

**GCE**

**Chemistry B (Salters)**

**H033/01: Foundations of chemistry**

Advanced Subsidiary GCE

**Mark Scheme for November 2020**

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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## Annotations

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

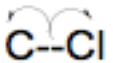
Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

<b>Annotation</b>	<b>Meaning</b>
<b>DO NOT ALLOW</b>	Answers which are not worthy of credit
<b>IGNORE</b>	Statements which are irrelevant
<b>ALLOW</b>	Answers that can be accepted
( )	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
<b>ECF</b>	Error carried forward
<b>AW</b>	Alternative wording
<b>ORA</b>	Or reverse argument


**Section A**

<b>Question</b>	<b>Key</b>	<b>AO element</b>
1	D	1.1
2	A	2.1
3	B	1.1
4	C	1.2
5	A	1.2
6	A	1.2
7	C	2.3
8	D	2.7
9	D	1.2
10	C	2.1
11	D	1.1
12	C	2.1
13	D	1.1
14	B	1.2
15	A	1.2
16	B	2.7
17	D	1.1
18	C	2.1
19	C	2.6
20	B	2.7

## Section B

Question			Answer	Mark	AO	Guidance
21	(a)		dichlorodifluoromethane ✓	1	1.2	IGNORE spaces, and other separators
21	(b)	(i)	causes skin cancer/mutations OR damages crops ✓	1	1.1	ALLOW eye damage NOT eye problems
21	(b)	(ii)	It causes photochemical smog ✓	1	1.1	ALLOW toxic/poisonous/respiratory/breathing problems OR damage to plants/rubber
21	(b)	(iii)	Bonds vibrate (more) ✓	1	1.1	ALLOW They vibrate (more) NOT Atoms vibrate (more) IGNORE reference to collisions
21	(c)	(i)	$ClO + O \rightarrow Cl + O_2$ ✓	1	1.2	
	(c)	(ii)	$Cl + Cl \rightarrow Cl_2$ OR $2Cl \rightarrow Cl_2$ OR $2ClO \rightarrow Cl_2 + O_2$ ✓	1	2.1	
21	(c)	(iii)	Both 'propagation' ✓	1	1.1	
21	(d)	(i)	 AND homolytic (fission) ✓	1	1.2	NB Half arrows
21	(d)	(ii)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = <math>3.46 \times 10^{-5}</math> (cm) award 4 marks</b>  Use of $v = E/h$ or implied by correct evaluation step(s) ✓  $v = 346000 / 6.63 \times 10^{-34} \times 6.02 \times 10^{23}$ (or correct evaluation $8.67 \times 10^{14}$ ) ✓  $\lambda = 3.00 \times 10^8 / 8.67 \times 10^{14} (= 3.48 \times 10^{-7} \text{ m})$ ✓  $= 3.46 \times 10^{-5} \text{ (cm)}$ ✓	4	2.2	ALLOW 2 or more sf.  ALLOW ecf
	(e)	(i)	molecule/negatively charged ion with a (lone) pair of electrons which it donates(AW) to a (positively charged) atom (to form a covalent bond). ✓	1	1.1	

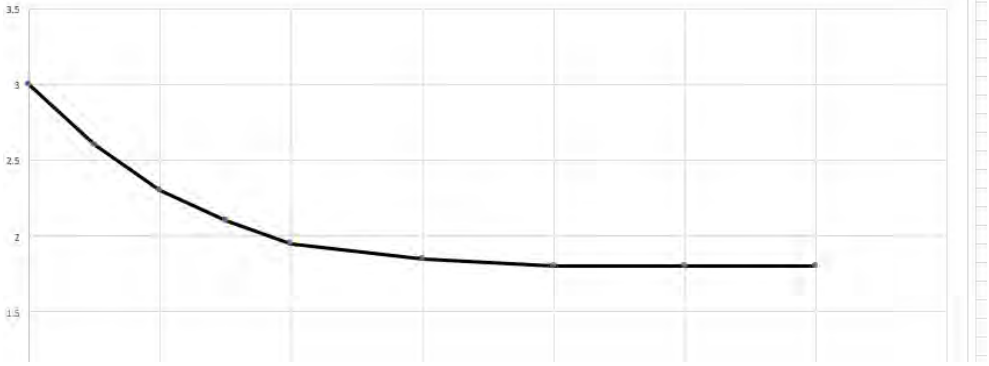
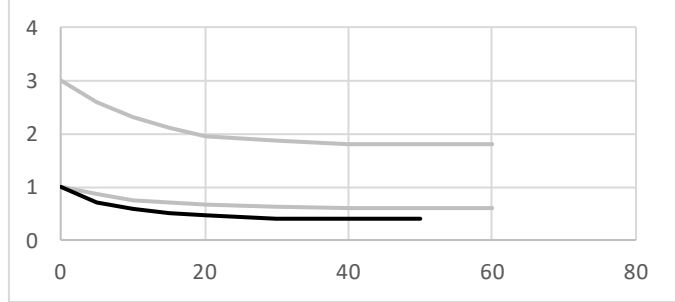
Question		Answer	Mark	AO	Guidance
(e)	(ii)	$  \begin{array}{c}  \delta+ \quad \delta- \\  \text{C}-\text{Cl} \\  \curvearrowright \\  \text{OH} \\  \checkmark  \end{array}  \quad \text{-----} \rightarrow \quad \text{C}-\text{OH} + \text{Cl}^-  $	2	2.5	<p>One arrow (double headed) must start (when projected back) at bond and end (when projected forward) on Cl <b>AND</b> partial charges on C and Cl</p> <p>Other arrow (double headed) must start (when projected back) at minus (or a lone pair on OH) and end (when projected forward) on C  <b>IGNORE</b> other atoms bonded to C.            If both charges omitted can award second mark for balanced equation.</p>

