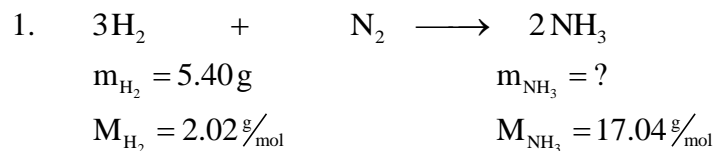


## Chemistry 20 – Lesson 6

### Gravimetric stoichiometry

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#### Practice problems



I. calculate moles

$$n_{\text{H}_2} = \frac{5.40 \text{ g}}{2.02 \text{ g/mol}}$$

$$n_{\text{H}_2} = 2.673 \text{ mol}$$

II. mole ratio

$$\frac{n_{\text{NH}_3}}{2} = \frac{n_{\text{H}_2}}{3}$$

$$\frac{n_{\text{NH}_3}}{2} = \frac{2.673 \text{ mol}}{3}$$

$$n_{\text{NH}_3} = 1.782 \text{ mol}$$

III. calculate mass

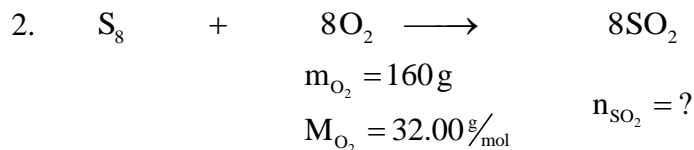
$$m_{\text{NH}_3} = 1.782 \text{ mol} \times 17.04 \text{ g/mol}$$

$$\boxed{m_{\text{NH}_3} = 30.4 \text{ g}}$$

**OR**

$$m_{\text{NH}_3} = 5.40 \text{ g H}_2 \times \frac{1 \text{ mol H}_2}{2.02 \text{ g H}_2} \times \frac{2 \text{ mol NH}_3}{3 \text{ mol H}_2} \times \frac{17.04 \text{ g NH}_3}{1 \text{ mol NH}_3}$$

$$\boxed{m_{\text{NH}_3} = 30.4 \text{ g}}$$



I. calculate moles

$$n_{\text{O}_2} = \frac{160 \text{ g}}{32.00 \text{ g/mol}}$$

$$n_{\text{O}_2} = 5.00 \text{ mol}$$

II. mole ratio

$$\frac{n_{\text{SO}_2}}{8} = \frac{n_{\text{O}_2}}{8}$$

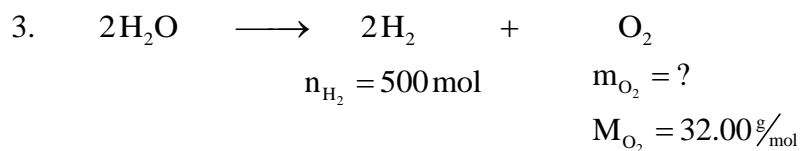
$$\frac{n_{\text{SO}_2}}{8} = \frac{5.00 \text{ mol}}{8}$$

$$\boxed{n_{\text{SO}_2} = 5.00 \text{ mol}}$$

**OR**

$$n_{\text{O}_2} = 160 \text{ g O}_2 \times \frac{1 \text{ mol O}_2}{32.00 \text{ g O}_2} \times \frac{8 \text{ mol SO}_2}{8 \text{ mol O}_2}$$

$$\boxed{n_{\text{O}_2} = 5.00 \text{ mol}}$$



I. mole ratio

$$\frac{n_{\text{O}_2}}{1} = \frac{n_{\text{H}_2}}{2}$$

$$\frac{n_{\text{O}_2}}{1} = \frac{500 \text{ mol}}{2}$$

$$n_{\text{O}_2} = 250 \text{ mol}$$

II. calculate mass

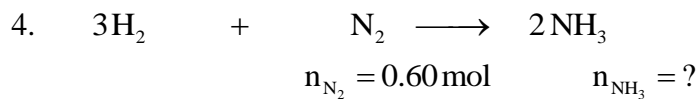
$$m_{\text{O}_2} = 250 \text{ mol} \times 32.00 \text{ g/mol}$$

$$m_{\text{O}_2} = 8.00 \text{ kg}$$

**OR**

$$m_{\text{O}_2} = 500 \cancel{\text{ mol H}_2} \times \frac{1 \cancel{\text{ mol O}_2}}{2 \cancel{\text{ mol H}_2}} \times \frac{32.00 \text{ g O}_2}{1 \cancel{\text{ mol O}_2}}$$

