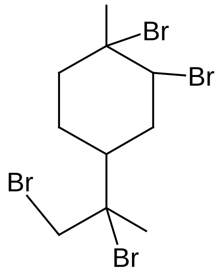
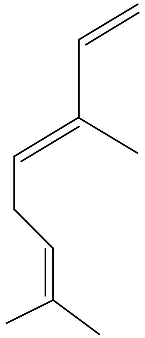
GCE

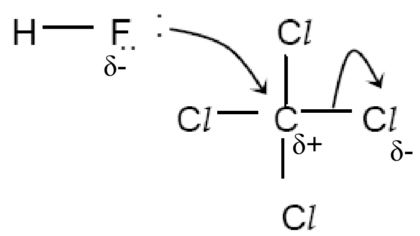
Chemistry B (Salters)

Mark Scheme

Question			Answer	Marks	Guidance
1	**(a)**	**(i)**	Alkene ✓	1	**ALLOW** ‘carbon-carbon double bond'
1	**(a)**	**(ii)**	Ether ✓	1	**ALLOW** alkoxy.
1	**(b)**	**(i)**	 One C=C bond removed and 2 Brs correctly added ✓ Second C=C bond removed and 2 Brs correctly added with rest of structure correct ✓	2	Candidate can draw structural formula instead of skeletal. The remainder of the molecule must be correct for both marks to be awarded. **IGNORE** missing or extra hydrogen atoms on structural formulae.
1	**(b)**	**(ii)**	Electrophilic ✓ Addition ✓	2	Any clear indication scores the marks (e.g.: ringed). More than two indicated: each additional incorrect answer indicated negates a correct answer.
1	**(b)**	**(iii)**	(Anhydrous) sodium sulfate *or other salt with an anhydrous and hydrated form* ✓	1	**ALLOW** <u>conc.</u> H_2SO_4 / silica gel, but not just silica. **ALLOW** correct formula. **ALLOW** sodium carbonate **IGNORE** calcium carbonate and sodium hydrogencarbonate
1	**(b)**	**(iv)**	Distillation / distilling	1	**DO NOT ALLOW** reflux **IGNORE** fractional

Question			Answer	Marks	Guidance
1	**(c)**		Nickel ✓ Heat / high temp / 100ºC – 400 ºC / pressure / 4 -10 atm ✓ **OR** Platinum ✓ Room temperature ✓	2	In both cases, second mark depends on first – unless answer gives an additional incorrect reagent. In this case reagent mark is not scored, but conditions mark can be awarded. If answer gives both Ni and Pt and correct conditions for one of them, award 1 mark. **IGNORE** pressures below 2atm for Pt conditions
1	**(d)**	**(i)**	Tertiary ✓	1	**ALLOW** abbreviation 3°
1	**(d)**	**(ii)**	C to which OH / alcohol group / hydroxy(l) group is bonded is itself bonded to 3 other C **OR** No H on C to which OH is bonded **OR** 3 alkyl groups on C to which OH is bonded ✓	1	Can refer to R groups **IGNORE** 'OH in middle of chain' **ALLOW** 'it' or O for 'OH'. Must have the idea of bonded, or attached, not just surrounded by 3 other Cs. **DO NOT ALLOW** ecf from (d)(i)
1	**(d)**	**(iii)**	(Reaction mixture) stays <u>orange</u> ✓ (Tertiary alcohol groups) are not oxidised / do not react **OR** dichromate is not reduced / does not react ✓	2	**ALLOW** ecf from an incorrect answer in (d)(i) – [orange to green ✓ because alcohol group is oxidised / alcohol group reacts / dichromate is reduced. ✓] **ALLOW** 'it' for alcohol group. Mark independently.
1	**(e)**	**(i)**	$C_{10}H_{16}$ ✓✓ **OR** 10 Cs ✓ 16 Hs ✓	2	Elements in either order. Mark independently.
1	**(e)**	**(ii)**	Water / H_2O ✓	1	
1	**(e)**	**(iii)**	Elimination ✓	1	Any clear indication scores the mark (e.g.: ringed). More than one indicated: an additional incorrect answer indicated negates the mark for the correct answer.

