

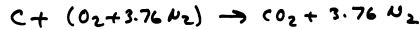
PROBLEM 13.24

KNOWN: Carbon burns with 80% theoretical air yielding CO_2 , CO , and N_2 only.

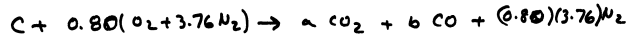
FIND: Determine (a) the balanced reaction equation, (b) AF, (c) the analysis of the products on a molar basis.

ASSUMPTIONS: 3.76 moles of N_2 accompany each mole of O_2 in the air, and N_2 is inert.

ANALYSIS: (a) Complete combustion of C with the theoretical amount of air is described by



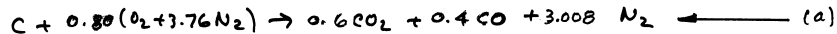
Thus, combustion with 80% theoretical air to produce CO_2 , CO , and N_2 is



$$\text{C: } 1 = a + b \Rightarrow b = 1 - a$$

$$\text{O: } (80)(2) = 2a + b \Rightarrow b = 2a + (1 - a) \Rightarrow a = 0.6, b = 0.4$$

Accordingly, the balanced reaction equation is



(b) The air fuel ratio is

$$\overline{\text{AF}} = 0.80(4.76)/1 = 3.808 \text{ kmol (air)/kmol (fuel)}$$

Then with Eq. 13-2

$$\text{AF} = \overline{\text{AF}} \left(\frac{M_{\text{air}}}{M_{\text{fuel}}} \right) = (3.808) \left(\frac{28.97}{12.01} \right) = 9.19 \frac{\text{kg (air)}}{\text{kg (fuel)}} \quad \leftarrow (b)$$

(c) The molar analysis of the products is

$$\% \text{CO}_2 = \left(\frac{0.6}{4.008} \right) (100) = 15\%, \quad \% \text{CO} = \frac{0.4}{4.008} = 10\%, \quad \% \text{N}_2 = 75\% \quad \leftarrow (c)$$

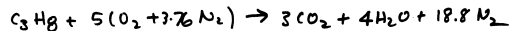
PROBLEM 13.25

KNOWN: C_3H_8 reacts with 80% of theoretical air yielding CO_2 , CO , H_2O and N_2 only.

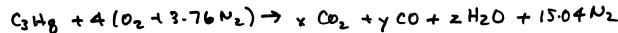
FIND: Determine (a) the balanced reaction equation, (b) AF, (c) the analysis of the products on a dry molar basis.

ASSUMPTIONS: 3.76 moles of N_2 accompany each mole of O_2 in the air, and N_2 is inert.

ANALYSIS: (a) Complete combustion of C_3H_8 with the theoretical amount of air is described by



Combustion with 80% of theoretical air is then

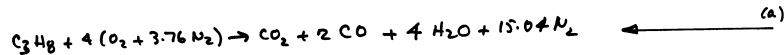


$$\text{C: } 3 = x + y \Rightarrow y = 3 - x$$

$$\text{H: } 8 = 2z \Rightarrow z = 4$$

$$\text{O: } 8 = 2x + y + 4 \Rightarrow 4 = 2x + (3 - x) \Rightarrow x = 1, y = 2$$

Accordingly



$$(b) \text{ AF} = \overline{\text{AF}} \left(\frac{M_{\text{air}}}{M_{\text{fuel}}} \right) = (4)(4.76) \left[\frac{28.97}{44.09} \right] = 12.51 \frac{\text{kg (air)}}{\text{kg (fuel)}} \quad \leftarrow (b)$$

(c)

The amount of dry products per mole of fuel is $n_{\text{dry}} = 1 + 2 + 15.04 = 18.04$. Thus, the analysis of the products on a dry basis is

$$y_{\text{CO}_2} = \frac{1}{18.04} = 0.0554 (5.54\%), \quad y_{\text{CO}} = \frac{2}{18.04} = 0.1109 (11.09\%), \quad y_{\text{N}_2} = \frac{15.04}{18.04} = 0.8337 (83.37\%)$$