$$m_{\text{O}_2} = 8.00 \text{ kg}$$



I. mole ratio

$$\frac{n_{\text{NH}_3}}{2} = \frac{n_{\text{N}_2}}{1}$$

$$\frac{n_{\text{NH}_3}}{2} = \frac{0.60 \text{ mol}}{1}$$

$$n_{\text{NH}_3} = 1.20 \text{ mol}$$

**OR**

$$n_{\text{NH}_3} = 0.60 \cancel{\text{ mol N}_2} \times \frac{2 \text{ mol NH}_3}{1 \cancel{\text{ mol N}_2}}$$

$$n_{\text{NH}_3} = 1.20 \text{ mol}$$

## Assignment



$$m_{\text{Zn}} = 25 \text{ g}$$

$$m_{\text{S}_8} = ?$$

$$M_{\text{Zn}} = 65.38 \frac{\text{g}}{\text{mol}}$$

$$M_{\text{S}_8} = 256.56 \frac{\text{g}}{\text{mol}}$$

/8

I. calculate moles

$$n_{\text{Zn}} = \frac{25 \text{ g}}{65.38 \frac{\text{g}}{\text{mol}}}$$

$$n_{\text{Zn}} = 0.38 \text{ mol}$$

II. mole ratio

$$\frac{n_{\text{S}_8}}{1} = \frac{n_{\text{Zn}}}{8}$$

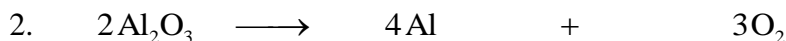
$$\frac{n_{\text{S}_8}}{1} = \frac{0.38 \text{ mol}}{8}$$

$$n_{\text{S}_8} = 0.048 \text{ mol}$$

III. calculate mass

$$m_{\text{S}_8} = 0.048 \text{ mol} \times 256.56 \frac{\text{g}}{\text{mol}}$$

$$m_{\text{S}_8} = 12 \text{ g}$$



$$m_{\text{Al}_2\text{O}_3} = 100 \text{ g}$$

$$m_{\text{Al}} = ?$$

$$M_{\text{Al}_2\text{O}_3} = 101.96 \frac{\text{g}}{\text{mol}}$$

$$M_{\text{Al}} = 26.98 \frac{\text{g}}{\text{mol}}$$

/8

I. calculate moles

$$n_{\text{Al}_2\text{O}_3} = \frac{100 \text{ g}}{101.96 \frac{\text{g}}{\text{mol}}}$$

$$n_{\text{Al}_2\text{O}_3} = 0.981 \text{ mol}$$

II. mole ratio

$$\frac{n_{\text{Al}}}{4} = \frac{n_{\text{Al}_2\text{O}_3}}{2}$$

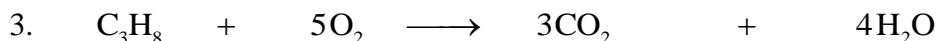
$$\frac{n_{\text{Al}}}{4} = \frac{0.981 \text{ mol}}{2}$$

$$n_{\text{Al}} = 1.96 \text{ mol}$$

III. calculate mass

$$m_{\text{Al}} = 1.96 \text{ mol} \times 26.98 \frac{\text{g}}{\text{mol}}$$

$$m_{\text{Al}} = 52.9 \text{ g}$$



$$m_{\text{C}_3\text{H}_8} = 10.0 \text{ g}$$

$$m_{\text{O}_2} = ?$$

$$M_{\text{C}_3\text{H}_8} = 44.11 \frac{\text{g}}{\text{mol}}$$

$$M_{\text{O}_2} = 32.00 \frac{\text{g}}{\text{mol}}$$

/8

I. calculate moles

$$n_{\text{C}_3\text{H}_8} = \frac{10.0 \text{ g}}{44.11 \frac{\text{g}}{\text{mol}}}$$

$$n_{\text{C}_3\text{H}_8} = 0.227 \text{ mol}$$

II. mole ratio

$$\frac{n_{\text{O}_2}}{5} = \frac{n_{\text{C}_3\text{H}_8}}{1}$$

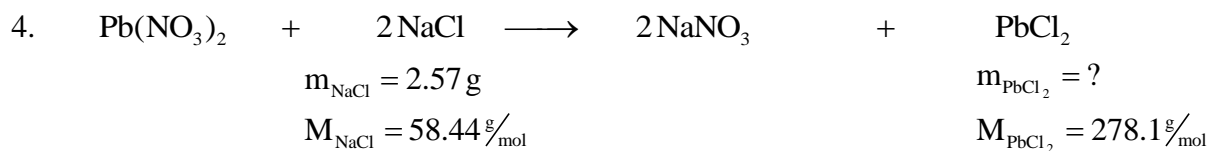
$$\frac{n_{\text{O}_2}}{5} = \frac{0.227 \text{ mol}}{1}$$

