Percentage yield and atom economy

Chemistry calculations | AQA GCSE Chemistry 8462 only (not Combined Science) | 12 questions, 38 marks

GCSE science calculations

Scan for the solutions

Equations for this topic (cover this box to practise recalling them)

- percentage yield = $\frac{\text{mass of product actually made}}{\text{maximum theoretical mass of product}} \times 100$ learn this one
- atom economy = $\frac{\text{relative formula mass of desired product from equation}}{\text{sum of relative formula masses of all reactants from equation}} \times 100$ learn this one
- number of moles = $\frac{\text{mass (g)}}{\text{Mr}}$ learn this one

Name: _____ **Date:** _____ **Score:** _____ **/ 38**

1 Amira makes copper sulfate crystals in a Year 10 practical. The maximum theoretical mass of crystals she could make is 5.0 g. She actually makes 4.2 g.

Calculate the percentage yield.

(2 marks)

Answer _____

2 Hydrogen for fuel cells can be made by reacting methane with steam.

$CH_4 + H_2O \rightarrow CO + 3H_2$

Hydrogen is the desired product.

- Sum of the relative formula masses of the reactants = 34
- Relative formula mass of $3H_2$ = 6

Calculate the atom economy for making hydrogen by this reaction.

(2 marks)

Answer _____

3 Callum makes zinc chloride three times using the same method. The maximum theoretical mass each time is 3.75 g.

Attempt	Mass of zinc chloride made in g
1	3.12
2	3.30
3	3.21

Calculate the mean percentage yield.

(3 marks)

Answer _____

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4 A fertiliser works in Lincolnshire makes ammonium nitrate in batches. For one batch, the maximum theoretical mass is 2.4 tonnes. The works actually makes 1950 kg.

1 tonne = 1000 kg

Calculate the percentage yield for this batch.

(3 marks)

Answer _____

5 A technician in a hospital pharmacy lab makes a small sample of a painkiller. The maximum theoretical mass is 1.20 g. She actually makes 850 mg.

Calculate the percentage yield.

Give your answer to 3 significant figures.

(3 marks)

Answer _____

6 Priya makes magnesium sulfate crystals and dries them in an evaporating basin. The maximum theoretical mass of crystals is 4.80 g.

- Mass of the empty evaporating basin = 32.40 g
- Mass of the evaporating basin and dry crystals = 36.15 g

Calculate the percentage yield.

Give your answer to 3 significant figures.

(3 marks)

Answer _____

7 A chemist expects a percentage yield of 65% when making an ester. The maximum theoretical mass of the ester is 12.0 g.

Calculate the mass of ester the chemist expects to make.

(2 marks)

Answer _____

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8 Tomasz heats 9.6 g of a metal carbonate and collects 5.4 g of the metal oxide. His percentage yield is 72%.

Calculate the maximum theoretical mass of the metal oxide.

(3 marks)

Answer _____

9 Railway engineers weld rails together using the thermite reaction.

$Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$

Iron is the desired product.

Relative atomic masses (A_r): O = 16, Al = 27, Fe = 56

Calculate the atom economy for making iron by this reaction.

(3 marks)

Answer _____

10 **Higher tier**

Grace heats 4.94 g of copper carbonate until it has all decomposed.

$CuCO_3 \rightarrow CuO + CO_2$

She collects 2.86 g of copper oxide.

Relative atomic masses (A_r): C = 12, O = 16, Cu = 63.5

Calculate the percentage yield of copper oxide.

Give your answer to 3 significant figures. Show your working.

(4 marks)

Answer _____

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11 Zinc sulfate is used in some dietary supplements. A company can make it by two different routes.

Route A: $ZnO + H_2SO_4 \rightarrow ZnSO_4 + H_2O$

Route B: $ZnCO_3 + H_2SO_4 \rightarrow ZnSO_4 + H_2O + CO_2$

Zinc sulfate is the desired product.

Relative atomic masses (A_r): H = 1, C = 12, O = 16, S = 32, Zn = 65

a. Calculate the atom economy for making zinc sulfate by Route A. Give your answer to 3 significant figures. Show your working.

b. Calculate the atom economy for making zinc sulfate by Route B. Give your answer to 3 significant figures.

c. Give one reason why Route B has a lower atom economy than Route A.

(5 marks)

Answer _____

12 **Higher tier**

In a blast furnace, iron(III) oxide is reduced to iron.

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

In one test run, 800 kg of iron(III) oxide produced 532 kg of iron.

Relative atomic masses (A_r): O = 16, Fe = 56

Calculate the percentage yield of iron. Show your working.

(5 marks)

Answer _____

End of questions | Total 38 marks

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