OCR
Oxford Cambridge and RSA

GCE

Chemistry B (Salters)

Unit **H033/01:** Foundations of chemistry

Advanced Subsidiary GCE

Mark Scheme for June 2016

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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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Annotations

Annotation	Meaning
✓	Correct response
✗	Incorrect response
^	Omission mark
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	Ignore
BP	Blank page

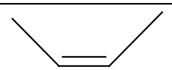
Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

SECTION A

Question	Answer	Marks	AO element
1	C	1	1.1
2	B	1	1.1
3	C	1	1.2
4	B	1	2.5
5	C	1	1.1
6	A	1	1.1
7	B	1	1.1
8	D	1	1.2
9	B	1	1.2
10	D	1	2.5
11	A	1	2.4
12	D	1	2.5
13	C	1	2.1
14	D	1	2.4
15	D	1	2.1
16	C	1	1.2
17	D	1	2.7
18	D	1	2.2
19	C	1	2.4
20	B	1	1.1

Question			Answer	Marks	AO element	Guidance
21	(a)		mass number 56 protons 28 neutrons 28	1	2.2	
	(b)		(28 x 92.17) + (29 x 4.71) + (30 x 3.12) /100 = 28.1(095) √ 28.11 (2dp) √	2	1.2 1.2	**NO** ecf 28.11 alone on the answer line scores 1 mark without some evidence of working. Answers to other dp without working score zero.
	(c)	(i)	1. (Add $NiCO_3$ to H_2SO_4) until fizzing/reaction stops/all sulfuric acid has reacted√ 2. filter (prior to crystallisation)√ 3. (partially) <u>evaporate</u> √ 4. Filter the crystals/pick out the crystals/leave crystals to dry/fully evaporate to produce crystals√	4	1.2 1.2 1.2 1.2	2. **IGNORE** what is being filtered but **NOT** nickel sulfate 3. **ALLOW** a word derived from evaporate e.g.evaporation 4. boiling to dryness **CON** pt 4, ALLOW products/$NiSO_4.6H_2O$ for “crystals” fully evaporate to produce crystals scores pts 3 & 4
		(ii)	**A** no – this would have resulted in a higher mass/yield √ **B** no – nickel carbonate is added in <u>excess</u> AW/ moles of sulphuric acid are the limiting factor/(excess)nickel carbonate is removed √ **C** yes – loss of water would reduce <u>mass</u> (AW) √	3	3.1 3.1 3.1	for each mark, ‘yes’ or ‘no’ (or ‘correct’/‘incorrect’) must be stated (or implied) and the reason given. **ALLOW** weight for mass
				10		

Question			Answer	Marks	AO element	Guidance
22	(a)		(2-)methylpropene	1	1.2	**IGNORE** dashes, commas and gaps **ALLOW** ....prop-1-ene **ALLOW** minor spelling errors
	(b)			1	2.5	**ALLOW** any unambiguous representation of the structure but **NOT** C for CH_3 **IGNORE** name
	(c)	(i)	water/steam **AND** phosphoric/ concentrated sulfuric acid	1	1.2	**ALLOW** names of acids (including oxidation states) or formulae (c.H_2SO_4, $H_2SO_4(l)$, H_3PO_4) but if name **AND** formula present both must be correct. **IGNORE** isobutylene/2-methylpropene
	(c)	(ii)	tertiary **AND** OH/functional group attached/bonded to C that has... no H atoms **or** 3 C/methyl/alkyl/R (groups)	1	1.1	**IGNORE** 'it' for 'OH' **ALLOW** Alcohol/hydroxyl group attached to C........ **NOT** hydroxide
		(iii)	(heat with) acidified dichromate(VI) √ A/tertiary has no reaction/stays orange /doesn't change colour. Others/primary/secondary go green/change colour √	2	3.4 3.4	**Mark separately** **ALLOW** correct formulae **ALLOW** sulfuric acid or sulfuric(VI) acid as replacement for acidified. **IGNORE** formulae if names correct **ALLOW** dichromate without 'VI' as long as no other number is there
		(iv)	forms the weakest/smallest/ fewest instantaneous (dipole) – induced dipole bonds/forces √ smallest surface area **OR** non-linear molecules are unable to get closer together/align AW √	2	2.1 1.2	**Mark separately** **IGNORE** references to other intermolecular bonding **ALLOW** weaker/smaller/fewer **ALLOW** Van der Waal's forces or London forces **DO NOT ALLOW** id-id in first instance **ALLOW** minor spelling errors **ALLOW** 'less contact between molecules'
	(d)	(i)	Ether/alkoxy/methoxy	1	1.2	
		(ii)	$C_4H_8 + CH_4O \rightarrow C_5H_{12}O$	1	2.6	must be molecular formulae as shown **ALLOW** element symbols in any order **IGNORE** state symbols
				10		

