

Formulae, Stoichiometry and the Mole Concept

Question Paper 2

Level	O Level
Subject	Chemistry
Exam Board	Cambridge International Examinations
Topic	Formulae, Stoichiometry and the Mole Concept
Booklet	Question Paper 2

Time Allowed: 53 minutes

Score: /44

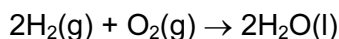
Percentage: /100

- 1 Calcium reacts with water as shown.



What is the total mass of the solution that remains when 40 g of calcium reacts with 100 g of water?

- A 58 g B 74 g C 138 g D 140 g
- 2 Hydrogen reacts with oxygen as shown in the equation below.



How much gas will remain if 2 dm³ of hydrogen are reacted with 1 dm³ of oxygen at room temperature?

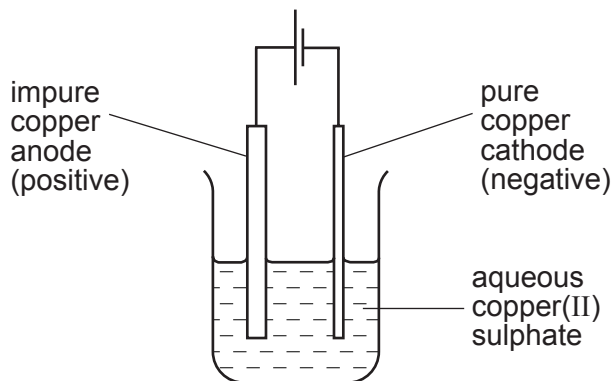
- A 0 dm³ B 1 dm³ C 2 dm³ D 3 dm³
- 3 Element Z is in Group VI of the Periodic Table.

Which formula is **incorrect**?

- A Z²⁻ B Z₂O₃ C ZO₄²⁻ D ZO₃
- 4 What is the concentration of hydrogen ions in 0.05 mol/dm³ sulfuric acid?
- A 0.025 g/dm³ B 0.05 g/dm³ C 0.10 g/dm³ D 2.0 g/dm³
- 5 Which equation describes the most suitable reaction for making lead sulphate?

- A Pb + H₂SO₄ → PbSO₄ + H₂
- B PbCO₃ + H₂SO₄ → PbSO₄ + CO₂ + H₂O
- C Pb(NO₃)₂ + H₂SO₄ → PbSO₄ + 2HNO₃
- D Pb(OH)₂ + H₂SO₄ → PbSO₄ + 2H₂O

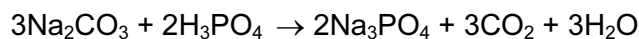
- 6 A sample of copper contains a metal impurity which is below copper in the reactivity series. The diagram shows the apparatus used for refining the sample.



The loss in mass of the anode (positive electrode) is 50 g and the gain in mass of the cathode (negative electrode) is 45 g.

What is the percentage purity of this sample of copper?

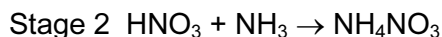
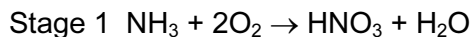
- A** 10.0% **B** 11.1% **C** 90.0% **D** 95.0%
- 7 One mole of a sample of hydrated sodium sulphide contains 162 g of water of crystallisation. What is the correct formula of this compound?
- A** $\text{Na}_2\text{S}\cdot 3\text{H}_2\text{O}$ **B** $\text{Na}_2\text{S}\cdot 5\text{H}_2\text{O}$ **C** $\text{Na}_2\text{S}\cdot 7\text{H}_2\text{O}$ **D** $\text{Na}_2\text{S}\cdot 9\text{H}_2\text{O}$
- 8 When added to 20 cm³ of 0.5 M sulphuric acid, which substance would give a neutral solution?
- A** 20 cm³ of 0.5 M sodium hydroxide
B 10 cm³ of 0.5 M sodium hydroxide
C 40 cm³ of 1.0 M sodium hydroxide
D 20 cm³ of 1.0 M sodium hydroxide
- 9 Carbon dioxide can be obtained as shown in the equation.



How many moles of phosphoric acid, H_3PO_4 , are needed to produce 1.5 mol of carbon dioxide?

- A** 0.5 **B** 1.0 **C** 1.5 **D** 2.0

- 10 The fertiliser ammonium nitrate (NH_4NO_3 , $M_r = 80$) is manufactured from ammonia (NH_3 , $M_r = 17$) by a two-stage process.



What is the maximum mass of fertiliser that can be made if only 17 tonnes of ammonia is available?

