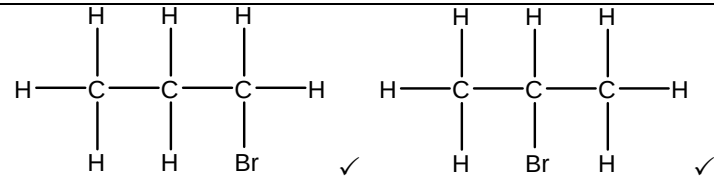
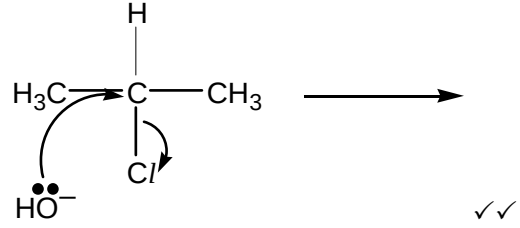
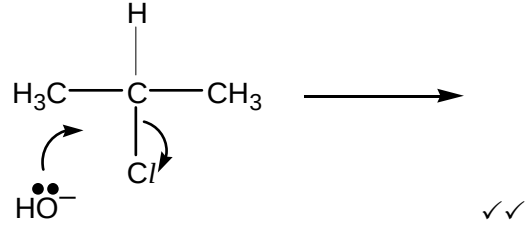
OCR
RECOGNISING ACHIEVEMENT

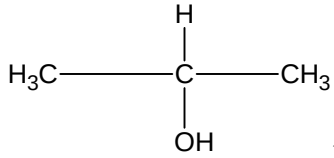
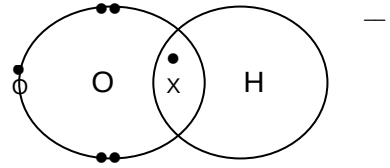
GCE

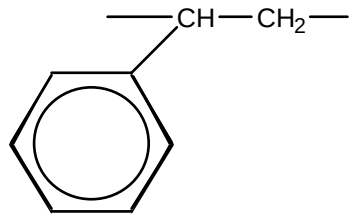
Chemistry B (Salters)

Mark Scheme

Question			Answer	Mark	Guidance
1	(a)		Alkene(s) ✓	1	**DO NOT ALLOW** C=C
1	(b)		(Processing of) crude oil / (dehydration of) propan-1-ol / propan-2-ol / propanol ✓	1	**IGNORE** cracking **NOT** 'oil', without 'crude' Hydrolysis of propanol **CON**s this mark
1	(c)		(Colour change) brown / orange / yellow to colourless ✓	1	Any combination of these colours but no others **DO NOT ALLOW** "clear" instead of "colourless" **IGNORE** red
1	(d)		Electrophilic ✓ Addition ✓	2	**ALLOW** answers indicated in other ways, such as circling Each additional underline **CON**s a mark
1	(e)	(i)	Secondary ✓	1	
1	(e)	(ii)	C to which OH / alcohol group / hydroxy(l) group is bonded is itself bonded to 2 other C / one H on C to which OH is bonded / 2 alkyl groups on C ✓	1	Can refer to R groups **IGNORE** 'OH in middle of chain' **NOT** 'it' for 'OH'
1	(e)	(iii)	Water / steam ✓ Phosphoric acid ✓ High temperature and pressure ✓	3	**IGNORE** aqueous **ALLOW** sulphuric acid instead of phosphoric acid or correct formulae Additional reagents **CON** acid mark **IGNORE** concentrations **IGNORE** inert catalyst supports such as alumina **ALLOW** temps 200-400 °C and pressure above 1 atm **ALLOW** heat (but not warm) and pressure. Award the high temperature and pressure mark only if the water/steam mark has been gained

Question			Answer	Mark	Guidance
1	(f)		 ✓ ✓	2	**ALLOW** any clear structure, e.g.: $CH_3CHBrCH_3$
1	(g)		Chlorine ✓ UV radiation ✓	2	**ALLOW** Cl_2 **NOT** chlorine water Other reagents **CON** this mark **ALLOW** UV light / UV Other conditions **CON** this mark
1	(h)	(i)	Either:  ✓✓ **OR**  ✓✓	2	One mark for each curly arrow **DO NOT ALLOW** single headed arrows. However, if candidate draws two single headed arrows to the correct positions then award one mark Curly arrow must be drawn carefully starting from the lone pair or bond and ending on an atom or pointing to the line between C and O **ALLOW** arrows starting at negative charges. Arrow must start within a radius of one lone pair width from either lone pair or minus. (i.e.: lower example is JUST OK) Mark separately

