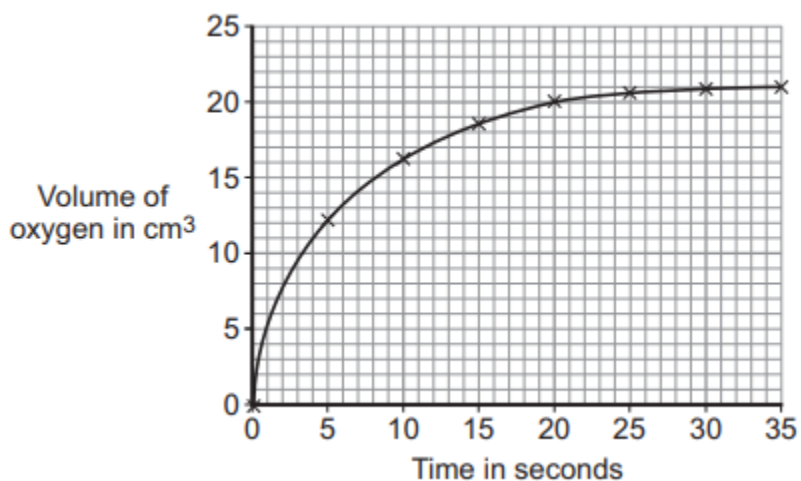


RELATIVE FORMULA MASS, ATOM ECONOMY & PERCENTAGE YIELD 1

Q1. A student measured the volume of oxygen produced by 50 cm³ of hydrogen peroxide. The graph shows the results.



(i) What was the total volume of oxygen gas collected?

(1 mark)

(ii) The student had calculated that the hydrogen peroxide used should produce 25 cm³ of oxygen. Calculate the percentage yield of oxygen.

(2 marks)

Q2. This question is about sodium hydrogen carbonate.

(i) Calculate the relative formula mass of sodium hydrogen carbonate (NaHCO_3).

Relative atomic masses (A_r): H=1; C=12; O=16; Na=23

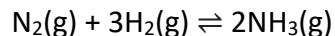
(2 marks)

(ii) Calculate the percentage by mass of carbon in sodium hydrogen carbonate.

(1 mark)

Q3. Ammonia is produced from nitrogen and hydrogen.

The equation for this reaction is:



(i) A company wants to make 6.8 tonnes of ammonia.

Calculate the mass of nitrogen needed.

Relative atomic masses (A_r): H = 1; N = 14

(3 marks)

(ii) The company expected to make 6.8 tonnes of ammonia.

The yield of ammonia was only 4.2 tonnes.

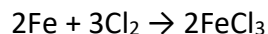
Calculate the percentage yield of ammonia.

(2 marks)

(iii) Use the equation above to explain why the percentage yield of ammonia was less than expected.

(1 mark)

Q4. Iron(III) chloride can be produced by the reaction shown in the equation:



(i) Calculate the maximum mass of iron(III) chloride (FeCl_3) that can be produced from 11.20 g of iron.

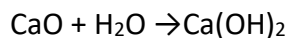
Relative atomic masses (A_r): Cl = 35.5; Fe = 56.

(3 marks)

(2 marks)

Q7. A student added water to calcium oxide to make calcium hydroxide.

The equation for the reaction is shown below.



Calculate the maximum mass of calcium hydroxide which could be made from 2.00 g of calcium oxide.

Relative atomic masses (A_r): H = 1; O = 16; Ca = 40.

(3 marks)

Q8.

(a) A chemist was asked to identify a nitrogen compound. The chemist carried out an experiment to find the relative formula mass (M_r) of the compound.

The M_r of the compound was 44.

Relative atomic masses: N = 14, O = 16

Draw a ring around the formula of the compound.

NO

NO₂

N₂O₄

N₂O

(1 mark)

(b) Potassium nitrate is another nitrogen compound. It is used in fertilisers.

It has the formula KNO_3 .

The M_r of potassium nitrate is 101.

Calculate the percentage of nitrogen by mass in potassium nitrate.

Relative atomic mass: $\text{N} = 14$.

(2 marks)

Q9. Iron is an essential part of the human diet. Iron(II) sulfate is sometimes added to white bread flour to provide some of the iron in a person's diet.



The formula of iron(II) sulfate is FeSO_4 .

Calculate the relative formula mass (M_r) of FeSO_4

Relative atomic masses: $\text{O} = 16$; $\text{S} = 32$; $\text{Fe} = 56$.

(2 marks)

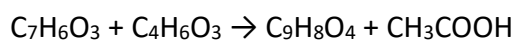
Q10. Aspirin tablets have important medical uses.



A student carried out an experiment to make aspirin. The method is given below.

1. Weigh 2.00 g of salicylic acid.
2. Add 4 cm³ of ethanoic anhydride (an excess).
3. Add 5 drops of concentrated sulfuric acid.
4. Warm the mixture for 15 minutes.
5. Add ice cold water to remove the excess ethanoic anhydride.
6. Cool the mixture until a precipitate of aspirin is formed.
7. Collect the precipitate and wash it with cold water.
8. The precipitate of aspirin is dried and weighed.

(a) The equation for this reaction is shown below.



Calculate the maximum mass of aspirin that could be made from 2.00 g of salicylic acid.

The relative formula mass (M_r) of salicylic acid, $\text{C}_7\text{H}_6\text{O}_3$, is 138

The relative formula mass (M_r) of aspirin, $\text{C}_9\text{H}_8\text{O}_4$, is 180

(2 marks)

(b) The student made 1.10 g of aspirin from 2.00 g of salicylic acid.

Calculate the percentage yield of aspirin for this experiment.

(2 marks)

(c) Suggest one possible reason why this method does not give the maximum amount of aspirin.

(1 mark)

Q11. Look at the following reaction.



The table gives the relative formula masses (M_r) of the reactants and the products for this reaction.

Formula of reactant or product	Relative formula masses (M_r)
NH_3	17
CO_2	44
NH_2CONH_2	60
H_2O	18

(i) One factory produces 6000 g of urea each second. Calculate the mass of ammonia needed to make 6000 g of urea.

(3 marks)

(ii) Calculate the percentage atom economy for the reaction.

(2 marks)

Q12. Calamine lotion is used to treat itching. The main ingredients are two metal oxides.



One of the metal oxides has a relative formula mass (M_r) of 81.

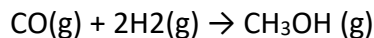
The formula of this metal oxide is MO . (M is not the correct symbol for the metal.)

The relative atomic mass (A_r) of oxygen is 16.

(2 marks)

Q13.

(i) Calculate the maximum mass of methanol that could be made from 14 g of carbon monoxide.



Relative formula masses (M_r): CO = 28; CH₃OH = 32.

(2 marks)

(ii) In an experiment the actual mass of methanol made from 14 g of carbon monoxide was 12 g. Use this information and your answer from part **(i)** to calculate the percentage yield of methanol in this experiment.

(2 marks)

(iii) Suggest one reason why the yield obtained is less than the maximum yield.

(1 mark)

Total marks (47)