

14.18 For an alternating copolymer that has a number-average molecular weight of 100,000 g/mol and a degree of polymerization of 2210, we are to determine one of the repeat unit types if the other type is ethylene. It is first necessary to calculate  $\bar{m}$  using Equation 14.6 as

$$\bar{m} = \frac{\bar{M}_n}{DP} = \frac{100,000 \text{ g/mol}}{2210} = 45.25 \text{ g/mol}$$

Since this is an alternating copolymer we know that chain fraction of each repeat unit type is 0.5; that is  $f_e = f_x = 0.5$ ,  $f_e$  and  $f_x$  being, respectively, the chain fractions of the ethylene and unknown repeat units. Also, the repeat unit molecular weight for ethylene is

$$m_s = 2(A_C) + 4(A_H)$$

$$= 2(12.01 \text{ g/mol}) + 4(1.008 \text{ g/mol}) = 28.05 \text{ g/mol}$$

Now, using Equation 14.7, it is possible to calculate the repeat unit weight of the unknown repeat unit type,  $m_x$ .

Thus

$$m_x = \frac{\bar{m} - f_e m_e}{f_x}$$

$$= \frac{45.25 \text{ g/mol} - (0.5)(28.05 \text{ g/mol})}{0.5} = 62.45 \text{ g/mol}$$

Finally, it is necessary to calculate the repeat unit molecular weights for each of the possible other repeat unit types. These are calculated below:

$$m_{\text{styrene}} = 8(A_C) + 8(A_H) = 8(12.01 \text{ g/mol}) + 8(1.008 \text{ g/mol}) = 104.16 \text{ g/mol}$$

$$m_{\text{propylene}} = 3(A_C) + 6(A_H) = 3(12.01 \text{ g/mol}) + 6(1.008 \text{ g/mol}) = 42.08 \text{ g/mol}$$

$$m_{\text{TFE}} = 2(A_C) + 4(A_F) = 2(12.01 \text{ g/mol}) + 4(19.00 \text{ g/mol}) = 100.02 \text{ g/mol}$$

$$m_{\text{VC}} = 2(A_C) + 3(A_H) + (A_{\text{Cl}}) = 2(12.01 \text{ g/mol}) + 3(1.008 \text{ g/mol}) + 35.45 \text{ g/mol} = 62.49 \text{ g/mol}$$

Therefore, vinyl chloride is the other repeat unit type since its  $m$  value is almost the same as the calculated  $m_x$ .