



PAPER 1

AS CHEMISTRY

TOPICAL PAST

YEAR

QUESTIONS

(with answers)

(2002-2018)

Cambridge International Examination
Based on New syllabus 2016

CINDY NG

Contents

Chapter 1: Atoms, molecules and stoichiometry	1-18
Chapter 2: Atomic structure	19-44
Chapter 3: Chemical bonding	45-73
Chapter 4: States of matter	74-95
Chapter 5: Chemical energetics	96-130
Chapter 6: Electrochemistry	131-144
Chapter 7: Equilibria	145-175
Chapter 8: Reaction Kinetics	176-211
Chapter 9: The Periodic Table chemical periodicity	212-233
Chapter 10: Group 2	234-258
Chapter 11: Group 17	259-284
Chapter 13: Nitrogen and Sulfur	285-305
Chapter 14: An introduction to organic chemistry	306-334
Chapter 15: Hydrocarbon	335-369
Chapter 16: Halogen Derivatives	370-394
Chapter 17: Hydroxy compounds	395-419
Chapter 18: Carbonyl compounds	420-442
Chapter 19: Carboxylic acids and derivatives	443-469
Combine Organic	470-515
Answer	Facebook

This AS topical revision book has been prepared to help in your study of chemistry to Cambridge International Examination. The past year questions have been sorted out according to topics. The answer can be downloaded from Facebook Page stated below.

About Cindy Ng

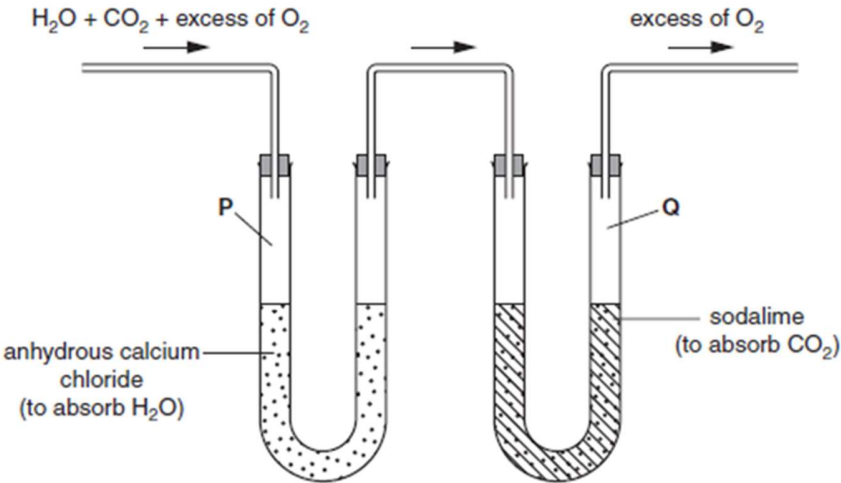
Cindy Ng, hold a Master's Degree in Analytical Chemistry & Instrumental Analysis, is a motivated enthusiastic chemistry educator with excellent communication skills demonstrated by 12 years of teaching experience in well-known private college and tuition centres. Proven results in delivering excellent curriculum management and achievement to students of varying backgrounds while motivating educational success.

Facebook Page: CINDYCHEMTUITION
Contact number: 012-6454389

**If you need any clarification of the syllabus, do not be hesitated to contact for help.
One to one/ group tuition service is provided.**

Chapter 1 Atoms, molecules and stoichiometry

1	<p>M/J 02</p> <p>2 As a simplification, an adult human can be considered to have a daily diet of 1.80 kg of carbohydrate (empirical formula CH_2O).</p> <p>Which mass of carbon dioxide does a person produce each day if all the carbohydrate eaten is digested and oxidised?</p> <p>A 0.267 kg B 0.800 kg C 1.32 kg D 2.64 kg</p>
2	<p>O/N 02</p> <p>1 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.</p> <p>What volume of gas was absorbed by the alkali?</p> <p>A 15 cm^3 B 20 cm^3 C 30 cm^3 D 40 cm^3</p>
3	<p>M/J 03</p> <p>1 <i>The use of the Data Booklet is relevant to this question.</i></p> <p>What is the number of molecules in 500 cm^3 of oxygen under room conditions?</p> <p>A 1.25×10^{22} B 1.34×10^{22} C 3.0×10^{22} D 3.0×10^{26}</p>
4	<p>O/N 03</p> <p>1 <i>Use of the Data Booklet is relevant to this question.</i></p> <p>Analytical chemists can detect very small amounts of amino acids, down to $3 \times 10^{-21}\text{ mol}$. How many molecules of an amino acid ($M_r = 200$) would this be?</p> <p>A 9 B 200 C 1800 D 360 000</p>
5	<p>2 <i>Use of the Data Booklet is relevant to this question.</i></p> <p>A garden fertiliser is said to have a phosphorus content of 30.0% 'P_2O_5 soluble in water'.</p> <p>What is the percentage by mass of phosphorus in the fertiliser?</p> <p>A 6.55% B 13.1% C 26.2% D 30.0%</p>

