Chemistry

As - LEVEL

CAMBRIDGE UNIVERSITY EXAMINATIONS

General Certificate of Education Advanced Subsidiary Level
and Advanced Level (As Level and A Level)
Paper 1 Multiple Choice Questions(MCQs)

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Chapter 7

Moles

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1 *The use of the Data Booklet is relevant to this question.*

What is the number of molecules in 500 cm^3 of oxygen under room conditions?

A 1.25×10^{22}

B 1.34×10^{22}

C 3.0×10^{22}

D 3.0×10^{26}

2 Which of these samples of gas contains the same number of atoms as 1g of hydrogen (M_r : H_2, 2)?

A 22 g of carbon dioxide (M_r : CO_2, 44)

B 8 g of methane (M_r : CH_4, 16)

C 20 g of neon (M_r : Ne, 20)

D 8 g of ozone (M_r : O_3, 48)

3 Self-igniting flares contain Mg_3P_2. With water this produces diphosphane, P_2H_4, which is spontaneously flammable in air.

Which equation that includes the formation of diphosphane is balanced?

A $Mg_3P_2 + 6H_2O \rightarrow 3Mg(OH)_2 + P_2H_4$

B $Mg_3P_2 + 6H_2O \rightarrow 3Mg(OH)_2 + P_2H_4 + H_2$

C $2Mg_3P_2 + 12H_2O \rightarrow 6Mg(OH)_2 + P_2H_4 + 2PH_3$

D $2Mg_3P_2 + 12H_2O \rightarrow 6Mg(OH)_2 + 3P_2H_4$

4 *Use of the Data Booklet is relevant to this question.*

Most modern cars are fitted with airbags. These work by decomposing sodium azide to liberate nitrogen gas, which inflates the bag.

$$2NaN_3 \rightarrow 3N_2 + 2Na$$

A typical driver's airbag contains 50 g of sodium azide.

Calculate the volume of nitrogen this will produce at room temperature.

A 9.2 dm^3 **B** 13.9 dm^3 **C** 27.7 dm^3 **D** 72.0 dm^3

5 Which substance, in 1 mol dm^{-3} aqueous solution, would have the same hydrogen ion concentration as 1 mol dm^{-3} of hydrochloric acid?

A ethanoic acid

B nitric acid

C sodium hydroxide

D sulphuric acid

6 A pure hydrocarbon is used in bottled gas for cooking and heating.

When 10 cm^3 of the hydrocarbon is burned in 70 cm^3 of oxygen (an excess), the final gaseous mixture contains 30 cm^3 of carbon dioxide and 20 cm^3 of unreacted oxygen. All gaseous volumes were measured under identical conditions.

What is the formula of the hydrocarbon?

A C_2H_6 **B** C_3H_6 **C** C_3H_8 **D** C_4H_{10}

7 On collision, airbags in cars inflate rapidly due to the production of nitrogen.

The nitrogen is formed according to the following equations.

$$2NaN_3 \rightarrow 2Na + 3N_2$$

$$10Na + 2KNO_3 \rightarrow K_2O + 5Na_2O + N_2$$

How many moles of nitrogen gas are produced from 1 mol of sodium azide, NaN_3?

A 1.5 **B** 1.6 **C** 3.2 **D** 4.0

8 The first six ionisation energies of four elements, **A** to **D**, are given.

Which element is most likely to be in Group IV of the Periodic Table?

ionisation energy / kJ mol^{-1}	1st	2nd	3rd	4th	5th	6th
A	494	4560	6940	9540	13400	16600
B	736	1450	7740	10500	13600	18000
C	1090	2350	4610	6220	37800	47000
D	1400	2860	4590	7480	9400	53200

9 In which species are the numbers of electrons and neutrons equal?

A $^{9}_{4}Be$ **B** $^{19}_{9}F$ **C** $^{23}_{11}Na^{+}$ **D** $^{18}_{8}O^{2-}$

10 N_2O_4 is a poisonous gas. It can be disposed of safely by reaction with sodium hydroxide.

$$N_2O_4(g) + 2NaOH(aq) \rightarrow NaNO_3(aq) + NaNO_2(aq) + H_2O(l)$$

What is the minimum volume of 0.5 mol dm^{-3} NaOH(aq) needed to dispose of 0.02 mol of N_2O_4?

A 8 cm^3 **B** 12.5 cm^3 **C** 40 cm^3 **D** 80 cm^3

11 A sample of chlorine containing isotopes of mass numbers 35 and 37 was analysed in a mass-spectrometer.

How many peaks corresponding to Cl_2^+ were recorded?

