



AS Level Chemistry

ATOMS, MOLECULES & STOICHIOMETRY

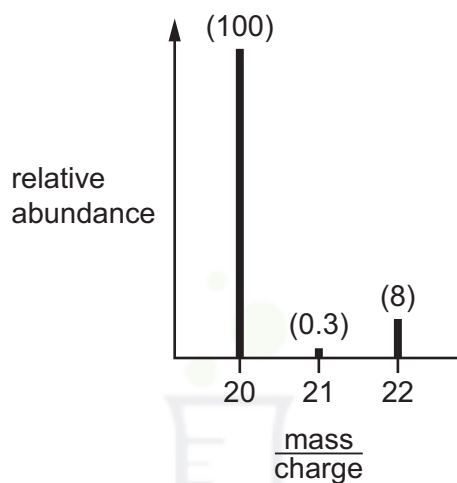
9701-MCQ

2026 EDITION

Q1 - Easy

9701/11/O/N/21/Q1

- 1 The mass spectrum of a sample of neon is shown. The relative abundance of each peak is written in brackets above it.



What is the relative atomic mass, A_r , of this sample of neon?

- A 20.15 B 20.20 C 21.00 D 21.82

Q2 - Easy

9701/12/O/N/21/Q2

- 2 Which statement is correct?
- A 1.0 g of hydrogen gas contains 3.0×10^{23} atoms.
- B 4.0 g of helium gas contains 1.2×10^{24} atoms.
- C 16 g of methane gas contains 3.0×10^{24} atoms.
- D 44 g of carbon dioxide gas contains 6.0×10^{23} atoms.

Q3 - Easy

9701/12/F/M/23/Q11

- 11 Molten aluminium chloride has a simple molecular structure. Each molecule consists of two aluminium atoms and six chlorine atoms.

Which statement is correct?

- A All the chlorine atoms in 1 g of molten aluminium chloride have the same mass.
- B One mole of molten aluminium chloride contains 6.02×10^{23} aluminium atoms.
- C One mole of molten aluminium chloride contains 3.61×10^{24} chlorine atoms.
- D The empirical formula of molten aluminium chloride is Al_2Cl_6 .

Q4 - Easy

9701/11/M/J/23/Q10

- 10 Which statement is correct?

- A The relative atomic mass of a ^{35}Cl atom is 35.5.
- B The relative formula mass of $CaCO_3$ is 100.1.
- C The relative isotopic mass of a ^{24}Mg atom is 24.3.
- D The relative molecular mass of O_2 is 16.0.

Q5 - Easy

9701/11/O/N/24/Q4

- 4 What contains the greatest number of the named particles?

- A 6.0 dm^3 of argon atoms at room conditions
- B 6.0 g of carbon dioxide molecules
- C 6.0 g of magnesium atoms
- D 6.0 g of water molecules

Q6 - Easy

9701/11/O/N/25/Q3

- 3 What contains 9.03×10^{23} oxygen atoms?
- A 0.25 mol aluminium oxide
 - B 0.75 mol sulfur dioxide
 - C 1.5 mol sulfur trioxide
 - D 3.0 mol water



Q7 - Easy

9701/12/O/N/21/Q1

- 1 Compound X consists of 40.0% carbon, 6.7% hydrogen and 53.3% oxygen by mass.

What is the empirical formula of compound X?

- A CH_2O B $\text{C}_2\text{H}_2\text{O}$ C $\text{C}_2\text{H}_4\text{O}$ D CHO

Q8 - Hard

9701/12/F/M/21/Q4

- 4 Originally, chemists thought indium oxide had the formula InO . By experiment they showed that 4.8 g of indium combined with 1.0 g of oxygen to produce 5.8 g of indium oxide. The A_r of oxygen was known to be 16.

Which value for the A_r of indium is calculated using these data?

- A 38 B 77 C 115 D 154

Q9 - Hard

9701/12/F/M/22/Q3

- 3 Compound X contains the elements C, H and O only.

2.00 g of X produces 4.00 g of carbon dioxide and 1.63 g of water when completely combusted.

What is the empirical formula of X?

- A CHO_2 B $\text{C}_2\text{H}_2\text{O}$ C $\text{C}_2\text{H}_4\text{O}$ D CH_2O_2

Q10 - Easy

9701/12/F/M/24/Q3

- 3 Which sodium compound contains 74.2% by mass of sodium?

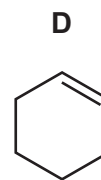
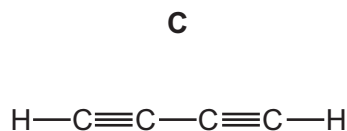
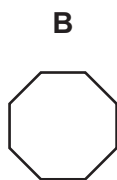
- A sodium carbonate
B sodium chloride
C sodium hydroxide
D sodium oxide

Q11 - Hard

9701/12/M/J/22/Q4

- 4 When a small sample of hydrocarbon Q is completely combusted, it produces 3.52 g of carbon dioxide and 1.44 g of water.