6	<p>3 A sample of the hydrocarbon C_6H_{12} is completely burned in dry oxygen and the product gases are collected as shown. [A_r: H, 1; C, 12; O, 16.]</p>  <p>The increases in mass of the collecting vessels P and Q of the apparatus are M_P and M_Q, respectively.</p> <p>What is the ratio M_P / M_Q?</p> <p>A 0.41 B 0.82 C 1.2 D 2.4</p>
7	<p>M/J 04</p> <p>1 Which of these samples of gas contains the same number of atoms as 1g of hydrogen (M_r: H_2, 2)?</p> <p>A 22 g of carbon dioxide (M_r: CO_2, 44)</p> <p>B 8 g of methane (M_r: CH_4, 16)</p> <p>C 20 g of neon (M_r: Ne, 20)</p> <p>D 8 g of ozone (M_r: O_3, 48)</p>
8	<p>2 Self-igniting flares contain Mg_3P_2. With water this produces diphosphane, P_2H_4, which is spontaneously flammable in air.</p> <p>Which equation that includes the formation of diphosphane is balanced?</p> <p>A $Mg_3P_2 + 6H_2O \rightarrow 3Mg(OH)_2 + P_2H_4$</p> <p>B $Mg_3P_2 + 6H_2O \rightarrow 3Mg(OH)_2 + P_2H_4 + H_2$</p> <p>C $2Mg_3P_2 + 12H_2O \rightarrow 6Mg(OH)_2 + P_2H_4 + 2PH_3$</p> <p>D $2Mg_3P_2 + 12H_2O \rightarrow 6Mg(OH)_2 + 3P_2H_4$</p>

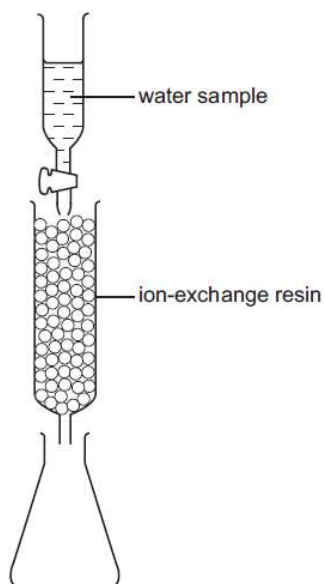
9	<p>3 Use of the Data Booklet is relevant to this question.</p> <p>Most modern cars are fitted with airbags. These work by decomposing sodium azide to liberate nitrogen gas, which inflates the bag.</p> $2\text{NaN}_3 \rightarrow 3\text{N}_2 + 2\text{Na}$ <p>A typical driver's airbag contains 50 g of sodium azide.</p> <p>Calculate the volume of nitrogen this will produce at room temperature.</p> <p>A 9.2 dm³ B 13.9 dm³ C 27.7 dm³ D 72.0 dm³</p>																				
10	<p>O/N 04</p> <p>1 Granular urea, CON_2H_4, can be used to remove NO_2 from the flue gases of power stations, converting it into harmless nitrogen.</p> $2\text{CON}_2\text{H}_4 + x\text{NO}_2 \rightarrow 2\text{CO}_2 + y\text{H}_2\text{O} + z\text{N}_2$ <p>What are the values of x, y and z in a balanced equation?</p> <table border="1"> <thead> <tr> <th></th><th>x</th><th>y</th><th>z</th></tr> </thead> <tbody> <tr> <td>A</td><td>1½</td><td>2</td><td>1¼</td></tr> <tr> <td>B</td><td>2</td><td>4</td><td>3</td></tr> <tr> <td>C</td><td>3</td><td>4</td><td>3½</td></tr> <tr> <td>D</td><td>3</td><td>4</td><td>3</td></tr> </tbody> </table>		x	y	z	A	1½	2	1¼	B	2	4	3	C	3	4	3½	D	3	4	3
	x	y	z																		
A	1½	2	1¼																		
B	2	4	3																		
C	3	4	3½																		
D	3	4	3																		
11	<p>2 The diagram shows the mass spectrum of a sample of zinc. Use the data to calculate the relative atomic mass of the sample.</p> <p>A 65 B 65.25 C 65.5 D 65.66</p>																				
12	<p>3 The foul smell that skunks spray is due to a number of thiols, one of which is methanethiol, CH_3SH, which burns as follows.</p> $\text{CH}_3\text{SH} + 3\text{O}_2 \rightarrow \text{CO}_2 + \text{SO}_2 + 2\text{H}_2\text{O}$ <p>A sample of 10 cm³ of methanethiol was exploded with 60 cm³ of oxygen.</p> <p>What would be the final volume of the resultant mixture of gases when cooled to room temperature?</p> <p>A 20 cm³ B 30 cm³ C 50 cm³ D 70 cm³</p>																				

