

(d) Calculate the relative formula mass of lactic acid.

The equation used to calculate the number of moles in a given mass of a sample is:

$$\text{Number of moles} = \frac{\text{mass}}{\text{molar mass}}$$

(e) Calculate the number of moles in 20 g of lactic acid.

2. Starch can be broken down to produce the simple sugar maltose by enzymes in the mouth and small intestine. The chemical formula of maltose is $\text{C}_{12}\text{H}_{22}\text{O}_{11}$.

(a) Calculate the relative formula mass of maltose.

$$A_r \text{ carbon} = 12 \quad A_r \text{ hydrogen} = 1 \quad A_r \text{ oxygen} = 16$$

The percentage of an element present in a compound can be determined using the equation:

$$\text{Percentage of element in compound (\%)} = \frac{\text{relative atomic mass of element}}{\text{relative formula mass of compound}} \times 100$$

(b) Use your answer to **part (a)**, along with the equation above, to calculate the percentage of carbon in maltose.

3. Scientists use a measure known as atom economy to assess the efficiency of an industrial process by comparing the relative formula masses of the reactants and products for the reactions used.

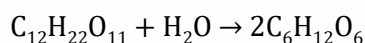
The atom economy of any chemical reaction can be calculated using the equation:

$$\text{Atom economy \%} = \frac{\text{total formula mass of the useful product}}{\text{total formula mass of all reactants}} \times 100$$

- (a) Define atom economy.

Maltose can be broken down, using water and an enzyme called maltase, to make glucose.

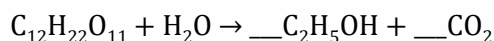
The chemical equation for this reaction is:



- (b) State the atom economy of this reaction and explain your answer.

Maltose can also be used in a process called fermentation where the maltose reacts with water to produce ethanol, $\text{C}_2\text{H}_5\text{OH}$, and carbon dioxide gas. The ethanol produced can be used as a biofuel to power vehicles such as cars and buses.

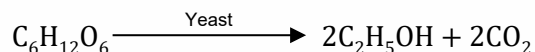
- (c) Complete the balanced chemical equation to represent this reaction.



- (d) Use your answer to **part (c)**, and the equation on the previous page, to calculate the atom economy for the production of ethanol using maltose and water.

Hint: Make sure you pay attention to the number of ethanol molecules produced in the balanced equation.

Ethanol can also be produced through the fermentation of glucose using yeast as shown in the equation:



(e) Calculate the atom economy for this process.

(f) Use your answers to **parts (d)** and **(e)** to compare the two methods of ethanol production and suggest which of the two may be preferred for the large-scale production of ethanol in industry.



Which question(s) did you get wrong? Why?

What will you do next time you're asked a similar question?