

Cambridge University Examinations

General Certificate of Education Ordinary Level
O – LEVEL 5070. Notes, P1, P2 and P4

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Chapter

The Mole Concepts

Work Sheet Paper 1

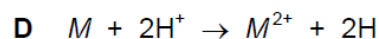
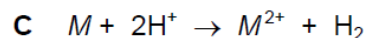
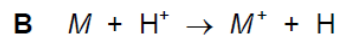
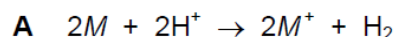
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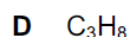
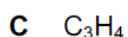
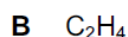
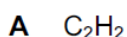
- 1 When reacted with an excess of dilute hydrochloric acid, 0.002 moles of a metal M liberated 48 cm^3 of hydrogen measured at r.t.p.

Which equation is correct for this reaction?



- 2 In an experiment, 1 cm^3 of a gaseous hydrocarbon, Z , requires 4 cm^3 of oxygen for complete combustion to give 3 cm^3 of carbon dioxide. All gas volumes are measured at r.t.p.

Which formula represents Z ?



- 3 What is the number of moles of hydrogen atoms in 3.2 g of methane?

A 0.02

B 0.2

C 0.4

D 0.8

- 4 The formula of the gas ozone is O_3 .

What is the volume of 48 g of ozone at r.t.p.?

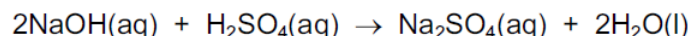
A 16 dm^3

B 24 dm^3

C 36 dm^3

D 72 dm^3

- 5 The equation shown represents the neutralisation of aqueous sodium hydroxide with dilute sulfuric acid.



How much sulfuric acid is required to neutralise 100 cm^3 of 1.0 mol/dm^3 NaOH?

A 50 cm^3 of 2.0 mol/dm^3 sulfuric acid

B 100 cm^3 of 1.0 mol/dm^3 sulfuric acid

C 25 cm^3 of 0.5 mol/dm^3 sulfuric acid

D 50 cm^3 of 1.0 mol/dm^3 sulfuric acid

- 6 Which element requires the largest number of electrons for one mole of the metal to be formed from its aqueous ions during electrolysis?

A aluminium

B calcium

C copper

D sodium

- 7 0.5 mol/dm^3 hydrochloric acid is added gradually to a flask containing 20 cm^3 of 2 mol/dm^3 sodium hydroxide solution.

What is the total volume, in cm^3 , of the mixture in the flask when the solution is just neutral?

A 30

B 40

C 60

D 100

8 A volume of ethane, C_2H_6 , at r.t.p. has a mass of 20 g.

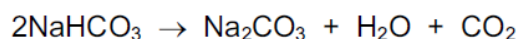
What is the mass of an equal volume of propene, C_3H_6 , at r.t.p.?

- A** 20 g **B** 21 g **C** 28 g **D** 42 g

9 18 g of water contains the same number of molecules as

- A** 18 g of ammonia gas.
B 2 g of hydrogen gas.
C 14 g of nitrogen gas.
D 16 g of oxygen gas.

10 Sodium hydrogencarbonate decomposes on heating.



In an experiment, a 5.0 mol sample of sodium hydrogencarbonate is heated.

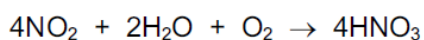
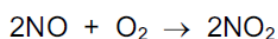
Which volume of carbon dioxide, measured at room temperature and pressure, is evolved?

- A** 24 dm³ **B** 36 dm³ **C** 48 dm³ **D** 60 dm³

11 What is the concentration of iodine molecules, I_2 , 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

12 Two of the reactions used in the manufacture of nitric acid, HNO_3 , are shown.



What is the maximum number of moles of nitric acid which could be formed from one mole of nitrogen monoxide, NO ?

- A** 0.5 **B** 1.0 **C** 2.0 **D** 4.0

13 If 1 mole of each alkane is completely burned in oxygen, which will provide 7 moles of products?

- A** CH_4 **B** C_2H_6 **C** C_3H_8 **D** C_4H_{10}

14 A compound Y is the only substance formed when two volumes of dry ammonia gas react with one volume of dry carbon dioxide (both volumes measured at s.t.p.).