13	<p>19 Ammonium sulphate in nitrogenous fertilisers in the soil can be slowly oxidised by air producing sulphuric acid, nitric acid and water.</p> <p>How many moles of oxygen are needed to oxidise completely one mole of ammonium sulphate?</p> <p>A 1 B 2 C 3 D 4</p>
14	<p>M/J 05</p> <p>1 A pure hydrocarbon is used in bottled gas for cooking and heating.</p> <p>When 10 cm³ of the hydrocarbon is burned in 70 cm³ of oxygen (an excess), the final gaseous mixture contains 30 cm³ of carbon dioxide and 20 cm³ of unreacted oxygen. All gaseous volumes were measured under identical conditions.</p> <p>What is the formula of the hydrocarbon?</p> <p>A C₂H₆ B C₃H₆ C C₃H₈ D C₄H₁₀</p>
15	<p>2 On collision, airbags in cars inflate rapidly due to the production of nitrogen.</p> <p>The nitrogen is formed according to the following equations.</p> $2\text{NaN}_3 \rightarrow 2\text{Na} + 3\text{N}_2$ $10\text{Na} + 2\text{KNO}_3 \rightarrow \text{K}_2\text{O} + 5\text{Na}_2\text{O} + \text{N}_2$ <p>How many moles of nitrogen gas are produced from 1 mol of sodium azide, NaN₃?</p> <p>A 1.5 B 1.6 C 3.2 D 4.0</p>
16	<p>O/N 05</p> <p>1 The petrol additive tetraethyl-lead(IV), Pb(C₂H₅)₄, is now banned in many countries. When it is completely burned in air, lead(II) oxide, CO₂ and H₂O are formed.</p> <p>How many moles of oxygen are required to burn one mole of Pb(C₂H₅)₄?</p> <p>A 9.5 B 11 C 13.5 D 27</p>
17	<p>M/J 06</p> <p>1 N₂O₄ is a poisonous gas. It can be disposed of safely by reaction with sodium hydroxide.</p> $\text{N}_2\text{O}_4(\text{g}) + 2\text{NaOH}(\text{aq}) \rightarrow \text{NaNO}_3(\text{aq}) + \text{NaNO}_2(\text{aq}) + \text{H}_2\text{O}(\text{l})$ <p>What is the minimum volume of 0.5 mol dm⁻³ NaOH(aq) needed to dispose of 0.02 mol of N₂O₄?</p> <p>A 8 cm³ B 12.5 cm³ C 40 cm³ D 80 cm³</p>
18	<p>2 A sample of chlorine containing isotopes of mass numbers 35 and 37 was analysed in a mass-spectrometer.</p> <p>How many peaks corresponding to Cl₂⁺ were recorded?</p> <p>A 2 B 3 C 4 D 5</p>

19

O/N 06

- 1 The amount of calcium ions in a sample of natural water can be determined by using an ion-exchange column as shown in the diagram.



A 50 cm^3 sample of water containing dissolved calcium sulphate was passed through the ion-exchange resin. Each calcium ion in the sample was exchanged for two hydrogen ions. The resulting acidic solution collected in the flask required 25 cm^3 of $1.0 \times 10^{-2}\text{ mol dm}^{-3}$ potassium hydroxide for complete neutralisation.

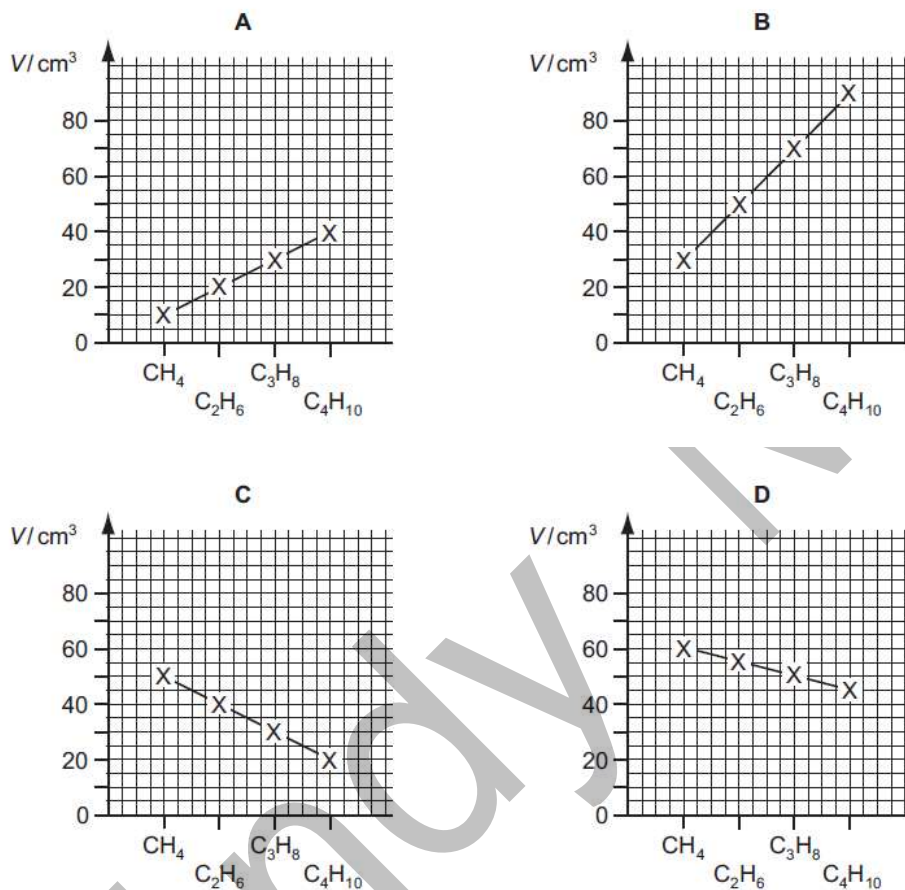
What was the concentration of the calcium sulphate in the original sample?

