

## Answer on Question #82092, Chemistry / General Chemistry

1. A 20.00 mL aqueous solution of ethanol (20.00% v/v) has 12.00 g of 3-methylbutanoic acid added to it. How much ethyl-3-methylbutanoate would theoretically be produced. Ethanol's density is 0.7893 g/mL.

### Solution:

Volume of ethanol on solution = 4mL (20% from 20mL).

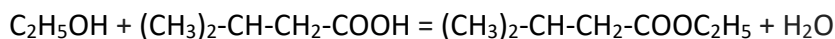
Mass of ethanol:

$$\text{mass} = \text{density} \times \text{volume}$$

$$m = \rho \times V$$

$$m (\text{ethanol}) = 4\text{mL} \times 0.7893 \text{ g/mL} = 3.16 \text{ g.}$$

Reaction:



$$n = \frac{m}{M}$$

$$M (\text{C}_2\text{H}_5\text{OH}) = 46 \text{ g/mol}$$

$$M ((\text{CH}_3)_2\text{-CH-CH}_2\text{-COOH}) = 102 \text{ g/mol}$$

$$n (\text{Ethanol}) = \frac{3.16 \text{ g}}{46 \text{ g/mol}} = 0.068 \text{ mol} - \text{limiting reactant}$$

$$n (3\text{-methylbutanoic acid}) = \frac{12 \text{ g}}{102 \text{ g/mol}} = 0.117 \text{ mol} - \text{excess}$$

Calculate mass of ethyl-3-methylbutanoate:

$$n (\text{Ethanol}) = n (\text{ethyl-3-methylbutanoate}) = 0.068 \text{ mol}$$

$$M ((\text{CH}_3)_2\text{-CH-CH}_2\text{-COOC}_2\text{H}_5) = 130 \text{ g/mol}$$

$$m = n \times M$$

$$m = 0.068 \text{ mol} \times 130 \text{ g/mol} = 8.84 \text{ g.}$$

**Answer:** theoretically can be produced 8.84 g. of ethyl-3-methylbutanoate.