

**1<sup>st</sup>: Determining Molar Yields of Species in Question:**

- 1) Balance the Equation in Moles.
- 2) Write out the **Number of Moles, n**, of all species where this data is given.
- 3) Calculate the required **Number of Moles, n**, for the species in question (the eventual solute).

**2<sup>nd</sup>: Calculating the Concentrations of Species in Question**

- 4) Rewrite the information given in the text to restate the **Volume (V)** of the solution.
- 5) If required, convert the **Volume (V)** of the solution into liters.
- 6) Calculate the **Concentration (C or [ ])** of the solute.

$$[ ] = n / V$$

$$V = n / [ ]$$

$$n = [ ] \times V$$

Note #1: Show all work for all questions.

Note #2: Use the number of significant figures in your final answer that is justified by the number of significant figures of the data you were given.

Determine the number of moles of the indicated products and/or starting materials as requested:<sup>1</sup>

1. The combustion of 1.2 moles of C<sub>4</sub>H<sub>8</sub> produces how many moles of water? If these were dissolved in 154 liters of Ethanol, what would be the concentration of water in ethanol?



$$n_{\text{C}_4\text{H}_8} = 1.2 \text{ moles}$$

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

$$n_{\text{H}_2\text{O}} = 4 \times n_{\text{C}_4\text{H}_8}$$

$$\underline{n_{\text{H}_2\text{O}}} = 4 \times 1.2 \text{ mole} = \underline{4.8 \text{ moles}}$$

$$[\text{H}_2\text{O}] = ???$$

$$V = 154 \text{ l}$$

$$[\text{H}_2\text{O}] = n / V$$

$$[\text{H}_2\text{O}] = 4.8 \text{ moles} / 154 \text{ l} =$$

<sup>1</sup> Note: The work & answers are shown in Red and/or Blue.

Concentrations - Problem Set #2 - Answers

$$[\text{H}_2\text{O}] = 0.031,168,8 \text{ m/l} = \underline{3.1 \times 10^{-2} \text{ m/l}}$$

2. When 0.024 moles of HF are reacted as follows in 2.67 liters of pentane solvent, how many moles of  $\text{C}_2\text{H}_4\text{F}_2$  are produced and what is its concentration in pentane?



$$n_{\text{HF}} = 0.024 \text{ moles}$$

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

$$n_{\text{C}_2\text{H}_4\text{F}_2} = 0.5 \times n_{\text{HF}}$$

$$\underline{n_{\text{C}_2\text{H}_4\text{F}_2}} = 0.5 \times 0.024 \text{ moles} = \underline{0.012 \text{ moles}}$$

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

$$V = 2.67 \text{ l}$$

$$[\text{C}_2\text{H}_4\text{F}_2] = n / V$$

$$[\text{C}_2\text{H}_4\text{F}_2] = 0.012 \text{ moles} / 2.67 \text{ l}$$

$$[\text{C}_2\text{H}_4\text{F}_2] = 0.004,494,38 \text{ m/l} = \underline{4.5 \times 10^{-3} \text{ m/l}}$$

3. If a person burns 0.24 moles of  $\text{C}_9\text{H}_{20}$  and traps the gasses in a 40 liter tank of water, how many moles of  $\text{CO}_2$  will be produced and what will be the  $\text{CO}_2$  concentration of that water?



$$n_{\text{C}_9\text{H}_{20}} = 0.24 \text{ moles}$$

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

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

$$\underline{n_{\text{CO}_2}} = 9 \times 0.24 \text{ moles} = \underline{2.16 \text{ moles}} = \underline{2.2 \text{ moles}}$$

Concentrations - Problem Set #2 - Answers

$$[\text{CO}_2] = ???$$

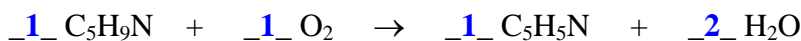
$$V = 40 \text{ l}$$

$$[\text{CO}_2] = n / V$$

$$[\text{CO}_2] = 2.16 \text{ moles} / 40 \text{ l}$$

$$[\text{CO}_2] = 0.054 \text{ m/l} = \underline{5.4 \times 10^{-2} \text{ m/l}}$$