- A $2.5 \times 10^{-3}\text{ mol dm}^{-3}$
- B $1.0 \times 10^{-2}\text{ mol dm}^{-3}$
- C $2.0 \times 10^{-2}\text{ mol dm}^{-3}$
- D $4.0 \times 10^{-2}\text{ mol dm}^{-3}$

20

- 4 Samples of 10 cm^3 of each of the first four members of the alkane series are separately mixed with 70 cm^3 of oxygen. Each is then burned and the total volume, V , of residual gas measured again at room temperature and pressure.

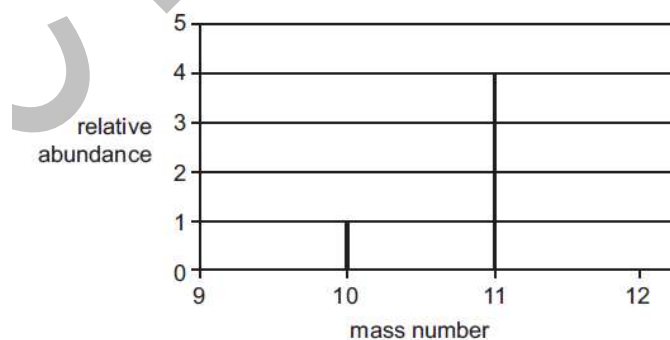
Which graph represents the results that would be obtained?



21

M/J 07

- 1 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

22	<p>O/N 07</p> <p>1 Use of the Data Booklet is relevant to this question.</p> <p>When a sports medal with a total surface area of 150 cm^2 was evenly coated with silver, using electrolysis, its mass increased by 0.216 g.</p> <p>How many atoms of silver were deposited per cm^2 on the surface of the medal?</p> <p>A 8.0×10^{18}</p> <p>B 1.8×10^{19}</p> <p>C 1.2×10^{21}</p> <p>D 4.1×10^{22}</p>																									
23	<p>3 The first stage in the manufacture of nitric acid is the oxidation of ammonia by oxygen.</p> $w\text{NH}_3(\text{g}) + x\text{O}_2(\text{g}) \rightarrow y\text{NO}(\text{g}) + z\text{H}_2\text{O}(\text{g})$ <p>Which values for w, x, y and z are needed to balance the equation?</p> <table border="1"> <thead> <tr> <th></th><th>w</th><th>x</th><th>y</th><th>z</th></tr> </thead> <tbody> <tr> <td>A</td><td>4</td><td>5</td><td>4</td><td>6</td></tr> <tr> <td>B</td><td>4</td><td>6</td><td>4</td><td>5</td></tr> <tr> <td>C</td><td>5</td><td>6</td><td>5</td><td>4</td></tr> <tr> <td>D</td><td>6</td><td>5</td><td>6</td><td>4</td></tr> </tbody> </table>		w	x	y	z	A	4	5	4	6	B	4	6	4	5	C	5	6	5	4	D	6	5	6	4
	w	x	y	z																						
A	4	5	4	6																						
B	4	6	4	5																						
C	5	6	5	4																						
D	6	5	6	4																						
24	<p>M/J 08</p> <p>1 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, $\text{Ca}_3(\text{PO}_4)_2$.</p> <p>In this reaction, how many moles of calcium oxide react with one mole of P_4O_{10}?</p> <p>A 1 B 1.5 C 3 D 6</p>																									
25	<p>2 Use of the Data Booklet is relevant to this question.</p> <p>A typical solid fertiliser for use with household plants and shrubs contains the elements N, P, and K in the ratio of $15 \text{ g} : 30 \text{ g} : 15 \text{ g}$ per 100 g of fertiliser. The recommended usage of fertiliser is 14 g of fertiliser per 5 dm^3 of water.</p> <p>What is the concentration of nitrogen atoms in this solution?</p> <p>A 0.03 mol dm^{-3}</p> <p>B 0.05 mol dm^{-3}</p> <p>C 0.42 mol dm^{-3}</p> <p>D 0.75 mol dm^{-3}</p>																									
26	<p>O/N 08</p> <p>1 Use of the Data Booklet is relevant to this question.</p> <p>Titanium(IV) oxide, TiO_2, is brilliantly white and much of the oxide produced is used in the manufacture of paint.</p> <p>What is the maximum amount of TiO_2 obtainable from 19.0 tonnes of the ore ilmenite, FeTiO_3?</p> <p>A 10.0 tonnes B 12.7 tonnes C 14.0 tonnes D 17.7 tonnes</p>																									

27 **2** Carbon disulphide vapour burns in oxygen according to the following equation.

$$\text{CS}_2(\text{g}) + 3\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{SO}_2(\text{g})$$

A sample of 10 cm^3 of carbon disulphide was burned in 50 cm^3 of oxygen. After measuring the volume of gas remaining, the product was treated with an excess of aqueous sodium hydroxide and the volume of gas measured again. All measurements were made at the same temperature and pressure, under such conditions that carbon disulphide was gaseous.

