A-Level Chemistry

Paper 2

Unsolved Topical

Past Papers with Marking Schemes

All Variants

2014-2021

Title A-LEVEL TOPICAL CHEMISTRY PAPER 2

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PREFACE

Excellence in learning cannot be claimed without application of concepts in a dexterous way. In this regard one of the logical approach is to start in chunks; like chapter wise learning and applying the concept on exam based questions.

This booklet provides an opportunity to candidates to practice topic wise questions from previous years to the latest. Extensive working of Team MS Books has tried to take this booklet to perfection by collaborating with top of the line teachers.

We have added answer key / marks scheme at the end of each topic for the candidate to compare the his/her answer to the best.

MS Books strives to maintain actual spacing between consecutive questions and within options as per CAIE format which gives students a more realistic feel of attempting question.

Review, feedback and contribution in this booklet by various competent teachers of a subject belonging to renowned school chains make it most valuable resource and tool for both teachers and students.
With all belief in strength of this resource material I can confidently claim that it is worth in achieving brilliance.

Our sincere thanks and gratification to **Mr. Muhammad Ali** who took out special time to help compile and manage this booklet. We would also like to appreciate chemistry faculty for reviewing and indorsing it.

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Atoms, Molecules & Stoichiometry

Q2/21/M/J/14

1 The commonest form of iron(II) sulfate is the heptahydrate, $FeSO_4.7H_2O$. On heating at 90 °C this loses **some** of its water of crystallisation to form a different hydrated form of iron(II) sulfate, $FeSO_4.xH_2O$.

3.40 g of $FeSO_4.xH_2O$ was dissolved in water to form 250 cm^3 of solution.

A 25.0 cm^3 sample of this solution was acidified and titrated with 0.0200 mol dm^{-3} potassium manganate(VII).

In this titration 20.0 cm^3 of this potassium manganate(VII) solution was required to react fully with the Fe^{2+} ions present in the sample.

(a) The MnO_4^- ions in the potassium manganate(VII) *oxidise* the Fe^{2+} ions in the acidified solution.

(i) Explain, in terms of electron transfer, the meaning of the term *oxidise* in the sentence above.

.....

..... [1]

(ii) Complete and balance the ionic equation for the reaction between the manganate(VII) ions and the iron(II) ions.

$MnO_4^-(aq) + 5Fe^{2+}(aq) + ...H^+(aq) \rightarrow .....(aq) + 5Fe^{3+}(aq) + ...H_2O(l)$

[3]

(b) (i) Calculate the number of moles of manganate(VII) used in the titration.

[1]

(ii) Use the equation in **(a)(ii)** and your answer to **(b)(i)** to calculate the number of moles of Fe^{2+} present in the 25.0 cm^3 sample of solution used.

[1]

(iii) Calculate the number of moles of $FeSO_4.xH_2O$ in 3.40 g of the compound.

[1]

(iv) Calculate the relative formula mass of $FeSO_4.xH_2O$.

[1]

(v) The relative formula mass of anhydrous iron(II) sulfate, $FeSO_4$, is 151.8.

Calculate the value of x in $FeSO_4.xH_2O$.

[1]

[Total: 9]

Q1(a,b,c)/22/M/J/14

2 **(a)** Explain what is meant by the term *nucleon number*.

.....

..... [1]

(b) Bromine exists naturally as a mixture of two stable isotopes, ^{79}Br and ^{81}Br, with relative isotopic masses of 78.92 and 80.92 respectively.

(i) Define the term *relative isotopic mass*.

.....

.....

..... [2]

(ii) Using the relative atomic mass of bromine, 79.90, calculate the relative isotopic abundances of ^{79}Br and ^{81}Br.

[3]

(c) Bromine reacts with the element **A** to form a compound with empirical formula $\mathbf{A}Br_3$. The percentage composition by mass of $\mathbf{A}Br_3$ is **A**, 4.31; Br, 95.69.

Calculate the relative atomic mass, A_r, of **A**.
Give your answer to **three** significant figures.