$$n_{\text{O}_2} = 1.13 \text{ mol}$$

III. calculate mass

$$m_{\text{O}_2} = 1.13 \text{ mol} \times 32.00 \frac{\text{g}}{\text{mol}}$$

$$m_{\text{O}_2} = 36.3 \text{ g}$$



/8

I. calculate moles

$$n_{\text{NaCl}} = \frac{2.57 \text{ g}}{58.44 \text{ g/mol}}$$

$$n_{\text{NaCl}} = 0.0440 \text{ mol}$$

II. mole ratio

$$\frac{n_{\text{PbCl}_2}}{1} = \frac{n_{\text{NaCl}}}{2}$$

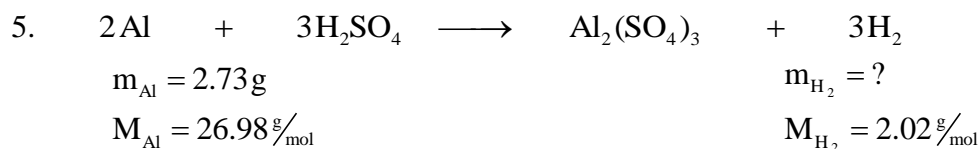
$$\frac{n_{\text{PbCl}_2}}{1} = \frac{0.0440 \text{ mol}}{2}$$

$$n_{\text{PbCl}_2} = 0.0220 \text{ mol}$$

III. calculate mass

$$m_{\text{PbCl}_2} = 0.0220 \text{ mol} \times 278.1 \text{ g/mol}$$

$$m_{\text{PbCl}_2} = 6.11 \text{ g}$$



/8

I. calculate moles

$$n_{\text{Al}} = \frac{2.73 \text{ g}}{26.98 \text{ g/mol}}$$

$$n_{\text{Al}} = 0.101 \text{ mol}$$

II. mole ratio

$$\frac{n_{\text{H}_2}}{3} = \frac{n_{\text{Al}}}{2}$$

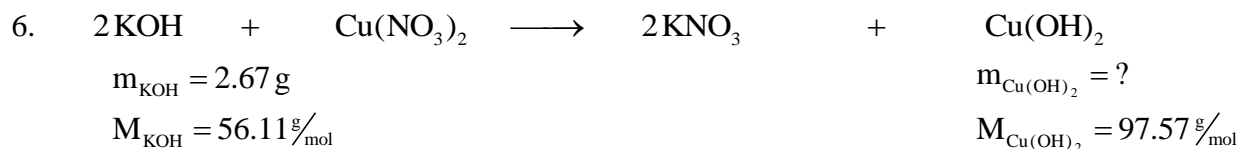
$$\frac{n_{\text{H}_2}}{3} = \frac{0.101 \text{ mol}}{2}$$

$$n_{\text{H}_2} = 0.152 \text{ mol}$$

III. calculate mass

$$m_{\text{H}_2} = 0.152 \text{ mol} \times 2.02 \text{ g/mol}$$

$$m_{\text{H}_2} = 0.307 \text{ g}$$



/8

I. calculate moles

$$n_{\text{KOH}} = \frac{2.67 \text{ g}}{56.11 \text{ g/mol}}$$

$$n_{\text{KOH}} = 0.0476 \text{ mol}$$

II. mole ratio

$$\frac{n_{\text{Cu}(\text{OH})_2}}{1} = \frac{n_{\text{KOH}}}{2}$$

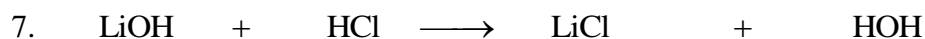
$$\frac{n_{\text{Cu}(\text{OH})_2}}{1} = \frac{0.0476 \text{ mol}}{2}$$

$$n_{\text{Cu}(\text{OH})_2} = 0.0238 \text{ mol}$$

III. calculate mass

$$m_{\text{Cu}(\text{OH})_2} = 0.0238 \text{ mol} \times 97.57 \text{ g/mol}$$

$$m_{\text{Cu}(\text{OH})_2} = 2.32 \text{ g}$$



$$m_{\text{LiOH}} = ? \quad m_{\text{HCl}} = ? \quad m_{\text{LiCl}} = 34.0 \text{ g}$$

$$M_{\text{LiOH}} = 23.95 \text{ g/mol} \quad M_{\text{HCl}} = 36.46 \text{ g/mol} \quad M_{\text{LiCl}} = 42.39 \text{ g/mol}$$

