

## Mass Yields - Problem Set #1 - Answers

Determine the number of grams of the indicated products and/or starting materials as requested:

1. The combustion of 1.2 grams of  $C_4H_8$  produces how many grams of water.



$$W_{C_4H_8} = 1.2 \text{ g [Note: There are only 2 Significant Figures for this datum]}$$

$$W_{H_2O} = ???$$

$$MW_{C_4H_8} = (4 \times 12.01) + (8 \times 1.008) = 56.104 \text{ g/mole}$$

$$MW_{H_2O} = (2 \times 1.008) + (1 \times 16.00) = 18.016 \text{ g/mole}$$

$$n = W / MW \quad \& \quad W = MW \times n$$

$$n_{C_4H_8} = W_{C_4H_8} / MW_{C_4H_8} = 1.2 \text{ g} / 56.104 \text{ g/mole} = 0.0213888 \text{ moles}$$

$$n_{H_2O} = ???$$

$$n_{H_2O} = 4 \times n_{C_4H_8} = 4 \times 0.0213888 \text{ moles} = 0.0855553 \text{ moles}$$

$$W_{H_2O} = MW_{H_2O} \times n_{H_2O}$$

$$W_{H_2O} = 18.016 \text{ g/mole} \times 0.0855553 \text{ moles}$$

$$W_{H_2O} = 1.541366 \text{ grams} = \underline{1.5 \text{ grams}}$$

[Note: Only 2 Significant Figures are allowed for this answer]

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2. When 0.024 grams of HF are reacted as follows, how many grams of C<sub>2</sub>H<sub>4</sub>F<sub>2</sub> are produced?



**W<sub>HF</sub> = 0.024 g** [Note: There are only 2 Significant Figures for this datum]

$$W_{\text{C}_2\text{H}_4\text{F}_2} = ???$$

$$MW_{\text{HF}} = (1 \times 19.00) + (1 \times 1.008) = 20.008 \text{ g/mole}$$

$$MW_{\text{C}_2\text{H}_4\text{F}_2} = (4 \times 1.008) + (2 \times 12.01) + (2 \times 19.00) = 66.052 \text{ g/mole}$$

$$n = W / MW \quad \& \quad W = MW \times n$$

$$n_{\text{HF}} = W_{\text{HF}} / MW_{\text{HF}} = 0.024 \text{ g} / 20.008 \text{ g/mole} = 0.00119952 \text{ moles}$$

$$n_{\text{C}_2\text{H}_4\text{F}_2} = ???$$

$$n_{\text{C}_2\text{H}_4\text{F}_2} = 1/2 \times n_{\text{HF}} = 1/2 \times 0.00119952 \text{ moles} = 0.00059976 \text{ moles}$$

$$W_{\text{C}_2\text{H}_4\text{F}_2} = MW_{\text{C}_2\text{H}_4\text{F}_2} \times n_{\text{C}_2\text{H}_4\text{F}_2}$$

$$W_{\text{C}_2\text{H}_4\text{F}_2} = 66.052 \text{ g/mole} \times 0.00059976 \text{ moles}$$

$$W_{\text{C}_2\text{H}_4\text{F}_2} = 0.0396153 \text{ grams} = \underline{0.040 \text{ grams}} \text{ (or } 4.0 \times 10^{-2} \text{ grams)}$$

[Note: Only 2 Significant Figures are allowed for this answer]

Mass Yields - Problem Set #1 - Answers

3. If a person burns 0.24 kilograms of C<sub>9</sub>H<sub>20</sub>, how many grams of CO<sub>2</sub> will be produced?



$$W_{\text{C}_9\text{H}_{20}} = 0.24 \text{ Kg} \text{ [Note: There are only 2 Significant Figures for this datum]}$$

$$W_{\text{C}_9\text{H}_{20}} = 0.24 \text{ Kg} \times 1,000 \text{ g/Kg} = 240 \text{ grams}$$

$$W_{\text{CO}_2} = ???$$

$$MW_{\text{C}_9\text{H}_{20}} = (20 \times 1.008) + (9 \times 12.01) = 128.25 \text{ g/mole}$$