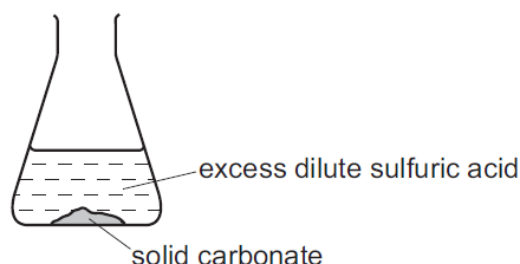
What is the most likely formula of Y?

- A** $(NH_4)_2CO_3$
B NH_2COONH_4
C $(NH_2)_2CO$
D NH_4COONH_4

- 15 Which contains the greatest mass of nitrogen?
- A** 0.5 moles $(\text{NH}_4)_2\text{SO}_4$
B 1 mole NH_4NO_3
C 1.5 moles $(\text{NH}_4)_3\text{PO}_4$
D 2 moles $\text{CO}(\text{NH}_2)_2$
- 16 Compound **P** is the only substance formed when two volumes of ammonia gas react with one volume of carbon dioxide gas (both volumes being measured at r.t.p.).

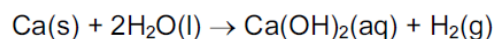
What is the formula of **P**?

- A** $\text{NH}_2\text{CO}_2\text{NH}_4$
B $(\text{NH}_2)_2\text{CO}$
C $\text{NH}_4\text{CO}_2\text{NH}_4$
D $(\text{NH}_4)_2\text{CO}_3$
- 17 One mole samples of each of the solid carbonates of lead, calcium, barium and magnesium are reacted in turn with excess dilute sulfuric acid.



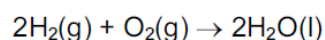
Which sample of carbonate will release the greatest volume of carbon dioxide?

- A** barium
B calcium
C lead
D magnesium
- 18 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
- 19 Hydrogen reacts with oxygen as shown in the equation below.



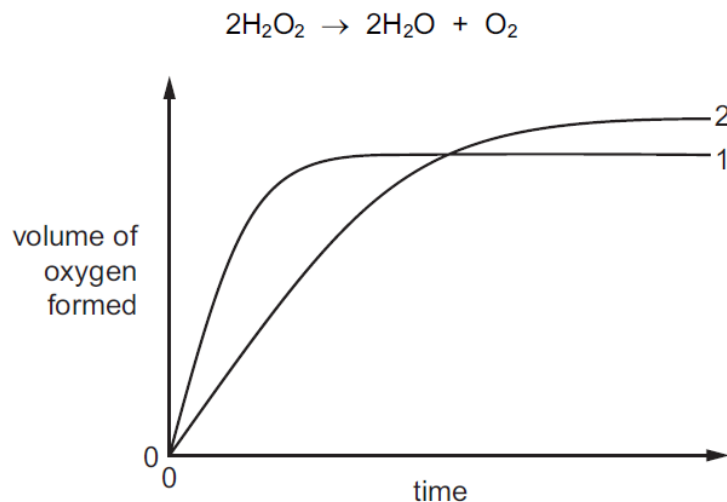
How much gas will remain if 2 dm^3 of hydrogen are reacted with 1 dm^3 of oxygen at room temperature?

- A** 0 dm^3 **B** 1 dm^3 **C** 2 dm^3 **D** 3 dm^3

20 What is the ratio of the number of molecules in 71 g of gaseous chlorine to the number of molecules in 2 g of gaseous hydrogen? [Relative atomic masses A_r (atomic weights): H, 1; Cl, 35.5]

- A** 1:1 **B** 1:2 **C** 2:1 **D** 71:2

21 In the graph, curve 1 was obtained by observing the decomposition of 100 cm³ of 1.0 mol/dm³ hydrogen peroxide solution, catalysed by manganese(IV) oxide.



Which alteration to the original experimental conditions would produce curve 2?

- A** adding some 0.1 mol/dm³ hydrogen peroxide solution
B lowering the temperature
C using less manganese(IV) oxide
D using a different catalyst

22 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

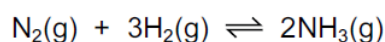
23 How many moles of hydrogen chloride are formed when one mole of methane reacts with a large excess of chlorine in sunlight?

