STOICHIOMETRIC PROBLEMS #2B – ANSWERS

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1. $\underset{\text{? g}}{2\ C_4H_{10}} + 13\ O_2 \rightarrow 8\ CO_2 + \underset{\text{100 g}}{10\ H_2O}$

$$100\text{ g } H_2O \times \frac{1\text{ mol } H_2O}{18.02\text{ g } H_2O} \times \frac{2\text{ mol } C_4H_{10}}{10\text{ mol } H_2O} \times \frac{58.14\text{ g } C_4H_{10}}{1\text{ mol } C_4H_{10}} = 64.53\text{ g } C_4H_{10}$$

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2. $\underset{\text{2.50 mol}}{2\ KClO_3} \rightarrow 2\ KCl + \underset{\text{? mol}}{3\ O_2}$

$$2.50\text{ mol } KClO_3 \times \frac{3\text{ mol } O_2}{2\text{ mol } KClO_3} = 3.75\text{ mol } O_2$$

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3. $\underset{\text{80.00 g}}{3\ Ca(NO_3)_2} + \underset{\text{? g}}{2\ K_3PO_4} \rightarrow \underset{\text{? g}}{Ca_3(PO_4)_2} + \underset{\text{? g}}{6\ KNO_3}$

$$80.00\text{ g } Ca(NO_3)_2 \times \frac{1\text{ mol } Ca(NO_3)_2}{164.10\text{ g } Ca(NO_3)_2} \times \frac{1\text{ mol } Ca_3(PO_4)_2}{3\text{ mol } Ca(NO_3)_2} \times \frac{310.18\text{ g } Ca_3(PO_4)_2}{1\text{ mol } Ca_3(PO_4)_2} = 50.41\text{ g } Ca_3(PO_4)_2$$

$$80.00\text{ g } Ca(NO_3)_2 \times \frac{1\text{ mol } Ca(NO_3)_2}{164.10\text{ g } Ca(NO_3)_2} \times \frac{2\text{ mol } K_3PO_4}{3\text{ mol } Ca(NO_3)_2} \times \frac{212.27\text{ g } K_3PO_4}{1\text{ mol } K_3PO_4} = 68.99\text{ g } K_3PO_4$$

$$80.00\text{ g } Ca(NO_3)_2 \times \frac{1\text{ mol } Ca(NO_3)_2}{164.10\text{ g } Ca(NO_3)_2} \times \frac{6\text{ mol } KNO_3}{3\text{ mol } Ca(NO_3)_2} \times \frac{101.11\text{ g } KNO_3}{1\text{ mol } KNO_3} = 98.58\text{ g } KNO_3$$

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4. mass reactants = mass $Ca(NO_3)_2$ + mass K_3PO_4
= 80.00 g + 68.99 g
= 148.99 g

mass products = mass $Ca_3(PO_4)_2$ + mass KNO_3
= 50.41 g + 98.58 g
= 148.99 g

The mass of reactants and products are the same (or nearly the same). This makes sense, since the law of conservation of mass states that matter cannot be created nor destroyed, therefore mass is conserved.

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5. $Al_2O_3 + 3\ H_2O \rightarrow 2\ Al(OH)_3$
25.0 g ? g

$$25.0\text{ g } Al_2O_3 \times \frac{1\text{ mol } Al_2O_3}{101.96\text{ g } Al_2O_3} \times \frac{2\text{ mol } Al(OH)_3}{1\text{ mol } Al_2O_3} \times \frac{78.01\text{ g } Al(OH)_3}{1\text{ mol } Al(OH)_3} = 38.3\text{ g } Al(OH)_3$$

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6. $4\ CuO \rightarrow 2\ Cu_2O + O_2$
35.0 g ? g

$$35.0\text{ g CuO} \times \frac{1\text{ mol CuO}}{79.55\text{ g CuO}} \times \frac{2\text{ mol } Cu_2O}{4\text{ mol CuO}} \times \frac{143.10\text{ g } Cu_2O}{1\text{ mol } Cu_2O} = 31.5\text{ g } Cu_2O$$

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7. $Ca(ClO_3)_2 \rightarrow CaCl_2 + 3\ O_2$
11.0 mol ? g ? mol

$$11.0\text{ mol } Ca(ClO_3)_2 \times \frac{3\text{ mol } O_2}{1\text{ mol } Ca(ClO_3)_2} = 33.0\text{ mol } O_2$$

$$11.0\text{ mol } Ca(ClO_3)_2 \times \frac{1\text{ mol } CaCl_2}{1\text{ mol } Ca(ClO_3)_2} \times \frac{110.98\text{ g } CaCl_2}{1\text{ mol } CaCl_2} = 1220\text{ g } CaCl_2$$

8.

$$\underset{\text{? mol}}{Cu} + \underset{\text{1.25 mol}}{2\ AgNO_3} \rightarrow Cu(NO_3)_2 + \underset{\text{132 g}}{2\ Ag}$$

? g

$$1.25\ \text{mol } AgNO_3 \times \frac{1\ \text{mol Cu}}{2\ \text{mol } AgNO_3} = 0.625\ \text{mol Cu}$$

$$132\ \text{g Ag} \times \frac{1\ \text{mol Ag}}{107.87\ \text{g Ag}} \times \frac{2\ \text{mol } AgNO_3}{2\ \text{mol Ag}} \times \frac{169.88\ \text{g } AgNO_3}{1\ \text{mol } AgNO_3} = 208\ \text{g } AgNO_3$$

9.

$$\underset{\text{25.0 kg}}{Fe_2O_3} + 3\ C \rightarrow \underset{\text{? kg}}{2\ Fe} + 3\ CO$$

$$25.0\ \text{kg } Fe_2O_3 \times \frac{1000\ \text{g}}{1\ \text{kg}} \times \frac{1\ \text{mol } Fe_2O_3}{159.70\ \text{g Fe}} \times \frac{2\ \text{mol Fe}}{1\ \text{mol } Fe_2O_3}$$

$$\times \frac{55.85\ \text{g Fe}}{1\ \text{mol Fe}} \times \frac{1\ \text{kg}}{1000\ \text{g}} = 17.5\ \text{kg Fe}$$

10.

$$\underset{\text{120 g}}{C_6H_{12}O_6} + 6\ O_2 \rightarrow \underset{\text{? g}}{6\ CO_2} + 6\ H_2O$$

$$120\ \text{g } C_6H_{12}O_6 \times \frac{1\ \text{mol } C_6H_{12}O_6}{180.18\ \text{g } C_6H_{12}O_6} \times \frac{6\ \text{mol } CO_2}{1\ \text{mol } C_6H_{12}O_6} \times \frac{44.01\ \text{g } CO_2}{1\ \text{mol } CO_2} = 176\ \text{g } CO_2$$

The mass of oxygen added to carbon in carbon dioxide gives this product more mass when compared to the mass of oxygen (and hydrogen) added to the carbon in glucose.

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11. $4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$

14.0 g ? mol ? g

$$14.0\ g\ NH_3 \times \frac{1\ mol\ NH_3}{17.04\ g\ NH_3} \times \frac{6\ mol\ H_2O}{4\ mol\ NH_3} \times \frac{18.02\ g\ H_2O}{1\ mol\ H_2O} = 22.2\ g\ H_2O$$

$$14.0\ g\ NH_3 \times \frac{1\ mol\ NH_3}{17.04\ g\ NH_3} \times \frac{5\ mol\ O_2}{4\ mol\ NH_3} = 1.03\ mol\ O_2$$