

- 1 The mass of magnesium ions in 1 kg of sea water is 1.3 g.
The concentration in parts per million (ppm) is

- A 1.3×10^6
 B 1.3×10^3
 C 1.3×10^{-3}
 D 1.3×10^{-6}

(Total for Question = 1 mark)

- 2 Calculate the total number of **ions** in 7.41 g of calcium hydroxide, $\text{Ca}(\text{OH})_2$.

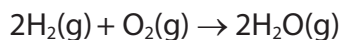
The molar mass of calcium hydroxide is 74.1 g mol^{-1} .

The Avogadro constant is $6.0 \times 10^{23} \text{ mol}^{-1}$.

- A 6.0×10^{22}
 B 1.2×10^{23}
 C 1.8×10^{23}
 D 3.0×10^{23}

(Total for Question = 1 mark)

- 3 100 cm^3 of hydrogen is mixed with 25 cm^3 of oxygen at a temperature of 150°C .
The gases react as shown in the equation below.



The total volume of gas present at the end of the reaction is

- A 50 cm^3
 B 100 cm^3
 C 125 cm^3
 D 150 cm^3

(Total for Question = 1 mark)

4 Sodium nitrate decomposes on heating.



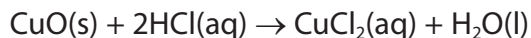
What is the maximum volume of oxygen, measured in dm^3 at room temperature and pressure, which could be obtained by heating 0.50 mol of sodium nitrate?

[Molar volume of a gas = $24 \text{ dm}^3 \text{ mol}^{-1}$ at room temperature and pressure]

- A 3
- B 6
- C 12
- D 24

(Total for Question = 1 mark)

- 5 An excess of copper(II) oxide is mixed with 40.0 cm³ of 2.50 mol dm⁻³ hydrochloric acid.



- (a) If the mass of copper(II) chloride produced is 5.50 g, what is the percentage yield of copper(II) chloride?

[Molar mass of copper(II) chloride = 134.4 g mol⁻¹]

(1)

- A 81.8%
- B 67.2%
- C 40.9%
- D 20.4%

- (b) The ionic equation for the reaction is

(1)

- A $\text{Cu}^{2+}\text{(s)} + 2\text{Cl}^-\text{(aq)} \rightarrow \text{CuCl}_2\text{(aq)}$
- B $\text{CuO(s)} + 2\text{H}^+\text{(aq)} \rightarrow \text{Cu}^{2+}\text{(aq)} + \text{H}_2\text{O(l)}$
- C $\text{CuO(s)} + 2\text{H}^+\text{(aq)} + 2\text{Cl}^-\text{(aq)} \rightarrow \text{Cu}^{2+}\text{(Cl}^-\text{)}_2\text{(aq)} + \text{H}_2\text{O(l)}$
- D $\text{CuO(s)} + 2\text{Cl}^-\text{(aq)} \rightarrow \text{CuCl}_2\text{(aq)} + \text{O}^{2-}\text{(l)}$

- (c) Some facts about copper(II) chloride are given below.

Which of these gives the **best** evidence that the bonding in copper(II) chloride is ionic?

(1)

- A It has a melting temperature of 620 °C.
- B It does not conduct electricity as a solid.
- C It decomposes before it reaches its boiling temperature.
- D In the electron density map, there are no contour lines around more than one nucleus.

(Total for Question = 3 marks)

6 A compound has the composition 62.1% C, 10.3% H and 27.6% O.

What is its empirical formula?

- A CH₂O
- B C₆H₂O
- C C₆H₃O
- D C₃H₆O

(Total for Question = 1 mark)

7 25.00 cm³ of 1.00 mol dm⁻³ sulfuric acid is fully neutralized by 50.00 cm³ of 1.00 mol dm⁻³ sodium hydroxide.

(a) What is the concentration of sodium sulfate solution produced by the reaction, in mol dm⁻³?

(1)

- A 1.00
- B 0.67
- C 0.50
- D 0.33

(b) The volumes are measured using burettes, with each burette reading having an uncertainty of ± 0.05 cm³.