$$MW_{\text{CO}_2} = (1 \times 12.01) + (2 \times 16.00) = 44.01 \text{ g/mole}$$

$$n = W / MW \quad \& \quad W = MW \times n$$

$$n_{\text{C}_9\text{H}_{20}} = W_{\text{C}_9\text{H}_{20}} / MW_{\text{C}_9\text{H}_{20}} = 240 \text{ g} / 128.25 \text{ g/mole} = 1.87134 \text{ moles}$$

$$n_{\text{CO}_2} = ???$$

$$n_{\text{CO}_2} = 9 \times n_{\text{C}_9\text{H}_{20}} = 9 \times 1.87134 \text{ moles} = 16.8421 \text{ moles}$$

$$W_{\text{CO}_2} = MW_{\text{CO}_2} \times n_{\text{CO}_2}$$

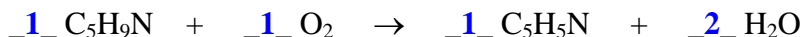
$$W_{\text{CO}_2} = 44.01 \text{ g/mole} \times 16.8421 \text{ moles}$$

$$W_{\text{CO}_2} = \del{741.221} \text{ grams} = \underline{7.4 \times 10^2 \text{ grams (or 0.74 Kg)}}$$

[Note: Only 2 Significant Figures are allowed for this answer]

Mass Yields - Problem Set #1 - Answers

4. When the following reaction consumes 234 grams of oxygen, how many kilograms of C<sub>5</sub>H<sub>5</sub>N are produced?



**W<sub>O<sub>2</sub></sub> = 234 g [Note: There are only 3 Significant Figures for this datum]**

**W<sub>C<sub>5</sub>H<sub>5</sub>N</sub> = ??? (Kg)**

**MW<sub>O<sub>2</sub></sub> = (2 x 16.00) = 32.00 g/mole**

**MW<sub>C<sub>5</sub>H<sub>5</sub>N</sub> = (5 x 12.01) + (5 x 1.008) + (1 x 14.01) = 79.10 g/mole**

**n = W / MW    &    W = MW x n**

**n<sub>O<sub>2</sub></sub> = W<sub>O<sub>2</sub></sub> / MW<sub>O<sub>2</sub></sub> = 234 g / 32.00 g/mole = 7.3125 moles**

**n<sub>C<sub>5</sub>H<sub>5</sub>N</sub> = ???**

**n<sub>C<sub>5</sub>H<sub>5</sub>N</sub> = 1 x n<sub>O<sub>2</sub></sub> = 1 x 7.3125 moles = 7.3125 moles**

**W<sub>C<sub>5</sub>H<sub>5</sub>N</sub> = MW<sub>C<sub>5</sub>H<sub>5</sub>N</sub> x n<sub>C<sub>5</sub>H<sub>5</sub>N</sub>**

**W<sub>C<sub>5</sub>H<sub>5</sub>N</sub> = 79.10 g/mole x 7.3125 moles**

**W<sub>C<sub>5</sub>H<sub>5</sub>N</sub> = 578.41875 grams**

**W<sub>C<sub>5</sub>H<sub>5</sub>N</sub> = 578.41875 grams / 1,000 grams/Kg = 0.5784187 Kg**

**W<sub>C<sub>5</sub>H<sub>5</sub>N</sub> = 0.5784187 Kg = 0.578 Kg (or 5.78 x 10<sup>-1</sup> Kg)**

**[Note: Only 3 Significant Figures are allowed for this answer]**

5. How many tonnes of Oxygen does it take to burn 1.6 kilograms of C<sub>2</sub>H<sub>4</sub>?



**W<sub>C<sub>2</sub>H<sub>4</sub></sub> = 1.6 Kg [Note: There are only 2 Significant Figures for this datum]**

$$\mathbf{W_{C_2H_4} = 1.6 \text{ Kg} \times 1,000 \text{ g/Kg} = 1,600 \text{ grams}}$$

