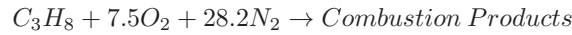


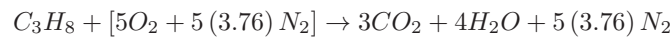
31.8 Propane is burned with approximately 50% excess air as shown in the reaction below. What is the mass fraction of CO_2 in the combustion products?



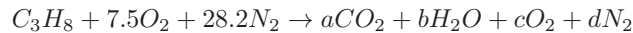
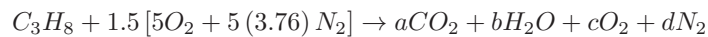
- A. 12%
- B. 22%
- C. 32%
- D. 42%

As a starting point, refer to the table on **Combustion Reactions of Common Fuel Constituents** and note the stoichiometric reaction for propane and air. Note nitrogen is excluded since it does not participate in the reaction; however, it is present in both the reactants and products and should be included since its presence will influence the mass fraction of any other constituent.

The full stoichiometric reaction for propane is:



Increase the air by 50% on the reactance side and include oxygen on the product side. Include variables coefficients to the product side of the reaction to allow for balancing.



Balancing carbon shows that $a = 3$. Balancing hydrogen shows that $b = 4$. This is unchanged from the stoichiometric reaction.

Balancing nitrogen shows that $d = 28.2$, which makes sense since nitrogen doesn't react in the combustion process.

Balance oxygen to find c . Substitute known values for a and b .

$$(2)(7.5) = 2a + b + 2c$$

$$15 = 6 + 4 + 2c$$

$$c = 2.5$$

The final balance reaction for propane burned with 50% excess air is:



To find the mass fraction of carbon dioxide in the reactants, use the **Periodic Table** to look up the atomic weights of each element as needed. Divide the mass of CO_2 by the total mass of all reactants.

$$m_{CO_2} = 3 [12 + (16) (2)] = 132$$

$$m_{H_2O} = 4 [(2) (1) + 16] = 72$$

$$m_{O_2} = 2.5 [(2) (16)] = 80$$

$$m_{N_2} = 28.2 [(2) (14)] = 789.6$$

$$\frac{m_{CO_2}}{m_{CO_2} + m_{H_2O} + m_{O_2} + m_{N_2}} = \frac{132}{132 + 72 + 80 + 789.6} = 0.12$$

Answer A