Question			Answer	Marks	Guidance
1	**(e)**	**(iv)**	 ✓	1	NB: there are other ways to represent this structure. The arrangement around the central C=C needs to have the methyl group and the chain ending with 2 methyl groups, on the same side of the double bond (i.e.: E configuration). The rest of the structure must also be correct for the mark to be awarded.
1	**(f)**		3,7-dimethyloct-3-ene ✓✓ Dimethyloctene ✓ 3,7 **and** 3 ✓ **OR** 2,6-dimethyloct-5-ene ✓✓ Dimethyloctene ✓ 2,6 **and** 5 ✓	2	Mark independently. **IGNORE** commas and dashes **ALLOW** minor spelling errors (e.g.: octa). **DO NOT ALLOW** extra numbers. **ALLOW** incorrect numbers anywhere for first mark (e.g.: 3,5-dimethyl-4-octene).
			Total	**21**	

Question			Answer	Marks	Guidance
2	**(a)**		Chlorofluorocarbon ✓	1	**ALLOW** minor spelling errors (e.g.: ‘fluro’, ‘floro’). **ALLOW** plural. **DO NOT ALLOW** hyphens.
2	**(b)**		Blowing agents / cleaning agents / de-greasing agent / <u>aerosol propellants</u> / solvents / flame retardant / fire extinguisher ✓	1	
2	**(c)**	**(i)**	(Catalyst) provides an alternative reaction path **OR** provides an alternative route ✓ lower activation enthalpy / energy **OR** Ea. ✓	2	Answer must have the idea of a different path to gain the first mark. Mark independently. **IGNORE** comments relating to surface area.
2	**(c)**	**(ii)**	 Curly arrow from any lone pair on F to C ✓ Curly arrow from any one C- C*l* bond to C*l* ✓ Partial charges ✓	3	**DO NOT ALLOW** single headed arrows. However, if candidate draws two single headed arrows to the correct positions then award one mark. Curly arrow from any lone pair on F: must start from one electron of the lone pair or between the electrons of the lone pair and point to the C or point to an imaginary line joining the C to the F. Curly arrow from C-C*l* bond: starting from the bond and pointing to the C*l.* Arrows when extrapolated must touch correct atom or bond. **IGNORE** extra arrow from H-F bond to F, but any additional incorrect arrows negate a mark. **IGNORE** additional correct partial charges. MP2/3: Maximum of one mark if correct partial charges are not on the C-C*l* bond being broken. Mark independently.

Question			Answer	Marks	Guidance
2	**(d)**	**(i)**	Homolytic / homolysis ✓	1	**IGNORE** 'photodissociation' and 'photolysis'
2	**(d)**	**(ii)**	($467 / 6.02 \times 10^{23}$) x 1000 and evaluate (= 7.757/ 7.76 / 7.8 x 10^{-19} J) ✓ ✓ 467 x 1000 ✓ or 467 / 6.02 x 10^{23} ✓	2	One mark is for converting 467 from kJ to J i.e.: multiply by 1000, the other mark is for dividing by 6.02×10^{23} (the Avogadro constant) - in either order. To gain both marks, expression must be correctly evaluated (e.g.: If answer is given as 7.75 x 10^{-19}, the second mark is not given, as this is an incorrect rounding of the correct value). A completely correct answer on its own scores both marks. Answer can be given to any number of sf.
2	**(d)**	**(iii)**	Answer to (d) (ii) (rounded or not rounded) / 6.63 x 10^{-34} ✓ = 1.17(0056574) x 10^{15} ✓ 3 sf (= 1.17 x 10^{15}) ✓	3	**DO NOT ALLOW** second mark for evaluating any other expression. e.g.: Answer to (d) (ii) x 6.63 x 10^{-34} **ALLOW** s.f. mark for any 3 sig fig answer that follows from any calculation A completely correct answer on its own scores all marks including the s.f. mark.

