**47.66 Decane ($C_{10}H_{22}$) undergoes complete, stoichiometric combustion in air. What is the mass fraction of carbon dioxide in the product gas?**

A. 13%

B. 19%

C. 49%

D. 69%

Decane is not listed in the table Combustion Reactions of Common Fuel Constituents. Therefore, it is necessary to write the balanced reaction. Since the combustion is stoichiometric, there is no excess air. Start by writing the products and reactants using arbitrary constant coefficients. For the reactants, there are 3.77 nitrogen molecules per oxygen molecule in air. The products are carbon dioxide, water vapor, and nitrogen. Nitrogen does not participate in the reaction.

$$C_{10}H_{22} + x\left(O_2 + 3.77N_2\right) \rightarrow aCO_2 + bH_2O + cN_2$$

Balance the carbon.

$$a = 10$$

Balance the hydrogen.

$$22 = 2b \rightarrow b = 11$$

Balance the oxygen.

$$2x = 2a + b = 2\left(10\right) + 11 = 31$$

$$x = \frac{31}{2} = 15.5$$

Balance the nitrogen.

$$2c = 2\left(3.77\right)x = 2\left(3.77\right)\left(15.5\right) = 116.87$$

$$c = \frac{116.87}{2} = 58.435$$

Re-write the product side of the reaction with all known coeffients.

$$Reactants \rightarrow 10CO_2 + 11H_2O + 58.435N_2$$

Determine the Mass Fraction of carbon dioxide in the product gas. Use the Periodic Table to look up atomic weights as required. The mass of each constiuent is the product of the number of moles and the molecular weight.

$$y_{CO_2} = \frac{m_{CO_2}}{\sum m_i} = \frac{m_{CO_2}}{m_{CO_2} + m_{H_2O} + m_{N_2}}$$

$$y_{CO_2} = \frac{(10)\left[12 + 2\,(16)\right]}{(10)\left[12 + 2\,(16)\right] + 11\left[2\,(1) + 16\right] + 58.435\left[2\,(14)\right]} = 0.19 = 19\%$$

**Answer B**

**47.67 A $1500cfm$ two-pipe fan coil unit with electric reheat maintains a room at $74°F$ and 50% relative humidity. The supply air from the unit is $58°F$. The cooling coil discharge condition is $48°F$ db / $46°F$ wb. There is $1°F$ of temperature rise across the fan. Neglecting losses, how much power is required to run the reheat coil?**

A. $4300W$

B. $4700W$

C. $5200W$

D. $5700W$

The electric reheat coil provides sensible heating only. Use the sensible heating rule of thumb for air.

$$\dot{Q}_{htg} = 1.08cfm\Delta T$$

The volume flow rate is given. Air enters the heating coil after leaving the cooling coil at a dry bulb temperature of $48°F$. Since the fan adds $1°F$ of temperature rise to achieve the $58°F$ supply air temperaure from the unit, the air leaving the reheat coil and entering the fan is $57°F$. Solve for the reheat load, and convert units to $W$.

$$\dot{Q}_{htg} = 1.08\,(1500)\,(57 - 48) = 14,580\frac{Btu}{hr}\left(\frac{1W}{3.412\frac{Btu}{hr}}\right) = 4273W$$

**Answer A**