What were the measured volumes?

	volume of gas after burning / cm^3	volume of gas after adding $\text{NaOH}(\text{aq}) / \text{cm}^3$
A	30	0
B	30	20
C	50	20
D	50	40

28 M/J 09

1 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

29 **2** A household bleach contains sodium chlorate(I), NaClO , as its active ingredient. The concentration of NaClO in the bleach can be determined by reacting a known amount with aqueous hydrogen peroxide, H_2O_2 .

$$\text{NaClO}(\text{aq}) + \text{H}_2\text{O}_2(\text{aq}) \rightarrow \text{NaCl}(\text{aq}) + \text{O}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$$

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 NaClO in the bleach?

A $8.75 \times 10^{-4} \text{ mol dm}^{-3}$
B $0.700 \text{ mol dm}^{-3}$
C $0.875 \text{ mol dm}^{-3}$
D 1.40 mol dm^{-3}

30

O/N 09 (11)

1 An element **X** consists of four isotopes. The mass spectrum of **X** is shown in the diagram.

m/e	Relative Abundance (%)
90	50
91	10
92	20
94	20

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

A 91.00

B 91.30

C 91.75

D 92.00

31

2 0.200 mol of a hydrocarbon undergo complete combustion to give 35.2 g of carbon dioxide and 14.4 g of water as the only products.

What is the molecular formula of the hydrocarbon?

A C₂H₄

B C₂H₆

C C₄H₄

D C₄H₈

32

O/N 10 (11)

5 Use of the Data Booklet is relevant to this question.

Nickel makes up 20 % of the total mass of a coin. The coin has a mass of 10.0 g.

How many nickel atoms are in the coin?

A 2.05×10^{22}

B 4.30×10^{22}

C 1.03×10^{23}

D 1.20×10^{24}

33

M/J 11 (12)

10 Tanzanite is used as a gemstone for jewellery. It is a hydrated calcium aluminium silicate mineral with a chemical formula Ca₂Al_xSi_yO₁₂(OH).6½H₂O. 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*?

	<i>x</i>	<i>y</i>
A	1	1
B	2	3
C	3	3
D	6	1

34	<p>11 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.</p> <p>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]</p> <p>A Al_2C_3 B Al_3C_4 C Al_4C_3 D Al_5C_3</p>
35	<p>O/N 11 (11) 2 Use of the Data Booklet is relevant to this question.</p> <p>Lead(IV) chloride will oxidise bromide ions to bromine. The Pb^{4+} ions are reduced to Pb^{2+} ions in this reaction.</p> <p>If 6.980 g of lead(IV) chloride is added to an excess of sodium bromide solution, what mass of bromine would be produced?</p> <p>A 0.799 g B 1.598 g C 3.196 g D 6.392 g</p>
36	<p>O/N 11 (12) 2 The following equations the letters W, X, Y and Z all represent whole numbers.</p> <p>When correctly balanced, which equation requires one of letters W, X, Y or Z to be 5?</p> <p>A $WC_3H_7COOH + XO_2 \rightarrow YCO_2 + ZH_2O$ B $WC_4H_8 + XO_2 \rightarrow YCO_2 + ZH_2O$ C $WH_3PO_4 + XNaOH \rightarrow YNa_2HPO_4 + ZH_2O$ D $WNH_3 + XO_2 \rightarrow YN_2 + ZH_2O$</p>
37	<p>M/J 12 (11) 14 Use of the Data Booklet is relevant to this question.</p> <p>The reaction between aluminium powder and anhydrous barium nitrate is used as the propellant in some fireworks. The metal oxides and nitrogen are the only products.</p> <p>Which volume of nitrogen, measured under room conditions, is produced when 0.783 g of anhydrous barium nitrate reacts with an excess of aluminium?</p> <p>A 46.8 cm^3 B 72.0 cm^3 C 93.6 cm^3 D 144 cm^3</p>
38	<p>O/N 12 (13) 9 During steel-making the impurity P_4O_{10} is removed by reacting it with calcium oxide. The only product of this reaction is the salt calcium phosphate, $Ca_3(PO_4)_2$.</p> <p>In this reaction, how many moles of calcium oxide react with one mole of P_4O_{10}?</p> <p>A 1 B 1.5 C 3 D 6</p>

39	<p>M/J 13 (11)</p> <p>2 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.</p> <p>All gas volumes were measured at the same temperature and pressure.</p> <p>What volume of gas was absorbed by the alkali?</p> <p>A 15 cm^3 B 20 cm^3 C 30 cm^3 D 40 cm^3</p>
40	<p>M/J 13 (13)</p> <p>9 Which formula represents the empirical formula of a compound?</p> <p>A CH_4O B C_2H_4 C C_6H_{12} D H_2O_2</p>
41	<p>10 <i>Use of the Data Booklet is relevant to this question.</i></p> <p>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.</p> <p>What is the percentage by mass of sodium hydrogencarbonate in the washing powder?</p> <p>A 3.0 B 6.0 C 12.0 D 24.0</p>
42	<p>O/N 13 (11)</p> <p>10 <i>Use of the Data Booklet is relevant to this question.</i></p> <p>Which sodium compound contains 74.2 % by mass of sodium?</p> <p>A sodium carbonate B sodium chloride C sodium hydroxide D sodium oxide</p>
43	<p>O/N 13 (13)</p> <p>11 <i>Use of the Data Booklet is relevant to this question.</i></p> <p>Which calcium compound contains 54.1 % by mass of calcium?</p> <p>A calcium hydroxide B calcium nitrate C calcium oxide D calcium sulfate</p>