A_r of **A** = ... [3]

Q2/22/M/J/14

3 A 6.30 g sample of hydrated ethanedioic acid, $H_2C_2O_4.xH_2O$, was dissolved in water and the solution made up to 250 cm^3.

A 25.0 cm^3 sample of this solution was acidified and titrated with 0.100 mol dm^{-3} potassium manganate(VII) solution. 20.0 cm^3 of this potassium manganate(VII) solution was required to react fully with the ethanedioate ions, $C_2O_4^{2-}$, present in the sample.

(a) The MnO_4^- ions in the potassium manganate(VII) *oxidise* the ethanedioate ions.

(i) Explain, in terms of electron transfer, the meaning of the term *oxidise* in the sentence above.

.....

..... [1]

(ii) Complete and balance the ionic equation for the reaction between the manganate(VII) ions and the ethanedioate ions.

$2MnO_4^-(aq) + 5C_2O_4^{2-}(aq) + ...H^+(aq) \rightarrow .....(aq) + 10CO_2(aq) + ...H_2O(l)$ [3]

(b) (i) Calculate the number of moles of manganate(VII) used in the titration.

[1]

(ii) Use the equation in **(a)(ii)** and your answer to **(b)(i)** to calculate the number of moles of $C_2O_4^{2-}$ present in the 25.0 cm^3 sample of solution used.

[1]

(iii) Calculate the number of moles of $H_2C_2O_4.xH_2O$ in 6.30 g of the compound.

[1]

(iv) Calculate the relative formula mass of $H_2C_2O_4.xH_2O$.

[1]

(v) The relative formula mass of anhydrous ethanedioic acid, $H_2C_2O_4$, is 90.

Calculate the value of x in $H_2C_2O_4.xH_2O$.

[1]

[Total: 9]

Q1(a,b)/23/M/J/14

4 **(a)** Define the term *mole*.

.....

..... [1]

(b) 10 cm^3 of a gaseous hydrocarbon, C_xH_y, was reacted with 100 cm^3 of oxygen gas, an excess.

The final volume of the gaseous mixture was 95 cm^3.

This gaseous mixture was treated with concentrated, aqueous sodium hydroxide to absorb the carbon dioxide present. This reduced the gas volume to 75 cm^3.

All gas volumes were measured at 298 K and 100 kPa.

(i) Write an equation for the reaction between sodium hydroxide and carbon dioxide.

..... [1]

(ii) Calculate the volume of carbon dioxide produced by the combustion of the hydrocarbon.

volume of CO_2 produced = ... cm^3 [1]

(iii) Calculate the volume of oxygen used up in the reaction with the hydrocarbon.

volume of O_2 used = ... cm^3 [1]

(iv) Use your answers to **(b)(ii)** and **(b)(iii)**, together with the initial volume of hydrocarbon, to balance the equation below.

.....C_xH_y + ...O_2 → .....CO_2 + zH_2O [2]

(v) Deduce the values of *x*, *y* and *z* in the equation in **(iv)**.

x = ...

y = ...

z = ...

[3]

Q2/23/M/J/14

5 A sample of a hydrated double salt, $Cu(NH_4)_x(SO_4)_2.6H_2O$, was boiled with an excess of sodium hydroxide. Ammonia was given off.

The ammonia produced was absorbed in 40.0 cm^3 of 0.400 mol dm^{-3} hydrochloric acid. The resulting solution required 25 cm^3 of 0.12 mol dm^{-3} sodium hydroxide to neutralise the excess acid.

(a) Write the ionic equation for the reaction between ammonium ions and hydroxide ions.

..... [1]

(b) **(i)** Calculate the amount, in moles, of hydrochloric acid in 40.0 cm^3 of 0.400 mol dm^{-3} solution.

[1]

(ii) Calculate the amount, in moles, of sodium hydroxide needed to neutralise the excess acid. This will be equal to the amount of hydrochloric acid left in excess.