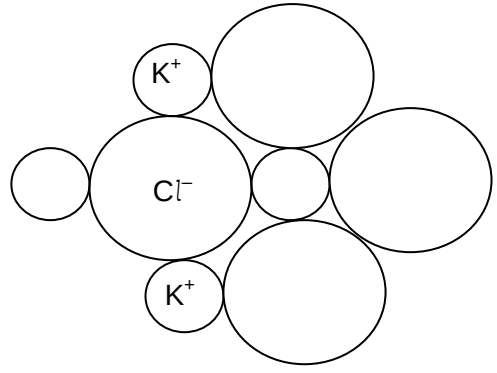
Question			Answer	Mark	Guidance
1	(h)	(ii)	 ✓	1	**ALLOW** any clear structure, e.g.: $CH_3CH(OH)CH_3$ **NOT** ambiguous attachments of OH (i.e.: bond is in line with left-hand arm of the H or further right) Left-hand CH_3 can be drawn the other way round
1	(h)	(iii)	 ✓	1	**ALLOW** negative charge in any position **IGNORE** circles **ALLOW** 'extra' electron shown as a dot **ALLOW** reversal of dots and crosses Must have correct total of electrons on appropriate atoms **ALLOW** diagram with no negative charge
1	(h)	(iv)	(It is a negative ion with a) lone <u>pair</u> / electron <u>pair</u> **AND** available to form a bond / can be donated.	1	
			Total	**19**	

Question			Answer	Mark	Guidance
2	(a)		(Good thermal) insulator / low density ✓	1	**ALLOW** lightweight, but not light **IGNORE** one other irrelevant response If more than one other irrelevant response, this **CON**s the mark
2	(b)		 ✓	1	The correct shape is not required for the mark More detailed structures can be drawn **IGNORE** brackets and 'n' **DO NOT ALLOW** ambiguous attachments to benzene ring, or benzene ring without circle
2	(c)		Softens / flows / melts / is deformed when <u>warmed / heated</u> ✓	1	**ALLOW** 'can be (re)moulded / <u>re</u>shaped when warm'
2	(d)	(i)	Amount of phenylethene / product increases **OR** higher yield ✓ (increased temperature) moves (position of) equilibrium in the endothermic direction (ORA) ✓	2	Endothermic must be correctly spelled for the second mark to be awarded or 'exothermic' if reverse argument given **ALLOW** 'reaction moves in / favours the endothermic direction' / forward reaction is endothermic / shifts towards the endothermic reaction **ALLOW** endothermic for QWC if written on equation 2.1. Mark independently
2	(d)	(ii)	Amount of phenylethene / product decreases / lower yield ✓ (increased pressure) moves (position of) <u>equilibrium</u> to the side with fewer molecules / moles / particles ✓	2	 **NOT** just 'equilibrium moves to the left'. **NOT** atoms. Mark independently

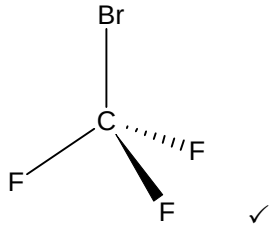
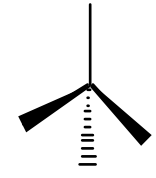
Question			Answer	Mark	Guidance
2	(e)	(i)	Larger / greater / more surface area of catalyst **OR** Higher surface area to volume ratio ✓ So more collisions per unit of time / more frequent collisions / collisions occur more often **OR** provides surface onto which reactants are adsorbed / can bond *(AW)* ✓	2	**NOT** higher surface area **NOT** just more collisions Mark independently
2	(e)	(ii)	(Catalyst) provides an alternative reaction path / route ✓ that has a lower activation enthalpy ✓	2	Answer must have the idea of a different path to gain the mark Mark independently
2	(f)		Elimination ✓	1	Any clear indication scores the mark (e.g.: ringed) More than one indicated scores zero