44	<p>M/J 14 (11)</p> <p>18 <i>Use of the Data Booklet is relevant to this question.</i></p> <p>A chemist took 2.00 dm^3 of nitrogen gas, measured under room conditions, and reacted it with a large volume of hydrogen gas, in order to produce ammonia. Only 15.0% of the nitrogen gas reacted to produce ammonia.</p> <p>What mass of ammonia was formed?</p> <p>A 0.213g B 0.425g C 1.42g D 2.83g</p>
45	<p>M/J 14 (12)</p> <p>9 <i>Use of the Data Booklet is relevant to this question.</i></p> <p>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.</p> <p>What is the final volume of gas, measured under room conditions?</p> <p>A 7.20 dm^3 B 8.40 dm^3 C 16.8 dm^3 D 18.00 dm^3</p>
46	<p>14 Ammonium sulfate in the soil is slowly oxidised by air, producing sulfuric acid, nitric acid and water as the only products.</p> <p>How many moles of oxygen gas are needed for the complete oxidation of one mole of ammonium sulfate?</p> <p>A 1 B 2 C 3 D 4</p>
47	<p>O/N 14 (11)</p> <p>6 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.</p> <p>What is the formula of the hydrocarbon?</p> <p>A CH_4 B C_2H_6 C C_3H_8 D C_6H_{12}</p>
48	<p>15 <i>Use of the Data Booklet is relevant to this question.</i></p> <p>A sample of potassium oxide, K_2O, is dissolved in 250 cm^3 of distilled water. 25.0 cm^3 of this solution is titrated against sulfuric acid of concentration 2.00 mol dm^{-3}. 15.0 cm^3 of this sulfuric acid is needed for complete neutralisation.</p> <p>Which mass of potassium oxide was originally dissolved in 250 cm^3 of distilled water?</p> <p>A 2.83g B 28.3g C 47.1g D 56.6g</p>

49	<p>29 Which equation correctly represents the balanced equation for the complete combustion of a hydrocarbon with the formula C_xH_y?</p> <p>A $C_xH_y + (x + \frac{y}{2})O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$</p> <p>B $C_xH_y + (x + \frac{y}{4})O_2 \rightarrow xCO_2 + yH_2O$</p> <p>C $C_xH_y + (x + \frac{y}{4})O_2 \rightarrow xCO_2 + \frac{y}{4}H_2O$</p> <p>D $C_xH_y + (x + \frac{y}{4})O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$</p>
50	<p>O/N 14 (13)</p> <p>6 Use of the Data Booklet is relevant to this question.</p> <p>In some countries, anhydrous calcium chloride is used as a drying agent to reduce dampness in houses. The anhydrous salt absorbs enough water to form the dihydrate $CaCl_2 \cdot 2H_2O$.</p> <p>What is the percentage increase in mass?</p> <p>A 14% B 24% C 32% D 36%</p>
51	<p>8 Use of the Data Booklet is relevant to this question.</p> <p>Ferrochrome is an alloy of iron and chromium. Ferrochrome can be dissolved in dilute sulfuric acid to produce a mixture of $FeSO_4$ and $Cr_2(SO_4)_3$. The $FeSO_4$ reacts with $K_2Cr_2O_7$ in acid solution according to the following equation.</p> $14H^+ + 6Fe^{2+} + Cr_2O_7^{2-} \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$ <p>When 1.00g of ferrochrome is dissolved in dilute sulfuric acid, and the resulting solution titrated, 13.1 cm^3 of 0.100 mol dm^{-3} $K_2Cr_2O_7$ is required for complete reaction.</p> <p>What is the percentage by mass of Fe in the sample of ferrochrome?</p> <p>A 1.22 B 4.39 C 12.2 D 43.9</p>
52	<p>12 What is the ionic equation for the reaction between aqueous sodium carbonate and dilute nitric acid?</p> <p>A $2HNO_3(aq) + CO_3^{2-}(aq) \rightarrow H_2O(l) + CO_2(g) + 2NO_3^-(aq)$</p> <p>B $2H^+(aq) + CO_3^{2-}(aq) \rightarrow CO_2(g) + H_2O(l)$</p> <p>C $2HNO_3(aq) + Na_2CO_3(aq) \rightarrow 2NaNO_3(aq) + CO_2(g) + H_2O(l)$</p> <p>D $2HNO_2(aq) + CO_3^{2-}(aq) \rightarrow H_2O(l) + CO_2(g) + 2NO_2^-(aq)$</p>