Question			Answer	Marks	AO element	Guidance
23	**(a)**	**(i)**	Cl_2+ $2Br^-$ ---> $2Cl^-$ + Br_2	1	1.2	**IGNORE** state symbols
		(ii)	chlorine is more reactive ..... and gains electrons more readily (than bromine) *ora* **OR** .... and removes electrons from bromide/bromine (ions)	1	1.1	**IGNORE** other references to halides **IGNORE** references to electronegativity **IGNORE** "attract" **ALLOW** "accept"
	(b)	**(i)**	move through: Na^+ √ not through: Cl^- **and** OH^- √	2	3.1 3.1	**IGNORE** H^+ any other ions are **CON** in each case **ALLOW** names of ions
		(ii)	2NaCl + $2H_2O$ ---> Cl_2 + H_2 + 2NaOH	1	2.6	**ALLOW** multiples or halves **IGNORE** state symbols
		(iii)	100% since... no waste **or** all useful/desired products	1	3.2	**IGNORE** by-products
		(iv)	1. 37000/40 **OR** 925 √ 2. 925x24/2 **OR** 11100 √ 3. 1.1×10^4 (dm^3)√ (2 sf and standard form)	3	2.2 2.2 2.2	Allow ecf from 1. and 2. No ecf from (b)(ii) ***without reference to working***: 1.1×10^4 scores 3 marks 2.2×10^4 scores 2 marks 11100 or 11000 score 2 marks 22000 or 22200 score 1 mark 11 or 1.1×10^1 scores 2 marks 22 or 2.2×10^1 scores 1 mark 9.3×10^2 scores 2 marks 0.93 scores 1 mark
	(c)	**(i)**	-1, +5, 0	1	2.4	**NOT** signs after numbers **ALLOW** roman numerals (-I; +V)
		(ii)	(Br in) BrO_3^- because oxidation state (of Br) goes down (+5 to 0)	1	1.2	**ALLOW** 'bromate' or 'bromate(V)' for BrO_3^- **ALLOW** 'bromine reduced' **IF** correct oxidation states given **ALLOW** ecf on oxidation states from (c)(i)
				11		

Question			Answer	Marks	AO element	Guidance
24	(a)	(i)	atom/molecule/species/ ion with <u>unpaired</u> electron(s) √ formed from chloroalkanes/ R-Cl/ haloalkanes/ chlorine compounds/ CFCs/ C-Cl √ by high-energy/ high frequency √ uv √ homolytic (fission)√	5	1.1 1.1 1.1 1.1 1.1	**IGNORE** 'single' 'lone' **ALLOW** 'it' for 'atom/molecule/species/ ion' **ALLOW** equation showing formation of radicals Mention of breakdown of Cl_2 **CONS** 2nd marking point **IGNORE** UVA for third marking point UVB and/or C covers both 3rd and 4th marking points. **ALLOW** homolysis
		(ii)	$Cl + O_3 \text{ ----> } ClO + O_2$ $ClO + O \text{ ----> } Cl + O_2$ √ $O_3 + O \text{ ----> } 2O_2$ √	2	1.2 1.2	**Mark separately** **IGNORE** dots $Cl + O_3 \text{ ----> } ClO + O_2$ $ClO + O_3 \text{ ----> } Cl + 2O_2$ and hence $2O_3 \text{ ----> } 3O_2$ scores 2nd marking point only
	(b)	(i)	Y axis (concentration) correctly labelled with units and standard form √ X axis (time) correctly labelled with units √ Points plotted utilising over half of each axis √	3	2.6 2.6 2.6	Linear scale labelled with conc(entration) of ozone/O_3 **NOT** $[O_3]$ **AND** units (molecules cm^{-3}). 10^{12} or 10^{-12} mentioned somewhere. Linear scale labelled with "Time" **AND** units. X and y axes swapped but otherwise correct scores only one of the first two marks. Exact position of points does not need checking. Line of best fit not essential but point to point or curved line is **CON**
		(ii)	4.979 – 4.983 x 10^{12} molecules cm^{-3}	1	2.6	Minimum of 4 sf required
		(iii)	it remains constant (AW) **AND** the gradient is constant/straight line graph (AW)	1	2.7	**NOT** almost/fairly/nearly constant **IGNORE** references to negative rate

Question			Answer	Marks	AO element	Guidance
	(c)		Rearrangement of gas equation to: n = PV/RT √	4	2.5	can be implied by later working
			Conversion of volume units to m^3 √		2.6	can be implied from working
			n = P x evaluated volume / 8.314 x 300 √		2.6	ALLOW ecf if gas equation has been incorrectly rearranged wrong evaluation of this expression is **CON** **Correct answer alone scores 4 marks** *with no working:*
			Conversion of moles to molecules and evaluate to 2 or more sf. (correct answer is 2.4(1) x 10^{17}) √		2.6	2.4 x 10^{23} or 2.4 x 10^{20}(incorrect conversion of v) scores 3 marks 4.0 x 10^{-7} (no N_A) scores 3 marks 0.4….. (incorrect v and no N_A) scores 2 marks

Question			Answer	Marks	AO element	Guidance
	(d)		Choice of method: **EITHER** *Calculate the energy of 1 mole of photons and compare with bond enthalpy.* Calculate energy of one photon ($9.5 \times 10^{14} \times 6.63 \times 10^{-34}$ OR 6.30×10^{-19}) √ Multiply up for 1 mole and convert to kJ (photon energy x $6.02 \times 10^{23}/1000$) √ Evaluate (379) and state whether bond will be broken. √ **OR** *Compare the energy of one photon with one bond* Calculate energy of one photon ($9.5 \times 10^{14} \times 6.63 \times 10^{-34}$ OR 6.30×10^{-19}) √ Calculate energy of one bond ($302 \times 1000/6.02 \times 10^{23}$) √ Evaluate both($6.30 \times 10^{-19}$ and 5.02×10^{-19}) and state whether bond will be broken. √ **OR** *Calculate minimum frequency needed to break bond* Calculate energy required per molecule ($302000/6.02 \times 10^{23}$) √ Calculate required frequency of radiation (energy/6.63×10^{-34}) √ Evaluate (7.57×10^{14}) and state whether bond will be broken. √	3	 3.2 3.2 3.2 3.2 3.2 3.2 3.2 3.2 3.2	The 3rd marking point can only be scored if the first 2 marks are scored OR if the only error is in conversion between J and kJ i.e. failure to convert or incorrect conversion
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