Bonding, Polarity & Intermolecular Forces

Mark Scheme 1

Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	Application of Core Principles of Chemistry
Sub Topic	Bonding, Polarity & Intermolecular Forces
Booklet	Mark Scheme 1

Time Allowed: **54 minutes**

Score: **/45**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

Question Number	Correct Answer	Mark
1	D	(1)
	Incorrect answers A – C-Cl is not non-polar and the molecule is not non-polar B - C-Cl is not non-polar C - the molecule is not non-polar	

Question Number	Correct Answer	Mark
2	D	(1)
	Incorrect answers A – is linear and has the highest boiling temperature B – has 1 branch and has 2nd highest boiling temperature C has 2 branches and has 3rd highest boiling temperature	

Question Number	Correct Answer	Mark
3	B	1

Question Number	Correct Answer	Mark
4	D	1

Question Number	Correct Answer	Mark
5	D	1

Question Number	Correct Answer	Mark
6	C	1

Question Number	Correct Answer	Reject	Mark
7	A		1

Question Number	Correct Answer	Reject	Mark
8	A		1

Question Number	Correct Answer	Reject	Mark
9(a)	B		1

Question Number	Correct Answer	Reject	Mark
9(b)	A		1

Question Number	Correct Answer	Reject	Mark
10	A		1

Question Number	Correct Answer	Reject	Mark
11	D		1

Question Number	Correct Answer	Reject	Mark
12	A		1

Question Number	Correct Answer	Reject	Mark
13	B		1

Question Number	Correct Answer	Reject	Mark
14	A		1

Question Number	Correct Answer	Reject	Mark
15	B		1

Question Number	Correct Answer	Reject	Mark
16	A		**1**

Question Number	Correct Answer	Reject	Mark
17	D		**1**

Question Number	Correct Answer	Reject	Mark
18	C		**1**

Question Number	Acceptable Answers	Reject	Mark
19(a)	iodine IGNORE I_2 / I	Iodide /I^-	(1)

Question Number	Acceptable Answers	Reject	Mark
19(b)	Allow oxidation numbers written under species in equation or in the text below **First mark** - oxidation numbers of reactants F_2 F is 0 OH^- O is -2 (1) **Second mark** - oxidation numbers of products OF_2 O is +2 and F is -1 H_2O O is -2 F^- F is -1 (1) **Third mark** – redox Fluorine / F_2 is reduced as oxidation number decreases / changes from 0 to -1 and oxygen is oxidised as oxidation number increases / changes from -2 to +2 OR Fluorine / F_2 is an oxidising agent as oxidation number decreases / changes from 0 to -1 and oxygen is a reducing agent as oxidation number increases / changes from -2 to +2 ALLOW O^{2-} for oxygen (1) IGNORE gain / loss of electrons	Just 'ON F decreases and ON O increases' If O is −2 and F is +1 in OF_2, fluorine is oxidised from 0 to +1 and reduced from 0 to −1 (disproportionation)	(3)

Question Number	Acceptable Answers	Reject	Mark
19(c)	$S_2O_3^{2-} + 5H_2O + 4Cl_2 \rightarrow 2SO_4^{2-} + 10H^+ + 8Cl^-$ ALLOW multiples ALLOW $Na_2S_2O_3 + 5H_2O + 4Cl_2$ $\rightarrow Na_2SO_4 + H_2SO_4 + 8H^+ + 8Cl^-$ IGNORE working	uncancelled electrons reverse reaction	(1)

Question Number	Acceptable Answers	Reject	Mark
19(d)(i)	Instantaneous / temporary dipole OR temporary asymmetric electron distribution (on one molecule) (1) Induces / creates / causes a dipole / charge and in adjacent / another molecule (and these opposite charges attract) (1) IGNORE ID – ID	Just 'induces a dipole'	(2)

Question Number	Acceptable Answers	Reject	Mark
19(d)(ii)	There are (18) more electrons in iodine (than bromine) OR There are more electrons in HI (than HBr) ALLOW There is a greater electron cloud in iodine (than bromine) ALLOW Iodide has more electrons (than bromide) ALLOW Iodine has a larger surface area (than bromine) IGNORE Iodine is larger / heavier / has larger instantaneous dipole / has a greater electron density / has more protons / has more neutrons (than bromine)	There are more electrons in I⁻ / iodide ions (than bromide ions / Br⁻)	(1)

