

1. Consider the following reaction:  $5\text{NaN}_3(\text{s}) + \text{NaNO}_3(\text{aq}) \rightarrow 3\text{Na}_2\text{O}(\text{s}) + 8\text{N}_2(\text{g})$

a. If you start with 52 moles of sodium azide and 12 moles of sodium nitrate, how many moles of nitrogen could be produced? choice = 2

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$$52 \text{ mol } \text{NaN}_3 \left( \frac{8 \text{ mol } \text{N}_2}{5 \text{ mol } \text{NaN}_3} \right) = 83.2 \text{ mol } \text{N}_2$$

$$12 \text{ mol } \text{NaNO}_3 \left( \frac{8 \text{ mol } \text{N}_2}{1 \text{ mol } \text{NaNO}_3} \right) = 96 \text{ mol } \text{N}_2$$

2 b. What is the limiting reactant?

$\text{NaN}_3$  (2)

2 c. What is the excess reactant?

$\text{NaNO}_3$  (2)

4 d. How many moles of the excess reactant would remain after the limiting reactant is completely consumed?

$$83.2 \text{ mol } \text{N}_2 \times \left( \frac{1 \text{ mol } \text{NaNO}_3}{8 \text{ mol } \text{N}_2} \right) = 10.4 \text{ mol } \text{NaNO}_3 \text{ consumed}$$

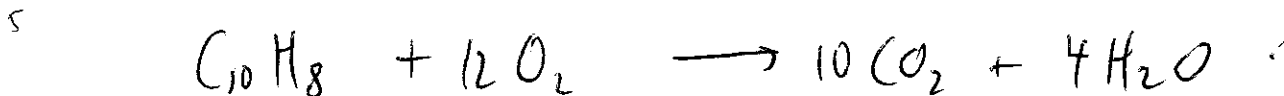
12 mol  $\text{NaNO}_3$  available  
 - 10.4 mol  $\text{NaNO}_3$  used

1.6 mol  $\text{NaNO}_3$  left over (1)

96 mol  $\text{N}_2$   
~~83.2~~ mol  $\text{N}_2$   
 13 mol  $\text{N}_2$  could have formed

$$13 \text{ mol } \text{N}_2 \left( \frac{1 \text{ mol } \text{NaNO}_3}{8 \text{ mol } \text{N}_2} \right) = 1.6 \text{ mol } \text{NaNO}_3 \text{ left over}$$

2. Write the balanced equation for the combustion of naphthalene (C<sub>10</sub>H<sub>8</sub>) in oxygen.



15 a. How many grams of carbon dioxide could be produced when 45 grams of naphthalene burns in 15 grams of oxygen?

Plan:  $g C_{10}H_8 \rightarrow mol C_{10}H_8 \rightarrow mol CO_2 \rightarrow g CO_2$   
 $g O_2 \rightarrow mol O_2 \rightarrow mol CO_2 \rightarrow g CO_2$  } pick smaller

molar masses

$$C_{10}H_8 = (12.01 \times 10) + (1.008 \times 8) = 128.164 g/mol$$

$$O_2 = (16.00 \times 2) = 32.00 g/mol$$

$$CO_2 = (12.01 \times 2) + (16.00 \times 2) = 44.01 g/mol$$

$$45 g C_{10}H_8 \left( \frac{1 mol C_{10}H_8}{128.164 g} \right) \left( \frac{10 mol CO_2}{1 mol C_{10}H_8} \right) \left( \frac{44.01 g}{1 mol} \right) = 155 g CO_2$$

$$15 g O_2 \left( \frac{1 mol O_2}{32.00 g} \right) \left( \frac{10 mol CO_2}{12 mol O_2} \right) \left( \frac{44.01 g}{1 mol} \right) = 17 g CO_2$$

choice (2)

2 b. Which is the limiting reactant O<sub>2</sub> (2)

2 c. Which is the excess reactant? C<sub>10</sub>H<sub>8</sub> (2)

6 d. What mass of the excess reactant would remain after the reaction went to completion?

$$17 g CO_2 \times \left( \frac{1 mol CO_2}{44.01 g} \right) \left( \frac{1 mol C_{10}H_8}{10 mol CO_2} \right) \left( \frac{128.164 g}{1 mol} \right) = 4.95 g C_{10}H_8 \text{ used.}$$

$$45 g C_{10}H_8 \text{ available} \\
 - 4.95 g C_{10}H_8 \text{ used}$$

$$40.05 g C_{10}H_8 \text{ left over}$$

other method:

$$\frac{155 g}{-17 g} CO_2 \left( \frac{1 mol CO_2}{44.01 g} \right) \left( \frac{1 mol C_{10}H_8}{10 mol CO_2} \right) \left( \frac{128.164 g}{1 mol} \right) = 40.05 g \text{ left over } C_{10}H_8$$