Percent Yield Problems:

Objective: Determine the percent yield of product based on the theoretical yield and the actual yield. This type of calculation relates the result of actual real world work to the results predicted from reaction stoichoimetry.

Techniques and Definitions

Actual Yield: The quantity of product produced in a real experiment.
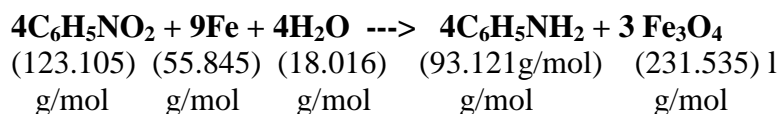Theoretical Yield: The quantity of product production predicted by the complete consumption of the limiting reagent.
Percent Yield: The ratio of Actual Yield to the Theoretical Yield times 100.

$$Percent\,Yield = \left(\frac{Actual\,Yield}{Theoretical\,Yield}\right)100$$

Tips: Identify moles of all reactants present and divide by stoichiometric coefficients. The smallest value represents the limiting reagent.

Analine, ($C_6H_5NH_2$) can be formed from nitro benzene ($C_6H_5NO_2$) by the following equation:

$4C_6H_5NO_2$ + 9Fe + $4H_2O$ ---> $4C_6H_5NH_2$ + 3 Fe_3O_4
(123.105) (55.845) (18.016)   (93.121g/mol)   (231.535) l
   g/mol   g/mol   g/mol   g/mol   g/mol

1)   What is the percent yield if 4.128 g of Fe_3O_4 was produced if 3.320g of nitrobenzene reacted with excess iron and water?

$$Theoretical\,Yield:\quad 3.320g\,C_6H_5NO_2\left(\frac{mol\,C_6H_5NO_2}{123.105g}\right)\left(\frac{3\,mol\,Fe_3O_4}{4\,mol\,C_6H_5NO_2}\right)\left(\frac{231.535g\,Fe_3O_4}{mol}\right) = 4.683g\,Fe_3O_4$$

$$Percent\,Yield:\quad \left(\frac{4.128g\,Fe_3O_4}{4.683g\,Fe_3O_4}\right)100 = 88.15\%$$

 2   What is the percent yield if 16.0g of anline was formed after mixing 23.89g of nitrobenzene with excess iron and water?

$$Theoretical\ Yield: \quad 23.89g\ C_6H_5NO_2 \left(\frac{mol\ C_6H_5NO_2}{123.105g} \right) \left(\frac{4\,mol\ C_6H_5NH_2}{4\,mol\ C_6H_5NO_2} \right) \left(\frac{93.121g\ C_6H_5NH_2}{mol} \right) = 18.07g\ C_6$$

$$Percent\ Yield: \quad \left(\frac{16.0g\ C_6H_5NH_2}{18.07g\ C_6H_5NH_2} \right) 100 = 88.53\%$$

3. What is the percent yield if 1.80 g of anline was formed after mixing 3.78g of iron with excess nitrobenzene and water?

$$Theoretical\ Yield: \quad 3.78g\ Fe \left(\frac{mol\ Fe}{55.846g} \right) \left(\frac{4\,mol\ C_6H_5NH_2}{9\,molFe} \right) \left(\frac{93.121g\ C_6H_5NH_2}{mol} \right) = 2.80g\ C_6H_5NH_2$$

$$Percent\ Yield: \quad \left(\frac{1.80g\ C_6H_5NH_2}{2.80g\ C_6H_5NH_2} \right) 100 = 64.3\%$$