14.21 For a random poly(styrene-butadiene) copolymer in which $\overline{M}_n$ = 350,000 g/mol and DP = 5000, we are asked to compute the fractions of styrene and butadiene repeat units.

From Table 14.5, the styrene repeat unit has eight carbon and eight hydrogen atoms. Thus,

$$m_{st} = (8)(12.01 \text{ g/mol}) + (8)(1.008 \text{ g/mol}) = 104.14 \text{ g/mol}$$

Also, from Table 14.5, the butadiene repeat unit has four carbon and six hydrogen atoms, and

$$m_{bu} = (4)(12.01 \text{ g/mol}) + (6)(1.008 \text{ g/mol}) = 54.09 \text{ g/mol}$$

From Equation 14.7

$$\overline{m} = f_{st} m_{st} + f_{bu} m_{bu}$$

Now, let $x = f_{st}$, such that

$$\overline{m} = 104.14x + (54.09)(1 - x)$$

since $f_{st} + f_{bu} = 1$. Also, from Equation 14.6

$$DP = \frac{\overline{M}_n}{\overline{m}}$$

Or

$$5000 = \frac{350{,}000 \text{ g/mol}}{[104.14\,x + 54.09(1 - x)] \text{ g/mol}}$$

Solving for x leads to $x = f_{st} = f$(styrene) = 0.32. Also,

$$f\text{(butadiene)} = 1 - x = 1 - 0.32 = 0.68$$