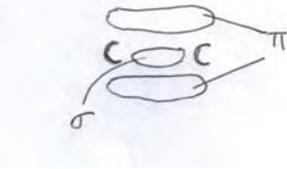
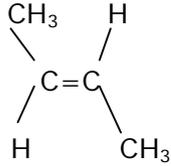


Question Number	Acceptable Answers	Reject	Mark
1(a)(i)	σ bond between C atoms (1) π bond above and below σ bond (1) 		2
	Max (1) if diagram is unlabelled.		

Question Number	Acceptable Answers	Reject	Mark
1(a)(ii)	Good overlap of s orbitals in sigma bonds (1) p orbitals are parallel so poor overlap when π bonds form (1) OR Overlap of orbitals in sigma bond is along the line between the two nuclei (1) whereas, in the π bond, there is sideways overlap (1) Can be shown on a diagram		2

Question Number	Acceptable Answers	Reject	Mark
1(b)(i)	 <i>E</i> -but-2-ene Allow angles of 90° between C=C and other bonds. Allow displayed or skeletal formula		1

Question Number	Acceptable Answers	Reject	Mark
1 (b) (ii)	<p>One C on the double bond has two of the same atoms/ two hydrogen atoms attached to it</p> <p>OR</p> <p>C on one end of double bond is not attached to two different atoms or groups</p> <p>Ignore references to restricted rotation about the C=C double bond</p>		1

Question Number	Acceptable Answers	Reject	Mark
1 (b) (iii)	<p>(Bromine water goes from brown/ red-brown / yellow/ orange to) colourless</p> <p>OR</p> <p>(Bromine water is) decolorised</p> <p style="text-align: right;">(1)</p> $ \begin{array}{ccccccc} & & \text{CH}_3 & & \text{H} & & \\ & & & & & & \\ \text{Br} & - & \text{C} & - & \text{C} & - & \text{OH} \\ & & & & & & \\ & & \text{H} & & \text{CH}_3 & & \end{array} $ <p>Accept any orientation</p> <p>Allow addition of two Br atoms</p> <p>Allow un-displayed CH₃ and OH groups</p> <p>Allow skeletal or structural formula</p> <p style="text-align: right;">(1)</p>	<p>To 'clear'</p> <p>Molecular formula</p>	2

Question Number	Acceptable Answers	Reject	Mark
1(c)	(Colour change purple/ purple-pink / pink to) colourless OR (KMnO ₄ is) decolorised $ \begin{array}{ccccccc} & \text{OH} & & \text{OH} & & & \\ & & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - \text{CH}_2 & - & \text{CH}_3 \\ & & & & & & \\ & \text{H} & & \text{H} & & & \end{array} $ Accept any orientation Allow un-displayed CH ₂ CH ₃ and OH groups, skeletal or structural formula (1)	To clear Molecular formula (1)	2

Question Number	Acceptable Answers	Reject	Mark
1(d)(i)	(2-) methylprop(-1)ene	2- methylprop-2-ene	

Question Number	Acceptable Answers	Reject	Mark
1(d)(ii)	$ \begin{array}{ccccccc} & \text{H} & & \text{CH}_3 & & \text{H} & & \text{CH}_3 \\ & & & & & & & \\ - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - \\ & & & & & & & \\ & \text{H} & & \text{CH}_3 & & \text{H} & & \text{CH}_3 \end{array} $ Allow methyl groups on C2 and C3 Allow complete polymer formula with square brackets and n		1

Question Number	Acceptable Answers	Reject	Mark
1(e)	Not sustainable as (polybutene) not made from a renewable resource / Not sustainable as made from non-renewable resource / not sustainable as made from crude oil / Not sustainable as crude oil is not renewable / Not sustainable as crude oil finite resource IGNORE References to non-biodegradability / long-lasting in use		1

Total = 13 marks

Question Number	Acceptable Answers	Reject	Mark
2(a)	(Electrostatic) attraction between (bonding) electrons and nuclei/protons	Just a 'shared pair of electrons'	1

- IGNORE ANY INNER SHELL ELECTRONS DRAWN
- ONLY THE TOTAL NUMBERS OF ELECTRONS IN OUTER SHELLS ARE BEING ASSESSED
- ALLOW ELECTRONS TO BE ALL DOTS OR ALL CROSSES OR BOTH

Question Number	Acceptable Answers	Reject	Mark
2(b)(i)	$ \begin{array}{c} \text{H} \\ \bullet \times \\ \text{H} \times \text{C} \times \text{H} \\ \times \bullet \\ \text{H} \end{array} $		1

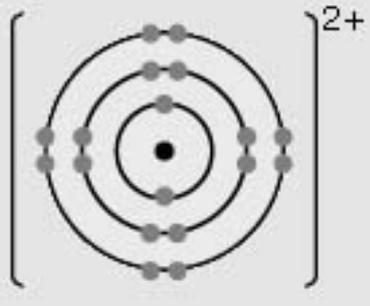
Question Number	Acceptable Answers	Reject	Mark
2(b)(ii)	$ \begin{array}{c} \text{H}^+ \times \text{C}^+ \times \text{H}^+ \\ \bullet \times \times \bullet \\ \text{H}^+ \times \text{C}^+ \times \text{H}^+ \end{array} $		1

Question Number	Acceptable Answers	Reject	Mark
2(b)(iii)	$ \begin{array}{c} \bullet \\ \times \\ \times \text{N} \times \text{N} \bullet \\ \times \\ \bullet \end{array} $ <p>NOTE: The lone pair of electrons on each N atom do not have to be shown as a pair</p>		1