- A** 1 **B** 2 **C** 3 **D** 4

24 Using the Periodic Table for the relative atomic masses, which has the greatest mass?

- A** 0.1 moles of iodine molecules, I₂
B 0.5 moles of carbon dioxide, CO₂
C 1.0 mole of beryllium oxide, BeO
D 1.0 mole of sodium, Na

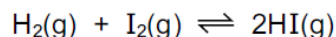
25 Ammonia is manufactured from nitrogen and hydrogen by the Haber process.



What is the percentage yield when 60 kg of ammonia is produced from 60 kg of hydrogen?

- A** 5.9% **B** 17.6% **C** 35.3% **D** 50.0%

- 26 Hydrogen reacts with iodine to form hydrogen iodide. This is a slow reaction.

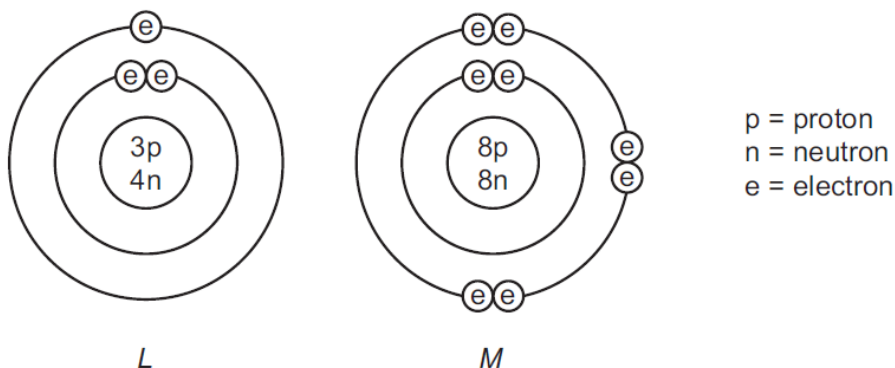


1 mole of hydrogen gas and 1 mole of iodine vapour were mixed and allowed to react. After t seconds, 0.6 moles of hydrogen remained.

What is the number of moles of iodine remaining after t seconds?

- A** 0.0 **B** 0.4 **C** 0.6 **D** 1.0

- 27 The diagram shows the structures of the atoms of elements L and M .



The elements combine to form a compound.

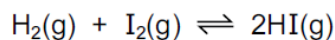
What is the mass of one mole of this compound?

- A** 11 g **B** 12 g **C** 23 g **D** 30 g

- 28 Which compound produces the greatest number of ions when 1 mole is dissolved in water?

- A** aluminium sulfate
B ammonium carbonate
C ammonium nitrate
D calcium nitrate

- 29 Hydrogen reacts with iodine to form hydrogen iodide. This is a slow reaction.



1 mole of hydrogen gas and 1 mole of iodine vapour were mixed and allowed to react. After t seconds, 0.6 moles of hydrogen remained.

What is the number of moles of iodine remaining after t seconds?

- A** 0.0 **B** 0.4 **C** 0.6 **D** 1.0

- 30 The relative atomic mass of chlorine is 35.5.

What is the mass of 2 moles of chlorine gas?

- A** 17.75 g **B** 35.5 g **C** 71 g **D** 142 g

- 31 Sulfuric acid and potassium hydroxide can react together to form potassium hydrogensulfate, KHSO_4 , and water only.

Which amounts of the reactants are required?

- A** equal masses of sulfuric acid and potassium hydroxide
B equal numbers of moles of sulfuric acid and potassium hydroxide
C 1 mol of sulfuric acid to 2 mol of potassium hydroxide
D 2 mol of sulfuric acid to 1 mol of potassium hydroxide
- 32 One volume of a gaseous element X_2 combines with an equal volume of gaseous hydrogen to form two volumes of a gaseous hydride.

What is the formula for the hydride of X?

- A** H_2X **B** HX **C** HX_2 **D** H_2X_2
- 33 A 10 cm^3 sample of a gaseous hydrocarbon is completely burnt in oxygen. The total volume of the products is 70 cm^3 . All gas volumes are measured at room temperature and pressure.

Which equation represents the combustion of the hydrocarbon?