- A 34 tonnes B 40 tonnes C 80 tonnes D 97 tonnes
- 11 The element X forms a gaseous molecule X_2 . One volume of X_2 combines with one volume of hydrogen to form two volumes of a gaseous hydride.

What is the formula for the hydride of X?

- A HX B HX_2 C H_2X D H_2X_2

- 12 Which substance has the highest percentage by mass of nitrogen?

- A NH_4NO_3 $M_r = 80$
B $(\text{NH}_4)_2\text{SO}_4$ $M_r = 132$
C $\text{CO}(\text{NH}_2)_2$ $M_r = 60$
D $(\text{NH}_4)_3\text{PO}_4$ $M_r = 149$

- 13 The element sulphur, S, is in Group VI of the Periodic Table.

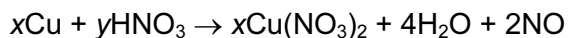
Which formula is **incorrect**?

- A S^{2-} B S_2O_3 C SO_4^{2-} D SO_3

- 14 Which equation represents the reaction of calcium with cold water?

- A $\text{Ca} + \text{H}_2\text{O} \rightarrow \text{CaO} + \text{H}_2$
B $2\text{Ca} + 2\text{H}_2\text{O} \rightarrow 2\text{CaOH} + \text{H}_2$
C $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$
D $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + 2\text{H}_2$

15 The equation represents the action of dilute nitric acid on copper.



What are the values of x and y ?

- A $x = 1, y = 4$
- B $x = 1, y = 8$
- C $x = 3, y = 4$
- D $x = 3, y = 8$

16 All ammonium salts on heating with sodium hydroxide produce ammonia gas.

From which ammonium salt can the greatest mass of ammonia be obtained?

- A 0.5 mol $(\text{NH}_4)_3\text{PO}_4$
- B 0.5 mol $(\text{NH}_4)_2\text{SO}_4$
- C 1.0 mol NH_4Cl
- D 1.0 mol NH_4NO_3

17 When ethanol is left standing in the air for some time it becomes acidic.

Which equation represents this change?

- A $\text{CH}_3\text{CH}_2\text{OH} + \text{CO} \rightarrow \text{CH}_3\text{CH}_2\text{CO}_2\text{H}$
- B $\text{CH}_3\text{CH}_2\text{OH} + \text{O}_2 \rightarrow \text{CH}_3\text{CO}_2\text{H} + \text{H}_2\text{O}$
- C $\text{CH}_3\text{CH}_2\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$
- D $2\text{CH}_3\text{CH}_2\text{OH} + \text{O}_2 \rightarrow 2\text{CH}_3\text{CO}_2\text{H} + 2\text{H}_2$

18 The symbols and electronic structures for some elements are shown below.

silicon, Si (2,8,4)

oxygen, O (2,6)

hydrogen, H (1)

fluorine, F (2,7)

nitrogen, N (2,5)

Which formula is correct for a compound containing silicon?

- A Si_4F
- B SiH_4
- C SiN_5
- D Si_2O

19 2 dm^3 of aqueous sodium hydroxide of concentration 5 mol/dm^3 were required for an experiment.

How many moles of sodium hydroxide were needed to make up this solution?

- A** 2.5 **B** 5 **C** 7 **D** 10

20 An 8 g sample of oxygen atoms contains the same number of atoms as 16 g of element **X**.

What is the relative atomic mass, A_r , of **X**?

- A** 4 **B** 8 **C** 16 **D** 32

21 Which quantity is the same for one mole of ethanol and one mole of ethane?

- A** mass
B number of atoms
C number of molecules
D volume at r.t.p.

22 In an experiment 264 g of strontium reacts with 213 g of chlorine.

What is the formula of strontium chloride?

- A** SrCl **B** SrCl_2 **C** SrCl_3 **D** Sr_2Cl

23 Three elements **X**, **Y** and **Z** have consecutive, increasing proton numbers.

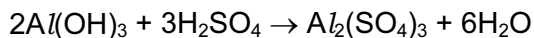
If element **X** is a noble gas, what will be the symbol for the ions of element **Z** in its compounds?

- A** Z^{2-} **B** Z^+ **C** Z^{2+} **D** Z^{3+}

24 How many moles per dm^3 of gaseous carbon dioxide are there if 4.4 g occupies 500 cm^3 ?

- A** 0.1 mol/dm^3 **B** 0.2 mol/dm^3 **C** 2.2 mol/dm^3 **D** 8.8 mol/dm^3

25 Aluminium sulphate can be obtained as shown in the equation.



How many moles of sulphuric acid are needed to produce 0.5 mol of aluminium sulphate?