$$\mathbf{W_{O_2} = ??? \text{ (tonnes)}}$$

$$\mathbf{MW_{C_2H_4} = (4 \times 1.008) + (1 \times 12.01) = 28.052 \text{ g/mole}}$$

$$\mathbf{MW_{O_2} = (2 \times 16.00) = 32.00 \text{ g/mole}}$$

$$\mathbf{n = W / MW \quad \& \quad W = MW \times n}$$

$$\mathbf{n_{C_2H_4} = W_{C_2H_4} / MW_{C_2H_4} = 1,600 \text{ g} / 28.052 \text{ g/mole} = 57.036931 \text{ moles}}$$

$$\mathbf{n_{O_2} = ???}$$

$$\mathbf{n_{O_2} = 3 \times n_{C_2H_4} = 3 \times 57.036931 \text{ moles} = 171.11079 \text{ moles}}$$

$$\mathbf{W_{O_2} = MW_{O_2} \times n_{O_2}}$$

$$\mathbf{W_{O_2} = 32.00 \text{ g/mole} \times 171.11079 \text{ moles}}$$

$$\mathbf{W_{O_2} = 5,475.5454 \text{ grams} = 5,475.5454 \text{ grams} / 1,000,000 \text{ grams/tonnes}^1}$$

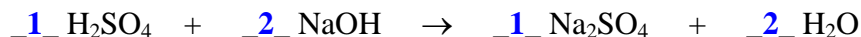
$$\mathbf{W_{O_2} = 0.00547554 \text{ tonnes} = \underline{0.005,5 \text{ tonnes} (5.5 \times 10^{-3} \text{ tonnes})}}$$

**[Note: Only 2 Significant Figures are allowed for this answer]**

<sup>1</sup> Note: A tonnes (a metric ton) is equal to 1,000 Kg or 1,000,000 grams.

Mass Yields - Problem Set #1 - Answers

6. How many kilograms of NaOH are consumed in the following reaction to produce 0.22 tonnes of Na<sub>2</sub>SO<sub>4</sub>?



**$W_{\text{Na}_2\text{SO}_4} = 0.22 \text{ tonnes}$  [Note: There are only 2 Significant Figures for this datum]**

$$W_{\text{Na}_2\text{SO}_4} = 0.22 \text{ tonnes} \times 1,000,000 \text{ g/tonne} = 220,000 \text{ grams}$$

$$W_{\text{NaOH}} = ??? \text{ (Kg)}$$

$$MW_{\text{Na}_2\text{SO}_4} = (2 \times 22.99) + (1 \times 32.07) + (4 \times 16.00) = 142.05 \text{ g/mole}$$

$$MW_{\text{NaOH}} = (1 \times 22.99) + (1 \times 1.008) + (1 \times 16.00) = 39.998 \text{ g/mole}$$

$$n = W / MW \quad \& \quad W = MW \times n$$

$$n_{\text{Na}_2\text{SO}_4} = W_{\text{Na}_2\text{SO}_4} / MW_{\text{Na}_2\text{SO}_4} = 220,000 \text{ g} / 142.05 \text{ g/mole} = 1,548.7504 \text{ moles}$$

$$n_{\text{NaOH}} = ???$$

$$n_{\text{NaOH}} = 2 \times n_{\text{Na}_2\text{SO}_4} = 2 \times 1,548.7504 \text{ moles} = 3,097.5009 \text{ moles}$$

$$W_{\text{NaOH}} = MW_{\text{NaOH}} \times n_{\text{NaOH}}$$

$$W_{\text{NaOH}} = 39.998 \text{ g/mole} \times 3,097.5009 \text{ moles}$$

$$W_{\text{NaOH}} = 123,893.84 \text{ grams}$$

$$W_{\text{NaOH}} = 123,893.84 \text{ grams} / 1,000 \text{ grams/Kg}$$

$$W_{\text{NaOH}} = 123.89384 \text{ Kg} = \underline{1.2 \times 10^2 \text{ Kg}}$$

**[Note: Only 2 Significant Figures are allowed for this answer]**

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7. How many grams of C<sub>6</sub>H<sub>6</sub> have to be burned to produce 6.06 grams of CO<sub>2</sub>.