The percentage error in measuring the 25.00 cm³ of the acid is

(1)

- A $\pm 0.05\%$
- B $\pm 0.10\%$
- C $\pm 0.20\%$
- D $\pm 0.40\%$

(Total for Question = 2 marks)

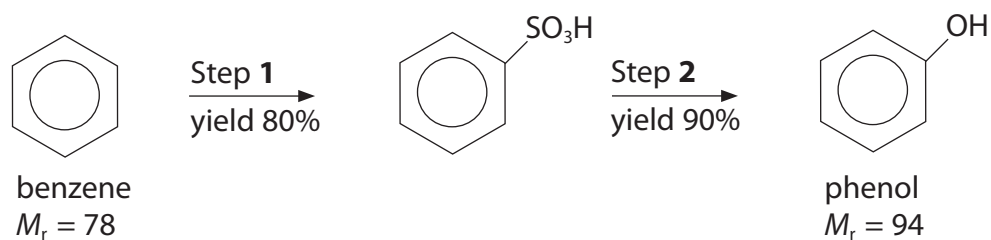
8 Complete combustion of a hydrocarbon produced 0.66 g of carbon dioxide and 0.225 g of water.

Which of the following molecular formulae is consistent with these data?

- A C_3H_6 .
- B C_3H_8 .
- C C_6H_6 .
- D C_6H_{10} .

(Total for Question = 1 mark)

9 Phenol can be produced from benzene as shown in the reaction sequence below.



The mass of phenol, to 2 decimal places, produced from 3.90 g of benzene is

- A 3.38 g.
- B 3.76 g.
- C 4.23 g.
- D 4.70 g.

(Total for Question = 1 mark)

10 Lithium reacts with water to produce hydrogen.



(a) In an experiment, 0.069 g (0.01 mol) of lithium produced 90 cm³ of hydrogen at room temperature and pressure. What is the percentage yield of hydrogen?

[1 mol of any gas occupies 24 dm³ at room temperature and pressure.]

(1)

A 45%

B 60%

C 75%

D 90%

(b) Which of the following is **not** a possible reason for the yield being less than 100%?

(1)

A Some oil remained on the surface of the lithium.

B Hydrogen gas is very soluble in water.

C A layer of oxide was present on the surface of the lithium.

D Some of the hydrogen gas escaped collection.

(Total for Question = 2 marks)

11 How many moles of **atoms** are present in 240 cm³ of carbon dioxide at room temperature and pressure?

[1 mol of any gas occupies 24 dm³ at room temperature and pressure.]

- A** 0.010
- B** 0.020
- C** 0.024
- D** 0.030

(Total for Question = 1 mark)

12 What is the percentage by mass of nitrogen in ammonium nitrate, NH₄NO₃?

[Molar masses/g mol⁻¹: N = 14.0; H = 1.0; O = 16.0]

- A** 14.0%
- B** 17.5%
- C** 28.0%
- D** 35.0%

(Total for Question = 1 mark)

13 A compound of nitrogen and hydrogen only is analyzed and found to contain 97.7% by mass of nitrogen. What is the empirical formula of the compound?

Molar masses /g mol⁻¹: H = 1; N = 14

- A** NH₃
- B** NH₂
- C** N₃H₅
- D** N₃H

(Total for Question = 1 mark)

14 Which of the following can be determined, for an unknown alkene, using **only** percentage composition by mass data?

- A** Molecular formula
- B** Empirical (simplest) formula
- C** Both the molecular formula and the empirical (simplest) formula
- D** Structural formula

(Total for Question = 1 mark)

15 1.12 g of iron reacts with oxygen to form 1.60 g of an oxide of iron.
Use relative atomic masses: Fe = 56, O = 16.

What is the formula of this oxide of iron?

- A** FeO₅
- B** Fe₂O₁₀
- C** Fe₃O₂
- D** Fe₂O₃

(Total for Question = 1 mark)

16 In an experiment, 1.226 g of potassium chlorate(V), KClO₃, was heated. A mass of 0.320 g of oxygen gas, O₂, was collected.



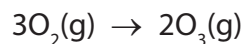
Use the molar mass of KClO₃ = 122.6 g mol⁻¹ and relative atomic mass O = 16.

The percentage yield of oxygen in this experiment is

- A** 17.4%
- B** 26.1%
- C** 66.7%
- D** 100%

(Total for Question = 1 mark)

- 17 Oxygen gas, O_2 , can be converted into ozone, O_3 , by passing it through an electric discharge.



In an experiment, a volume of 300 cm^3 of oxygen was used but only 10% of the oxygen was converted into ozone. All volumes were measured at the same temperature and pressure.

The **total** volume of gas present at the end of the experiment, in cm^3 , was

- A 200
- B 210
- C 290
- D 300

(Total for Question = 1 mark)

- 18 1.40 g of an alkene gave 3.77 g of a dichloroalkane on reaction with chlorine.