Question Number	Acceptable Answers	Reject	Mark
2(b)(iv)	$ \left[\begin{array}{c} \text{H} \\ \bullet \times \\ \text{H} \times \text{N} \times \text{H} \\ \times \bullet \\ \text{H} \end{array} \right]^+ $ <p>The + sign can be shown anywhere Ignore missing brackets Ignore if the + is missing</p>		1

Question Number	Acceptable Answers	Reject	Mark
2(c)(i)	<p>IGNORE any references to 'molecules' in this part only</p> <p>First mark: Location of silicon's electrons</p> <p>Silicon's (outer) electrons are fixed (in covalent bonds)/ silicon's (outer) electrons are in fixed positions (in covalent bonds)/ silicon's (outer) electrons are involved in bonding (1)</p> <p>Second mark: Lack of mobility of silicon's electrons</p> <p>(therefore) silicon's electrons are not free (to move)/ silicon has no free electrons/ there are no mobile electrons in silicon/ silicon has no delocalized electrons/ silicon's electrons cannot flow (1)</p> <p>IGNORE references to lack of ions</p>	<p>'Silicon is ionic' scores (0) for the question</p> <p>'silicon's ions are not free to move' scores (0) for the question</p>	2

Question Number	Acceptable Answers	Reject	Mark
2(c)(ii)	<p>(The covalent) bonds are strong (throughout the lattice) (1)</p> <p>(therefore) a lot of energy is required to break the bonds / a lot of energy is needed to overcome the attractions (1)</p> <p>IGNORE any references to 'giant molecular'</p>	<p>'(simple) molecular silicon' (0)</p> <p>/'molecules of silicon' (0)</p> <p>/'silicon has ions' (0)</p> <p>/'intermolecular forces' / 'van der Waals' forces' / 'London forces' (0)</p> <p>ALL THE ABOVE SCORE (0) OVERALL</p>	2

Question Number	Acceptable Answers	Reject	Mark
3 (a)(i)	 <p>electrons (1) charge (1) square brackets not essential</p> <p>Mark independently</p> <p>Ignore (labelling of) nucleus unless incorrect</p>		2

Question Number	Acceptable Answers	Reject	Mark
3 (a)(ii)	$1s^22s^22p^63s^23p^6$ Allow electron number as sub script Allow orbitals as capital letters Allow TE from (a) (i) if Ca atom or Ca ⁺ ion		1

Question Number	Acceptable Answers	Reject	Mark
3 (a)(iii)	<p>Smaller Because it has one less (sub) shell of electrons / orbital / energy level / less shielding (1)</p> <p>And the ratio of protons : electrons has increased / more protons than electrons / greater net force on remaining electrons (so remainder of electrons held more closely) / greater effective nuclear charge (1)</p>	<p>bigger scores zero</p> <p>greater nuclear charge /positive charge</p>	2

Question Number	Acceptable Answers	Reject	Mark
3 (a)(iv)	<p>Any two from: Strong (electrostatic) forces / attractions / bonds (between ions) (1)</p> <p>(ions) held in giant lattice / many (ionic) attractions / forces / bonds (1)</p> <p>So large amount of energy needed (to break apart ions) (1)</p>	<p>Any mention of covalent or metallic bonds or atoms or molecules scores zero</p> <p>High temperature</p>	2

Question Number	Acceptable Answers	Reject	Mark
3 (b)(i)	Because the ions are free to move (when a potential difference is applied)	Electrons / particles are free to move	1

Question Number	Acceptable Answers	Reject	Mark
3 (b)(ii)	<p>The cations / barium and calcium (ions) are different sizes</p> <p>Ignore any discussion of reasons</p> <p>(could select either the calcium ion because it has more water molecules associated with it OR the barium ion because it has more shells of electrons and so larger)</p>	Atoms are different sizes	1

Question Number	Acceptable Answers	Reject	Mark
3 (b)(iii)	<p>Mass of calcium ions in 1 kg = 0.100×40 (= 4.0) (g) (1)</p> <p>If mass quoted must be correct to score first mark</p> <p>Hence 4.0 g per 1000 g of solution So ppm = $(4.0/1000) \times 1000000$ = 4000 (ppm) (1)</p> <p>OR</p> <p>Mass of calcium ions in 1 kg = 0.100×40.1 (= 4.01) (g) (1)</p> <p>Hence 4.01 g per 1000 g of solution So ppm = $(4.01/1000) \times 1000000$ = 4010 (ppm) (1)</p> <p>Correct answer alone = 2 marks</p> <p>Allow TE for second mark from incorrect mass</p>		2

Question Number	Acceptable Answers	Reject	Mark
3 (c)	<p>(Sulfur / nitrogen oxides) form when (fossil) fuels are burnt / when petrol or diesel burn in vehicle engines / emissions from vehicle (engines) / volcanoes / lightning (1)</p> <p>They (react with water to) form sulfuric / sulfurous acid / nitric acid / acid rain / gases are acidic (1)</p> <p>Which reacts with limestone (to form soluble compounds) / limestone and acid take part in neutralisation / dissolves building / corrodes building (1)</p> <p>Allow correct equation for third mark but ignore equations if mark already awarded. ignore comments regarding erosion</p>	from factories alone	3

Question Number	Acceptable Answers	Reject	Mark
3 (d)	Either Yes, as the values match closely (so little deviation from ionic model) Or no, as the values are (slightly) different so a degree of covalency / not fully ionic	100% ionic covalent	1