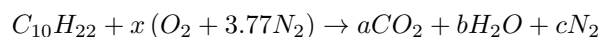


47.66 Decane ($C_{10}H_{22}$) undergoes complete, stoichiometric combustion in air. What is the mass fraction of carbon dioxide in the product gas?

- 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.



Balance the carbon.

$$a = 10$$

Balance the hydrogen.

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

Balance the oxygen.

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

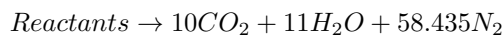
$$x = \frac{31}{2} = 15.5$$

Balance the nitrogen.

$$2c = 2(3.77)x = 2(3.77)(15.5) = 116.87$$

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

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



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 constituent is the product of the number of moles and the molecular weight.

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

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

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 temperature 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