- A** $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
B $\text{C}_2\text{H}_4(\text{g}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
C $\text{C}_3\text{H}_8(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 3\text{CO}_2(\text{g}) + 4\text{H}_2\text{O}(\text{g})$
D $2\text{C}_2\text{H}_6(\text{g}) + 7\text{O}_2(\text{g}) \rightarrow 4\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{g})$
- 34 The compounds $\text{CO}(\text{NH}_2)_2$ and NH_4NO_3 are used as fertilisers.

The proportion of nitrogen by mass in $\text{CO}(\text{NH}_2)_2$ is1..... that in NH_4NO_3 .

The proportion of nitrogen by mole in $\text{CO}(\text{NH}_2)_2$ is2..... that in NH_4NO_3 .

Which words correctly complete gaps 1 and 2?

	1	2
A	equal to	equal to
B	higher than	equal to
C	higher than	higher than
D	lower than	lower than

- 35 Which organic compound requires the least oxygen for the complete combustion of one mole of the compound?

- A** $\text{C}_3\text{H}_7\text{OH}$ **B** $\text{C}_3\text{H}_7\text{COOH}$ **C** C_3H_8 **D** C_4H_8

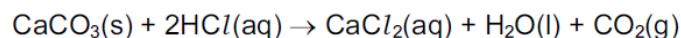
- 36 What has the same mass as 0.25 mol of copper atoms?

- A** 0.5 mol of oxygen molecules
B 1 mol of sulfur dioxide molecules
C 1.5 mol of water molecules
D 2 mol of oxygen atoms

37 What is the empirical formula of a compound containing 12g of carbon, 2g of hydrogen and 16g of oxygen only?

- A** CHO **B** CHO₂ **C** CH₂O **D** C₂HO

38 The equation for the reaction between calcium carbonate and hydrochloric acid is shown.



How many moles of calcium carbonate will give 24 cm³ of carbon dioxide when reacted with an excess of the acid?

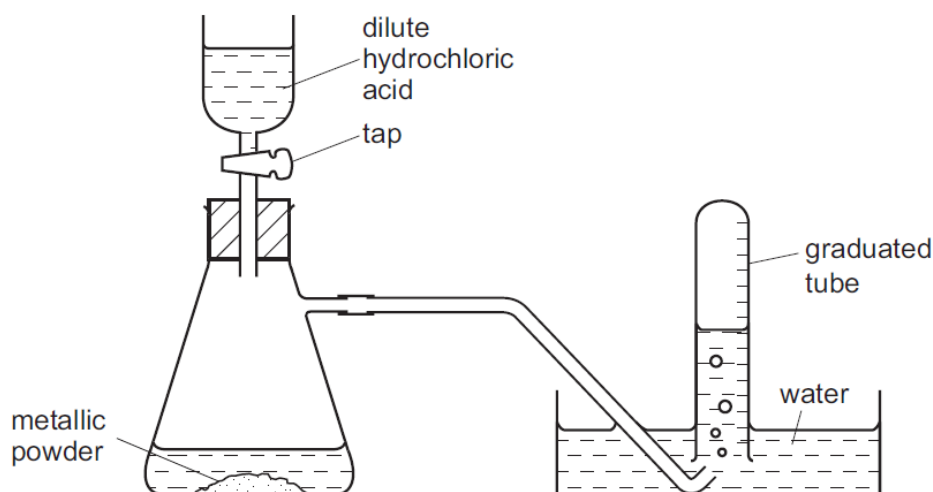
(Assume one mole of carbon dioxide occupies 24 dm³.)

- A** 1 mol **B** 0.1 mol **C** 0.01 mol **D** 0.001 mol

39 What is the mass of one mole of carbon-12?

- A** 0.012g **B** 0.024g **C** 1g **D** 12g

40 The diagram shows apparatus for measuring the volume of hydrogen given off when an excess of dilute hydrochloric acid is added to powdered metal. The volume of gas is measured at room temperature and pressure.



The experiment is carried out three times, using the same mass of powder each time but with different powders:

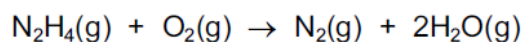
- pure magnesium
- pure zinc
- a mixture of magnesium and zinc

Which powder gives the greatest volume of hydrogen and which the least volume?

	greatest volume of H ₂	least volume of H ₂
A	magnesium	zinc
B	magnesium	the mixture
C	zinc	magnesium
D	zinc	the mixture

41 The gas hydrazine has the molecular formula N_2H_4 .

Hydrazine burns in air to form nitrogen gas and steam.