$W_{\text{CO}_2} = 6.06 \text{ g}$  [Note: There are only 3 Significant Figures for this datum]

$$W_{\text{C}_6\text{H}_6} = ???$$

$$MW_{\text{CO}_2} = (2 \times 12.01) + (1 \times 16.00) = 44.01 \text{ g/mole}$$

$$MW_{\text{C}_6\text{H}_6} = (6 \times 12.01) + (6 \times 1.008) = 78.108 \text{ g/mole}$$

$$n = W / MW \quad \& \quad W = MW \times n$$

$$n_{\text{CO}_2} = W_{\text{CO}_2} / MW_{\text{CO}_2} = 6.06 \text{ g} / 44.01 \text{ g/mole} = 0.1376959 \text{ moles}$$

$$n_{\text{C}_6\text{H}_6} = ???$$

$$n_{\text{C}_6\text{H}_6} = 1/6 \times n_{\text{CO}_2} = 1/6 \times 0.1376959 \text{ moles} = 0.0229493 \text{ moles}$$

$$W_{\text{C}_6\text{H}_6} = MW_{\text{C}_6\text{H}_6} \times n_{\text{C}_6\text{H}_6}$$

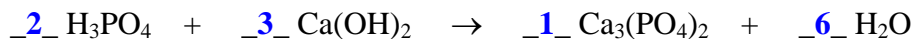
$$W_{\text{C}_6\text{H}_6} = 78.108 \text{ g/mole} \times 0.0229493 \text{ moles}$$

$$W_{\text{C}_6\text{H}_6} = 1.7925262 \text{ grams} = \underline{1.79 \text{ grams}}$$

[Note: Only 3 Significant Figures are allowed for this answer]

Mass Yields - Problem Set #1 - Answers

8. If one wants to produce 17 kilograms of  $\text{Ca}_3(\text{PO}_4)_2$ , how many kilograms of  $\text{H}_3\text{PO}_4$  should one use?



$$W_{\text{Ca}_3(\text{PO}_4)_2} = 17 \text{ Kg} \text{ [Note: There are only 2 Significant Figures for this datum]}$$

$$W_{\text{Ca}_3(\text{PO}_4)_2} = 17 \text{ Kg} \times 1,000 \text{ g/Kg} = 17,000 \text{ grams}$$

$$W_{\text{H}_3\text{PO}_4} = ??? \text{ (Kg)}$$

$$\text{MW}_{\text{Ca}_3(\text{PO}_4)_2} = (3 \times 40.08) + (2 \times 30.97) + (8 \times 16.00) = 310.18 \text{ g/mole}^2$$

$$\text{MW}_{\text{H}_3\text{PO}_4} = (1 \times 30.97) + (3 \times 1.008) + (4 \times 16.00) = 97.994 \text{ g/mole}$$

$$n = W / \text{MW} \quad \& \quad W = \text{MW} \times n$$

$$n_{\text{Ca}_3(\text{PO}_4)_2} = W_{\text{Ca}_3(\text{PO}_4)_2} / \text{MW}_{\text{Ca}_3(\text{PO}_4)_2} = 17,000 \text{ g} / 310.18 \text{ g/mole} = 54.806886 \text{ moles}$$

$$n_{\text{H}_3\text{PO}_4} = ???$$

$$n_{\text{H}_3\text{PO}_4} = 2 \times n_{\text{Ca}_3(\text{PO}_4)_2} = 2 \times 54.806886 \text{ moles} = 109.61377 \text{ moles}$$

$$W_{\text{H}_3\text{PO}_4} = \text{MW}_{\text{H}_3\text{PO}_4} \times n_{\text{H}_3\text{PO}_4}$$

$$W_{\text{H}_3\text{PO}_4} = 97.994 \text{ g/mole} \times 109.61377 \text{ moles}$$

$$W_{\text{H}_3\text{PO}_4} = 10,741.492 \text{ grams}$$

$$W_{\text{H}_3\text{PO}_4} = 10,741.492 \text{ grams} / 1,000 \text{ grams/Kg}$$

$$W_{\text{H}_3\text{PO}_4} = 10.741492 \text{ Kg} = \underline{11 \text{ Kg}}$$

[Note: Only 2 Significant Figures are allowed for this answer]

