14. (LCRM 3D46) A gaseous feed of pure A at \(9 \text{ mole/min} \) and \(500 \text{ mmole/liter} \) is to be 66.7% converted in a PFR. The kinetics of the reaction can be represented by

\[
A \rightarrow 2P; \quad -r_A = \frac{0.6}{\text{min}} C_A
\]

Find the size of the reactor needed to effect the conversion.

**Answer**

\[
\delta = \frac{1}{2} - 1; \quad C_{A0} = 0.5 \text{ mole/liter}; \quad \gamma_{A0} = 1.0; \quad \epsilon = \gamma_{A0} \delta; \\
X_f = 0.667; \quad F_{A0} = 9 \text{ mole/min}; \quad k = \frac{0.6}{\text{min}}; \quad r_A[x_\text{up}] = k C_{A0} \frac{1 - x}{1 + \epsilon x}; \\
V = \text{Chop}\left[F_{A0} \int_0^{X_f} \frac{1}{r_A[X]} \, dX\right]; \quad \text{Print}[\text{NumberForm}[V, 3]]
\]

46. liter

15. (LCRM 3D47) A gaseous feed of pure A (2 \(\text{ mole/liter} \), 100 \(\text{ mole/min} \)) decomposes to give a variety of products in a PFR. The kinetics of the conversion are represented by

\[
A \rightarrow 2.5(\text{products}); \quad -r_A = \frac{10}{\text{min}} C_A
\]

Find the volume of the reactor needed for a 80% decomposition of reactant A.

**Answer**

\[
C_{A0} = 2.0 \text{ mole/liter}; \quad F_{A0} = 100 \text{ mole/min}; \quad X_f = 0.8; \quad \delta = \frac{2.5}{1} - 1; \quad \gamma_{A0} = 1; \quad \epsilon = \gamma_{A0} \delta; \quad k = \frac{10.0}{\text{min}}; \\
r_A[x_\text{up}] = k C_{A0} \frac{1 - x}{1 + \epsilon x}; \\
V = \text{Chop}\left[F_{A0} \int_0^{X_f} \frac{1}{r_A[X]} \, dX\right]; \quad \text{Print}[\text{NumberForm}[V, 3]]
\]

14.1 liter