What could be the structure of hydrocarbon Q?



Q12 - Hard

9701/13/M/J/22/Q3

- 3 Analysis of the hormone thyroxine gives the results shown.

Heating 0.500 g of thyroxine with aqueous silver nitrate produces 0.604 g of silver iodide. All of the iodine in the thyroxine sample is converted to silver iodide.

Complete combustion of 0.500 g of thyroxine produces 232 cm³ of carbon dioxide and 7.72 cm³ of nitrogen, measured under room conditions.

Which molecular formula of thyroxine agrees with these values?

- A $\text{C}_{15}\text{H}_{11}\text{NO}_4\text{I}_4$ $M_r = 776.6$
B $\text{C}_{15}\text{H}_7\text{NO}_4\text{I}_8$ $M_r = 1280.2$
C $\text{C}_{30}\text{H}_{25}\text{NO}_6\text{I}_4$ $M_r = 1002.6$
D $\text{C}_{30}\text{H}_{21}\text{NO}_6\text{I}_8$ $M_r = 1506.2$

Q13 - Hard

9701/11/O/N/23/Q3

- 3 Aluminium carbide, Al_4C_3 , reacts readily with aqueous sodium hydroxide. The two products of the reaction are NaAlO_2 and a hydrocarbon. Water molecules are also involved as reactants.

What is the formula of the hydrocarbon?

- A CH_4 B C_2H_6 C C_3H_8 D C_6H_{12}

Q14 - Hard

9701/11/O/N/23/Q4

- 4 A sample of 35.6 g of hydrated sodium carbonate contains 25.84% sodium ions by mass.

When this sample is heated, anhydrous sodium carbonate and water are formed.

Which mass of water is given off?

- A 7.2g B 10.6g C 14.4g D 21.2g

Q15 - Hard

9701/11/O/N/24/Q3

- 3 Glauber's salt consists of crystals of hydrated sodium sulfate, $\text{Na}_2\text{SO}_4 \cdot x\text{H}_2\text{O}$, which can be used for the manufacture of detergents.

When a sample of Glauber's salt was heated, 1.91 g of water was removed leaving 1.51 g of anhydrous Na_2SO_4 .

What is the value of x in $\text{Na}_2\text{SO}_4 \cdot x\text{H}_2\text{O}$?

- A 1 B 8.85 C 10 D 11.25

Q16 - Hard

9701/12/O/N/24/Q3

- 3 A 0.216 g sample of aluminium carbide reacts with an excess of water to produce methane gas. This is the only carbon-containing product formed in the reaction. This methane gas burns completely in O_2 to form H_2O and CO_2 only. The volume of CO_2 produced at room temperature and pressure is 108 cm^3 .

What is the formula of aluminium carbide?

- A Al_2C_3 B Al_3C_2 C Al_3C_4 D Al_4C_3

Q17 - Hard

9701/11/M/J/25/Q6

- 6 P is a compound that burns in an excess of oxygen to give carbon dioxide and water only.

2.20 g of P contains 1.20 g of carbon and 0.20 g of hydrogen.

When P is added to a solution of sodium carbonate, bubbles of gas are seen.

What is P?

- A CH_3CHO
- B $\text{CH}_3\text{CO}_2\text{H}$
- C $\text{CH}_3\text{COCH}_2\text{CH}_2\text{OH}$
- D $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$



Q18 - Easy

9701/11/M/J/21/Q6

- 6 What is the minimum mass of oxygen required to ensure the complete combustion of 12 dm^3 of propane measured under room conditions?

A 60 g B 80 g C 120 g D 160 g

Q19 - Hard

9701/13/M/J/21/Q9

- 9 Copper dissolves in dilute nitric acid producing a blue solution of $\text{Cu}(\text{NO}_3)_2$, water and nitrogen(II) oxide as the only products.

How many moles of acid react with three moles of copper in the balanced equation?

A 2 B 4 C 6 D 8

Q20 - Easy

9701/11/M/J/22/Q3

- 3 In separate experiments, 5.0 g samples of each of four s-block metals are added to an excess of water. The gas evolved is collected and its volume measured under the same conditions of temperature and pressure for each sample.

Which metal produces the largest volume of gas?

- A calcium
B potassium
C rubidium
D strontium

Q21 - Easy

9701/11/M/J/22/Q4

- 4 A student reacts 1 mol of copper with concentrated nitric acid to produce 1 mol of copper(II) nitrate, 2 mol of water and substance X. No other product is formed.