<sup>2</sup> Note: A formula that says  $\text{Ca}_3(\text{PO}_4)_2$  means that there are two  $(\text{PO}_4)$  groups and thus this material contains 3 atoms of Ca, 2 atoms of P, and 8 atoms of O.

Mass Yields - Problem Set #1 - Answers

9. The burning of 1.2 grams of C<sub>4</sub>H<sub>8</sub> produces how many grams of CO<sub>2</sub>.



$W_{\text{C}_4\text{H}_8} = 1.2 \text{ g}$  [Note: There are only 2 Significant Figures for this datum]

$$W_{\text{CO}_2} = ???$$

$$MW_{\text{CO}_2} = (2 \times 12.01) + (1 \times 16.00) = 44.01 \text{ g/mole}$$

$$MW_{\text{C}_4\text{H}_8} = (4 \times 12.01) + (8 \times 1.008) = 56.104 \text{ g/mole}$$

$$n = W / MW \quad \& \quad W = MW \times n$$

$$n_{\text{C}_4\text{H}_8} = W_{\text{C}_4\text{H}_8} / MW_{\text{C}_4\text{H}_8} = 1.2 \text{ g} / 56.104 \text{ g/mole} = 0.0213888 \text{ moles}$$

$$n_{\text{CO}_2} = ???$$

$$n_{\text{CO}_2} = 4 \times n_{\text{C}_4\text{H}_8} = 4 \times 0.0213888 \text{ moles} = 0.0855553 \text{ moles}$$

$$W_{\text{CO}_2} = MW_{\text{CO}_2} \times n_{\text{CO}_2}$$

$$W_{\text{CO}_2} = 44.01 \text{ g/mole} \times 0.0855553 \text{ moles}$$

$$W_{\text{CO}_2} = \del{3.765293} \text{ grams} = \underline{\underline{3.8 \text{ grams}}}$$

[Note: Only 2 Significant Figures are allowed for this answer]

Mass Yields - Problem Set #1 - Answers

10. When 0.024 grams of HF are reacted as follows, how many grams of C<sub>6</sub>H<sub>9</sub>F<sub>3</sub> are produced?



**W<sub>HF</sub> = 0.024 g [Note: There are only 2 Significant Figures for this datum]**

$$W_{\text{C}_6\text{H}_9\text{F}_3} = ???$$

$$MW_{\text{HF}} = (1 \times 19.00) + (1 \times 1.008) = 20.008 \text{ g/mole}$$

$$MW_{\text{C}_6\text{H}_9\text{F}_3} = (9 \times 1.008) + (6 \times 12.01) + (3 \times 19.00) = 138.132 \text{ g/mole}$$

$$n = W / MW \quad \& \quad W = MW \times n$$

$$n_{\text{HF}} = W_{\text{HF}} / MW_{\text{HF}} = 0.024 \text{ g} / 20.008 \text{ g/mole} = 0.00119952 \text{ moles}$$

$$n_{\text{C}_6\text{H}_9\text{F}_3} = ???$$

$$n_{\text{C}_6\text{H}_9\text{F}_3} = 1/3 \times n_{\text{HF}} = 1/3 \times 0.00119952 \text{ moles} = 0.000399833 \text{ moles}$$

$$W_{\text{C}_6\text{H}_9\text{F}_3} = MW_{\text{C}_6\text{H}_9\text{F}_3} \times n_{\text{C}_6\text{H}_9\text{F}_3}$$

$$W_{\text{C}_6\text{H}_9\text{F}_3} = 138.132 \text{ g/mole} \times 0.000399833 \text{ moles}$$

$$W_{\text{C}_6\text{H}_9\text{F}_3} = 0.0552297 \text{ grams} = \underline{0.055 \text{ grams}} \text{ (or } 5.5 \times 10^{-2} \text{ grams)}$$