Question			Answer	Mark	Guidance
2	(g)		*Description of how intermolecular bonds form:* *Hydrogen bonds* 1. Lone pair on oxygen* / oxygen* small & electronegative ✓ 2. attracted to hydrogen with δ+ charge / partially positive charge **OR** attracted to H polarised in O*–H bond ✓ * could also be N or F *Instantaneous dipole – induced dipole* 3. Electron movements in the molecules create an uneven distribution of charge ✓ 4. A dipole is induced in a neighbouring molecule leading to attraction ✓ *Comparison in solubility:* 5. Poly(ethenol) can form hydrogen bonds with water ✓ 6. Poly(phenylethene) cannot form hydrogen bonds with water ✓ QWC for poly(ethenol) has OH groups, so can form H bonds **OR** Poly(phenylethene) has no OH groups, so cannot form H bonds	6 1	**Please use annotations in the answer in appropriate places** Can refer to intermolecular forces rather than intermolecular bonds **NOT** reference to hydrogen or oxygen molecules **NOT** H is electropositive **NOT** just 'positive hydrogen' Attraction must be mentioned to score mp2 **ALLOW** marking points 1 and 2 from a diagram, where dotted line shows attraction **ALLOW** 'dipole / polar' for 'uneven distribution of charge' Does not score if it just mentions negative (or +ve) charge **NOT** electron density changes or electrons are orbiting / spinning for movement **ALLOW** references to atoms rather than molecules In mp 3 & 4, both parts are needed for the mark **NOT** 'forming a bond' for attraction in mp4 **ALLOW** by implication for 2 marks, that 'only poly(ethenol) can form hydrogen bonds with water' ALLOW mp 5 & 6 if description of H bonds with water is given. **Please indicate QWC using green tick or red cross on the right of the pencil icon on the answer screen**
			Total	**19**	

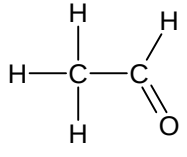
Question			Answer	Mark	Guidance
3	(a)		M_r(NaC*l*) = 58.5 and M_r(KC*l*) = 74.6 / 74.5 ✓ 2/ M_r(NaC*l*): 1/ M_r(KC*l*) and evaluate as 1: something (= 1 : 0.39) ✓	2	'moles Na : moles K = 1: 0.39' scores both marks **ALLOW** any number of s.f. for 2nd mp ALLOW 2nd mp if A_r values of K and Na have been used instead of M_r values (= 1: 0.29)
3	(b)	(i)	White ✓	1	**IGNORE** colour changes on standing
3	(b)	(ii)	Silver chloride ✓	1	
3	(b)	(iii)	$Ag^+ + Cl^- \rightarrow AgCl$ ✓	1	**ALLOW** with no state symbols **NOT** if state symbols are wrong
3	(c)	(i)	Green gas **OR** Green-yellow gas ✓	1	Both colour and 'gas' needed for mark **IGNORE** shades of colour, like dark or pale
3	(c)	(ii)	[Ne] 3s [↑↓] 3p [↑↓] [↑↓] [↑] ✓	1	**ALLOW** single arrow in any 3p atomic orbital pointing up or down **ALLOW** use of other arrow symbols (such as ↿, as long as – in each box that contains a pair– one points up and one down)
3	(d)	(i)	$1s^22s^22p^63s^23p^64s^1$ / [Ar] $4s^1$ ✓	1	**ALLOW** capital letters. **ALLOW** $1s^22s^22p^63s^23p^63d^04s^1$ **NOT** subscripts
3	(d)	(ii)	$K (g) \rightarrow K^+ (g) + e^-$ Equation ✓ K and K^+ both shown as (g) ✓	2	**ALLOW** e without a sign for the electron symbol **ALLOW** $K (g) - e^- \rightarrow K^+ (g)$ **IGNORE** state symbol on electron **NOT** capital 'G' for state symbol