Substance X does not contain copper or hydrogen.

What could be substance X?

- A N_2 B N_2O C NO D NO_2

Q22 - Easy

9701/13/M/J/22/Q4

- 4 How many moles of oxygen, O_2 , are needed to burn 1 mol of ethane if the products of the reaction are water and carbon only?

- A 1.5 B 3 C 3.5 D 5

Q23 - Easy

9701/12/M/J/23/Q4

- 4 If 1 mole of hexane combusts in an excess of oxygen, how many moles of products are formed?

- A 11 B 12 C 13 D 14

Q24 - Easy

9701/12/M/J/23/Q5

- 5 Separate samples, each of mass 1.0 g, of the compounds listed are treated with an excess of dilute acid.

Which compound releases the largest amount of CO_2 ?

- A 1.0 g CaCO_3 B 1.0 g Li_2CO_3 C 1.0 g MgCO_3 D 1.0 g Na_2CO_3

Q25 - Hard

9701/11/M/J/24/Q2

- 2 A mixture of 10 cm^3 of methane and 10 cm^3 of ethane was sparked with an excess of oxygen. After cooling, the residual gas was passed through aqueous potassium hydroxide.

All gas volumes were measured at the same temperature and pressure.

Which volume of gas was absorbed by the alkali?

- A 15 cm^3 B 20 cm^3 C 30 cm^3 D 40 cm^3

Q26 - Hard

9701/13/M/J/24/Q1

- 1 X is an impure sample of a Group 2 metal carbonate, MCO_3 . X contains 57% by mass of MCO_3 . The impurities in X do **not** react with hydrochloric acid.

7.4 g of X is reacted with an excess of dilute hydrochloric acid.

0.050 mol of the Group 2 metal chloride is produced.

What is the identity of the Group 2 metal?

- A Mg B Ca C Sr D Ba

Q27 - Hard

9701/12/F/M/24/Q4

- 4 What is the maximum volume of sulfur dioxide gas measured at room conditions produced from burning 100 dm^3 of diesel fuel containing 0.8346 g of sulfur?

- A 291 cm^3 B 312 cm^3 C 582 cm^3 D 624 cm^3

Q28 - Easy

9701/11/O/N/22/Q2

- 2 Mixture R consists of one mole of C_3H_6 and one mole of C_4H_6 .

What is the minimum number of moles of oxygen molecules needed for complete combustion of mixture R?

- A 6.5 B 7 C 10 D 20

Q29 - Hard

9701/11/O/N/22/Q8

- 8 The carbonate of an s-block element is reacted with an excess of hydrochloric acid.

0.833 g of the carbonate releases 200 cm^3 of gas, measured under room conditions.

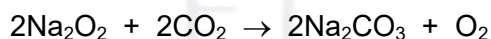
What is the identity of the metal carbonate?

- A Na_2CO_3 B K_2CO_3 C MgCO_3 D CaCO_3

Q30 - Easy

9701/12/O/N/22/Q2

- 2 Sodium peroxide, Na_2O_2 , is used to absorb carbon dioxide from the atmosphere and release oxygen in closed environments such as space capsules and submarines.



Which mass of sodium peroxide would be required to remove 2.4 dm^3 of carbon dioxide from the atmosphere at room temperature and pressure?

- A 2.4 g B 3.9 g C 7.8 g D 15.6 g

Q31 - Hard

9701/12/O/N/23/Q3

- 3 Zinc reacts with concentrated nitric acid giving three products only: zinc nitrate, an oxide of nitrogen and water.

3.0 moles of zinc react with 8.0 moles of nitric acid. Zinc nitrate contains Zn^{2+} ions.

What could be the formula of the oxide of nitrogen?

- A N_2O B NO C N_2O_3 D NO_2

Q32 - Hard

9701/12/O/N/23/Q8

- 8 In an experiment, 0.100 mol of propan-1-ol is burnt completely in 12.0 dm^3 of oxygen, measured at room conditions.

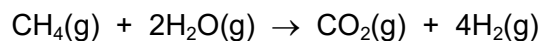
What is the final volume of gas, measured at room conditions?

- A 7.20 dm^3 B 8.40 dm^3 C 16.80 dm^3 D 18.00 dm^3

Q33 - Hard

9701/11/O/N/25/Q4

- 4 Methane and steam react to produce hydrogen.



0.80 g of methane and 1.35 g of steam react. One of the reactants is used up.

Which volume of hydrogen, measured at room conditions, will be produced?

- A** 1.80 dm³ **B** 3.60 dm³ **C** 4.80 dm³ **D** 7.20 dm³



Q34 - Easy

9701/13/M/J/23/Q3

- 3 A piece of rock has a mass of 2.00 g. It contains calcium carbonate, but no other basic substances. It neutralises exactly 36.0 cm^3 of $0.500 \text{ mol dm}^{-3}$ hydrochloric acid.

