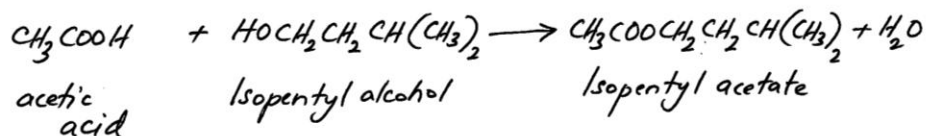


Example 2



85.0g acetic acid react with 45.0g of isopentyl alcohol to produce 46.51g of isopentyl acetate. What are the theoretical and percentage yields?

Solution

It is a limiting-reactant problem since amounts of the two reactants are given.

$$n_{\text{acid}} = \left(\frac{85}{60}\right) \text{mols} = 1.416 \text{ mols}$$

$$n_{\text{alcohol}} = \left(\frac{45}{88}\right) \text{mols} = 0.511 \text{ mols}$$

$$\left\| \begin{array}{l} M_r(\text{acetic acid}) = 60 \text{ g mol}^{-1} \\ M_r(\text{alcohol}) = 88 \text{ g mol}^{-1} \\ M_r(\text{acetate}) = 130 \text{ g mol}^{-1} \end{array} \right.$$

ratio of the reactants :

$$r_{\text{theoretical}} = \frac{n_{\text{acid}}}{n_{\text{alcohol}}} = \frac{1}{1} = 1.00 \quad \leftarrow \text{from the balanced equation.}$$

$$r_{\text{experimental}} = \frac{n_{\text{acid}}}{n_{\text{alcohol}}} = \left(\frac{1.416}{0.511}\right) = 2.77$$

$$r_{\text{experimental}} > r_{\text{theoretical}}$$

(2.77) (1.00)

This is due to the numerator is large (acid is in excess), whereas the denominator is small (alcohol is the limiting reagent)

$$n_{\text{acetate}} \equiv n_{\text{alcohol}} = 0.511 \text{ mols}$$

$$\therefore M_{\text{acetate}} = (0.511 \times 130 \text{ g mol}^{-1}) = 66.43 \text{ g}$$

$$\therefore \text{theoretical yield} = 66.43 \text{ g}$$

$$\% \text{ yield} = \frac{\text{acetate produced}}{\text{acetate calculated}} \times 100 = \left(\frac{46.51}{66.43} \times 100\right) = 70.0 \text{ (Ans)}$$