Question		Answer	Mark	AO	Guidance
22	(a)	6 protons; 7 neutrons ✓	1	1.2	
	(b)	(i) <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 12.01 award 2 marks</b>  (98.9 x 12) + (1.1 x 13) ✓  divide by 100 and answer to 2 dp (12.01) ✓	2	2.2	<b>ALLOW ECF</b>
	(b)	(ii) chance of 2 <sup>13</sup> C small (AW) ✓	1	3.2	
	(c)	 ✓  $M_r = 60$ (from $M^+$ peak in MS) ✓  $C_3H_8O/C_3H_7OH$ ✓  CH <sub>2</sub> OH only found in the primary isomer <b>OR</b> CH <sub>2</sub> OH means OH at end (AW) ✓	4	3.1 3.2 3.1 3.2	<b>ALLOW</b> "60-31=29; which can only be CH <sub>3</sub> CH <sub>2</sub> "



Question			Answer	Mark	AO	Guidance
23	(a)		(Otherwise) they react ✓	1	3.3	CON reactions with other substances
23	(b)	(i)	Na <sup>+</sup> AND its oxidation number goes down/goes from +1 to zero OR it gains electrons ✓	1	2.1	ALLOW 'sodium ion' NOT 'sodium'
23	(b)	(ii)	$2Cl^{-} \rightarrow Cl_2 + 2e^{-}$ OR $2Cl^{-} - 2e^{-} \rightarrow Cl_2$ ✓	1	2.4	ALLOW equation halved ALLOW 'e' without minus
23	(b)	(iii)	breathing apparatus (AW) ✓	1	1.1	ALLOW use in a fume cupboard ALLOW well ventilated room NOT face masks
23	(b)	(iv)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = <math>1.4 \times 10^5</math> (m<sup>3</sup>) award 5 marks</b>  (moles Na =) $1 \times 10^6/23$ (= 43478) ✓  moles Cl <sub>2</sub> = half Na (21739) ✓  Rearrangement $V = nRT/P$ ✓  substitute values $V$ (= $21739 \times 8.314 \times 873/1100$ ) = $1.43\dots \times 10^5$ (m <sup>3</sup> ) ✓  2sf and standard form ✓	5	2.8	ALLOW ecf Earlier points can be scored by implication in later ones, eg MP1 and MP2 from 21.74 in MP4; MP3 from correct expression in MP4 etc  Award last MP for any number to two sf and standard form resulting from a shown calculation.
23	(c)		<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 1.1 or 1.07 award 2 marks</b>  $33/58.5$ OR $0.56(4)$ (mole Na) AND $67/111(.1)$ OR $0.60(3)$ (mole Ca) ✓  ratio (= $0.60(3)/0.56(4)$ ) = $1.1/1.07$ ✓	2	2.6	ALLOW ecf
23	(d)		Na – sodium ions/(1)+ ions ✓	5	1.2	ALLOW labelled diagrams for all marks

Question			Answer	Mark	AO	Guidance
			delocalised electrons (AW) ✓ NaCl – <u>Na</u> <sup>+</sup> and <u>Cl</u> <sup>-</sup> ions ✓ 'lattice' or one structure point (eg 'alternating') ✓ Electrostatic forces (between oppositely charged ions) ✓			<b>ALLOW</b> opposite charges of ions attract
23	(e)	(i)	(colourless/pale green to) brown/orange/yellow ✓ $2\text{NaI} + \text{Cl}_2 \rightarrow 2\text{NaCl} + \text{I}_2$ ✓	2	2.5	<b>ALLOW</b> these colours alone or in any combination but no others. <b>ALLOW</b> ionic equation <b>IGNORE</b> state symbols
23	(e)	(ii)	<b>EITHER</b> add organic solvent – purple colour <b>OR</b> heat solution – purple vapour ✓	1	3.4	

Question		Answer	Mark	AO	Guidance
24	(a)	Plotting points ✓ Smooth line of best fit ✓ 	2	2.8 3.3	<b>ALLOW</b> best fit line +/- half square from each point <b>AND</b> point 4 (2.20) off the line <b>IGNORE</b> labelling of line
24	(b)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 0.046/4.6 x 10<sup>-2</sup> award 3 marks</b>  Expression for $K_c = [\text{CH}_4][\text{H}_2\text{O}]/[\text{CO}][\text{H}_2]^3$ ✓  Reading values from graph ✓  Calculation $(0.4)^2/0.6(1.8)^3 = 0.0457\dots$ ✓	3	2.8	<b>ALLOW</b> 2 or more sf. <b>ALLOW</b> ecf from expression or graph reading MP1 can be inferred from later steps <b>IGNORE</b> units
24	(c)	 line begins at or above 1 ✓ and flattens below 0.6 (but not to zero) ✓	2	3.1	Line can go below dotted line (or not)

Question		Answer	Mark	AO	Guidance
24	(d)	Heterogeneous <b>AND</b> catalyst and reactants in different states✓	1	1.1	

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