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General Certificate of Education
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Chemistry CHEM1

Foundation Chemistry

Mark Scheme

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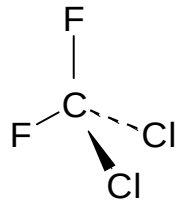
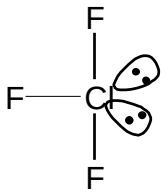
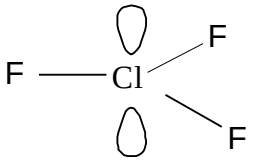
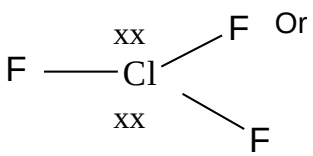
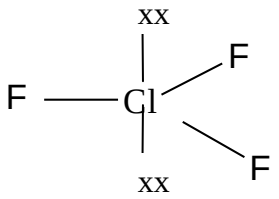
Qu	Part	Sub Part	Marking Guidance	Mark	Comments
1	a	i	shared <u>pair of electrons</u>	1	Can have one electron from each atom contributes to the bond Not both electrons from one atom
1	a	ii	$\frac{1}{2}\ Cl_2 + \frac{3}{2} F_2 \rightarrow ClF_3$	1	Only Ignore state symbols even if wrong
1	b		  **OR** 	1 1	Allow any structure with 4 bp Watch for Cl in centre- it must be C Ignore wrong bond angles Representations of lone pairs allowed are the two examples shown with or without the electrons in the lobe. Also they can show the lone pair for either structure by two crosses /dots or a line with two crosses/dots on it e.g.  Or  Or a structure with 3 bp and 2 lp
1	c		Dipole – dipole	1	Allow van der Waals/ vdw/ London/ dispersion/ temporary dipole - induced dipole Not dipole alone

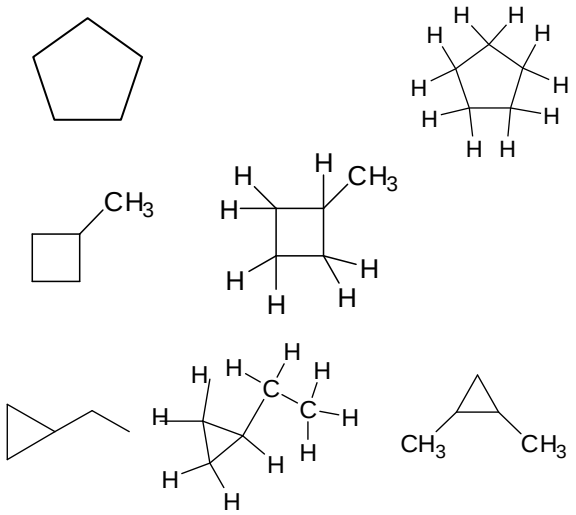
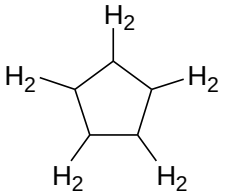
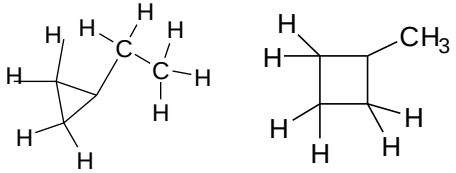
1	d	i	Coordinate/ dative (covalent) (Lone) pair of electrons/ both electrons (on F^-) Donated from F^- / fluoride or donated to the BF_3	1 1 1	If wrong CE = 0/3 but if 'covalent' or left top line blank, mark on. CE if lone pair is from B Must have the – sign on the F ie F^- Ignore Fl^- M3 dependent on M2
1	d	ii	109° to 109.5°	1	
1	e		$\frac{238 \times 100}{438}$ = 54.3%	1 1	For 1 mark allow 238 as numerator and 438 as denominator or correct strings 2 marks if correct answer to 3 sig figs. 54% or greater than 3 sig figs = 1 mark

