Chemistry 111-2012 NAME: ANSWER KEY
Vining; 9/24/2012 Exam #1 Exam Version 24
Q 1-20 = 4 points; Q 21-22 10 points each

1. You make some tea using a tea bag. Some tea dissolves, but some of the little leaves leak out and are floating around in the liquid. The result is a:

heterogeneous mixture

2. The atomic number of Si is: **14**

3. The mass number of the only stable isotope of manganese, Mn is: **55**

4. The species $^{36}S^{2-}$ has: 16 protons, 20 neutrons, and 18 electrons.

5. An atom becomes a cation by: **losing electrons**

An atom becomes an anion by: **gaining electrons**

6. Which ionic compound listed below does *not* have a correct formula? **$SrPO_4$**

7. The elements C and Si are in the same periodic **group** and the elements O and N are in the same periodic **period** .

8. The element iridium has two staple isotopes:

^{191}Ir Mass = 190.96 amu
^{193}Ir Mass = 192.96 amu

Which isotope is more abundant?

Ir-193 (the average mass from the periodic table is closer to 192.96 than to 190.96)

9. The relationship between O_2 and O_3 is that they are… **allotropes**

10. The molar mass of $Ca(NO_3)_2$ is **164.1 g/mol**

11. What kind of compound will be formed between the elements Mg and Br? **ionic**

12. How many F **atoms** are there in a 68.9-g sample of F_2? **2.18×10^{24}**

$$68.9g\ F_2 \times \frac{1mol\ F_2}{38.00g} \times \frac{2mol\ F\ atoms}{1mol\ F_2} \times \frac{6.022\times10^{23}\ atoms}{1\ mol\ F} = 2.18\times10^{24}\ atoms$$

13. What is the percent mass of carbon (to two significant figures) in $C_3H_8O_2$? **47%**

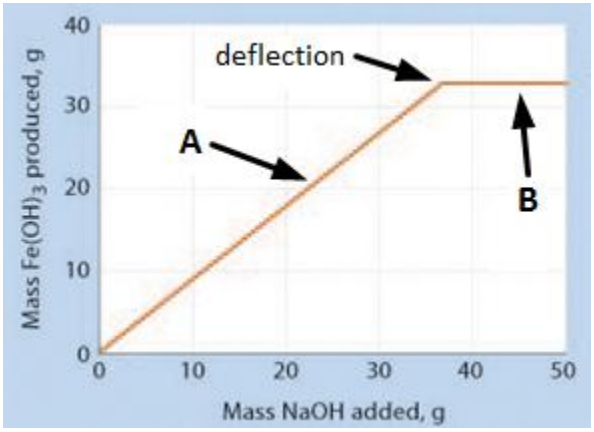
14. A compound has the empirical formula CH_2O and a molar mass of 120.10 g/mol. What is the molecular formula? $C_4H_8O_4$

15. Consider the reaction, $P_4 + 6\ Cl_2 \rightarrow 4\ PCl_3$

If 3.5 mol of P_4 react, how many moles of PCl_3 can be formed**?** **14**

$$3.5\ \text{mol}\ P_4 \times \frac{4\ \text{mol}\ PCl_3}{1\ \text{mol}\ P_4} = 14\ \text{mol}\ PCl_3$$

16. An experiment is performed where NaOH is slowly added to 50.0 g $FeCl_3$. The reaction that occurs produces $Fe(OH)_3$. The plot below shows the mass of $Fe(OH)_3$ produced as a function of the mass of NaOH added. **Choose two correct statements. Circle both on the answer sheet.**



a) at point A, $FeCl_3$ is the limiting reactant

b) at point A, NaOH is the limiting reactant

c) adding more $FeCl_3$ will move the deflection point to the right

d) adding more NaOH will move the deflection point to the right

17. How many moles of NO_2 are in 19.7 g of NO_2? **0.428 mol**

How many moles of CO_2 are in 29.7 g of CO_2? **0.675 mol**

18. The formula of ammonium sulfate is**:** **$(NH_4)_2SO_4$**

The name of SO_2 is: **sulfur dioxide**

The formula of ammonium carbonate is: **$(NH_4)_2CO_3$**

The name of SO_3 is: **sulfur trioxide**

19a. Name $AlCl_3$**: aluminum chloride** 19b. Name $FeCl_2$**: iron(II) chloride**

Name $MgCl_2$: **magnesium chloride** 19b. Name $FeCl_3$**: iron(III) chloride**

20. Balance the following reaction: $1\ C_6H_{12} + 9\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$

21. Consider the reaction, $4\ Cr + 3\ O_2 \rightarrow 2\ Cr_2O_3$

If 75.0 g of Cr are mixed with 25.0 g O_2, how many grams of Cr_2O_3 can be formed?

$$75.0\text{ g Cr} \times \frac{1\text{ mol Cr}}{52.00\text{ g}} = 1.44\text{ mol Cr}$$

$$25.0\text{ g O}_2 \times \frac{1\text{ mol O}_2}{32.00\text{ g}} = 0.781\text{ mol O}_2$$

$$\frac{1.44\text{ mol Cr}}{4} > \frac{0.781\text{ mol O}_2}{3}\ \text{so O}_2\text{ is the limiting reactant}$$

$$0.781\text{ mol O}_2 \times \frac{2\text{ mol Cr}_2\text{O}_3}{3\text{ mol O}_2} = 0.521\text{ mol Cr}_2\text{O}_3$$

$$0.521\text{ mol Cr}_2\text{O}_3 \times \frac{151.99\text{ g Cr}_2\text{O}_3}{1\text{ mol}} = 79.1\text{ g Cr}_2\text{O}_3$$

22. Chemical Analysis: You have a 10.56-gram sample that is a solid mixture of $Cr_2(CO_3)_3$ and Fe_2O_3. You heat it and the $Cr_2(CO_3)_3$ reacts according to the equation below:

$$Cr_2(CO_3)_3\ (s) \rightarrow Cr_2O_3(s) + 3\ CO_2(g)$$

No reaction occurs to the Fe_2O_3. After heating, the mass is found to be 8.46 g. What is the mass percent of $Cr_2(CO_3)_3$ in the original mixture?

The mass lost is all due to CO_2 lost, which comes from $Cr_2(CO_3)_3$.

Map: g CO_2 → mol CO_2 → mol $Cr_2(CO_3)_3$ → g $Cr_2(CO_3)_3$ → percent $Cr_2(CO_3)_3$.

g CO_2 lost = 10.56 g – 8.46 g = 2.10 g CO_2

$$2.10\text{ g CO}_2 \times \frac{1\text{ mol CO}_2}{44.01\text{ g}} = 0.0477\text{ mol CO}_2$$

$$0.0477\text{ mol CO}_2 \times \frac{1\text{ mol Cr}_2(\text{CO}_3)_3}{3\text{ mol CO}_2} = 0.0159\text{ mol Cr}_2(\text{CO}_3)_3$$

$$0.0159\text{ mol Cr}_2(\text{CO}_3)_3 \times \frac{284.01\text{ g Cr}_2(\text{CO}_3)_3}{1\text{ mol}} = 4.51\text{ g Cr}_2(\text{CO}_3)_3$$

$$\%\text{Cr}_2(\text{CO}_3)_3 = \frac{4.51\text{ g Cr}_2(\text{CO}_3)_3}{10.56\text{ g sample}} \times 100 = 42.8\%$$