Question			Answer	Mark	Guidance
3	(d)	(iii)	Outer shell / outermost electron(s) of K **AND** further from the nucleus (than Na) / shielded more (than Na) (*ORA*) ✓ Attraction / pull from the nucleus is weaker <u>and</u> less energy is needed to remove an electron (*ORA*) ✓	2	Must be a comparison. **IGNORE** 'molecule' **NOT** 'it' for potassium but second mark does not need element specified Mark separately. **NOT** 'harder to remove'
3	(e)		 Alternating K^+ and Cl^- (at least 3 correct labels) ✓ At least one small circle surrounded by 4 large circles ✓	2	**IGNORE** particles drawn in other layers Any incorrect labels **CON**s the K^+ Cl^- labels mark
3	(f)	(i)	(25.00 x 0.100 /1000) = 0.00250 ✓	1	**ALLOW** 0.0025 or standard form
3	(f)	(ii)	Burette ✓	1	**ALLOW** small spelling error (e.g.: 2 rs or one t). **NOT** biuret
3	(f)	(iii)	Answer to (f) (i) ✓	1	
3	(f)	(iv)	Answer to f(iii)/20.10 ✓ x 1000 and evaluated (= 0.1244) ✓ Correct evaluation of candidates calculation to 3 sf (=0.124) ✓	3	**ALLOW** sf mark for any 3 sig fig answer that follows from any calculation **NB**: 0.124 does not score all three marks if (f)(iii) is incorrect

Question			Answer	Mark	Guidance
3	(g)	(i)	Method 1 / burning potassium in chlorine, as KCl is the only product / all reacting atoms used / all products are useful (*ORA*) ✓	1	**ALLOW** 100% atom economy / only one product / no co-product / no other products / no by-products / no atoms lost / no waste / addition reaction. An incorrect statement about method 2 **CON**s the mark
3	(g)	(ii)	A lot of energy / high temperature is required **OR** reaction produces a low yield of KCl ✓	1	**ALLOW** K <u>and</u> Cl_2 / reagent<u>s</u> of method 1 are expensive **ALLOW** reagent<u>s</u> are dangerous **and** safety precautions / reaction conditions are expensive
3	(h)	(i)	(Mg is in) Group II and has a 2+ / +2 charge ✓	1	**ALLOW** 'second group'
3	(h)	(ii)	$MgCO_3$ ✓	1	
3	(h)	(iii)	<u>Giant</u> network / <u>giant</u> lattice ✓ With every C bonded to four other Cs / every C is tetrahedrally bonded ✓ Covalent ✓	3	**ALLOW** <u>giant</u> structure. Answer must imply 'every' or 'all' carbons to score the mark. References to ionic or intermolecular bonds **CON** 'covalent' mark
			Total	**27**	

Question			Answer	Mark	Guidance
4	(a)		Bromotrifluoromethane ✓	1	**IGNORE** 1s, commas, dashes and minor spelling errors (e.g.: 'fluro', flouro') **ALLOW** trifluorobromomethane
4	(b)		 ✓ Bond angle 109 ^{o} ✓	2	Shape must be 3-dimensional **ACCEPT** 105 – 110 ^{o} Two bonds that are shown in the same plane **MUST** be next to each other **ACCEPT** 
4	(c)		C–Br ✓	1	**ALLOW** in words
4	(d)	(i)	Homolytic (fission) / homolysis ✓	1	**IGNORE** 'photodissociation' and 'photolysis'
4	(d)	(ii)	$8.67 \times 10^{14} \times 6.63 \times 10^{-34}$ ✓ $= 5.75 \times 10^{-19}$ (J) ✓	2	A completely correct answer on its own scores both marks. **ALLOW** ecf only if the sole error is a mis-copy of one of the number values. **ALLOW** 2sf or more but rounding must be correct

Question			Answer	Mark	Guidance
4	(d)	(iii)	= answer to (d) (ii) x 6.02 x 10^{23} ✓ /1000 (= + 346 KJ mol^{-1}) ✓	2	One mark for multiplying answer to (d)(ii) by 6.02 x 10^{23} (Avogadro's constant) Other mark for converting the answer from J to KJ, i.e.: dividing by 1000 Can be scored in either order, but must be correctly evaluated to score both marks A completely correct answer on its own scores both marks (**ALLOW** 2 or more sf but rounding must be correct)
4	(e)		Prediction / discovery (in the lab) that C*l* can damage ozone layer ✓ Spectroscopic measurements showed ozone levels depleted/ lower than expected ✓ Results (initially) disregarded/ignored/overlooked/ thought to be an error/ thought to be anomalous as they were so low / depletion so high ✓	3	**IGNORE** 'hole in the ozone layer'. Must be lower, not different. Must mention 'spectroscopic' or one particular spectroscopic method (e.g.: ir) Must imply 'very low' and not just 'anomalous' or different. Both parts needed for the mark.
4	(f)	(i)	(Greenhouse gas) <u>absorbs</u> IR <u>from Earth</u> ✓ More greenhouse gas means more IR absorbed ✓	2	Mark separately
4	(f)	(ii)	There is a relationship/ correlation between models of gas and models of <u>temperature</u> **OR** models of gas and measured <u>temperatures</u> **OR** gas levels and measured <u>temperatures</u>	1	**NOT** 'global warming' for 'temperature'
			Total	**15**	