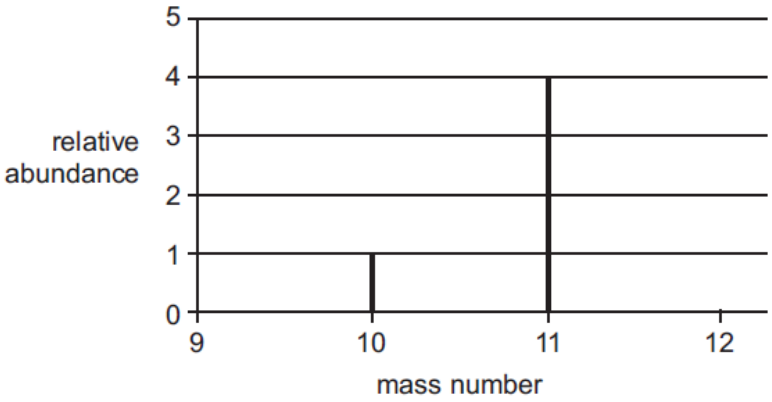
A 2 **B** 3 **C** 4 **D** 5

12 *Use of the Data Booklet is relevant to this question.*

What mass of solid residue can be obtained from the thermal decomposition of 4.10 g of anhydrous calcium nitrate?

A 0.70 g **B** 1.00 g **C** 1.40 g **D** 2.25 g

13 The isotopic composition of an element is indicated below.



What is the relative atomic mass of the element?

A 10.2 **B** 10.5 **C** 10.8 **D** 11.0

14 *Use of the Data Booklet is relevant to this question.*

Oxides of nitrogen are pollutant gases which are emitted from car exhausts.

In urban traffic, when a car travels one kilometre, it releases 0.23 g of an oxide of nitrogen N_xO_y, which occupies 120 cm^3.

What are the values of *x* and *y*?
(Assume 1 mol of gas molecules occupies 24.0 dm^3.)

A $x = 1, y = 1$

B $x = 1, y = 2$

C $x = 2, y = 1$

D $x = 2, y = 4$

15 In the Basic Oxygen steel-making process the P_4O_{10} impurity is removed by reacting it with calcium oxide. The only product of this reaction is the salt calcium phosphate, $Ca_3(PO_4)_2$.

In this reaction, how many moles of calcium oxide react with one mole of P_4O_{10}?

A 1 **B** 1.5 **C** 3 **D** 6

16 *Use of the Data Booklet is relevant to this question.*

A typical solid fertiliser for use with household plants and shrubs contains the elements N, P, and K in the ratio of 15 g : 30 g : 15 g per 100 g of fertiliser. The recommended usage of fertiliser is 14 g of fertiliser per 5 dm^3 of water.

What is the concentration of nitrogen atoms in this solution?

A 0.03 mol dm^{-3}

B 0.05 mol dm^{-3}

C 0.42 mol dm^{-3}

D 0.75 mol dm^{-3}

17 *Use of the Data Booklet is relevant to this question.*

The combustion of fossil fuels is a major source of increasing atmospheric carbon dioxide, with a consequential rise in global warming. Another significant contribution to carbon dioxide levels comes from the thermal decomposition of limestone, in the manufacture of cement and of lime for agricultural purposes.

Cement works roast 1000 million tonnes of limestone per year and a further 200 million tonnes is roasted in kilns to make lime.

What is the total annual mass output of carbon dioxide (in million tonnes) from these two processes?

A 440 **B** 527 **C** 660 **D** 880

18 *Use of the Data Booklet is relevant to this question.*

In leaded petrol there is an additive composed of lead, carbon and hydrogen only. This compound contains 29.7 % carbon and 6.19 % hydrogen by mass.

What is the value of **x** in the empirical formula PbC_8H_x?

A 5 **B** 6 **C** 16 **D** 20

19 A household bleach contains sodium chlorate(I), NaC*l*O, as its active ingredient. The concentration of NaC*l*O in the bleach can be determined by reacting a known amount with aqueous hydrogen peroxide, H_2O_2.

$$NaClO(aq) + H_2O_2(aq) \rightarrow NaCl(aq) + O_2(g) + H_2O(l)$$

When 25.0 cm^3 of bleach is treated with an excess of aqueous H_2O_2, 0.0350 mol of oxygen gas is given off.

What is the concentration of NaC*l*O in the bleach?

A 8.75×10^{-4} mol dm^{-3}

B 0.700 mol dm^{-3}

C 0.875 mol dm^{-3}

D 1.40 mol dm^{-3}

20 *Use of the Data Booklet is relevant to this question.*

2.920 g of a Group II metal, **X**, reacts with an excess of chlorine to form 5.287 g of a compound with formula **X**Cl_2.

What is metal **X**?

A barium

B calcium

C magnesium

D strontium

21 Which element of the third period requires the least number of moles of oxygen for the complete combustion of 1 mol of the element?

