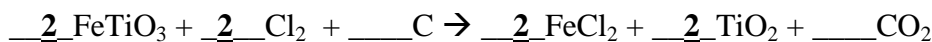


September 17, 2001

QUIZ #1

CHEM 101

- 1) Fill in the blanks to balance the following equations:



- 2) Name the following compounds



- 3) Mandelic acid is an organic acid composed of carbon (63.15%), hydrogen (5.30%), and oxygen (31.55%) by mass.

- a) What is the empirical formula for this compound? Assume 100 g

$$\text{C: } (63.15 \text{ g C}) \times (1 \text{ mol C}/12.011 \text{ g C}) = 5.258 \text{ mol C} \quad \rightarrow 5.258/1.972 = 2.666 = 8/3$$

$$\text{H: } (5.30 \text{ g H}) \times (1 \text{ mol H}/1.008 \text{ g H}) = 5.26 \text{ mol H} \quad \rightarrow 5.26/1.972 = 2.667 = 8/3$$

$$\text{O: } (31.55 \text{ g O}) \times (1 \text{ mol O}/15.999 \text{ g O}) = 1.972 \text{ mol O} \quad \rightarrow 1.972/1.972 = 1.000 = 1$$



- b) If the molar mass of the compound is 152.14 g/mol what is the molecular formula of the acid?

$$\text{Using empirical formula molar mass of } \text{C}_8\text{H}_8\text{O}_3 = (8 \times 12.011 \text{ g/mol}) + (8 \times 1.008 \text{ g/mol}) + (3 \times 15.999 \text{ g/mol}) = 152.15 \text{ g/mol}$$

$$\text{Molar mass/Emprical molar mass} = 152.14/152.15 = 0.99993 = 1$$

Molecular formula is same as empirical formula, C₈H₈O₃

- 4) Ammonia gas can be prepared by the reaction of a metal oxide such as calcium oxide with ammonium chloride by the reaction shown below.



A reaction takes place between 112 g of CaO and 224 g of NH₄Cl and goes to completion.

- a) What is the limiting reagent (
- circle one shown to the right
-):
- CaO
- NH
- ₄
- Cl

SHOW WORK!!

$$\text{CaO: } 112 \text{ g CaO} \times [1 \text{ mol}/(40.078 \text{ g} + 15.999 \text{ g})] = 2.00 \text{ mol CaO}$$

$$\text{NH}_4\text{Cl: } 224 \text{ g NH}_4\text{Cl} \times \{1 \text{ mol}/[14.007 \text{ g} + 4(1.008 \text{ g}) + 35.453 \text{ g}]\} = 4.19 \text{ mol NH}_4\text{Cl}$$

$$\text{Need } 2.00 \text{ mol CaO} \times (2 \text{ mol NH}_4\text{Cl}/1 \text{ mol CaO}) = 4.00 \text{ mol NH}_4\text{Cl} \rightarrow \text{Have that much}$$

$$\text{Need } 4.19 \text{ mol NH}_4\text{Cl} \times (1 \text{ mol CaO}/2 \text{ mol NH}_4\text{Cl}) = 2.10 \text{ mol CaO} \rightarrow \text{Do not have that much}$$

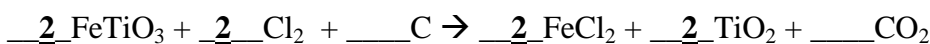
Thus, CaO is limiting reagent

- b) Calculate the maximum yield of NH
- ₃
- .

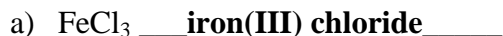
$$2.00 \text{ mol CaO} \times (2 \text{ mol NH}_3/1 \text{ mol CaO}) = 4.00 \text{ mol NH}_3$$

$$4.00 \text{ mol NH}_3 \times \{[14.007 \text{ g} + 3(1.008 \text{ g})/1 \text{ mol NH}_3]\} = \underline{68.1 \text{ g NH}_3}$$

- 1) Fill in the blanks to balance the following equations:



- 2) Name the following compounds:



- 3) Salicylic acid, or aspirin, is 60.87% C, 4.38% H, and 34.65% O by mass.

- a) What is the empirical formula for this compound? Assume 100 g

$$\text{C: } (60.87 \text{ g C}) \times (1 \text{ mol C}/12.011 \text{ g C}) = 5.068 \text{ mol C} \quad \rightarrow 5.068/2.166 = 2.340 = 7/3$$

$$\text{H: } (4.38 \text{ g H}) \times (1 \text{ mol H}/1.008 \text{ g H}) = 4.35 \text{ mol H} \quad \rightarrow 4.35/2.166 = 2.01 = 2$$

$$\text{O: } (34.65 \text{ g O}) \times (1 \text{ mol O}/15.999 \text{ g O}) = 2.166 \text{ mol O} \quad \rightarrow 2.474/2.166 = 1.000 = 1$$



- b) If the molar mass of the compound is 138.12 g/mol what is the molecular formula of the compound?

$$\text{Using empirical formula molar mass of } \text{C}_7\text{H}_6\text{O}_3 = (7 \times 12.011 \text{ g/mol}) + (6 \times 1.008 \text{ g/mol}) + (3 \times 15.999 \text{ g/mol}) = 138.12 \text{ g/mol}$$

$$\text{Molar mass/Emprical molar mass} = 138.12/138.12 = 1.000 = 1$$

Molecular formula is same as empirical formula, $\text{C}_7\text{H}_6\text{O}_3$

- 3) Diborane,
- B_2H_6
- , is a valuable compound in the synthesis of new organic compounds. One way this compound can be made is by the reaction shown below.



A reaction takes place between 1.23 g of NaBH_4 and 4.57 g of I_2 and goes to completion.

- a) What is the limiting reagent (
- circle one shown to the right
-):



SHOW WORK!!

$$\text{NaBH}_4: 1.23 \text{ g NaBH}_4 \times \{1 \text{ mol}/[22.990 \text{ g} + 10.811 \text{ g} + 4(1.008 \text{ g})]\} = 0.0325 \text{ mol NaBH}_4$$

$$\text{I}_2: 4.57 \text{ g I}_2 \times [1 \text{ mol}/(2 \times 126.904)] = 0.0180 \text{ mol I}_2$$

$$\text{Need } 0.0325 \text{ NaBH}_4 \times (1 \text{ mol I}_2/2 \text{ mol NaBH}_4) = 0.0163 \text{ mol I}_2 \rightarrow \text{Have that much}$$

$$\text{Need } 0.0180 \text{ mol I}_2 \times (2 \text{ mol NaBH}_4/2 \text{ I}_2) = 0.0360 \text{ mol NaBH}_4 \rightarrow \text{Do not have that much}$$

Thus, NaBH_4 is limiting reagent

- b) Calculate the maximum yield of
- B_2H_6
- .

$$0.0325 \text{ mol NaBH}_4 \times (1 \text{ mol B}_2\text{H}_6/2 \text{ mol NaBH}_4) = 0.0163 \text{ mol B}_2\text{H}_6$$

$$0.0163 \text{ mol B}_2\text{H}_6 \times \{[(2 \times 10.811 \text{ g}) + (6 \times 1.008 \text{ g})]/1 \text{ mol B}_2\text{H}_6\} = \underline{0.451 \text{ g B}_2\text{H}_6}$$