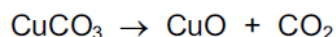
Which statements are correct?

- 1 1 mole of hydrazine gives 72 dm^3 of gaseous products when it reacts with oxygen at room temperature and pressure.
- 2 The empirical formula of hydrazine is NH_2 .
- 3 The total number of atoms in 1 mole of hydrazine is $6 \times$ the Avogadro constant.
- 4 The volume of 1 mole of hydrazine at room temperature and pressure is $6 \times 24 \text{ dm}^3$.

A 1, 2 and 3 **B** 1 and 2 only **C** 2, 3 and 4 **D** 3 and 4 only

42 Copper(II) carbonate is broken down by heating to form copper(II) oxide and carbon dioxide gas.

The equation for the reaction is shown.



31.0 g of copper(II) carbonate are heated until all of the contents of the test-tube have turned from green to black.

The yield of copper(II) oxide formed is 17.5 g.

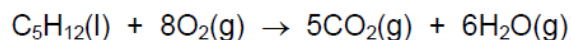
What is the percentage yield?

A 19.02% **B** 21.88% **C** 56.50% **D** 87.50%

43 What are the relative formula masses of one mole of solid magnesium and one mole of gaseous chlorine?

	magnesium	chlorine
A	12	17
B	24	35.5
C	24	71
D	48	71

44 Complete combustion of a hydrocarbon produces only carbon dioxide, CO_2 , and water, H_2O .



When 0.1 mol of the hydrocarbon C_5H_{12} is completely combusted, which volume of carbon dioxide, measured at room temperature and pressure, is produced?

A 0.5 dm^3 **B** 2.4 dm^3 **C** 5.0 dm^3 **D** 12 dm^3

45 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

- 46 A mass of 63 g of potassium manganate(VII), KMnO_4 , is needed for the complete oxidation of 23 g of ethanol, $\text{C}_2\text{H}_5\text{OH}$, under acidic conditions.

How many moles of ethanol can be completely oxidised by one mole of potassium manganate(VII) under these conditions?

- A** 0.37 **B** 0.80 **C** 1.00 **D** 1.25

- 47 Two characteristics of a gas, **G**, are given.

- **G** reduces copper(II) oxide to a pink-brown solid.
- 1.4 g of **G** has a volume of 1.2 dm^3 at room temperature and pressure.

What is **G**?

- A** carbon monoxide, CO
B hydrogen, H_2
C nitrogen, N_2
D nitrogen monoxide, NO

- 48 The relative formula masses of four compounds are given.

A student has a 1.0 g sample of each compound.

Which sample contains the highest number of moles of oxygen atoms?

	compound	relative formula mass
A	Al_2O_3	102
B	CuO	80
C	H_2SO_4	98
D	HNO_3	63

- 49 When 1 volume of gas **R** reacts with exactly 5 volumes of oxygen, it forms carbon dioxide and water only.

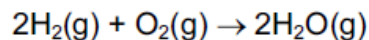
What is **R**?

- A** butane, C_4H_{10}
B ethane, C_2H_6
C methane, CH_4
D propane, C_3H_8

- 50 What is the concentration of iodine, I_2 , molecules in a solution containing 2.54 g of iodine in 250 cm^3 of solution?

- A** 0.01 mol/dm^3 **B** 0.02 mol/dm^3 **C** 0.04 mol/dm^3 **D** 0.08 mol/dm^3

- 51 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.
- 52 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
- 53 How many moles per dm³ of gaseous carbon dioxide are there if 4.4 g occupies 500 cm³?
- A** 0.1 mol/dm³ **B** 0.2 mol/dm³ **C** 2.2 mol/dm³ **D** 8.8 mol/dm³
- 54 2 dm³ of aqueous sodium hydroxide of concentration 5 mol/dm³ 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
- 55 One mole of each of the following compounds is burnt in excess oxygen.
Which compound will produce three moles of carbon dioxide and three moles of steam only?
- A** C₃H₈ **B** C₃H₇OH **C** C₃H₇CO₂H **D** CH₃CO₂CH₃