Qu	Part	Sub Part	Marking Guidance	Mark	Comments
2	a		Cross between the Na cross and the Mg cross	1	
2	b		$Al(g) \rightarrow Al^+(g) + e–$ $Al(g) - e– \rightarrow Al^+(g)$ $Al(g) + e– \rightarrow Al^+(g) + 2e–$	2	One mark for state symbols consequential on getting equation correct. Electron does not have to have the – sign on it Ignore (g) if put as state symbol with e^- but penalise state symbol mark if other state symbols on e^-
2	c		2^{nd} / second / 2 / II	1	Only
2	d		Paired electrons <u>in (3)p orbital</u> repel	1 1	Penalise wrong number If paired electrons repel allow M2
2	e		Neon/ Ne $1s^22s^22p^6$ / $[He]2s^22p^6$	1 1	No consequential marking from wrong element Allow capital s and p Allow subscript numbers
2	f		Decreases Atomic radius increases/ electron removed further from nucleus or nuclear charge/ electron in higher energy level/ Atoms get larger/ more shells As group is descended more shielding	1 1 1	CE if wrong Accept more repulsion between more electrons for M2 Mark is for distance from nucleus Must be comparative answers from M2 and M3 CE M2 and M3 if mention molecules Not more sub-shells

Qu	Part	Sub Part	Marking Guidance	Mark	Comments
3	a	i	M_r MgO = 40.3 0.741/40.3 = 0.0184	1 1	If used 40 then penalise this mark but allow consequential M2 (0.0185) 0.018 with no M_r shown = 0 Penalise if not 3 sig figs in this clip only
3	a	ii	0.0184 x $\frac{5}{2}$ = 0.0460	1	Allow 0.0459 to 0.0463 Allow their 3(a)(i) x 5/2 ie allow process mark of x 5/2 but insist on a correct answer being written down Ignore sig figs
3	b		pV=nRT (V= $\frac{0.402 \times 8.31 \times 333}{100\ 000}$) 0.0111 11.1 (dm^3)	1 1 1	If rearranged incorrectly then lose M1 If this expression correct then candidate has scored first mark Ignore units 3 marks for 11.1 (dm^3) However if 11.1 m^3 or cm^3 allow 2 (ie penalise wrong units in final answer) Ignore sig figs- but must be 2 sig figs or greater
3	c	i	0.0152 x 2 = 0.0304	1	Allow 0.03
3	c	ii	0.938 mol dm^{-3}	1	Allow range 0.92 – 0.94 Minimum 2 sig figs Allow consequential marking from 3(c)(i) Ignore units even if wrong

Qu	Part	Sub Part	Marking Guidance	Mark	Comments
4	a		O = 74.1% 25.9 74.1 14 16 1.85 4.63 1 2.5 N_2O_5	1 1 1	 If atomic numbers or molecular masses are used lose M2 This ratio alone will not score the final mark. (It would get 2) Allow 3 marks for N_2O_5
4	b		Toxic/ poisonous/ forms an acidic gas / forms NO_2 which is acidic/ respiratory irritant/ forms $HNO_3$when NO reacts with water and oxygen/ triggers asthma attacks/ greenhouse gas/ photochemical smog/ contributes to global warming /formation of acid rain	1	ignore NO is an acidic gas or NO is acidic in water Not references to ozone layer
4	c		$2NO + O_2 \rightarrow 2NO_2$	1	Accept multiples or fractions of equation Ignore wrong state symbols
4	d		Nitrogen / N_2 and oxygen / O_2 combine/react spark / high temperature / 2500-4000 °C	1 1	QWC (not N and O combine) Not nitrogen in fuel Allow $N_2 + 0_2 \rightarrow 2NO$ for M1 only
4	e		$2NO + 2CO \rightarrow N_2 + 2CO_2$ ***OR*** $2NO \rightarrow N_2 + O_2$	1	Accept multiples or fractions of equation Ignore wrong state symbols Allow $C_8H_{18} + 25NO \rightarrow 8CO_2 + 12.5\ N_2 + 9H_20$

