Conservation of mass

Worked solutions

GCSE science calculations

This topic online

1 A sparkler contains aluminium powder. When it is lit, 5.4 g of aluminium burns in 4.8 g of oxygen. Aluminium oxide is the only product.

aluminium + oxygen → aluminium oxide

Calculate the mass of aluminium oxide made. (1 mark)

Total mass of reactants = total mass of products

mass of aluminium oxide = 5.4 + 4.8

10.2 g

2 In a Year 10 practical, Oliver mixes two colourless solutions. A white precipitate forms. Nothing escapes from the beaker.

- Mass of silver nitrate solution: 25.40 g
- Mass of sodium chloride solution: 30.15 g

Calculate the total mass of the products. (1 mark)

Total mass of reactants = total mass of products

total mass = 25.40 + 30.15

55.55 g

3 Zinc powder reacts with sulfur when heated to make zinc sulfide.

zinc + sulfur → zinc sulfide

6.5 g of zinc reacts completely and 9.7 g of zinc sulfide is made.

Calculate the mass of sulfur that reacted. (2 marks)

Total mass of reactants = total mass of products

$6.5 + m = 9.7$

$m = 9.7 - 6.5$

3.2 g

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4 At a chemical works, 460 g of sodium reacts with 0.71 kg of chlorine. Sodium chloride is the only product.

Calculate the mass of sodium chloride made, in kg. (2 marks)

Convert g to kg: 1000 g = 1 kg

460 g = 460 ÷ 1000 = 0.46 kg

Total mass of reactants = total mass of products

mass of NaCl = 0.46 + 0.71

1.17 kg

5 A lime kiln heats 2.5 tonnes of limestone (calcium carbonate). It breaks down completely into 1.4 tonnes of calcium oxide and carbon dioxide gas.

calcium carbonate → calcium oxide + carbon dioxide

1 tonne = 1000 kg

Calculate the mass of carbon dioxide given off, in kg. (2 marks)

Total mass of reactants = total mass of products

2.5 = 1.4 + m

m = 2.5 − 1.4 = 1.1 tonnes

Convert tonnes to kg

m = 1.1 × 1000

1100 kg

6 Aisha heats 2.47 g of green copper carbonate in a boiling tube. It turns into black copper oxide and carbon dioxide gas escapes. After heating, the copper oxide has a mass of 1.59 g.

Calculate the mass of carbon dioxide given off, in milligrams (mg). (2 marks)

Total mass of reactants = total mass of products

2.47 = 1.59 + m

m = 2.47 − 1.59 = 0.88 g

Convert g to mg: 1 g = 1000 mg

m = 0.88 × 1000

880 mg

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7 Baking powder contains sodium hydrogencarbonate. When it is heated it breaks down:

sodium hydrogencarbonate → sodium carbonate + water + carbon dioxide

Hamza heats 8.40 g of sodium hydrogencarbonate. It makes 5.30 g of sodium carbonate and 0.90 g of water.

Calculate the mass of carbon dioxide made. (2 marks)

Total mass of reactants = total mass of products

$8.40 = 5.30 + 0.90 + m$

$8.40 = 6.20 + m$

$m = 8.40 - 6.20$

2.20 g

8 Lucy finds the mass of carbon dioxide given off when marble chips react with hydrochloric acid in an open conical flask on a balance.

Measurement	Mass in g
empty conical flask	98.30
conical flask + acid	152.40
marble chips added	5.00
conical flask + contents when the fizzing stops	155.20

Calculate the mass of carbon dioxide that escaped. (3 marks)

The empty flask mass (98.30 g) is not needed: the flask is in both the before and after readings

mass at start = 152.40 + 5.00 = 157.40 g

Mass lost = mass of gas that escaped

mass of CO_2 = 157.40 - 155.20

2.20 g

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9 Tomasz heats copper powder in an evaporating basin, stirring it, until it has all turned into black copper oxide by reacting with oxygen from the air.

Measurement	Mass in g
evaporating basin	31.52
evaporating basin + copper	32.79
evaporating basin + copper oxide	33.11

a. Calculate the mass of copper used.

b. Calculate the mass of oxygen that combined with the copper.

(3 marks)

a)

Take away the mass of the evaporating basin

mass of Cu = 32.79 - 31.52

1.27 g

b)

The mass gain is oxygen taken in from the air

mass of O = 33.11 - 32.79

0.32 g

10 Kwame puts an open flask of acid and marble chips on a balance and records the reading every minute.

Time in minutes	0	1	2	3	4
Mass in g	186.42	185.90	185.61	185.54	185.54

a. Calculate the total mass of carbon dioxide given off.

b. Calculate the mass of carbon dioxide given off in the first minute.

c. Explain why the reading on the balance goes down.

Show your working.

(4 marks)

a)

The reading stops changing at 185.54 g, so the reaction is over

mass of CO_2 = 186.42 - 185.54

0.88 g

b)

mass of CO_2 = 186.42 - 185.90

0.52 g

c)

CO_2 gas escapes from the open flask into the air

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11 Precious heats 4.20 g of iron wool in air until it has all turned into iron oxide. The iron oxide has a mass of 5.80 g.

a. Calculate the mass of oxygen that combined with the iron.

b. Calculate the mass of iron oxide made when 10.5 g of iron wool reacts completely in the same way.

Show your working. (4 marks)

a)

Mass gained = oxygen taken in from the air

mass of O = 5.80 − 4.20

1.60 g

b)

How many times more iron?

scale factor = 10.5 ÷ 4.20 = 2.5

mass of iron oxide = 2.5 × 5.80

14.5 g

12 An open fermentation vat at a brewery contains 1250 kg of sugary liquid. During fermentation, 36.0 kg of glucose in the liquid reacts:

glucose → ethanol + carbon dioxide

18.4 kg of ethanol is made and stays in the vat. All of the carbon dioxide escapes into the air.

a. Calculate the mass of carbon dioxide made, in kg.

b. Calculate the mass of the contents of the vat at the end, in tonnes. 1 tonne = 1000 kg. Give your answer to 3 significant figures.

Show your working. (4 marks)

a)

Use 36.0 kg: only the glucose reacts, not the whole 1250 kg of liquid

36.0 = 18.4 + m

m = 36.0 − 18.4

17.6 kg

b)

Only the CO_2 leaves the vat; the ethanol stays

mass at end = 1250 − 17.6 = 1232.4 kg

Convert kg to tonnes: 1000 kg = 1 tonne

mass at end = 1232.4 ÷ 1000 = 1.2324 tonnes

1.23 tonnes

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