What is the percentage by mass of calcium carbonate in the 2.00 g piece of rock?

- A 22.5% B 45.0% C 72.0% D 90.1%

Q35 - Easy

9701/13/M/J/23/Q11

- 11 Which mixture will react to form exactly one mole of water?

	volume 2.00 mol dm^{-3} $\text{H}_2\text{SO}_4 / \text{cm}^3$	volume 1.00 mol dm^{-3} $\text{NaOH} / \text{cm}^3$
A	250	500
B	250	1000
C	500	500
D	500	1000

Q36 - Easy

9701/11/M/J/24/Q1

- 1 Sample X is added to water and made up to a total volume of 200 cm^3 . This gives a solution of $0.100 \text{ mol dm}^{-3} \text{ HCl}$.

What is X?

- A 10 cm^3 of $1.00 \text{ mol dm}^{-3} \text{ HCl}$
B 30 cm^3 of $0.90 \text{ mol dm}^{-3} \text{ HCl}$
C 50 cm^3 of $0.40 \text{ mol dm}^{-3} \text{ HCl}$
D 100 cm^3 of $0.30 \text{ mol dm}^{-3} \text{ HCl}$

Q37 - Hard

9701/12/F/M/25/Q2

- 2 Crystals of copper(II) nitrate are prepared by adding an excess of malachite to nitric acid.

The formula of malachite is $\text{Cu}(\text{OH})_2 \cdot \text{CuCO}_3$. ($M_r = 221.0$)

12.0 g of malachite is added to 30.0 cm^3 of 1.50 mol dm^{-3} nitric acid.

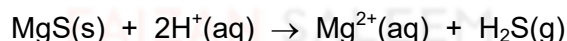
Which mass of malachite is left unreacted when the reaction is complete?

- A 2.05 g B 2.49 g C 7.03 g D 9.51 g

Q38 - Hard

9701/12/O/N/22/Q4

- 4 Calcium oxide and magnesium sulfide each react with acid.



A mixture of these two compounds, X, reacts with exactly 0.125 mol of dilute hydrochloric acid.

The amount of hydrogen sulfide formed is 0.0250 mol.

What was the mass of calcium oxide in mixture X?

- A 1.4 g B 2.1 g C 2.8 g D 4.2 g

Q39 - Hard

9701/12/O/N/23/Q4

- 4 A 3.7 g sample of copper(II) carbonate is added to 25 cm^3 of 2.0 mol dm^{-3} hydrochloric acid.

Which volume of gas is produced at room conditions?

- A 0.60 dm^3 B 0.72 dm^3 C 1.20 dm^3 D 2.40 dm^3

Question	Answer	Original paper reference
1	A	9701/11/O/N/21/Q1
2	C	9701/12/O/N/21/Q2
3	C	9701/12/F/M/23/Q11
4	B	9701/11/M/J/23/Q10
5	D	9701/11/O/N/24/Q4
6	B	9701/11/O/N/25/Q3
7	A	9701/12/O/N/21/Q1
8	B	9701/12/F/M/21/Q4
9	C	9701/12/F/M/22/Q3
10	D	9701/12/F/M/24/Q3
11	B	9701/12/M/J/22/Q4
12	A	9701/13/M/J/22/Q3
13	A	9701/11/O/N/23/Q3
14	C	9701/11/O/N/23/Q4
15	C	9701/11/O/N/24/Q3
16	D	9701/12/O/N/24/Q3
17	D	9701/11/M/J/25/Q6
18	B	9701/11/M/J/21/Q6
19	D	9701/13/M/J/21/Q9
20	A	9701/11/M/J/22/Q3
21	D	9701/11/M/J/22/Q4
22	A	9701/13/M/J/22/Q4
23	C	9701/12/M/J/23/Q4
24	B	9701/12/M/J/23/Q5
25	C	9701/11/M/J/24/Q2
26	A	9701/13/M/J/24/Q1
27	D	9701/12/F/M/24/Q4
28	C	9701/11/O/N/22/Q2

Question	Answer	Original paper reference
29	D	9701/11/O/N/22/Q8
30	C	9701/12/O/N/22/Q2
31	B	9701/12/O/N/23/Q3
32	B	9701/12/O/N/23/Q8
33	B	9701/11/O/N/25/Q4
34	B	9701/13/M/J/23/Q3
35	B	9701/13/M/J/23/Q11
36	C	9701/11/M/J/24/Q1
37	D	9701/12/F/M/25/Q2
38	B	9701/12/O/N/22/Q4
39	A	9701/12/O/N/23/Q4