Question Number	Acceptable Answers	Reject	Mark
19(d)(iii)	**Identification of intermolecular forces** HF (also) has hydrogen bonds (1) IGNORE HCl only has London forces **Comparison of strength** Hydrogen bonds are stronger than London forces / other intermolecular forces ALLOW Hydrogen bonding is stronger OR Hydrogen bonding is the strongest intermolecular force OR More energy is needed to break hydrogen bonds (than London forces) OR The intermolecular forces in HF are stronger (than those in HCl) (1) IGNORE Fluorine is more electronegative than chlorine / there is a greater electronegativity difference in HF than HCl	Any reference to breaking H-Hal bond London forces in HF are stronger (than those in HCl)	(2)

Question Number	Acceptable Answers	Reject	Mark
19(e)	(Shape $[PCl_4]^+$) tetrahedral (1) (Shape $[PCl_6]^-$) octahedral (1) **Justification** 4 electron / bond pairs in $[PCl_4]^+$ and 6 electron / bond pairs in $[PCl_6]^-$ (1) Electron/bond pairs / regions of electron density arranged to minimise repulsion ALLOW Maximum separation of electron/bond pairs / regions of electron density (1) IGNORE Lone pairs repel more than bond pairs / bond angles, even if incorrect	Penalise use of bonds for electron pairs once only Just 'minimise repulsion / maximum separation'	(4)

(Total for Question **19** = 14 marks)

Question Number	Acceptable Answers	Reject	Mark
20 (a)(i)	 **OR** 7x and 5 • around the bromine. **(1)** Total of 8 electrons round each oxygen One octet MUST INCLUDE the electron represented by * **(1)** ALLOW x for oxygen and • for bromine if clear Electrons in bonds to be shown in rows eg xx •• or x•x• between the relevant atoms; non-bonded electrons not in pairs.. All dots or all crosses then max 1 Two dative covalent bonds by the bromine to the oxygens then max 1 (loses first mark) IGNORE circles round outer shells of atoms		2

Question Number	Acceptable Answers	Reject	Mark
20 (a)(ii)	There are vacant (3)**d** orbitals / They are using (3)**d** orbitals ALLOW Sub-shells for orbitals Use of D for d	2d p/ f orbitals Shell for sub-shell	1

Question Number	Acceptable Answers	Reject	Mark
20 (b)(i)	(n=8.35 ÷ 167 =) 0.05(00) (mol) **(1)** Ignore any units even if incorrect. (c= 0.05 ÷ 0.25 =) 0.2(00) (mol dm^{-3}) TE on incorrect number of moles in first mark **(1)** Correct answer without working scores **(2)** If final units are given they must be correct. ALLOW 1sf mol /dm^3 OR M	mol /dm^{-3}	2

Question Number	Acceptable Answers	Reject	Mark
20 (b)(ii)	(0.0025 x 6 =) 0.015 (mol) **(1)** (0.015 x 166 = 2.49 (g)) TE from first mark **(1)** 2.6 ≤ value ≤ 5.0 (g) TE for third mark as long as a calculation has been done for second mark. Values should be at least 0.1 g above calculated value and less than double calculated value. **(1)** ALLOW 1sf for suitable mass		3

Question Number	Acceptable Answers	Reject	Mark
20 (b)(iii)	(0.001 x 2 =) 0.002/ 2 x 10^{-3} (mol) **(1)** (V = 0.002 ÷ 0.1x1000 =) 20 (cm^3) ALLOW 0.02 **dm^3**/ 0.020 **dm^3** **(1)** If units are not in cm^3 they must be stated TE from incorrect number of mol Correct answer without working scores **(2)**	0.02 0.02 dm^{-3}	2

Question Number	Acceptable Answers	Reject	Mark
20 (b)(iv)	Mass of $KBrO_3$ **(1)** **Second mark depends on correct choice in first.** Percentage error/ uncertainty large with a small mass OR Mass is only to 1sf **(1)** IGNORE calculation, even if incorrect	Just "Mass is only to 2 decimal places" / "mass is only 0.07g"/ "mass is not accurate"	2

TOTAL FOR Q20 = **12 MARKS**