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I. calculate moles

$$n_{\text{LiCl}} = \frac{34.0 \text{ g}}{42.39 \text{ g/mol}}$$

$$n_{\text{LiCl}} = 0.802 \text{ mol}$$

II. mole ratios

$$\frac{n_{\text{LiOH}}}{1} = \frac{n_{\text{LiCl}}}{1}$$

$$\frac{n_{\text{LiOH}}}{1} = \frac{0.802 \text{ mol}}{1}$$

$$n_{\text{LiOH}} = 0.802 \text{ mol}$$

III. calculate masses

$$m_{\text{LiOH}} = 0.802 \text{ mol} \times 23.95 \text{ g/mol}$$

$$\boxed{m_{\text{LiOH}} = 19.2 \text{ g}}$$

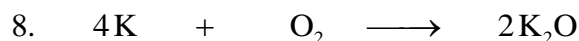
$$\frac{n_{\text{HCl}}}{1} = \frac{n_{\text{LiCl}}}{1}$$

$$\frac{n_{\text{HCl}}}{1} = \frac{0.802 \text{ mol}}{1}$$

$$n_{\text{HCl}} = 0.802 \text{ mol}$$

$$m_{\text{HCl}} = 0.802 \text{ mol} \times 36.46 \text{ g/mol}$$

$$\boxed{m_{\text{HCl}} = 29.2 \text{ g}}$$



$$m_{\text{K}} = 4.57 \text{ g} \quad m_{\text{K}_2\text{O}} = ?$$

$$M_{\text{K}} = 39.10 \text{ g/mol} \quad M_{\text{K}_2\text{O}} = 94.20 \text{ g/mol}$$

/8

I. calculate moles

$$n_{\text{KOH}} = \frac{4.57 \text{ g}}{39.10 \text{ g/mol}}$$

$$n_{\text{KOH}} = 0.117 \text{ mol}$$

II. mole ratio

$$\frac{n_{\text{K}_2\text{O}}}{2} = \frac{n_{\text{KOH}}}{4}$$

$$\frac{n_{\text{K}_2\text{O}}}{2} = \frac{0.117 \text{ mol}}{4}$$

$$n_{\text{K}_2\text{O}} = 0.058 \text{ mol}$$

III. calculate mass

$$m_{\text{K}_2\text{O}} = 0.058 \text{ mol} \times 94.20 \text{ g/mol}$$

$$\boxed{m_{\text{K}_2\text{O}} = 5.51 \text{ g}}$$



$$m_{\text{N}_2} = 5.40 \text{ g} \quad m_{\text{NH}_3} = ?$$

$$M_{\text{N}_2} = 28.02 \text{ g/mol} \quad M_{\text{NH}_3} = 17.04 \text{ g/mol}$$

/8

I. calculate moles

$$n_{\text{N}_2} = \frac{5.40 \text{ g}}{28.02 \text{ g/mol}}$$

$$n_{\text{N}_2} = 0.193 \text{ mol}$$

II. mole ratio

$$\frac{n_{\text{NH}_3}}{2} = \frac{n_{\text{N}_2}}{1}$$

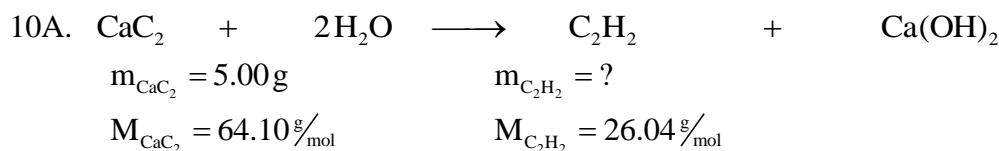
$$\frac{n_{\text{NH}_3}}{2} = \frac{0.193 \text{ mol}}{1}$$