**[Note: Only 2 Significant Figures are allowed for this answer]**

Mass Yields - Problem Set #1 - Answers

11. If a person combusts 0.24 grams of C<sub>9</sub>H<sub>20</sub>, how many grams of water will be produced?



$W_{\text{C}_9\text{H}_{20}} = 0.24 \text{ g}$  [Note: There are only 2 Significant Figures for this datum]

$$W_{\text{H}_2\text{O}} = ???$$

$$MW_{\text{C}_9\text{H}_{20}} = (20 \times 1.008) + (9 \times 12.01) = 128.25 \text{ g/mole}$$

$$MW_{\text{H}_2\text{O}} = (2 \times 1.008) + (1 \times 16.00) = 18.016 \text{ g/mole}$$

$$n = W / MW \quad \& \quad W = MW \times n$$

$$n_{\text{C}_9\text{H}_{20}} = W_{\text{C}_9\text{H}_{20}} / MW_{\text{C}_9\text{H}_{20}} = 0.24 \text{ g} / 128.25 \text{ g/mole} = 0.001,871,34 \text{ moles}$$

$$n_{\text{H}_2\text{O}} = ???$$

$$n_{\text{H}_2\text{O}} = 9 \times n_{\text{C}_9\text{H}_{20}} = 9 \times 0.001,871,34 \text{ moles} = 0.0168421 \text{ moles}$$

$$W_{\text{H}_2\text{O}} = MW_{\text{H}_2\text{O}} \times n_{\text{H}_2\text{O}}$$

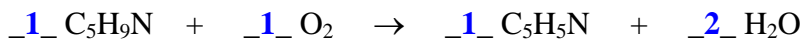
$$W_{\text{H}_2\text{O}} = 18.016 \text{ g/mole} \times 0.0168421 \text{ moles}$$

$$W_{\text{H}_2\text{O}} = 0.3034273 \text{ grams} = \underline{3.0 \times 10^{-1} \text{ grams}} \text{ (or } 0.30 \text{ Kg)}$$

[Note: Only 2 Significant Figures are allowed for this answer]

Mass Yields - Problem Set #1 - Answers

12. For the following reaction, how many grams of C<sub>5</sub>H<sub>9</sub>N must be consumed to produce 2.2 grams of water?



$$W_{\text{H}_2\text{O}} = 2.2 \text{ g [Note: There are only 3 Significant Figures for this datum]}$$

$$W_{\text{C}_5\text{H}_5\text{N}} = ??? \text{ (Kg)}$$

$$MW_{\text{H}_2\text{O}} = (2 \times 1.008) + (1 \times 16.00) = 18.016 \text{ g/mole}$$

$$MW_{\text{C}_5\text{H}_5\text{N}} = (5 \times 12.01) + (5 \times 1.008) + (1 \times 14.01) = 79.10 \text{ g/mole}$$

$$n = W / MW \quad \& \quad W = MW \times n$$

$$n_{\text{H}_2\text{O}} = W_{\text{H}_2\text{O}} / MW_{\text{H}_2\text{O}} = 2.2 \text{ g} / 18.016 \text{ g/mole} = 0.1221136 \text{ moles}$$

$$n_{\text{C}_5\text{H}_5\text{N}} = ???$$

$$n_{\text{C}_5\text{H}_5\text{N}} = 1/2 \times n_{\text{H}_2\text{O}} = 1/2 \times 0.1221136 \text{ moles} = 0.0610568 \text{ moles}$$

$$W_{\text{C}_5\text{H}_5\text{N}} = MW_{\text{C}_5\text{H}_5\text{N}} \times n_{\text{C}_5\text{H}_5\text{N}}$$

$$W_{\text{C}_5\text{H}_5\text{N}} = 79.10 \text{ g/mole} \times 0.0610568 \text{ moles}$$

$$W_{\text{C}_5\text{H}_5\text{N}} = 4.8295959 \text{ grams} = \underline{4.8 \text{ g}}$$