A aluminium

B magnesium

C phosphorus

D sodium

22 Tanzanite is used as a gemstone for jewellery. It is a hydrated calcium aluminium silicate mineral with a chemical formula $Ca_2Al_xSi_yO_{12}(OH).6½H_2O$. Tanzanite has M_r of 571.5.

Its chemical composition is 14.04 % calcium, 14.17 % aluminium, 14.75 % silicon, 54.59 % oxygen and 2.45 % hydrogen.

(A_r values: H = 1.0, O = 16.0, Al = 27.0, Si = 28.1, Ca = 40.1)

What are the values of x and y?

	x	y
A	1	1
B	2	3
C	3	3
D	6	1

23 0.144 g of an aluminium compound **X** react with an excess of water, to produce a gas. This gas burns completely in O_2 to form H_2O and 72 cm^3 of CO_2 only. The volume of CO_2 was measured at room temperature and pressure.

What could be the formula of **X**?
[C = 12.0, Al = 27.0; 1 mole of any gas occupies 24 dm^3 at room temperature and pressure]

A Al_2C_3 **B** Al_3C_4 **C** Al_4C_3 **D** Al_5C_3

24 *Use of the Data Booklet is relevant to this question.*

Which element is likely to have an electronegativity similar to that of aluminium?

A barium

B beryllium

C magnesium

D strontium

25 *Use of the Data Booklet is relevant to this question.*

Magnesium nitrate, $Mg(NO_3)_2$, will decompose when heated to give a white solid and a mixture of gases. One of the gases released is oxygen.

29.7 g of anhydrous magnesium nitrate is heated until no further reaction takes place.

What mass of oxygen is produced?

A 3.2 g **B** 6.4 g **C** 12.8 g **D** 19.2 g

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

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

What volume of gas was absorbed by the alkali?

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

27 A solution of Sn^{2+} ions will reduce an acidified solution of MnO_4^- ions to Mn^{2+} ions. The Sn^{2+} ions are oxidised to Sn^{4+} ions in this reaction.

How many moles of Mn^{2+} ions are formed when a solution containing 9.5 g of $SnCl_2$ (M_r: 190) is added to an excess of acidified $KMnO_4$ solution?

A 0.010 **B** 0.020 **C** 0.050 **D** 0.125

28 *Use of the Data Booklet is relevant to this question.*

Magnesium nitrate, $Mg(NO_3)_2$, will decompose when heated to give a white solid and a mixture of gases. One of the gases released is an oxide of nitrogen, X.

7.4 g of anhydrous magnesium nitrate is heated until no further reaction takes place.

What mass of X is produced?

A 1.5 g **B** 2.3 g **C** 3.0 g **D** 4.6 g

29 Which formula represents the empirical formula of a compound?

A CH_4O **B** C_2H_4 **C** C_6H_{12} **D** H_2O_2

30 *Use of the Data Booklet is relevant to this question.*

A washing powder contains sodium hydrogencarbonate, $NaHCO_3$, as one of the ingredients. In a titration, a solution containing 1.00 g of washing powder requires 7.15 cm^3 of 0.100 mol dm^{-3} sulfuric acid for complete reaction. The sodium hydrogencarbonate is the only ingredient that reacts with the acid.

What is the percentage by mass of sodium hydrogencarbonate in the washing powder?

A 3.0 **B** 6.0 **C** 12.0 **D** 24.0

31 *Use of the Data Booklet is relevant to this question.*

Anhydrous magnesium nitrate, $Mg(NO_3)_2$, will decompose when heated, giving a white solid and a mixture of two gases **X** and **Y**.

Y is oxygen.

What is the ratio $\frac{\text{mass of } \mathbf{X} \text{ released}}{\text{mass of } \mathbf{Y} \text{ released}}$?

A $\frac{1}{0.174}$ **B** $\frac{1}{0.267}$ **C** $\frac{1}{0.348}$ **D** $\frac{1}{3.43}$

32 *Use of the Data Booklet is relevant to this question.*

In an experiment, 12.0 dm^3 of oxygen, measured under room conditions, is used to burn completely 0.10 mol of propan-1-ol.

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

A 7.20 dm^3 **B** 8.40 dm^3 **C** 16.8 dm^3 **D** 18.00 dm^3

33 Ammonium sulfate in the soil is slowly oxidised by air, producing sulfuric acid, nitric acid and water as the only products.

How many moles of oxygen gas are needed for the complete oxidation of one mole of ammonium sulfate?

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

34

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1	A	11	B	21	D	31	A
2	C	12	C	22	C	32	B
3	B	13	C	23	C	33	D
4	C	14	B	24	B	34	
5	B	15	D	25	A	35	
6	C	16	A	26	C	36	
7	B	17	B	27	B	37	
8	C	18	D	28	D	38	
9	D	19	D	29	A	39	
10	D	20	D	30	C	40	