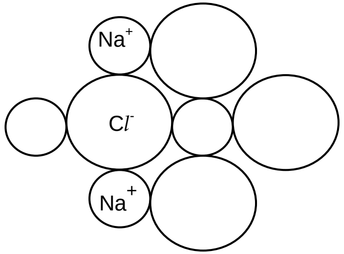
Question			Answer	Marks	Guidance
2	**(d)**	**(iv)**	C–F bonds / they are stronger (than C–C*l* bonds) (ORA) **OR** C-F bonds need more energy to break (than C-C*l* bonds) (ORA) **OR** C-F bonds have higher bond enthalpy (than C-C*l* bonds) (ORA) ✓ <u>UV/ radiation / light</u> is not of a high enough energy to break C–F bond **OR** <u>UV/ radiation / light</u> is not high enough frequency to break C–F bond ✓	2	**DO NOT ALLOW** 'holds onto electrons more strongly'. MP1: Answer must refer specifically and correctly to one of C-F or C-C*l* to gain the mark. **IGNORE** answers in terms of electronegativity. MP2: Answer is for UV / radiation / light and 'high enough' energy or frequency (so **NOT** 'not enough high frequency energy' and **NOT** 'not enough energy of high frequency'). Mark independently.
2	**(d)**	**(v)**	(Values) were very / unexpectedly low (AW) ✓	1	Answers need to show that values were much less and not just different from the expected ones. **ALLOW** 'small' for 'low' and any qualifier indicating 'very (low)', such as 'too', 'impossibly', 'really'. **ALLOW** mark for 'ozone depletion was very high' (AW)

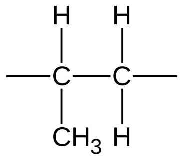
Question			Answer	Marks	Guidance
2	**(e)**		1,1,1- ✓ trifluoroethane ✓	2	Mark independently. **IGNORE** commas and dashes. **ALLOW** minor spelling errors. **DO NOT ALLOW** other numbers, such as 2,2,2.
2	**(f)**		*Four from MP1-5:* 1. UV / visible / <u>near</u> IR (from Sun) **OR** High frequency / high energy radiation (from Sun) ✓ 2 Earth absorbs some of the energy / radiation **OR** (energy from the Sun) heats up Earth ✓ 3 Earth radiates IR / emits IR / re-emits IR ✓ 4 HFC 143a (molecules) absorb (IR) radiation ✓ 5 Which makes their <u>bonds</u> vibrate (more) **OR** increases the vibrational energy of the <u>bonds</u> ✓ ***<u>PLUS:</u>*** 6 increases kinetic energy that raises the temperature **OR** transfers kinetic energy to thermal energy / heat **OR** IR is re-emitted <u>in all directions</u> ✓	5	**Please use annotations on answer in appropriate places.** **MP1: DO NOT ALLOW** light or sunlight instead of UV / visible / near IR. **IGNORE** references to what happens to radiation before it reaches Earth. **MP3: DO NOT ALLOW** Earth reflects IR. **ALLOW** transmits for radiates. **MP4:** Must be in the context of HFC 143a, not just greenhouse gases. **MP5:** Must be in the context of molecules absorbing radiation. **MP6:** Must be in the context of molecules absorbing radiation or bonds vibrating. Award marks for points 5 and 6 if the wrong frequency range of radiation is given as being absorbed in 4. (e.g.: candidate states HFC 143a absorbs UV).