53	<p>M/J 15 (11)</p> <p>3 Use of the Data Booklet is relevant to this question.</p> <p>1.00 g of carbon is combusted in a limited supply of pure oxygen. 0.50 g of the carbon combusts to form CO_2 and 0.50 g of the carbon combusts to form CO.</p> <p>The resultant mixture of CO_2 and CO is passed through excess NaOH(aq) and the remaining gas is then dried and collected.</p> <p>What is the volume of the remaining gas? (All gas volumes are measured at 25°C and 1 atmosphere pressure.)</p> <p>A 1 dm^3 B 1.5 dm^3 C 2 dm^3 D 3 dm^3</p>
54	<p>M/J 15 (12)</p> <p>2 The shell of a chicken's egg makes up 5% of the mass of an average egg. An average egg has a mass of 50 g.</p> <p>Assume the egg shell is pure calcium carbonate.</p> <p>How many complete chicken's egg shells would be needed to neutralise 50 cm^3 of 2.0 mol dm^{-3} ethanoic acid?</p> <p>A 1 B 2 C 3 D 4</p>
55	<p>O/N 15 (11)</p> <p>3 Use of the Data Booklet is relevant to this question.</p> <p>The compound S_2O_7 is hydrolysed by water to produce sulfuric acid and oxygen only.</p> <p>Which volume of oxygen, measured at room temperature and pressure, is evolved when 0.352 g of S_2O_7 is hydrolysed?</p> <p>A 12 cm^3 B 24 cm^3 C 48 cm^3 D 96 cm^3</p>
56	<p>M/J 16 (11)</p> <p>3 Tetraethyl lead, $\text{Pb}(\text{C}_2\text{H}_5)_4$, has been used as a petrol additive.</p> <p>What is the percentage by mass of carbon in tetraethyl lead?</p> <p>A 10.2 B 14.9 C 29.7 D 32.0</p>

57	<p>6 A white powder is known to be a mixture of magnesium oxide and aluminium oxide.</p> <p>100 cm³ of 2 mol dm⁻³ NaOH(aq) is just sufficient to cause the aluminium oxide in x grams of the mixture to dissolve.</p> <p>The reaction occurring is $Al_2O_3 + 2OH^- + 3H_2O \rightarrow 2Al(OH)_4^-$.</p> <p>800 cm³ of 2 mol dm⁻³ HCl(aq) is just sufficient to cause all of the oxide in x grams of the mixture to dissolve.</p> <p>The reactions occurring are $Al_2O_3 + 6H^+ \rightarrow 2Al^{3+} + 3H_2O$ and $MgO + 2H^+ \rightarrow Mg^{2+} + H_2O$.</p> <p>How many moles of each oxide are present in x grams of the mixture?</p> <table border="1"> <thead> <tr> <th></th><th>aluminium oxide</th><th>magnesium oxide</th></tr> </thead> <tbody> <tr> <td>A</td><td>0.05</td><td>0.25</td></tr> <tr> <td>B</td><td>0.05</td><td>0.50</td></tr> <tr> <td>C</td><td>0.10</td><td>0.25</td></tr> <tr> <td>D</td><td>0.10</td><td>0.50</td></tr> </tbody> </table>		aluminium oxide	magnesium oxide	A	0.05	0.25	B	0.05	0.50	C	0.10	0.25	D	0.10	0.50
	aluminium oxide	magnesium oxide														
A	0.05	0.25														
B	0.05	0.50														
C	0.10	0.25														
D	0.10	0.50														
58	<p>17 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 cm³ of 0.500 mol dm⁻³ hydrochloric acid.</p> <p>What is the percentage of calcium carbonate in the 2.00 g piece of rock?</p> <p>A 22.5% B 45.0% C 72.0% D 90.1%</p>															
59	<p>M/J 16 (12)</p> <p>4 In China, the concentration of blood glucose, C₆H₁₂O₆, is measured in mmol / l. In Pakistan, the concentration of blood glucose is measured in mg / dl.</p> <p>The unit l is a litre (1 dm³). The unit dl is a decilitre (0.1 dm³).</p> <p>A blood glucose concentration of 18.5 mmol / l indicates a health problem.</p> <p>What is 18.5 mmol / l converted to mg / dl?</p> <p>A 33.3 mg / dl B 178 mg / dl C 333 mg / dl D 3330 mg / dl</p>															
60	<p>31 In an experiment, 10 cm³ of an organic compound, J, in the gaseous state was sparked with an excess of oxygen. 20 cm³ of carbon dioxide and 5 cm³ of nitrogen were obtained among the products. All gas volumes were measured at the same temperature and pressure.</p> <p>What could be the identity of J?</p> <p>1 C₂H₆N₂ 2 C₂H₃N 3 C₂H₇N</p>															
61	<p>M/J 16 (13)</p> <p>3 Which mass of urea, CO(NH₂)₂, contains the same mass of nitrogen as 101.1 g of potassium nitrate?</p> <p>A 22 g B 30 g C 44 g D 60 g</p>															

