

# Percentage Yield — Worksheet

**Relative atomic masses (Ar) to use:**

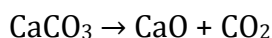
H=1, C=12, O=16, N=14, Na=23, Cl=35.5, Ca=40, Mg=24, S=32, Al=27, K=39, P=31, Fe=56

For each question:

- The balanced equation is shown.
- The named reactant is the limiting reagent; other reagents are in excess.
- Use the mass of the limiting reagent and the actual mass of the desired product to calculate the percentage yield to 1 decimal place.

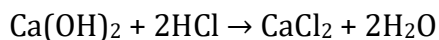
## Question 1

A reaction is carried out to make CaO. The balanced equation is given below. You start with 20.8 g of CaCO<sub>3</sub> (the limiting reagent), and obtain 8.3 g of CaO. Calculate the percentage yield of CaO to 1 decimal place.



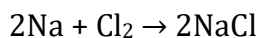
## Question 2

A reaction is carried out to make CaCl<sub>2</sub>. The balanced equation is given below. You start with 29.4 g of Ca(OH)<sub>2</sub> (the limiting reagent), and obtain 37.8 g of CaCl<sub>2</sub>. Calculate the percentage yield of CaCl<sub>2</sub> to 1 decimal place.



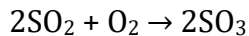
## Question 3

A reaction is carried out to make NaCl. The balanced equation is given below. You start with 22.9 g of Na (the limiting reagent), and obtain 39.1 g of NaCl. Calculate the percentage yield of NaCl to 1 decimal place.



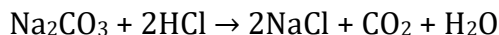
## Question 4

A reaction is carried out to make SO<sub>3</sub>. The balanced equation is given below. You start with 17.2 g of SO<sub>2</sub> (the limiting reagent), and obtain 14.6 g of SO<sub>3</sub>. Calculate the percentage yield of SO<sub>3</sub> to 1 decimal place.



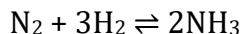
### Question 5

A reaction is carried out to make NaCl. The balanced equation is given below. You start with 8.5 g of Na<sub>2</sub>CO<sub>3</sub> (the limiting reagent), and obtain 8.1 g of NaCl. Calculate the percentage yield of NaCl to 1 decimal place.



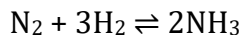
### Question 6

A reaction is carried out to make NH<sub>3</sub>. The balanced equation is given below. You start with 27.5 g of N<sub>2</sub> (the limiting reagent), and obtain 23.2 g of NH<sub>3</sub>. Calculate the percentage yield of NH<sub>3</sub> to 1 decimal place.



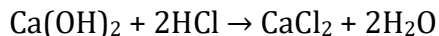
### Question 7

A reaction is carried out to make NH<sub>3</sub>. The balanced equation is given below. You start with 13.5 g of N<sub>2</sub> (the limiting reagent), and obtain 12.3 g of NH<sub>3</sub>. Calculate the percentage yield of NH<sub>3</sub> to 1 decimal place.



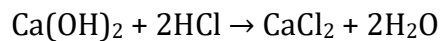
### Question 8

A reaction is carried out to make CaCl<sub>2</sub>. The balanced equation is given below. You start with 38.2 g of Ca(OH)<sub>2</sub> (the limiting reagent), and obtain 49.0 g of CaCl<sub>2</sub>. Calculate the percentage yield of CaCl<sub>2</sub> to 1 decimal place.

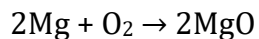


### Question 9

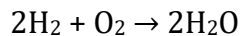
A reaction is carried out to make CaCl<sub>2</sub>. The balanced equation is given below. You start with 16.5 g of Ca(OH)<sub>2</sub> (the limiting reagent), and obtain 17.6 g of CaCl<sub>2</sub>. Calculate the percentage yield of CaCl<sub>2</sub> to 1 decimal place.

**Question 10**

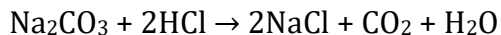
A reaction is carried out to make MgO. The balanced equation is given below. You start with 26.0 g of Mg (the limiting reagent), and obtain 30.5 g of MgO. Calculate the percentage yield of MgO to 1 decimal place.

**Question 11**

A reaction is carried out to make H<sub>2</sub>O. The balanced equation is given below. You start with 29.7 g of H<sub>2</sub> (the limiting reagent), and obtain 218.7 g of H<sub>2</sub>O. Calculate the percentage yield of H<sub>2</sub>O to 1 decimal place.

**Question 12**

A reaction is carried out to make NaCl. The balanced equation is given below. You start with 9.4 g of Na<sub>2</sub>CO<sub>3</sub> (the limiting reagent), and obtain 7.1 g of NaCl. Calculate the percentage yield of NaCl to 1 decimal place.