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4. When the following reaction consumes 234 moles of oxygen, how many moles of  $\text{C}_5\text{H}_5\text{N}$  are produced? What would their concentration be if they were dissolved in 20 cubic meters of water? <sup>2</sup>



$$n_{\text{O}_2} = 234 \text{ moles}$$

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

$$n_{\text{C}_5\text{H}_5\text{N}} = 1 \times n_{\text{O}_2} = \underline{234 \text{ moles}}$$

$$[\text{C}_5\text{H}_5\text{N}] = ???$$

$$V = 20 \text{ m}^3$$

$$V = 20 \text{ m}^3 \times 1,000 \text{ l/m}^3 = 20,000 \text{ l}$$

$$[\text{C}_5\text{H}_5\text{N}] = n / V$$

$$[\text{C}_5\text{H}_5\text{N}] = 234 \text{ moles} / 20,000 \text{ l}$$

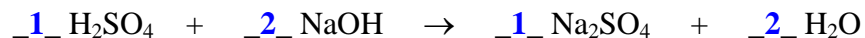
$$[\text{C}_5\text{H}_5\text{N}] = 0.0117 \text{ m/l} = \underline{1.17 \times 10^{-2} \text{ m/l}}$$

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5. How many moles of NaOH are consumed in the following reaction to produce 0.22 moles of  $\text{Na}_2\text{SO}_4$ ? What would be the starting concentration of that NaOH if the reaction were carried in 12.0 liters of water?

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<sup>2</sup> Note: Under standard conditions, a cubic meter of a substance is composed of exactly 1,000 liters of that substance.

Concentrations - Problem Set #2 - Answers



$$n_{\text{Na}_2\text{SO}_4} = 0.22 \text{ moles}$$

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

$$n_{\text{NaOH}} = 2 \times n_{\text{Na}_2\text{SO}_4}$$

$$\underline{n_{\text{NaOH}}} = 2 \times 0.22 \text{ moles} = \underline{0.44 \text{ moles}}$$

$$[\text{NaOH}] = ???$$

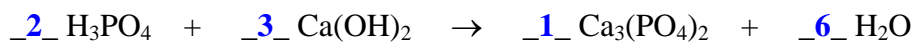
$$V = 12.0 \text{ l}$$

$$[\text{NaOH}] = n / V$$

$$[\text{NaOH}] = 0.44 \text{ moles} / 12.0 \text{ l}$$

$$[\text{NaOH}] = \underline{\underline{0.0366666 \text{ m/l}}} = \underline{\underline{3.7 \times 10^{-2} \text{ m/l}}}$$

6. If one wants to produce 17 moles of  $\text{Ca}_3(\text{PO}_4)_2$ , how many moles of  $\text{H}_3\text{PO}_4$  should one use? If this reaction were done in 46 liters of water, what would the starting concentration of  $\text{H}_3\text{PO}_4$  be?



$$n_{\text{Ca}_3(\text{PO}_4)_2} = 17 \text{ moles}$$

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

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

$$\underline{n_{\text{H}_3\text{PO}_4}} = 2 \times 17 \text{ moles} = \underline{34 \text{ moles}}$$

$$[\text{H}_3\text{PO}_4] = ???$$

$$V = 46 \text{ l}$$

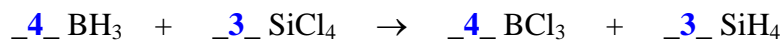
$$[\text{H}_3\text{PO}_4] = n / V$$

Concentrations - Problem Set #2 - Answers

$$[\text{H}_3\text{PO}_4] = 34 \text{ moles} / 46 \text{ l}$$

$$[\text{H}_3\text{PO}_4] = \text{0.7391304 m/l} = \underline{7.4 \times 10^{-1} \text{ m/l}}$$

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7. How many moles of  $\text{BH}_3$  are consumed in the following reaction to produce 12 moles of  $\text{SiH}_4$ ? If this reaction were carried out in 17 liters of pentane, what would the initial concentration of  $\text{BH}_3$  be?



$$n_{\text{SiH}_4} = 12 \text{ moles}$$

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

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

$$\underline{n_{\text{BH}_3}} = 4/3 \times 12 \text{ moles} = \underline{16 \text{ moles}}$$

$$[\text{BH}_3] = ???$$

$$V = 17 \text{ l}$$

$$[\text{BH}_3] = n_{\text{BH}_3} / V$$

$$[\text{BH}_3] = 16 \text{ moles} / 17 \text{ l}$$

$$[\text{BH}_3] = \text{0.9411764 m/l} = \underline{9.4 \times 10^{-1} \text{ m/l}}$$