Question			Answer	Mark	Guidance
5	(a)		*Explanation:* 1. A sequence / series / cycle of reactions OR several reactions✓ 2. where a product of one reaction continues reacting / becomes a reactant in the next reaction OR a radical is used and a new one is regenerated which is then used in the next step ✓ *Example:* At least two **consecutive** radical propagation steps, from the article, either as equations (not necessarily balanced) or words e.g.: '$OH^{\bullet}$ reacts with hydrocarbons to form $RO_2^{\bullet}$, which then reacts further to give $HO_2^{\bullet}$ ✓	3	**SCRIPT SHOWS A MARK OF 2 AND 1, BUT YOU WILL NEED TO ENTER A SINGLE SCORE OUT OF 3.** **NOT** continuous mp1 and mp2 must be stated clearly in the explanation, not gained by implication from the example **ALLOW** 'radical produced in each step to continue the cycle' for 2 marks (mp 1 and 2) **ALLOW** examples that are correct, but not from the article
5	(b)	(i)	(A particle) with an unpaired electron ✓	1	**IGNORE** 'free' or 'lone' or single electron **NOT** 'is an unpaired electron'
5	(b)	(ii)	$O + H_2O \rightarrow 2\ {}^{\bullet}OH$ / $O + H_2O \rightarrow {}^{\bullet}OH + {}^{\bullet}OH$ ✓	1	Radicals do **NOT** need to have the • to show the unpaired electron **IGNORE** position of dot on radical
5	(c)	(i)	 ✓	1	

Question			Answer	Mark	Guidance
5	(c)	(ii)	(The IR spectrum of the gas mixture would show) a peak / trough / absorption value in the range 1720 – 1740 (cm^{-1}) for the C=O ✓ fingerprint (region) for ethanal / same as known spectrum of ethanal ✓	2	 **IGNORE** wavenumber for fingerprint region.
5	(d)		The •OH removes the H atom / the •OH reacts to form water ✓ This leaves an (alkyl) radical / molecule, which breaks down (in the atmosphere) ✓	2	Can show first marking point using equation
5	(e)		NO_2 concentration increases to 11 am, then decreases / peaks at 11 am ✓ Increase caused by reaction of NO with oxygen / NO forms NO_2 ✓ Decrease caused by <u>UV</u> (radiation) breaking bonds in NO_2 / Decrease caused by <u>UV</u> (radiation) breaking down NO_2 ✓	3	**IGNORE** references to 'rush-hour' **ALLOW** times for maximum NO_2 between 10.30 and 11.30 Both increase and reaction required for the mark All three parts needed for the mark **ALLOW** 'photolysis / photodissociation' for 'breaking bonds' **NOT** h*v* for UV

Question			Answer	Mark	Guidance
5	(f)		***Four from points 1 to 5:*** ***Formation of ozone***: 1. $NO_2^{\bullet}$ breaks down, forming O ✓ 2. O_2 breaks down forming O ✓ 3. O reacts with O_2 to produce an ozone molecule ✓ ***Removal of ozone***: 4. Ozone molecules are broken down <u>by UV</u> (into O and O_2) ✓ 5. Ozone molecules react with radicals (such as O), producing oxygen ✓ *plus those below:* Smog chambers / EUPHORE / simulation chambers / computer models / atmospheric studies (*AW*) / laboratory experiments (predict changes in ozone levels) ✓ Respiratory problems / breathing difficulties / asthma attacks / weakens immune system / photochemical smog / greenhouse gas / toxic ✓ QWC for linking marking point 1 or 2 with 3 **OR** linking 4 and 5, providing it is through the O radical ✓	6 1	**Please indicate QWC using green tick or red cross on the right of the pencil icon on the answer screen** mp 1 **ALLOW** 'photolysis' for 'breaks down'. Marking points 1 - 5 can be gained from correct equations In mp 1-5, both parts needed for the mark mp 4 **ALLOW** 'photolysis' for 'broken down by UV' **NOT** h*v* for UV mp 5 **ALLOW** any radical **NOT** just modelling **NOT** just harmful to health
			Total	**20**	