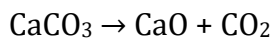


## Percentage Yield — Answers & Worked Solutions

Relative atomic masses (Ar) to use:

H=1, C=12, O=16, N=14, Na=23, Cl=35.5, Ca=40, Mg=24, S=32, Al=27, K=39, P=31, Fe=56

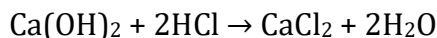
### Question 1



**Working:**

- 1) Moles of  $\text{CaCO}_3 = \text{mass} \div \text{Mr} = 20.8 \div 100.0 = 0.21 \text{ mol}$
- 2) Stoichiometric ratio  $\text{CaCO}_3 \rightarrow \text{CaO} = 1:1 \Rightarrow \text{moles of CaO (theoretical)} = 0.21 \times (1/1) = 0.21 \text{ mol}$
- 3) Theoretical mass of  $\text{CaO} = \text{moles} \times \text{Mr} = 0.21 \times 56.0 = 11.6 \text{ g}$
- 4) % yield =  $(\text{actual} \div \text{theoretical}) \times 100 = (8.3 \div 11.6) \times 100 = 71.2\%$

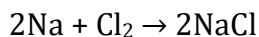
### Question 2



**Working:**

- 1) Moles of  $\text{Ca(OH)}_2 = \text{mass} \div \text{Mr} = 29.4 \div 74.0 = 0.40 \text{ mol}$
- 2) Stoichiometric ratio  $\text{Ca(OH)}_2 \rightarrow \text{CaCl}_2 = 1:1 \Rightarrow \text{moles of CaCl}_2 \text{ (theoretical)} = 0.40 \times (1/1) = 0.40 \text{ mol}$
- 3) Theoretical mass of  $\text{CaCl}_2 = \text{moles} \times \text{Mr} = 0.40 \times 111.0 = 44.1 \text{ g}$
- 4) % yield =  $(\text{actual} \div \text{theoretical}) \times 100 = (37.8 \div 44.1) \times 100 = 85.7\%$

### Question 3



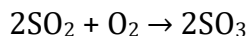
**Working:**

- 1) Moles of  $\text{Na} = \text{mass} \div \text{Mr} = 22.9 \div 23.0 = 1.00 \text{ mol}$
- 2) Stoichiometric ratio  $\text{Na} \rightarrow \text{NaCl} = 2:2 \Rightarrow \text{moles of NaCl (theoretical)} = 1.00 \times (2/2) = 1.00 \text{ mol}$

3) Theoretical mass of NaCl = moles  $\times$  Mr = 1.00  $\times$  58.5 = 58.2 g

4) % yield = (actual  $\div$  theoretical)  $\times$  100 = (39.1  $\div$  58.2)  $\times$  100 = 67.1%

#### Question 4



##### Working:

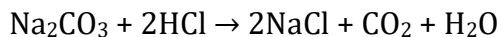
1) Moles of SO<sub>2</sub> = mass  $\div$  Mr = 17.2  $\div$  64.0 = 0.27 mol

2) Stoichiometric ratio SO<sub>2</sub>  $\rightarrow$  SO<sub>3</sub> = 2:2  $\Rightarrow$  moles of SO<sub>3</sub> (theoretical) = 0.27  $\times$  (2/2) = 0.27 mol

3) Theoretical mass of SO<sub>3</sub> = moles  $\times$  Mr = 0.27  $\times$  80.0 = 21.5 g

4) % yield = (actual  $\div$  theoretical)  $\times$  100 = (14.6  $\div$  21.5)  $\times$  100 = 67.8%

#### Question 5



##### Working:

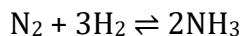
1) Moles of Na<sub>2</sub>CO<sub>3</sub> = mass  $\div$  Mr = 8.5  $\div$  106.0 = 0.08 mol

2) Stoichiometric ratio Na<sub>2</sub>CO<sub>3</sub>  $\rightarrow$  NaCl = 1:2  $\Rightarrow$  moles of NaCl (theoretical) = 0.08  $\times$  (2/1) = 0.16 mol

3) Theoretical mass of NaCl = moles  $\times$  Mr = 0.16  $\times$  58.5 = 9.4 g

4) % yield = (actual  $\div$  theoretical)  $\times$  100 = (8.1  $\div$  9.4)  $\times$  100 = 86.2%

#### Question 6



##### Working:

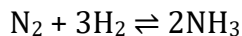
1) Moles of N<sub>2</sub> = mass  $\div$  Mr = 27.5  $\div$  28.0 = 0.98 mol

2) Stoichiometric ratio N<sub>2</sub>  $\rightarrow$  NH<sub>3</sub> = 1:2  $\Rightarrow$  moles of NH<sub>3</sub> (theoretical) = 0.98  $\times$  (2/1) = 1.96 mol

3) Theoretical mass of NH<sub>3</sub> = moles  $\times$  Mr = 1.96  $\times$  17.0 = 33.4 g

$$4) \% \text{ yield} = (\text{actual} \div \text{theoretical}) \times 100 = (23.2 \div 33.4) \times 100 = 69.5\%$$