What is the molecular formula of the alkene?

- A C_2H_4
- B C_3H_6
- C C_4H_8
- D C_6H_{12}

(Total for Question = 1 mark)

19 The recommended limit for safe exposure to sulfur dioxide in the air is 0.000025 %.
What is this concentration in parts per million, ppm?

- A 25
- B 0.25
- C 0.025
- D 0.0025

(Total for Question = 1 mark)

20 What is the number of **atoms** in 2.8 g of ethene, C₂H₄?

DATA

- The molar mass of C₂H₄ is 28 g mol⁻¹
- The Avogadro constant is 6.0 × 10²³ mol⁻¹

- A 1.0 22
- B 6.0 22
- C 1.2 23
- D 3.6 23

(Total for Question = 1 mark)

21 A compound has the following percentage composition by mass.

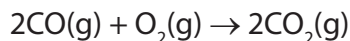
C 61.0% H 15.3% N 23.7%

The empirical formula of the compound is

- A CH₃N
- B C₃H₉N
- C C₆H₉N₂
- D C₈H₂N₃

(Total for Question = 1 mark)

22 Carbon monoxide and oxygen react together as follows.



If all volumes of gas are measured at the same temperature and pressure, the volume of carbon dioxide produced after 50 cm³ of carbon monoxide react with 25 cm³ of oxygen is

- A** 100 cm³
- B** 75 cm³
- C** 50 cm³
- D** 25 cm³

(Total for Question = 1 mark)

23 Potassium chlorate(V), KClO₃, decomposes on heating as follows.



What is the maximum volume of oxygen, measured in dm³ at room temperature and pressure, which could be obtained by heating 0.50 mol potassium chlorate(V)?

[Molar volume of a gas = 24 dm³ mol⁻¹ at room temperature and pressure.]

- A** 8
- B** 18
- C** 36
- D** 72

(Total for Question = 1 mark)

24 One definition of the term 'carbon footprint' is

'the amount of carbon dioxide produced when a fuel is burned.'

Fuel	Energy density / MJ l ⁻¹	CO ₂ produced on combustion / g l ⁻¹
Paraffin	46	2580

Given the information above, what is the carbon footprint for paraffin in terms of grams of CO₂ produced per MJ of energy?

- A 46
- B 56.09
- C 2580
- D 118 680

(Total for Question = 1 mark)

25 Sodium thiosulfate was used to determine the concentration of iodine by titration.

(a) The sodium thiosulfate solution was prepared by dissolving 4.5 g of sodium thiosulfate in water and making the solution up to 250 cm³ in a volumetric flask. The volumetric flask is accurate to ± 0.3 cm³ so, to match this accuracy, the mass of the sodium thiosulfate should be accurate to at least

- A ± 0.5 g
- B ± 0.05 g
- C ± 0.005 g
- D ± 0.0005 g

(1)

(b) With the sodium thiosulfate in the burette, what is the colour of the solution in the conical flask at the end-point of the reaction?

- A Blue-black
- B Colourless
- C Red-brown
- D Yellow

(1)

(Total for Question = 2 marks)

26 15 cm³ of a gaseous hydrocarbon requires 90 cm³ of oxygen for complete combustion, both volumes being measured at 15 °C and 1 atm. The formula of the hydrocarbon is



D impossible to calculate without knowing the molar volume of gases under these conditions.

(Total for Question = 1 mark)

27 A drop of sodium manganate(VII) solution is placed at the centre of a piece of moist filter paper on a microscope slide. The ends of the paper are clipped to a 30 V DC power supply. After a few minutes,

- A** a purple colour has moved towards the positive terminal.
- B** a purple colour has moved towards the negative terminal.
- C** an orange colour has moved towards the positive terminal.
- D** an orange colour has moved towards the negative terminal.

(Total for Question = 1 mark)

28 How many moles of **ions** are present in 20 cm³ of 0.050 mol dm⁻³ calcium chloride solution, CaCl₂(aq)?

- A** 0.0050
- B** 0.0030
- C** 0.0020
- D** 0.0010

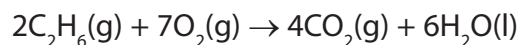
(Total for Question = 1 mark)

29 The Avogadro constant is $6.0 \times 10^{23} \text{ mol}^{-1}$. The number of **atoms** in 1 mol of dinitrogen tetroxide, N₂O₄, is

- A** 3.6 24
- B** 1.8 24
- C** 6.0 23
- D** 1.0 23

(Total for Question = 1 mark)

30 The equation for the complete combustion of ethane is



What volume of oxygen, measured at room temperature and pressure, is needed to completely burn 0.1 mol of ethane?

