

Solutions

2.1 Any two of: reversible reaction does not go to completion; product lost on separation from the mixture; reactants react in unwanted/side reactions.

2.2 $20 \div 25 \times 100 = 80 \%$.

2.3 Fewer raw materials are wasted and less needs disposing of – sustainable and cheaper.

3.1 $8.4 \div 12.0 \times 100 = 70 \%$. Reasons: the reaction may be reversible and stop before completion; some product is lost when separated/filtered/purified; some reactants may react differently in side reactions.

3.2 $\text{Mr}(\text{CH}_4) = 16$, $\text{Mr}(\text{H}_2\text{O}) = 18 \rightarrow$ reactants total 34; Mr of desired product = $3 \times 2 = 6$ for the hydrogen; atom economy = $6 \div 34 \times 100 = 17.6 \% \approx 18 \%$.

3.3 Percentage yield compares what was actually made with what could theoretically be made from the reactant used – an experimental measure. Atom economy compares the Mr of the desired product with the total Mr of all reactants from the equation – a property of the reaction itself. A reaction can run at 100 % yield yet low atom economy if by-products form as the only other outcome.