[Note: Only 3 Significant Figures are allowed for this answer]

Mass Yields - Problem Set #1 - Answers

13. How many kilograms of C<sub>2</sub>H<sub>4</sub> does it take to consume 1.5 kilograms of oxygen in a combustion reaction?



$$W_{\text{O}_2} = 1.5 \text{ Kg} \text{ [Note: There are only 2 Significant Figures for this datum]}$$

$$W_{\text{O}_2} = 1.5 \text{ Kg} \times 1,000 \text{ g/Kg} = 1,500 \text{ grams}$$

$$W_{\text{C}_2\text{H}_4} = ??? \text{ (Kg)}$$

$$\text{MW}_{\text{O}_2} = (2 \times 16.00) = 32.00 \text{ g/mole}$$

$$\text{MW}_{\text{C}_2\text{H}_4} = (4 \times 1.008) + (1 \times 12.01) = 28.052 \text{ g/mole}$$

$$n = W / \text{MW} \quad \& \quad W = \text{MW} \times n$$

$$n_{\text{O}_2} = W_{\text{O}_2} / \text{MW}_{\text{O}_2} = 1,500 \text{ g} / 32.00 \text{ g/mole} = 46.875 \text{ moles}$$

$$n_{\text{C}_2\text{H}_4} = ???$$

$$n_{\text{C}_2\text{H}_4} = 1/3 \times n_{\text{O}_2} = 1/3 \times 46.875 \text{ moles} = 15.625 \text{ moles}$$

$$W_{\text{C}_2\text{H}_4} = \text{MW}_{\text{C}_2\text{H}_4} \times n_{\text{C}_2\text{H}_4}$$

$$W_{\text{C}_2\text{H}_4} = 28.052 \text{ g/mole} \times 15.625 \text{ moles}$$

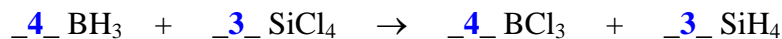
$$W_{\text{C}_2\text{H}_4} = 438.3125 \text{ grams} = 438.3125 \text{ grams} / 1,000 \text{ grams/Kg}$$

$$W_{\text{C}_2\text{H}_4} = 0.4383125 \text{ Kg} = \underline{0.44 \text{ Kg}} \text{ (} 4.4 \times 10^{-1} \text{ Kg)}$$

[Note: Only 2 Significant Figures are allowed for this answer]

Mass Yields - Problem Set #1 - Answers

14. How many grams of  $\text{BH}_3$  are consumed in the following reaction to produce 12 grams of  $\text{SiH}_4$ ?



$W_{\text{SiH}_4} = 12 \text{ grams}$  [Note: There are only 2 Significant Figures for this datum]

$$W_{\text{BH}_3} = ???$$

$$MW_{\text{SiH}_4} = (1 \times 28.09) + (4 \times 1.008) = 32.112 \text{ g/mole}$$

$$MW_{\text{BH}_3} = (1 \times 10.81) + (3 \times 1.008) = 13.834 \text{ g/mole}$$

$$n = W / MW \quad \& \quad W = MW \times n$$

$$n_{\text{SiH}_4} = W_{\text{SiH}_4} / MW_{\text{SiH}_4} = 12 \text{ g} / 32.112 \text{ g/mole} = 0.373692 \text{ moles}$$

$$n_{\text{BH}_3} = ???$$

$$n_{\text{BH}_3} = 4/3 \times n_{\text{SiH}_4} = 4/3 \times 0.373692 \text{ moles} = 0.4982561 \text{ moles}$$

$$W_{\text{BH}_3} = MW_{\text{BH}_3} \times n_{\text{BH}_3}$$

$$W_{\text{BH}_3} = 13.834 \text{ g/mole} \times 0.4982561 \text{ moles}$$

$$W_{\text{BH}_3} = 6.8928749 \text{ grams} = \underline{\underline{6.9 \text{ grams}}}$$