- A** 0.5 **B** 1.0 **C** 1.5 **D** 3.0

26 What is the ratio of the volume of 2 g of hydrogen to the volume of 16 g of methane, both volumes at r.t.p.?

- A** 1 to 1 **B** 1 to 2 **C** 1 to 8 **D** 2 to 1

27 What is the mass of aluminium in 204 g of aluminium oxide, Al_2O_3 ?

- A** 26 g **B** 27 g **C** 54 g **D** 108 g

28 The relative molecular mass, M_r , of copper(II) sulphate, $CuSO_4$, is 160.

The relative molecular mass, M_r , of water is 18.

What is the percentage by mass of water in copper(II) sulphate crystals, $CuSO_4 \cdot 5H_2O$?

- A** $\frac{18 \times 100}{160}$ **B** $\frac{5 \times 18 \times 100}{160 + 18}$ **C** $\frac{18 \times 100}{160 + 18}$ **D** $\frac{5 \times 18 \times 100}{160 + (5 \times 18)}$

29 The formula of china clay (aluminium silicate) was shown in an old book as $Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$.

This formula is shown in a modern book as $Al_2(OH)_x Si_2O_y$.

What are the values of x and y in the modern formula?

	x	y
A	2	4
B	2	5
C	4	3
D	4	5

30 What is the concentration of iodine, I₂, molecules in a solution containing 2.54 g of iodine in 250 cm³ of solution?

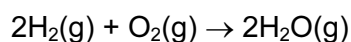
- A** 0.01 mol/dm³ **B** 0.02 mol/dm³ **C** 0.04 mol/dm³ **D** 0.08 mol/dm³

31 The formula of an oxide of uranium is UO₂.

What is the formula of the corresponding chloride?

- A** UC_l₂ **B** UC_l₄ **C** U₂Cl **D** U₄Cl

32 The equation for the burning of hydrogen in oxygen is shown below.

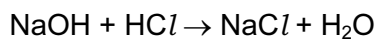


Which information does this equation give about the reaction?

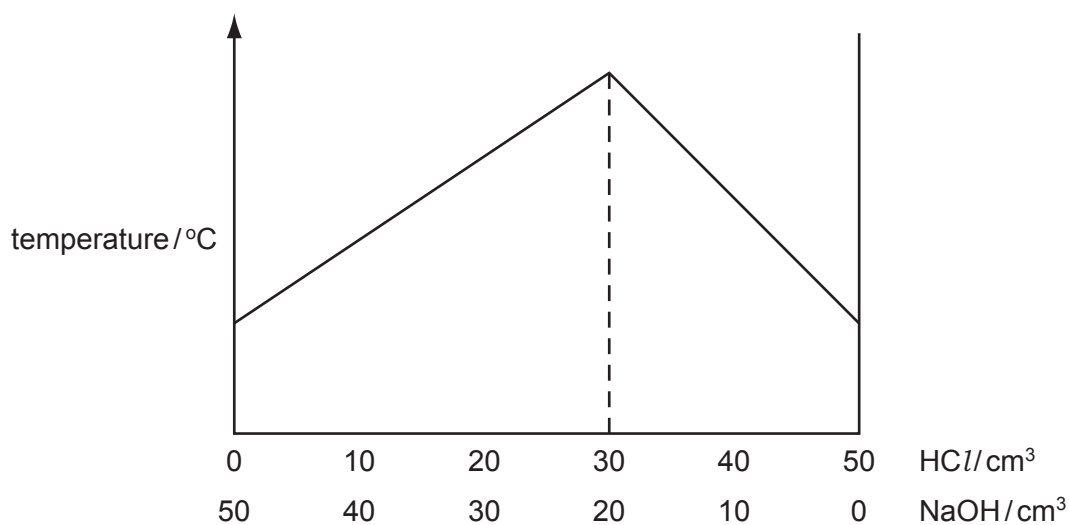
- A** 36 g of steam can be obtained from 16 g of oxygen.
B 2 g of hydrogen combine with 1 g of oxygen.
C 2 mol of steam can be obtained from 1 mol of oxygen.
D 2 atoms of hydrogen combine with 2 atoms of oxygen.

33 A solution of hydrochloric acid has a concentration of 2 mol/dm^3 .

Different volumes of the acid are added to different volumes of aqueous sodium hydroxide.



The maximum temperature of each mixture is measured. The graph shows the results.



What is the concentration of the aqueous sodium hydroxide?

- A 0.67 mol/dm^3
- B 1.3 mol/dm^3
- C 1.5 mol/dm^3
- D 3.0 mol/dm^3

34 'Cracking' of hydrocarbons breaks them into smaller molecules.

