Read the following statements carefully and indicate whether they are true or false. For partial credit (if your answers turn out to be wrong), summarize how exactly you arrived at your conclusions.

T (F) If the assumptions of P1.31 are used (200 million vehicles, 12,000 miles/yr/vehicle, 18 mpg, 5 lb C/gal), the 15% increase in vehicle efficiency results in the reduction of less than 150 million metric tons of CO₂/year.

Before: \( \frac{1 \text{ gal}}{18 \text{ mi}} \times \frac{5.8 \text{ lb} \text{ C}}{1000 \text{ mi}} \times \frac{12,000 \text{ mi}}{1 \text{ yr/vehicle}} \times \frac{200 \times 10^6 \text{ vehicles}}{10^6 \text{ vehicles}} = \frac{453 \text{ lb} \text{ C}}{18 \text{ lb} \text{ C}} \times \frac{10^8 \text{ C}}{12 \text{ lb} \text{ C}} = 1.1 \times 10^9 \)

After: \( \left( \frac{1}{18 \times 1.15} \right) \times \frac{453 \text{ lb} \text{ C}}{1.15 \times 10^9 \text{ lb} \text{ C}} \times \frac{10^8 \text{ C}}{12 \text{ lb} \text{ C}} = 9.7 \times 10^8 \text{ lb} \text{ C/yr} \)

\( \Rightarrow \text{Reduction} = 1.45 \times 10^8 \text{ lb} \text{ C/yr} \leq 1.50 \times 10^8 \text{ lb} \text{ C/yr} \)

T If the gas-phase mass transfer coefficient for CO₂ is 0.01 m/s, the droplet diameter is 1 mm and the liquid occupies 10% of the absorber volume, the resistance to mass transfer in the gas phase does not exceed 1.0 h m⁻³ Pa/mol.

\( R_g = 0.01 \text{ m/s} \); \( Q_D = 6/000 \text{ m}^3 \text{ mol}^{-1} \text{ s}^{-1} \Rightarrow R_g A = 21600 \frac{1}{h} \Rightarrow R_g = \frac{285 \text{ Pa m}^3}{\text{mol h}} \)

\( \Rightarrow R_g = 0.132 \text{ Pa m}^3/\text{mol} \)

F Based on the calculations carried out in HW5-3, the curve representing adsorber cost vs. pollutant removal efficiency is convex downward (i.e., characterized by a decreasing slope).

\( \Rightarrow \text{increasing slope! (Convex upward)} \)

F If a power plant uses two PM removal devices whose efficiencies are 50% and 90%, their arrangement in series results in less than 20% overall efficiency improvement with respect to a parallel arrangement in which 70% of the exhaust gas is directed to the more efficient device.

\( E_{\text{series}} = (1 - (0.5) (0.9)) = 0.45 \)

\( E_{\text{parallel}} = [(1 - (0.5)(0.3)) - (1 - 0.9)(0.7)] = 0.78 \)

\( \frac{E_s}{E_p} = \frac{0.45}{0.78} = 0.58 > 1.20 \)

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