Question			Answer	Marks	Guidance
2	**(g)**		There is a relationship/ correlation between: models of gas <u>concentration</u> and predicted <u>temperature</u> **OR** measured gas <u>concentration</u> and measured <u>temperature</u> **OR** models of gas <u>concentration</u> and measured <u>temperatures</u> **OR** measured gas <u>concentration</u> and predicted <u>temperatures</u> ✓	1	**NOT** 'global warming' for 'temperature'. **ALLOW** 'gas levels' for 'gas concentration', but not other qualifiers such as 'amount'. Idea of correlation is needed (e.g.: 'concentration of greenhouse gases and temperatures have both increased').
			Total	**24**	

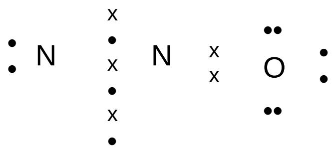
Question			Answer	Marks	Guidance
3	(a)		They produce less CO_2 (per tonne of Cl_2) ✓ Use less energy / electricity ✓	2	**IGNORE** references to voltage.
3	(b)	(i)	$2Cl^- \rightarrow Cl_2 + 2e^-$ or balanced with ½ ✓✓	2	**IGNORE** state symbols. **ALLOW** $2Cl^- - 2e^- \rightarrow Cl_2$ **ALLOW** e without the negative charge and multiples in balancing. **ALLOW** 1 mark for $Cl^- \rightarrow Cl_2$
3	(b)	(ii)	$1s^22s^22p^63s^23p^5$ ✓	1	**ALLOW** upper or lower case letters but numbers must be superscripts. **ALLOW** [Ne] $3s^23p^5$
3	(b)	(iii)	***Any two from:*** ✓✓ Bleach Disinfectant / killing bacteria / sterilising Extraction of bromine Water treatment (AW) (Making) PVC (Making) solvents (Making) hydrochloric acid (Making) medicines (Making) pesticides (Making) CFCs / HCFCs / chloroalkanes	2	**IGNORE** 'cleaning', 'making plastics', chemical weapons or 'in swimming pools'.
3	(b)	(iv)	Chlorine is volatile / a gas / a vapour ✓ Toxic / poisonous / causes respiratory problems / choking ✓	2	 **IGNORE** harmful / irritant / dangerous / corrosive.

Question			Answer	Marks	Guidance
3	(c)		$O_2 + 2H_2O + 4\ e^- \rightarrow 4\ OH^-$ ✓	1	**ALLOW** halves and multiples **ALLOW** e without the negative charge Must have cancelled extra species to gain mark.
3	(d)	(i)	(Moles Na*Cl* =) 200000 / 58.5 (= 3418.803 / 3419 / 3420) ✓ Moles Cl_2 = ½ moles Na*Cl* ✓ Volume Cl_2 = moles Cl_2 x 24 (= 41025.64 / 41028 / 41040 dm^3) ✓	3	Indication of halving moles of Na*Cl* or doubling 58.5 = 117 in first step If neither MP1 nor MP2 have been awarded marks, award 1 mark for multiplying any number by 24 and correctly evaluating. Correct answer on answer line scores 3 marks, without reference to working. **ALLOW** any number of significant figures.
3	(d)	(ii)	100% ✓	1	
3	(e)	(i)	$Na\ (g) \rightarrow Na^+\ (g) + e^-$ Equation ✓ Na and Na^+ both shown as (g) ✓	2	**ALLOW** e without a sign for the electron symbol. **ALLOW** $Na\ (g)\ - e^- \rightarrow Na^+\ (g)$ **DO NOT ALLOW** multiples. **ALLOW** state symbols mark for (g) → (g) **IGNORE** state symbol on electron **NOT** capital 'G' for state symbol. Mark independently.