62	<p>4 The relative atomic mass of copper is 63.5.</p> <p>Which chart is a correct mass spectrum that would lead to this value?</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>A</p> </div> <div style="text-align: center;"> <p>B</p> </div> </div> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>C</p> </div> <div style="text-align: center;"> <p>D</p> </div> </div>						
63	<p>26 Which volume of oxygen, at room temperature and pressure, is needed for complete combustion of 1.0 mol of methylpropan-1-ol?</p> <p>A 108 dm³ B 144 dm³ C 156 dm³ D 288 dm³</p>						
64	<p>M/J 17 (11)</p> <p>2 The mass spectrum of a sample of lithium shows that it contains two isotopes, ⁶Li and ⁷Li.</p> <p>The isotopic abundances are shown in the table.</p> <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>isotope</th><th>isotopic abundance</th></tr> </thead> <tbody> <tr> <td>⁶Li</td><td>7.42%</td></tr> <tr> <td>⁷Li</td><td>92.58%</td></tr> </tbody> </table> <p>What is the relative atomic mass of this sample of lithium, given to three significant figures?</p> <p>A 6.07 B 6.50 C 6.90 D 6.93</p>	isotope	isotopic abundance	⁶ Li	7.42%	⁷ Li	92.58%
isotope	isotopic abundance						
⁶ Li	7.42%						
⁷ Li	92.58%						
65	<p>3 A sports medal has a total surface area of 150 cm². It was evenly coated with silver by electrolysis. Its mass increased by 0.216 g.</p> <p>How many atoms of silver were deposited per cm² on the surface of the medal?</p> <p>A 8.0×10^{18} B 1.8×10^{19} C 8.7×10^{20} D 1.2×10^{21}</p>						

66	<p>M/J 17 (12)</p> <p>2 Which would contain 9.03×10^{23} oxygen atoms?</p> <p>A 0.25 mol aluminium oxide</p> <p>B 0.75 mol sulfur dioxide</p> <p>C 1.5 mol sulfur trioxide</p> <p>D 3.0 mol water</p>
67	<p>19 A chemist took 2.00 dm^3 of nitrogen gas, measured under room conditions, and reacted it with a large volume of hydrogen gas to produce ammonia. Only 15.0% of the nitrogen gas reacted to produce ammonia.</p> <p>Which mass of ammonia was formed?</p> <p>A 0.213 g B 0.425 g C 1.42 g D 2.83 g</p>
68	<p>M/J 17 (13)</p> <p>2 A 0.216 g sample of an aluminium compound X reacts with an excess of water to produce a single hydrocarbon gas. This gas burns completely in O_2 to form H_2O and CO_2 only. The volume of CO_2 at room temperature and pressure is 108 cm^3.</p> <p>What is the formula of X?</p> <p>A Al_2C_3 B Al_3C_2 C Al_3C_4 D Al_4C_3</p>
69	<p>O/N 17 (11)</p> <p>1 Which formula represents the empirical formula of a compound?</p> <p>A $\text{C}_2\text{H}_4\text{O}$ B $\text{C}_2\text{H}_4\text{O}_2$ C C_6H_{12} D H_2O_2</p>
70	<p>32 A student makes sodium chloride by reacting together 0.025 mol of sodium carbonate with an excess of 0.2 mol dm^{-3} hydrochloric acid.</p> $\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$ <p>Which statements about the quantities of substance are correct?</p> <p>1 600 cm^3 of carbon dioxide are produced at room temperature and pressure.</p> <p>2 250 cm^3 of the hydrochloric acid are needed to exactly neutralise the sodium carbonate.</p> <p>3 1.46 g of sodium chloride are produced.</p>

71	<p>O/N 17 (12)</p> <p>2 Two hydrocarbons have the formulae $C_W H_X$ and $C_Y H_Z$. W, X, Y and Z represent different whole numbers.</p> $\frac{W}{X} = \frac{Y}{Z}$ <p>Which row is correct when comparing the two hydrocarbons?</p> <table> <tr> <th></th><th>empirical formula</th><th>molecular formula</th><th>relative molecular mass</th></tr> <tr> <td>A</td><td>different</td><td>same</td><td>different</td></tr> <tr> <td>B</td><td>different</td><td>same</td><td>same</td></tr> <tr> <td>C</td><td>same</td><td>different</td><td>different</td></tr> <tr> <td>D</td><td>same</td><td>different</td><td>same</td></tr> </table>		empirical formula	molecular formula	relative molecular mass	A	different	same	different	B	different	same	same	C	same	different	different	D	same	different	same
	empirical formula	molecular formula	relative molecular mass																		
A	different	same	different																		
B	different	same	same																		
C	same	different	different																		
D	same	different	same																		
72	<p>F/M 18</p> <p>6 Sodium hydroxide neutralises acid.</p> $H^+ + OH^- \rightarrow H_2O$ <p>In a $11\,000\text{ dm}^3$ sample of an aqueous solution, the concentration of acid, $[H^+]$, is $1.26 \times 10^{-3} \text{ mol dm}^{-3}$.</p> <p>Which mass of solid sodium hydroxide neutralises the acid?</p> <p>A 0.0214 g B 0.0504 g C 236 g D 554 g</p>																				
73	<p>31 Compound Q contains 40% carbon by mass.</p> <p>What could Q be?</p> <p>1 glucose, $C_6H_{12}O_6$</p> <p>2 starch, $(C_6H_{10}O_5)_n$</p> <p>3 sucrose, $C_{12}H_{22}O_{11}$</p>																				