(13 points) In 2012 the United States released 6,526 million metric tons of carbon dioxide. The atmosphere of the Earth has a known volume of 4.183×10^9 km^3.

[1 km = 1000 m, 1 m = 100 cm, 1 L = 1000 mL or cm^3, 1 metric ton = 1000 kg,
1 part per million = ppm = 0.00100 g/L, density of liquid octane is 0.692 g/mL]

A) How many years will it take for the United States to increase the CO_2 content of the entire atmosphere by one part per million? (5 pts)

B) If we just focus on the CO_2 being generated by U.S. automobiles combusting octane (C_8H_{18}), how many gallons of gas are required to raise the entire Earth's atmosphere by 1 part per million? (5 pts)

C) If the U.S. consumes 134.51 billion gallons of gas per year, how many years will it take to reach a 1 ppm CO_2 increase from octane combustion? (3 pts)

(13 points) In 2012 the United States released 6,526 million metric tons of carbon dioxide. The atmosphere of the Earth has a known volume of 4.183×10^9 km³.

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A) How many years will it take for the United States to increase the CO2 content of the entire atmosphere by one part per million? (5 pts)

$$4.183 \times 10^{9}\ \text{Km}^3 \times \frac{(1000\,\text{m})^3}{\text{Km}^3} \times \frac{(100\,\text{cm})^3}{\text{m}^3} \times \frac{1\,\text{L}}{1000\,\text{cm}^3} \times \frac{.00100\,\text{g}}{\text{L}} \times \frac{1\,\text{kg}}{1000\,\text{g}} \times \frac{\text{metric ton}}{1000\,\text{Kg}} \times \frac{1\,\text{YEAR}}{6{,}526{,}000{,}000\ \text{metric tons}} = 6.410 \times 10^{2}\ \text{years}$$

or 641.0 years

↗ 6.526×10^{9}

B) If we just focus on the CO2 being generated by U.S. automobiles combusting octane (C_8H_{18}), how many gallons of gas are required to raise the entire Earth's atmosphere by 1 part per million? (5 pts)

$$4.183 \times 10^{9}\ \text{Km}^3 \times \frac{(1000\,\text{m})^3}{1\,\text{Km}^3} \times \frac{(100\,\text{cm})^3}{\text{m}^3} \times \frac{1\,\text{L}}{1000\,\text{cm}^3} \times \frac{.00100\,\text{g}}{\text{L}} = 4.183 \times 10^{18}\ \text{g of } CO_2$$

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

$$4.183 \times 10^{18}\ \text{g}\ CO_2 \times \frac{1\,\text{mol}\ CO_2}{44.01\,\text{g}\ CO_2} \times \frac{2\,\text{mol}\ C_8H_{18}}{16\,\text{mol}\ CO_2} \times \frac{114.26\,\text{g}\ C_8H_{18}}{1\,\text{mol}\ C_8H_{18}} \times \frac{1\,\text{mL}}{0.692\,\text{g}} \times \frac{1\,\text{Liter}}{1000\,\text{mL}} \times \frac{1\,\text{gal}}{3.785\,\text{L}} = 5.18 \times 10^{14}\ \text{gallons}$$

C) If the U.S. consumes 134.51 billion gallons of gas per year, how many years will it take to reach a 1 ppm CO2 increase from octane combustion? (3 pts)

$$\frac{5.18 \times 10^{14}\ \text{gallons}}{134{,}510{,}000{,}000\ \text{gallons/year}} = 3.85 \times 10^{3}\ \text{years}$$

↑ 1.3451×10^{11}

or 3,850 years