$$n_{\text{NH}_3} = 0.385 \text{ mol}$$

III. calculate mass

$$m_{\text{NH}_3} = 0.385 \text{ mol} \times 17.04 \text{ g/mol}$$

$$\boxed{m_{\text{NH}_3} = 6.57 \text{ g}}$$



/6

I. calculate moles

$$n_{\text{CaC}_2} = \frac{5.00 \text{ g}}{64.10 \text{ g/mol}}$$

$$n_{\text{CaC}_2} = 0.0780 \text{ mol}$$

II. mole ratio

$$\frac{n_{\text{C}_2\text{H}_2}}{1} = \frac{n_{\text{CaC}_2}}{1}$$

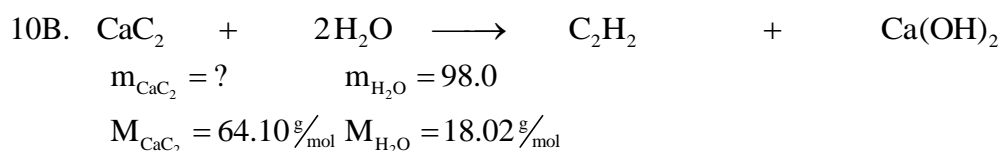
$$\frac{n_{\text{C}_2\text{H}_2}}{1} = \frac{0.0780 \text{ mol}}{1}$$

$$n_{\text{C}_2\text{H}_2} = 0.0780 \text{ mol}$$

III. calculate mass

$$m_{\text{C}_2\text{H}_2} = 0.0780 \text{ mol} \times 26.04 \text{ g/mol}$$

$$m_{\text{C}_2\text{H}_2} = 2.03 \text{ g}$$



/6

I. calculate moles

$$n_{\text{H}_2\text{O}} = \frac{98.0 \text{ g}}{18.02 \text{ g/mol}}$$

$$n_{\text{H}_2\text{O}} = 5.44 \text{ mol}$$

II. mole ratio

$$\frac{n_{\text{CaC}_2}}{1} = \frac{n_{\text{H}_2\text{O}}}{2}$$

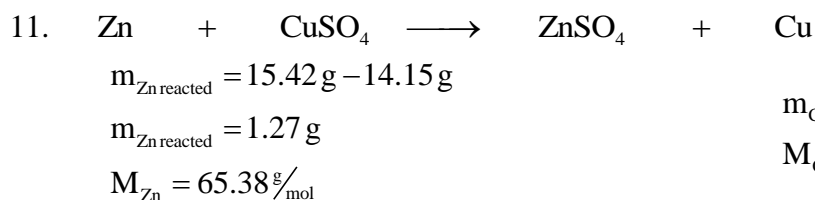
$$\frac{n_{\text{CaC}_2}}{1} = \frac{5.44 \text{ mol}}{2}$$

$$n_{\text{CaC}_2} = 2.72 \text{ mol}$$

III. calculate mass

$$m_{\text{CaC}_2} = 2.72 \text{ mol} \times 64.10 \text{ g/mol}$$

$$m_{\text{CaC}_2} = 174 \text{ g}$$



/8

I. calculate moles

$$n_{\text{Zn}} = \frac{1.27 \text{ g}}{65.38 \text{ g/mol}}$$

$$n_{\text{Zn}} = 0.0194 \text{ mol}$$

II. mole ratio

$$\frac{n_{\text{Cu}}}{1} = \frac{n_{\text{Zn}}}{1}$$

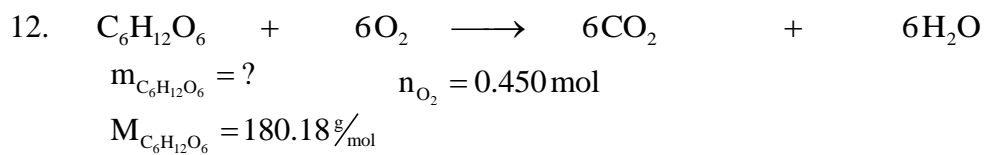
$$\frac{n_{\text{Cu}}}{1} = \frac{0.0194 \text{ mol}}{1}$$

$$n_{\text{Cu}} = 0.0194 \text{ mol}$$

III. calculate mass

$$m_{\text{Cu}} = 0.0194 \text{ mol} \times 63.55 \text{ g/mol}$$

$$m_{\text{Cu}} = 1.23 \text{ g}$$



/6

I. mole ratio

II. calculate mass

$$\frac{n_{\text{C}_6\text{H}_{12}\text{O}_6}}{1} = \frac{n_{\text{O}_2}}{6}$$

$$\frac{n_{\text{C}_6\text{H}_{12}\text{O}_6}}{1} = \frac{0.450 \text{ mol}}{6} \quad m_{\text{C}_6\text{H}_{12}\text{O}_6} = 0.0750 \text{ mol} \times 180.18 \frac{\text{g}}{\text{mol}}$$

$$n_{\text{C}_6\text{H}_{12}\text{O}_6} = 0.0750 \text{ mol} \quad \boxed{m_{\text{C}_6\text{H}_{12}\text{O}_6} = 13.5 \text{ g}}$$