

## Relative mass

These **In context worksheets** ask learners to use their knowledge of relative mass in an applied context, building their confidence and capability to face exam questions. Calculation questions give opportunities to practise mathematical skills within this topic. The worksheets are available at Foundation and Higher level and as fully editable versions, giving you the flexibility to select the questions most relevant to a particular lesson.

Also available to assess this topic:

- **Review my learning worksheets:** available with three levels of scaffolded support to help build confidence in every learner. Use before, during or after teaching the relevant topic, to understand progress and identify misconceptions, [rsc.li/44igB7V](https://www.rsc.li/44igB7V).
- **Knowledge check worksheets:** select from Foundation and Higher level to assess learners' knowledge and understanding at the end of a period of teaching or as revision, [rsc.li/4uSvyue](https://www.rsc.li/4uSvyue).

## Answers

### Foundation

1.

(a) Relative formula mass of glucose:  $(12 \times 6) + (12 \times 1) + (6 \times 16) = 72 + 12 + 96 = 180$  (g/mol)

(b) glucose + oxygen  $\rightarrow$  carbon dioxide + water

(c) **D**  $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

(d)  $C_3H_6O_3$

(e) Relative formula mass of lactic acid:  $(3 \times 12) + (6 \times 1) + 16 = 36 + 6 + 48 = 90$  (g/mol)

2.

(a) Relative formula mass of maltose:  $(12 \times 12) + (22 \times 1) + (11 \times 16) = 144 + 22 + 176 = 342$  (g/mol)

(b) Percentage of carbon in maltose (%) =  $\frac{\text{relative atomic mass of carbon}}{\text{relative formula mass of maltose}} \times 100$

$$\text{Percentage of carbon in maltose (\%)} = \frac{144}{342} \times 100 = 42.1 \%$$

3.

(a) **C** Atom economy is a measure of the amount of the reactants used to produce the useful product.

(b) The atom economy for this reaction is **100%**. This is because **all** of the atoms of the reactants are used to make the **useful** product and there is no **waste** product.

$$(c) \text{ Formula mass of } C_{12}H_{22}O_{11} = (12 \times 12) + (22 \times 1) + (11 \times 16) = 144 + 22 + 176 = 342 \text{ (g/mol)}$$

$$\text{Formula mass of } H_2O = (2 \times 1) + 16 = 18$$

$$\text{Total formula mass of all reactants} = 342 + 18 = 360$$

$$\text{Formula mass of ethanol} = (12 \times 2) + 5 + 16 + 1 = 46$$

$$\text{Total mass of desired product} = 4 \times 46 = 184$$

$$\text{Atom economy \%} = \frac{184}{360} \times 100$$

$$\text{Atom economy} = 51.1\%$$

$$(d) \text{ Total formula mass of } C_6H_{12}O_6 = (6 \times 12) + (12 \times 1) + (6 \times 16) = 180 \text{ (g/mol)}$$

$$\text{Formula mass of ethanol} = (12 \times 2) + 5 + 16 + 1 = 46$$

$$\text{Total formula mass of desired product} = 2 \times 32 = 64$$

$$\text{Atom economy \%} = \frac{64}{180} \times 100$$

$$\text{Atom economy} = 51.1\%$$

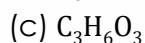
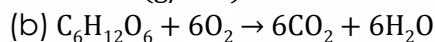
(e) Both methods have the same atom economy, meaning that both methods are equally efficient at producing the desired product.

However, the method using maltose also needs water and produces a higher amount of carbon dioxide gas. Carbon dioxide is a problem because it contributes to global warming and climate change.

## Higher

### 1.

$$(a) \text{ Relative formula mass of glucose: } (12 \times 6) + (12 \times 1) + (6 \times 16) = 72 + 12 + 96 = 180 \text{ (g/mol)}$$



$$(d) \text{ Relative formula mass of lactic acid: } (3 \times 12) + (6 \times 1) + (3 \times 16) = 36 + 6 + 48 = 90 \text{ (g/mol)}$$

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

$$\text{Number of moles} = \frac{20}{90} = 0.2 \text{ mols}$$

### 2.

$$(a) \text{ Relative formula mass of maltose: } (12 \times 12) + (22 \times 1) + (11 \times 16) = 144 + 22 + 176 = 342 \text{ (g/mol)}$$

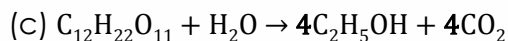
$$(b) \text{ Percentage of carbon in maltose (\%)} = \frac{\text{relative atomic mass of carbon}}{\text{relative formula mass of maltose}} \times 100$$

$$\text{Percentage of carbon in maltose (\%)} = \frac{144}{342} \times 100 = 42.1 \%$$

3.

(a) Atom economy provides a measure of the amount of the reactants used to produce the useful product.

(b) The atom economy for this reaction is 100%. This is because all of the atoms of the reactants are used to make the useful product and there is no waste product.



(d) Formula mass of  $C_{12}H_{22}O_{11} = (12 \times 12) + (22 \times 1) + (11 \times 16) = 144 + 22 + 176 = 342$  (g/mol)

Formula mass of  $H_2O = (2 \times 1) + 16 = 18$

Total formula mass of all reactants =  $342 + 18 = 360$

Formula mass of ethanol =  $(2 \times 12) + 5 + 16 + 1 = 46$

Total mass of desired product =  $4 \times 46 = 184$

$$\text{Atom economy \%} = \frac{184}{360} \times 100$$

$$\text{Atom economy} = 51.1\%$$

(e) Total formula mass of  $C_6H_{12}O_6 = (6 \times 12) + (12 \times 1) + (6 \times 16) = 180$  (g/mol)

Formula mass of ethanol =  $(2 \times 12) + 5 + 16 + 1 = 46$

Total formula mass of desired product =  $2 \times 46 = 92$

$$\text{Atom economy \%} = \frac{92}{180} \times 100$$

$$\text{Atom economy} = 51.1\%$$

(f) Both methods have the same atom economy, meaning that both methods are equally efficient at producing the desired product.

However, the method using maltose also needs water and produces a higher amount of carbon dioxide gas. Carbon dioxide is a problem because it contributes to global warming and climate change. Therefore, the use of glucose may be the most environmentally friendly and preferred method to produce ethanol on a large scale.