[1]

(iii) Calculate the amount, in moles, of hydrochloric acid that reacted with ammonia.

[1]

(iv) Calculate the amount, in moles, of ammonium ions in the sample of the double salt.

[1]

(v) The sample contained 0.413 g of copper. Use this information and your answer to **(iv)** to calculate the value of x in $Cu(NH_4)_x(SO_4)_2.6H_2O$.

[2]

(vi) Calculate the M_r of $Cu(NH_4)_x(SO_4)_2.6H_2O$.

[1]

[Total: 8]

Q1(c)/22/O/N/14

6 **(c)** A compound of barium, **A**, is used in fireworks as an oxidising agent and to produce a green colour.

(i) Explain, in terms of electron transfer, what is meant by the term *oxidising agent*.

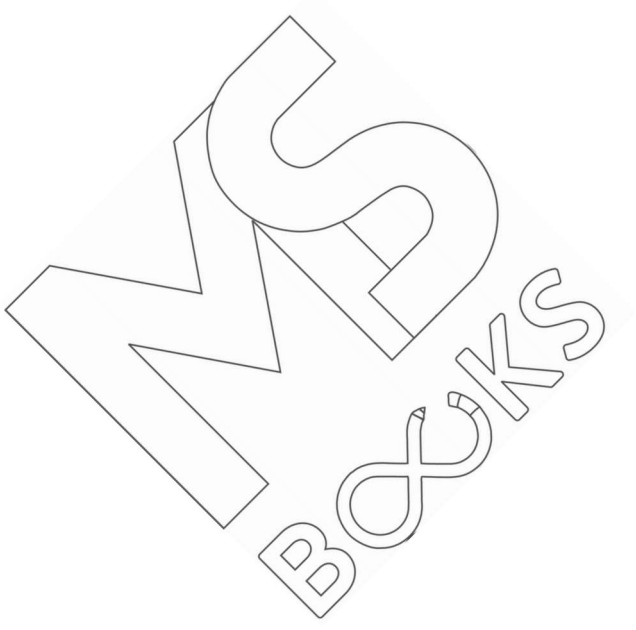
.....

..... [1]

(ii) **A** has the following percentage composition by mass: Ba, 45.1; C*l*, 23.4; O, 31.5.

Calculate the empirical formula of **A**.

empirical formula of **A** ..... [3]



Q2/21/M/J/14 **Q 1**

2 (a) (i)	(The MnO_4^- ions cause the Fe^{2+} ions to) lose electrons owtte / ora	1	1
(ii)	$MnO_4^-(aq) + 5Fe^{2+}(aq) + \mathbf{8}H^+(aq) \rightarrow \mathbf{Mn^{2+}}(aq) + 5Fe^{3+}(aq) + \mathbf{4}H_2O(l)$	1+1+1	3
(b) (i)	$\frac{20.0 \times 0.020}{1000} = 4(.00) \times 10^{-4}$ (mol)	1	1
(ii)	MnO_4^- : Fe^{2+} = 1 : 5 so amount of $Fe^{2+} = 5 \times 4.00 \times 10^{-4} = 2(.00) \times 10^{-3}$ (mol) ecf from **(b)(i)**	1	1
(iii)	$2.00 \times 10^{-3} \times 250/25 = 0.02(00)$ (mol) ecf from **(b)(ii)**	1	1
(iv)	3.40 / 0.02 = 170 ecf from **(b)(iii)**	1	1
(v)	170 – 151.8 = 18.2 18.2 / 18 = 1.01 x = 1 ecf from **(b)(iv)** if appropriate	1	1
			9

