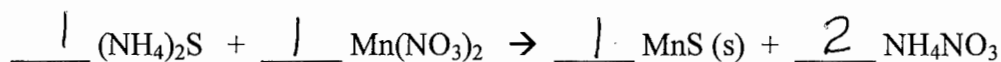
1. (5 pts) Fill-in the blank with an appropriate chemical formula

- a. HNO₃ is an example of a strong acid.
- b. HC₂H₃O₂ is an example of a weak acid.
- c. KOH is an example of a strong base.
- d. NH₃ is an example of a weak base.
- e. H₂O and a salt are formed in a reaction of a strong acid and a strong base.

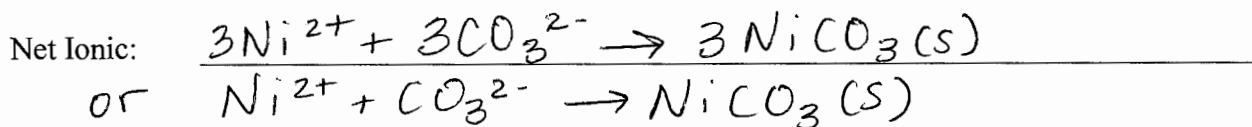
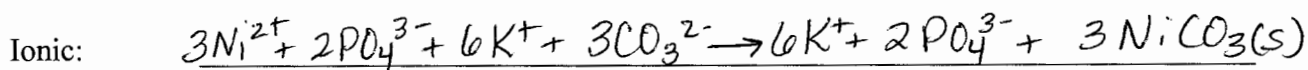
2. (10 pts) Identify each compound below as soluble (S) or insoluble (IS) in water. If the compound is soluble in water, write the dissociation reaction.

Compound	S or IS	Dissociation Reaction
Fe(C ₂ H ₃ O ₂) ₂	S	$Fe(C_2H_3O_2)_2 \rightarrow Fe^{2+} + 2C_2H_3O_2^-$
Al(NO ₃) ₃	S	$Al(NO_3)_3 \rightarrow Al^{3+} + 3NO_3^-$
MnO ₂	IS	_____
(NH ₄) ₂ SO ₄	S	$(NH_4)_2SO_4 \rightarrow 2NH_4^+ + SO_4^{2-}$
BaSO ₄	IS	_____

3. (10 pts) Balance the reactions below



4. (15 pts) Write the complete, ionic and net ionic balanced equations for the reaction of nickel(II) phosphate with potassium carbonate. Don't forget to indicate the precipitate.



5. (10 pts) Sucrose has a formula of $\text{C}_{12}\text{H}_{22}\text{O}_{11}$.

- a. Calculate the molar mass of sucrose

$$\begin{aligned} 12\text{C} &= 12(12.01\text{g/mol}) = 144.1\text{g/mol} \\ 22\text{H} &= 22(1.008\text{g/mol}) = 22.18\text{g/mol} \\ 11\text{O} &= 11(16.00\text{g/mol}) = 176.0\text{g/mol} \\ \hline &342.3\text{g/mol} \end{aligned}$$

- b. There is 3.10×10^4 mg of sucrose in a Snicker's bar. How many molecules of sucrose is this?

$$\begin{aligned} 3.10 \times 10^4 \text{mg} \times \frac{1\text{g}}{1000\text{mg}} \times \frac{1\text{mol C}_{12}\text{H}_{22}\text{O}_{11}}{342.3\text{g C}_{12}\text{H}_{22}\text{O}_{11}} \times \frac{6.02 \times 10^{23} \text{molecules C}_{12}\text{H}_{22}\text{O}_{11}}{1\text{mol C}_{12}\text{H}_{22}\text{O}_{11}} \\ = 5.45 \times 10^{22} \text{molecules C}_{12}\text{H}_{22}\text{O}_{11} \end{aligned}$$

6. (10 pts) Doctors recommend soaking sore feet in a solution of Epsom salt, also known as MgSO_4 .

- a. If you want to prepare 3.00 L of the soaking solution with a concentration of 0.750M, how many grams of MgSO_4 should you dissolve in water? (MM of $\text{MgSO}_4 = 120.37$ g/mol)
- 3.00L 0.750 mol/L ?? g

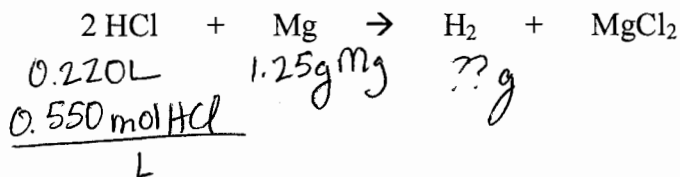
$$3.00\text{L} \times \frac{0.750\text{mol MgSO}_4}{\text{L}} \times \frac{120.37\text{g MgSO}_4}{1\text{mol MgSO}_4} = 271\text{g MgSO}_4$$

- b. What volume of the 0.750M Epsom salt would be needed to make a 1.00L solution with a concentration of 0.450M? (hint: you do not need anything from 6a do complete 6b)

$$\begin{aligned} V_{\text{dil}} M_{\text{dil}} &= V_{\text{conc}} M_{\text{conc}} \\ (1.00\text{L})(0.450\text{M}) &= V_{\text{con}}(0.750\text{M}) \\ V_{\text{conc}} &= 0.600\text{L} \end{aligned}$$

9. (15 pts) Hydrochloric acid reacts with magnesium metal to form magnesium chloride and hydrogen gas. What mass of hydrogen gas is produced if 0.220L of 0.550M HCl is allowed to react with 1.25g of Mg? (MM of H₂ = 2.016 g/mol)

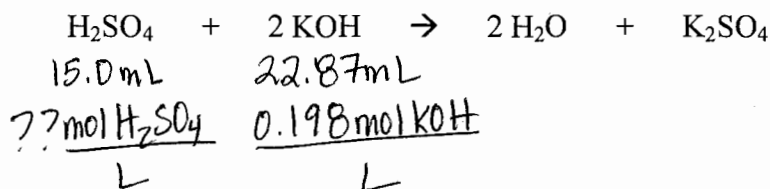
LR Problem



$$0.220\text{L} \times \frac{0.550\text{ mol HCl}}{\text{L}} \times \frac{1\text{ mol H}_2}{2\text{ mol HCl}} \times \frac{2.016\text{g H}_2}{1\text{ mol H}_2} = 0.122\text{g H}_2$$

$$1.25\text{g Mg} \times \frac{1\text{ mol Mg}}{24.31\text{g Mg}} \times \frac{1\text{ mol H}_2}{1\text{ mol Mg}} \times \frac{2.016\text{g H}_2}{1\text{ mol H}_2} = \boxed{0.104\text{g H}_2}$$

10. (10 pts) The titration of a 15.0mL sample of an H₂SO₄ solution of unknown concentration requires 22.87mL of a 0.198 M KOH solution to reach the end point. What is the concentration of the unknown H₂SO₄?



$$22.87\text{mL} \times \frac{1\text{L}}{1000\text{mL}} \times \frac{0.198\text{ mol KOH}}{\text{L}} \times \frac{1\text{ mol H}_2\text{SO}_4}{2\text{ mol KOH}} = 2.264 \times 10^{-3}\text{ mol H}_2\text{SO}_4$$

$$\frac{2.264 \times 10^{-3}\text{ mol H}_2\text{SO}_4}{15.0\text{ mL}} \times \frac{1000\text{ mL}}{\text{L}} = 0.151\text{ M H}_2\text{SO}_4$$