Question			Answer	Marks	Guidance
3	**(e)**	**(ii)**	 Smaller circles labelled Na^+ and larger circles labelled Cl^-. ✓ At least one more small circle correctly drawn, to show ions alternate. ✓ At least one large circle surrounded by 4 small circles. ✓	3	**IGNORE** particles shown in other layers. Any incorrectly labelled circles negates the first mark (Na^+ / Cl^- labels). MP1: **DO NOT ALLOW** mark if diagram includes electrons. MP1: **ALLOW** positive ions labelled 'sodium' and negative ions labelled 'chloride'. MP2: **ALLOW** just Na and Cl **OR** + and - labels MP2: **DO NOT ALLOW** mark if any large circles are in contact with each other. Mark independently.
			Total	**19**	

Question			Answer	Marks	Guidance
4	**(a)**		 ✓	1	**IGNORE** brackets, n and ambiguous attachments. **DO NOT ALLOW** more than one simplest repeat unit. **ALLOW** more displayed versions. **ALLOW** $–CH(CH_3)CH_2–$
4	**(b)**		Electrical insulator / does not conduct electricity / flexible / does not react with water / unreactive / not prone to stress fractures / abrasion resistant / impermeable / insoluble ✓	1	**IGNORE** strong, hard, durable, tough, malleable, dense, high melting point, heat insulator, can be moulded or remoulded. **ALLOW** waterproof or 'will not wear away'.
4	**(c)**		Softens / flows / melts / is deformed when <u>warmed / heated</u> ✓	1	**ALLOW** 'can be (re)moulded / <u>re</u>shaped when warm'. **DO NOT ALLOW** 'reformed' for 'deformed'.
4	**(d)**		1 Propene forms <u>instantaneous dipole-induced dipole</u> forces/bonds. 2 Propan-1-ol forms <u>hydrogen bonds</u>. 3 Intermolecular bonds or named imb must be broken for the liquid to boil / change to a gas. 4 Imb in propan-1-ol are stronger (than those in propene) (ORA) **OR** more energy required to break imb in propan-1-ol (than in propene). (ORA). **AND** **QWC –** mark for connection of ideas: idea of linking strength of imb to amount of energy needed to break them **OR** linking 'more energy required' to 'higher boiling point' ✓	5	**Please use a full range of annotations on answer in appropriate places.** MP1: **ALLOW** van der Waals' **IGNORE** comments about how imbs form. MP1 and 2: **DO NOT ALLOW** if answer refers to imb with different molecules (e.g.: water). MP3: Needs to give a correct change of state, not just refer to boiling point. MP4: **ALLOW** Hydrogen bonds are the strongest type of imb **ALLOW** MP4 even if imbs mentioned are incorrect. **IGNORE** harder / easier to break / 'higher temperature' for 'more energy'. Please indicate QWC mark using red cross or green tick on the right of the pencil icon on the answer screen.

Question			Answer	Marks	Guidance
4	**(e)**	**(i)**	(Yield) decreases ✓ (Increased temperature) moves (position of) equilibrium in the <u>endothermic</u> direction (ORA) ✓	2	**ALLOW** 'it' or 'amount of' for yield. MP1: 'Equilibrium moves to the right/products' negates this mark only. Endothermic must be correctly spelled for the second mark to be awarded or 'exothermic' if reverse argument given. **ALLOW** 'reaction moves in endothermic direction **OR** favours the endothermic direction' / backward reaction is endothermic / shifts towards the endothermic reaction (ORA). Mark independently.
4	**(e)**	**(ii)**	(Yield) increases ✓ (increased pressure) pushes (position of) <u>equilibrium</u> to the side with fewer / fewest / less / least molecules ✓	2	Mark independently. MP1: 'Equilibrium moves to the left/reactants' negates this mark only. **MUST** mention equilibrium and refer to numbers of molecules for the second mark. **ALLOW** moles for molecules.
4	**(f)**	**(i)**	1 (At higher temperatures) particles (AW) have more energy/move faster ✓ 2 Particles have more frequent collisions / particles have more collisions per unit of time ✓ 3 More <u>collisions</u> have (total) energy of at least the activation energy / more successful collisions ✓	3	Reverse argument allowed throughout. MP1: Not reactants have more energy. MP2: Award if 'reactants collide more frequently' is given, only if candidate has not scored MP1 because they have said 'reactants'. MP2: **DO NOT ACCEPT** more chance of / likelihood of collisions. MP3: **IGNORE** more particles have energy greater than E_a MP3: 'More frequent successful collisions' only scores this mark, not MP2.
4	**(f)**	**(ii)**	Increases ✓	1	**IGNORE** reasons for increase.
			Total	**16**	

