

## Yield and Atom Efficiency/Atom Economy : 8<sup>th</sup> December 2018

(This is a blog for First Year students who are just starting to do calculations for 'A' Level chemistry.)

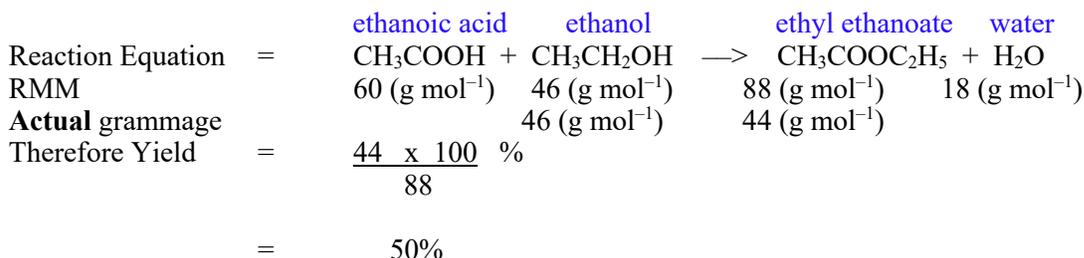
### YIELD

- Students are required to know how to calculate the **yield** of reactions, and there are many different reasons why the **Actual** output of a particular reaction may not be the same as its **Theoretical** output.
- Yield is a measure of how **successful** a process may be.

$$\text{Yield} = \frac{\text{Actual Output}}{\text{Theoretical Output}} \times 100 \%$$

If we obtain 44 g mol<sup>-1</sup> out of a theoretical output of 88 g mol<sup>-1</sup>, then the yield would be 50%.

- Calculating the "Yield" of a particular experiment is very easy and it is best shown by doing the calculation involved. Let us look at a sample question, and please remember to start always with the appropriate reaction equation (**otherwise you will arrive at an incorrect answer**) e.g. "Only 44g of Ethyl Ethanoate were obtained by reacting 1 mole of CH<sub>3</sub>COOH (ethanoic acid) with 1 mole of CH<sub>3</sub>CH<sub>2</sub>OH (ethanol) in the presence of conc. Sulphuric Acid. What was the Yield?" (*The reaction below takes place in the presence of concentrated Sulphuric Acid.*)



### ATOM ECONOMY/EFFICIENCY

- AE is a measure of **how wasteful or how fruitful** a process may be. Here we have used 106 g mol<sup>-1</sup> to obtain 44 g mol<sup>-1</sup>. The AE is 41.5%, viz. we used 58.5% of the materials consumed *without obtaining what we wanted*. **58.5% was used unproductively. That is a rather wasteful/inefficient process!**

$$\text{Atom Economy} = \frac{\text{Actual Output}}{\text{Total Mass of the Reactants}} \times 100 \%$$
$$= \left( \frac{44}{106} \times 100 \right) \% = 41.5 \%$$

NB The Conservation of Mass Law requires that the total mass of the reactants = the total mass of the products.<sup>1</sup>

<sup>1</sup> At 'A' Level we do not worry about the conversion of mass into energy (Einstein's famous E = m.c<sup>2</sup>).