Qu	Part	Sub Part	Marking Guidance	Mark	Comments
5	a	i	$C_4H_{10} + 6\frac{1}{2}O_2 \rightarrow 4CO_2 + 5H_2O$	1	Allow multiples
5	a	ii	insufficient oxygen / low temperature / poor mixing of butane and air	1	Allow insufficient air Allow lack or oxygen / air Do not allow no oxygen Not incomplete combustion
5	b	i	Sulfur dioxide / SO_2	1	Allow sulfur trioxide/ SO_3 (allow spelling of sulphur to be sulphur)
5	b	ii	It is basic / the gas (SO_2) is acidic	1	Idea of neutralisation It = calcium oxide
5	b	iii	bigger surface area to react	1	Do not allow cheaper

Qu	Part	Sub Part	Marking Guidance	Mark	Comments
6	a		(Different) boiling points	1	Ignore mp's, references to imf, different volatilities
6	b	i	Compound which have the same <u>molecular</u> formula but different structures/different structural formulae/different displayed formulae	1 1	Accept same no and type of atom for M1 But If same (chemical) formula M1 = 0 but allow M2 If empirical formula CE = 0/2 M2 dependent on M1
6	b	ii	3-methylbut-1-ene	1	only ignore commas and hyphens
6	b	iii	 Allow any correct structure with a cyclic alkane	1	Do not allow  or  i.e with an H missing on one C

6	c		$C_{13}H_{28}$ Making plastics/ used to make polymers or polythene/ used to make antifreeze/ make ethanol/ ripening fruit/ any named additional polymer	1 1	only not used **as** a plastic/polymer/antifreeze not just 'polymers' – we need to see that they are being made

Qu	Part	Sub Part	Marking Guidance	Mark	Comments
7	a		Iodine – molecular Graphite- macromolecular/giant covalent/giant atomic	1 1	Not covalent lattice
7	b		Layers of (C atoms) Connected by covalent bonds within each layer Van der Waals forces/ IMF between layers/ weak forces between layers Many/strong covalent bonds need to be broken	1 1 1 1	If any other element mentioned other than C, CE = 0 Ignore the no of covalent bonds around the C if mentioned The first 3 marks could be scored with a labelled diagram. Need to label or state covalent bonds within the layers. Covalent or ionic or metallic bonds between molecules CE = 0
7	c		Van der Waals forces are weak or easily broken Van der Waals between molecules (or implied)	1 1	Not vdw between atoms Allow weak IMF = 2
7	d		Does not have delocalised/free electrons	1	Only allow answer with respect to iodine Not all electrons used in bonding Ignore free ions

Qu	Part	Sub Part	Marking Guidance	Mark	Comments
8	a		Mass number = number of protons + neutrons (in the nucleus/atom) 7 protons <u>and</u> 7 electrons 8 neutrons	1 1 1	Not in a substance or compound or element
8	b		<u>Average/mean mass of (1) atom(s) (of an element)</u> 1/12 mass of one atom of ^{12}C ***OR*** <u>(Average) mass of one mole of atoms</u> 1/12 mass of one mole of ^{12}C ***OR*** <u>(Weighted) average mass of all the isotopes</u> 1/12 mass of one atom of ^{12}C ***OR*** Average mass of an atom/isotope compared to C-12 on a scale in which an atom of C-12 has a mass of 12 <u>(95.12 x 14) + (4.88 x 15)</u> 100 = 14.05	1 1 1 1	Accept answer in words Can have top line x 12 instead of bottom line ÷12 Allow 95.12 + 4.88 instead of 100 If not to 2 d.p. then lose last mark Not 14.04

8	c		^{15}N is heavier / ^{15}N has a bigger m/z / different m/z values Electromagnet/ electric field/ magnet /accelerating potential or voltage / electric current	1 1	Not different no's of neutrons Not ionisation potential
8	d		No difference Same no of electrons (in outer orbital/shell/sub shell)/ same electron configuration	1 1	 M2 dependent on M1 Not just electrons determine chemical properties Ignore protons