Percent Yield/Percent Error

Name_____
Period_____Date_____

Calculate (a) the theoretical yield, (b) percentage yield and (c) experimental error.

1. In preparing a paint pigment of chrome yellow, $PbCrO_4$, a student used 6.94 grams of $Pb(No_3)_2$ (Molar Mas = 323.2). His actual yield of $PbCrO_4$ (Molar Mass = 331.2) was 6.37.

$$\underset{6.94g}{Pb(NO_3)_2} + Na_2CrO_4 \rightarrow \underset{6.37g}{PbCrO_4} + 2NaNO_3$$

$$6.94g \times \frac{1\ mol}{323.2\ g} \times \frac{1\ mol}{1\ mol} \times \frac{331.2\ g}{1\ mol} = 7.11g$$

$$\%\ yield = \frac{act}{theor} \times 100 = \frac{6.37g}{7.11g} \times 100 = 89.6\%$$

$$\%\ error = 100\% - \%\ yield \quad 100\% - 89.6\% = 10.4\%$$

2. Crystals of chrome alum, $KCr(SO_4)_2 \cdot 12H_2O$ (Molar Mass = 499.3), were prepared from 16.2 grams of potassium dichromate, $K_2Cr_2O_7$ (Molar Mass = 294.2), reacting according to the following equation. The actua yield was 53.3 grams.

$$\underset{16.2g}{K_2Cr_2O_7} + 4H_2SO_4 + 3K_2SO_3 + 20H_2O \rightarrow \underset{?}{2KCr(SO_4)_2 \cdot 12H_2O} + 3K_2SO_4$$

$$16.2g \times \frac{1\ mol}{294.2g} \times \frac{2\ mol}{1\ mol} \times \frac{499.3g}{1\ mol} = 55.0g$$

$$\%\ yield = \frac{act}{theor.} \times 100 = \frac{53.3g}{55.0} \times 100 = 96.9\%$$

$$\%\ error = 3.1\% \quad 100\% - 96.9\% =$$

3. In preparing the ammonia complex of copper sulfate, $Cu(NH_3)_4 \cdot SO_4 \cdot H_2O$ (Molar Mass = 245.6), by reacting 25.0 grams of $CuSO_4 \cdot 5H_2O$ (Molar Mass = 249.6) with NH_4OH, 22.2 grams of the product were formed.

$$\underset{25.0g}{CuSO_4 \cdot 5H_2O} + 4NH_4OH \rightarrow \underset{22.2g}{Cu(NH_3)_4 \cdot SO_4 \cdot H_2O} + 8H_2O$$

$$25.0g \times \frac{1\ mol}{249.6\ g} \times \frac{1\ mol}{1\ mol} \times \frac{245.6g}{1\ mol} = 24.6g$$

$$\%\ yield = \frac{22.2g}{24.6g} \times 100 = 90.2\%$$

$$\%\ error \quad 100\% - 90.2\% = 9.8\%$$

4. 24.8 g of calcium carbonate can be decomposed by heating to produce 13.1 g of CaO.

24.8g → 13.1g

$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

$24.8\,g \times \frac{1\ mol}{100.1\ g} \times \frac{1\ mol}{1\ mol} \times \frac{56.1\ g}{1\ mol} = 13.9\,g$

$\%\ yield = \frac{actual}{theoretical} \times 100 = \frac{13.1\,g}{13.9\,g} \times 100 = 94.2\%$

$\%\ error = 100 - \%\ yield \quad 100\% - 94.2\% = 5.8\%$

5. 3.74g. of copper is produced when 1.87g. of aluminum is reacted with an excess of copper(II)sulfate

1.87g → 3.74

$2Al(s) + 3CuSO_4(aq) \rightarrow Al_2(SO_4)_3(aq) + 3Cu(s)$

$1.87\,g\ of\ Al \times \frac{1\ mol\ of\ Al}{27.0\ g\ of\ Al} \times \frac{3\ mol}{2\ mol} \times \frac{63.5\ g}{1\ mol} = 6.6\,g$

$\%\ yield = \frac{act}{theor} \times 100 \quad \frac{3.74\,g}{6.6\,g} \times 100 = 56.7\%$

$\%\ error = 100\% - 56.7\% = 43.3\%$

6. 84.8g. of iron(III) oxide reacts with an excess of carbon monoxide and 57.8g. of iron is produced

84.8g → 57.8g

$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3O_2(g)$

$84.8\,g \times \frac{1\ mol}{159.6\,g} \times \frac{2\ mol}{1\ mol} \times \frac{55.8\ g}{1\ mol} = 59.3\,g$

$\%\ yield = \frac{act}{theor} \times 100 = \frac{57.8\,g}{59.3\,g} \times 100 = 97.5\%$

$\%\ error = 100\% - \%\ yield \quad 100\% - 97.5\% = 2.5\%$

7. 50.0g. of silicon dioxide is heated with an excess of carbon to produce 32.2g. of silicon carbide.

50.0g → 32.2

$SiO_2(s) + 3C(s) \rightarrow SiC(s) + 2CO(g)$

$50.0\,g \times \frac{1\ mol}{60.1\ g} \times \frac{1\ mol}{1\ mol} \times \frac{40.1\ g}{1\ mol} = 33.4\,g$

$\%\ yield = \frac{act}{theor} \times 100 = \frac{32.2\,g}{33.4\,g} \times 100 = 96.4\%$

$\%\ error = 100\%\ \%\ yield = 100\% - 96.4\% = 3.6\%$