

14.16 For a poly(acrylonitrile-butadiene) alternating copolymer with a number-average molecular weight of 1,000,000 g/mol, we are asked to determine the average number of acrylonitrile and butadiene repeat units per molecule.

Since it is an alternating copolymer, the number of both types of repeat units will be the same. Therefore, consider them as a single repeat unit, and determine the number-average degree of polymerization. For the acrylonitrile repeat unit, there are three carbon atoms, three hydrogen atoms, and one nitrogen atom, while the butadiene repeat consists of four carbon atoms and six hydrogen atoms. Therefore, the acrylonitrile-butadiene combined repeat unit weight is just

$$\begin{aligned} m &= 7(A_C) + 9(A_H) + 1(A_N) \\ &= (7)(12.01 \text{ g/mol}) + (9)(1.008 \text{ g/mol}) + (14.01 \text{ g/mol}) = 107.15 \text{ g/mol} \end{aligned}$$

From Equation 14.6, the degree of polymerization is just

$$DP = \frac{\bar{M}_n}{m} = \frac{1,000,000 \text{ g/mol}}{107.15 \text{ g/mol}} = 9333$$

Thus, there is an average of 9333 of both repeat unit types per molecule.