[Note: Only 2 Significant Figures are allowed for this answer]

Mass Yields - Problem Set #1 - Answers

15. How many grams of C<sub>6</sub>H<sub>6</sub> have to be burned to produce 6.00 grams of water?



**W<sub>H<sub>2</sub>O</sub> = 6.00 g [Note: There are only 3 Significant Figures for this datum]**

$$W_{\text{C}_6\text{H}_6} = ???$$

$$MW_{\text{H}_2\text{O}} = (2 \times 1.008) + (1 \times 16.00) = 18.016 \text{ g/mole}$$

$$MW_{\text{C}_6\text{H}_6} = (6 \times 12.01) + (6 \times 1.008) = 78.108 \text{ g/mole}$$

$$n = W / MW \quad \& \quad W = MW \times n$$

$$n_{\text{H}_2\text{O}} = W_{\text{H}_2\text{O}} / MW_{\text{H}_2\text{O}} = 6.00 \text{ g} / 18.016 \text{ g/mole} = 0.3330373 \text{ moles}$$

$$n_{\text{C}_6\text{H}_6} = ???$$

$$n_{\text{C}_6\text{H}_6} = \frac{1}{3} \times n_{\text{H}_2\text{O}} = \frac{1}{3} \times 0.3330373 \text{ moles} = 0.1110124 \text{ moles}$$

$$W_{\text{C}_6\text{H}_6} = MW_{\text{C}_6\text{H}_6} \times n_{\text{C}_6\text{H}_6}$$

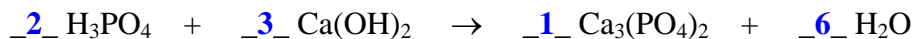
$$W_{\text{C}_6\text{H}_6} = 78.108 \text{ g/mole} \times 0.1110124 \text{ moles}$$

$$W_{\text{C}_6\text{H}_6} = 8.6709591 \text{ grams} = \underline{8.67 \text{ grams}}$$

**[Note: Only 3 Significant Figures are allowed for this answer]**

Mass Yields - Problem Set #1 - Answers

16. If this reaction produces 6.0 grams of  $\text{Ca}_3(\text{PO}_4)_2$ , how many grams of water would be produced?



$$W_{\text{Ca}_3(\text{PO}_4)_2} = 6.0 \text{ g} \text{ [Note: There are only 2 Significant Figures for this datum]}$$

$$W_{\text{H}_2\text{O}} = ???$$

$$\text{MW}_{\text{Ca}_3(\text{PO}_4)_2} = (3 \times 40.08) + (2 \times 30.97) + (8 \times 16.00) = 310.18 \text{ g/mole}$$

$$\text{MW}_{\text{H}_2\text{O}} = (2 \times 1.008) + (1 \times 16.00) = 18.016 \text{ g/mole}$$

$$n = W / \text{MW} \quad \& \quad W = \text{MW} \times n$$

$$n_{\text{Ca}_3(\text{PO}_4)_2} = W_{\text{Ca}_3(\text{PO}_4)_2} / \text{MW}_{\text{Ca}_3(\text{PO}_4)_2} = 6.0 \text{ g} / 310.18 \text{ g/mole} = 0.0193436 \text{ moles}$$

$$n_{\text{H}_2\text{O}} = ???$$

$$n_{\text{H}_2\text{O}} = 6 \times n_{\text{Ca}_3(\text{PO}_4)_2} = 6 \times 0.0193436 \text{ moles} = 0.1160616 \text{ moles}$$

$$W_{\text{H}_2\text{O}} = \text{MW}_{\text{H}_2\text{O}} \times n_{\text{H}_2\text{O}}$$

$$W_{\text{H}_2\text{O}} = 18.016 \text{ g/mole} \times 0.1160616 \text{ moles}$$

$$W_{\text{H}_2\text{O}} = 2.0909658 \text{ g} = \underline{2.1 \text{ grams}}$$

[Note: Only 2 Significant Figures are allowed for this answer]