[The volume of 1 mol of any gas measured at room temperature and pressure is 24 dm³]

- A** 2.4 dm³
- B** 4.8 dm³
- C** 8.4 dm³
- D** 16.8 dm³

(Total for Question = 1 mark)

31 A sample of swimming pool water contains 0.482 parts per million (ppm) of chlorine. This is equal to a percentage of

- A** 0.000482
- B** 0.0000482
- C** 0.00000482
- D** 0.000000482

(Total for Question = 1 mark)

32 A compound was found to contain 2.8 g of nitrogen and 8.0 g of oxygen.

What is the empirical formula of the compound?

Use the Periodic Table as a source of data.

- A** NO
- B** NO₂
- C** N₂O₃
- D** N₂O₅

(Total for Question = 1 mark)

33 What is the total number of **atoms** in 1.8 g of water, H₂O?

DATA

- The molar mass of H₂O is 18 g mol⁻¹
- The Avogadro Constant is 6.0×10^{23} mol⁻¹

- A** 6.0×10^{22}
- B** 6.0×10^{23}
- C** 1.8×10^{23}
- D** 1.8×10^{24}

(Total for Question = 1 mark)

34 Phosphorus(V) chloride, PCl₅, reacts with water according to the equation



If 1.04 g of phosphorus pentachloride (molar mass = 208 g mol⁻¹) is reacted completely with water and the solution made up to 1 dm³, the concentration of the hydrochloric acid in mol dm⁻³ is

- A** 0.001
- B** 0.005
- C** 0.025
- D** 0.250

(Total for Question = 1 mark)

- 35** A sample of sodium chlorate(V), NaClO_3 , was heated and 120 cm^3 of oxygen gas was collected.



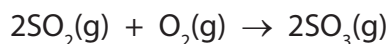
Calculate the number of moles of sodium chlorate(V) that were decomposed in the above reaction.

[Molar volume of a gas under the conditions of the experiment = $24000 \text{ cm}^3 \text{ mol}^{-1}$]

- A** 2.50×10^{-3}
- B** 3.33×10^{-3}
- C** 5.00×10^{-3}
- D** 7.50×10^{-3}

(Total for Question = 1 mark)

- 36** 3.0 dm^3 of sulfur dioxide reacts with 1.5 dm^3 of oxygen, under suitable conditions, according to the equation below.



What is the maximum volume of sulfur trioxide that can be formed in the above reaction?

[The volumes of the gases are measured at the same temperature and pressure.]

- A** 6.0 dm^3
- B** 4.5 dm^3
- C** 3.0 dm^3
- D** 1.5 dm^3

(Total for Question = 1 mark)

37 Hydrochloric acid and sodium carbonate solution react as shown below.



Which sample of sodium carbonate solution will be neutralized by 20 cm³ of 0.05 mol dm⁻³ hydrochloric acid?

	Volume of sodium carbonate/ cm ³	Concentration of sodium carbonate/ mol dm ⁻³
<input type="checkbox"/> A	10	0.05
<input type="checkbox"/> B	40	0.05
<input type="checkbox"/> C	40	0.10
<input type="checkbox"/> D	10	0.10

(Total for Question = 1 mark)

38 The concentration of a solution of potassium iodate(V) can be determined by the liberation of iodine, followed by titration with sodium thiosulfate.

A suitable indicator is

- A** methyl orange.
- B** phenolphthalein.
- C** starch.
- D** universal indicator.

(Total for Question = 1 mark)

39 A 50 cm³ sample of a gaseous hydrocarbon required exactly 250 cm³ of oxygen for complete combustion. A volume of 150 cm³ of carbon dioxide was produced.

[All volume measurements were made at the same temperature and pressure.]

Which of the following is the correct formula of the hydrocarbon?

- A** C₃H₄
- B** C₃H₈
- C** C₅H₁₀
- D** C₅H₁₂

(Total for Question = 1 mark)

40 A solution contains 66 ppm of a solute. The mass of the solute dissolved in 1 kg of this solution is

- A** 66 g
- B** 0.66 g
- C** 0.066 g
- D** 0.000066 g

(Total for Question 1 mark)