Which example of 'cracking' would produce the largest volume of products from one mole of hydrocarbon? Assume that all measurements are made at the same temperature and pressure.

- A $C_6H_{14}(g) \rightarrow 3C_2H_4(g) + H_2(g)$
- B $C_8H_{18}(g) \rightarrow 2C_3H_8(g) + C_2H_2(g)$
- C $C_{10}H_{22}(g) \rightarrow C_8H_{18}(g) + C_2H_4(g)$
- D $C_{12}H_{26}(g) \rightarrow C_8H_{18}(g) + 2C_2H_4(g)$

35 When 20 cm^3 of a gaseous alkene burns in an excess of oxygen, 60 cm^3 of carbon dioxide are formed. Both volumes are measured at r.t.p.

What is the formula of the alkene?

- A C_3H_6
- B C_3H_8
- C C_6H_{12}
- D C_6H_{14}

36 'Meta-fuel', $C_8H_{16}O_4$, is a fuel used in camping stoves.

What is the equation for its complete combustion?

- A $C_8H_{16}O_4 + 2O_2 \rightarrow 8C + 8H_2O$
- B $C_8H_{16}O_4 + 5O_2 \rightarrow 8CO + 8H_2O$
- C $C_8H_{16}O_4 + 10O_2 \rightarrow 8CO_2 + 8H_2O$
- D $C_8H_{16}O_4 + 8O_2 \rightarrow 4CO_2 + 4CO + 8H_2O$

37 All ammonium salts on heating with sodium hydroxide produce ammonia gas.
From which ammonium salt can the greatest mass of ammonia be obtained?

- A 0.5 mol $(NH_4)_3PO_4$
- B 0.5 mol $(NH_4)_2SO_4$
- C 1.0 mol NH_4Cl
- D 1.0 mol NH_4NO_3

38 A 25 cm³ sample of dilute sulphuric acid contains 0.025 moles of the acid.

What is the hydrogen ion concentration in the solution?

- A 0.25 mol / dm³
- B 0.50 mol / dm³
- C 1.00 mol / dm³
- D 2.00 mol / dm³

39 Elements X and Y combine to form the gas XY₂.

What are X and Y?

	X	Y
A	calcium	chlorine
B	carbon	hydrogen
C	carbon	oxygen
D	hydrogen	oxygen

40 Which sulphide contains the greatest mass of sulphur in a 10 g sample?

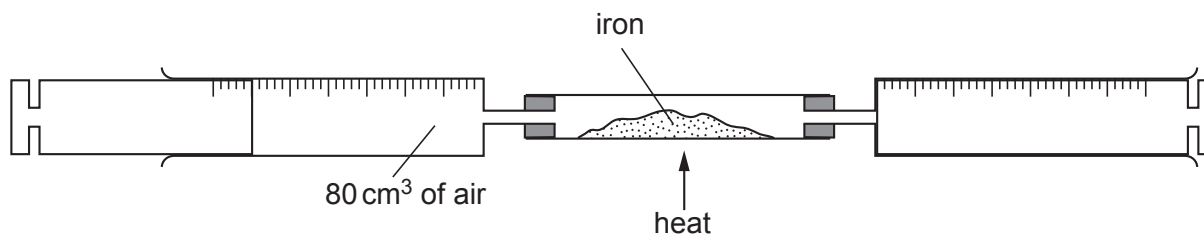
sulphide	formula	mass of one mole / g
A	NiS	90
B	FeS ₂	120
C	MoS ₂	160
D	PbS	239

41 124 g of phosphorus vapour has the same volume as 71 g of chlorine gas at the same temperature and pressure.

What is the formula of a molecule of phosphorus?

- A P₈
- B P₄
- C P₂
- D P

- 42 An 80 cm^3 sample of air is trapped in a syringe. The air is slowly passed over heated iron in a tube until there is no further decrease in volume.



When cooled to the original temperature, which volume of gas remains?

- A** 80 cm^3 **B** 64 cm^3 **C** 20 cm^3 **D** 16 cm^3
- 43 What is the mass of magnesium which completely reacts with 250 cm^3 of 1.0 mol/dm^3 sulphuric acid?
- A** 6 g **B** 12 g **C** 48 g **D** 96 g
- 44 A volume of ethane, C_2H_6 , at r.t.p. has a mass of 20 g.
- What is the mass of an equal volume of propene, C_3H_6 , at r.t.p.?
- A** 20 g **B** 21 g **C** 28 g **D** 42 g