Q1(a,b,c)/22/M/J/14 **Q 2**

Question	Answers	Mark	Total
1 (a)	The (total) number of protons and neutrons (in the nucleus of an atom)	1	1
(b) (i)	Mass of an atom(s) or isotope	1	
	relative to $\frac{1}{12}$ (the mass) of (an atom of) carbon–12	1	
	OR		
	relative to carbon–12 which is (exactly) 12 (units)		2
	allow a correct expression		
(ii)	^{79}Br ^{81}Br $78.92x$ $80.92(100–x)$ where x = % abundance of ^{79}Br		
	so $\frac{78.92x + 80.92(100-x)}{100} = 79.9$	1	
	$x = 51$	1	
	hence ^{79}Br : ^{81}Br = 51 : 49	1	3
(c)	A Br $\frac{4.31}{A_r}$ $\frac{95.69}{79.9} = 1:3$		
	So $\frac{95.69/79.9}{4.31/A_r} = 3$	1	
	$A_r = \frac{3 \times 4.31 \times 79.9}{95.69} = 10.796 = 10.8$ to 3 s.f.	1	
	3 sig figs	1	3
	allow alternative correct methods		

Q2/22/M/J/14 **Q 3**

2 (a) (i)	(The $C_2O_4^{2-}$ ions) lose electrons owtte / ora	1	1
(ii)	$2MnO_4^-(aq) + 5C_2O_4^{2-}(aq) + \mathbf{16}H^+(aq) \rightarrow \mathbf{2Mn^{2+}}(aq) + 10CO_2(aq) + \mathbf{8}H_2O(l)$	1+1+1	3
(b) (i)	$\frac{20.0 \times 0.100}{1000} = 2(.00) \times 10^{-3}$ (mol)	1	1
(ii)	$MnO_4^- : C_2O_4^{2-} = 2 : 5$ so amount of $C_2O_4^{2-} = (5/2) \times 2.00 \times 10^{-3} = 5(.00) \times 10^{-3}$ (mol) ecf from **(b)(i)**	1	1
(iii)	$5.00 \times 10^{-3} \times 250/25 = 0.05(0)$ (mol) ecf from **(b)(ii)**	1	1
(iv)	amount = mass / M_r so M_r = mass / amount = 6.30 / 0.05 = 126 ecf from **(b)(iii)**	1	1
(v)	126 – 90 = 36 36 / 18 = 2.00 x = 2 Ecf from **(b)(iv)** if suitable	1	1
			9

Q1(a,b)/23/M/J/14 **Q 4**

Question	Mark Scheme – 9701 / 23	Mark	Total mark
1 (a)	the amount of substance containing 6(.02) x 10^{23} (fundamental) particles of that substance (or; the amount of substance containing as many particles as there are atoms in 12 g of carbon-12)	(1)	[1]
(b) (i)	$2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$ allow ionic equations or formation of $NaHCO_3$	(1)	[1]
(ii)	95 – 75 = 20 cm^3	(1)	[1]
(iii)	excess oxygen = 75 cm^3 so used = 25 cm^3	(1)	[1]
(iv)	$2C_xH_y + 5O_2 \rightarrow 4CO_2 + zH_2O$	(2)	[2]
(v)	$x = 2$; $y = 2$; $z = 2$ (or z = 1 if $C_xH_y + 2.5O_2 \rightarrow 2CO_2 + zH_2O$)	(1+1+1)	[3]

Q2/23/M/J/14 **Q 5**

2 (a)	$NH_4^+ + OH^- \rightarrow NH_3 + H_2O$	(1)	[1]
(b) (i)	Initial acid = 40 × 0.4 / 1000 = 0.016 (mol)	(1)	[1]
(ii)	$\frac{25 \times 0.12}{1000} = 3.0 \times 10^{-3}$ (mol) (of OH^- used)	(1)	[1]
(iii)	excess acid = OH^- = 0.003 acid reacted = 0.016 – 0.003 = 0.013 (mol)	(1)	[1]
(iv)	NH_4^+:H^+ = 1:1 so = 0.013 (mol NH_4^+)	(1)	[1]
(v)	amount of Cu = mass / M_r = 0.413 / 63.5 = 6.5 × 10^{-3} (mol) so Cu:NH_4 = 0.0065:0.013 = 1:2 so x = 2	(1) (1)	[2]
(vi)	M_r = 399.7	(1)	[1]
		Total	**8**