Answer on the question #59815, Chemistry / Other

Question:

Calculate the number of pounds of CO2 released into the atmosphere when a 21.0-gallon tank of gasoline is burned in an automobile engine. Assume that gasoline is primarily octane, C8H18, and that the density of gasoline is 0.692 g·mL–1 (this assumption ignores additives). Also assume complete combustion.

Solution:

Reaction equation of gasoline with oxygen is:

$$2C_8H_{18} + 25O_2 = 16CO_2 + 18H_2O$$

Then, number of the moles of octane and CO_2 relate as:

$$n(C_8H_{18}) = \frac{n(CO_2)}{8}$$

To calculate the number of the moles of octane, we divide its mass by the molar mass:

$$n(C_8H_{18}) = \frac{m(C_8H_{18})}{M(C_8H_{18})}$$

$$m(C_8H_{18}) = V \cdot \rho = 4.55 \cdot 21\ (L) \cdot 0.692 \cdot 10^3 (g \cdot L^{-1}) = 6.612 \cdot 10^4 g$$

$$n(C_8H_{18}) = \frac{6.612 \cdot 10^4 g}{114.23\ g \cdot mol^{-1}} = 5.79 \cdot 10^2 mol$$

Then, mass of CO_2 is the product of its molar mass and number of the moles:

$$m(CO_2) = n(CO_2) \cdot M(CO_2) = 8 \cdot 5.79 \cdot 10^2\ (mol) \cdot 44.01 (g \cdot mol^{-1}) = 2.04 \cdot 10^5 g$$

$$m(CO_2) = 0.454 (lb \cdot kg^{-1}) \cdot 2.04 \cdot 10^2 (kg) = 92.5\ lb$$

Answer: 92.5 lb