### Question 7



#### Working:

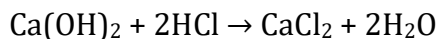
$$1) \text{ Moles of N}_2 = \text{mass} \div \text{Mr} = 13.5 \div 28.0 = 0.48 \text{ mol}$$

$$2) \text{ Stoichiometric ratio N}_2 \rightarrow \text{NH}_3 = 1:2 \Rightarrow \text{moles of NH}_3 \text{ (theoretical)} = 0.48 \times (2/1) = 0.96 \text{ mol}$$

$$3) \text{ Theoretical mass of NH}_3 = \text{moles} \times \text{Mr} = 0.96 \times 17.0 = 16.4 \text{ g}$$

$$4) \% \text{ yield} = (\text{actual} \div \text{theoretical}) \times 100 = (12.3 \div 16.4) \times 100 = 75.2\%$$

### Question 8



#### Working:

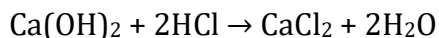
$$1) \text{ Moles of Ca(OH)}_2 = \text{mass} \div \text{Mr} = 38.2 \div 74.0 = 0.52 \text{ mol}$$

$$2) \text{ Stoichiometric ratio Ca(OH)}_2 \rightarrow \text{CaCl}_2 = 1:1 \Rightarrow \text{moles of CaCl}_2 \text{ (theoretical)} = 0.52 \times (1/1) = 0.52 \text{ mol}$$

$$3) \text{ Theoretical mass of CaCl}_2 = \text{moles} \times \text{Mr} = 0.52 \times 111.0 = 57.3 \text{ g}$$

$$4) \% \text{ yield} = (\text{actual} \div \text{theoretical}) \times 100 = (49.0 \div 57.3) \times 100 = 85.5\%$$

### Question 9



#### Working:

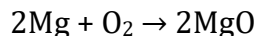
$$1) \text{ Moles of Ca(OH)}_2 = \text{mass} \div \text{Mr} = 16.5 \div 74.0 = 0.22 \text{ mol}$$

$$2) \text{ Stoichiometric ratio Ca(OH)}_2 \rightarrow \text{CaCl}_2 = 1:1 \Rightarrow \text{moles of CaCl}_2 \text{ (theoretical)} = 0.22 \times (1/1) = 0.22 \text{ mol}$$

$$3) \text{ Theoretical mass of CaCl}_2 = \text{moles} \times \text{Mr} = 0.22 \times 111.0 = 24.8 \text{ g}$$

$$4) \% \text{ yield} = (\text{actual} \div \text{theoretical}) \times 100 = (17.6 \div 24.8) \times 100 = 71.1\%$$

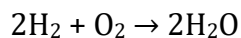
### Question 10



#### Working:

- 1) Moles of Mg = mass  $\div$  Mr =  $26.0 \div 24.0 = 1.08$  mol
- 2) Stoichiometric ratio Mg  $\rightarrow$  MgO = 2:2  $\Rightarrow$  moles of MgO (theoretical) =  $1.08 \times (2/2) = 1.08$  mol
- 3) Theoretical mass of MgO = moles  $\times$  Mr =  $1.08 \times 40.0 = 43.3$  g
- 4) % yield = (actual  $\div$  theoretical)  $\times$  100 =  $(30.5 \div 43.3) \times 100 = 70.4\%$

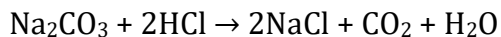
### Question 11



#### Working:

- 1) Moles of H<sub>2</sub> = mass  $\div$  Mr =  $29.7 \div 2.0 = 14.85$  mol
- 2) Stoichiometric ratio H<sub>2</sub>  $\rightarrow$  H<sub>2</sub>O = 2:2  $\Rightarrow$  moles of H<sub>2</sub>O (theoretical) =  $14.85 \times (2/2) = 14.85$  mol
- 3) Theoretical mass of H<sub>2</sub>O = moles  $\times$  Mr =  $14.85 \times 18.0 = 267.3$  g
- 4) % yield = (actual  $\div$  theoretical)  $\times$  100 =  $(218.7 \div 267.3) \times 100 = 81.8\%$

### Question 12



#### Working:

- 1) Moles of Na<sub>2</sub>CO<sub>3</sub> = mass  $\div$  Mr =  $9.4 \div 106.0 = 0.09$  mol
- 2) Stoichiometric ratio Na<sub>2</sub>CO<sub>3</sub>  $\rightarrow$  NaCl = 1:2  $\Rightarrow$  moles of NaCl (theoretical) =  $0.09 \times (2/1) = 0.18$  mol
- 3) Theoretical mass of NaCl = moles  $\times$  Mr =  $0.18 \times 58.5 = 10.4$  g
- 4) % yield = (actual  $\div$  theoretical)  $\times$  100 =  $(7.1 \div 10.4) \times 100 = 68.8\%$