Question			Answer	Marks	Guidance
5	(a)		Radical: (A particle) with one (or more) unpaired electron(s). ✓ Example: NO_2 / O / N / NO ✓	2	Answer must be in the context of an electron as part of some sort of particle. **IGNORE** 'free' or 'lone' or single electron. **IGNORE** other examples of radicals that are not from the article. **IGNORE** dots on radicals, including O **ALLOW** O_2 / O_3
5	(b)	(i)	 Bonding electrons correct ✓ Lone pairs correct ✓	2	Any 2 or 3 different symbols can be used to represent the electrons of the 3 atoms. Candidate may draw circles for electron shells. It **MUST** be clear that the pair of electrons being shared between the N and the right-hand O are both from the N. **IGNORE** arrow showing dative bond between N and O.
5	(b)	(ii)	***<u>Answer must follow from diagram drawn in (b)(i). If no diagram, use the following marking points:</u>*** Linear shape / (bond angle) 180 ^{o} ✓ Two regions / groups of electrons around central N **OR** two regions of electron density around central N **OR** two sets of bonding electrons around central N *AW* ✓ Electron regions repel to get as far apart as possible ✓	3	MP1: **IGNORE** 'straight' for 'linear' MP2: Answer needs to make clear that it is the central N being considered [e.g. 'there is a triple bond and a single bond around the N] **ALLOW** mp1 and mp2 from an incorrect diagram in (b)(i), except where the diagram has unpaired electrons. MP3: **IGNORE** 'electrons repel as much (or as far) as possible'. MP3: Must be in the context of the electron regions around central atom. Mark independently

Question			Answer	Marks	Guidance
5	**(c)**	**(i)**	N in NH_4^+ = -3 ✓ N in NO_2^- = +3 ✓ (Oxidation because) the oxidation state / number (of N) has increased ✓	3	Answers must have a sign in front for mark to be awarded. **ALLOW** 1 mark if answers are 3- **AND** 3+. **ALLOW** 'more positive' for increased. **IGNORE** answers referring to loss of electrons
5	**(c)**	**(ii)**	Nitrate(III) ✓	1	**ALLOW** gap
5	**(d)**	**(i)**	$(NH_2)_2CO + H_2O \rightarrow 2NH_3 + CO_2$ ✓	1	**IGNORE** state symbols and extra brackets either end of $(NH_2)_2CO$ **ALLOW** formula as $CO(NH_2)_2$ **ALLOW** multiples
5	**(d)**	**(ii)**	78% = 780000 (ppm) ✓ 780000/0.0010 = 7.8×10^8 times more ✓ **OR** 0.0010ppm = 1.0×10^{-7} (%) ✓ $78/1.0\times10^{-7}$ = 7.8×10^8 times more ✓	2	**ALLOW** ecf for second mark. Correct answer on its own scores both marks without reference to working.

Question			Answer	Marks	Guidance
5	(e)		***N_2O Put into atmosphere*** ***ONE from:*** ✓ 1 From soils 2 From aquatic systems 3 From oceans *PLUS:* ✓ 4 Denitrifying bacteria transform nitrate to N_2O under anaerobic conditions / in the absence of oxygen ***N_2O Removed from atmosphere*** ***Two from:*** ✓✓ 5 (N_2O destroyed) by photolysis / photodissociation / action of UV (AW) 6 (N_2O destroyed) by reaction with oxygen atoms / oxygen radicals 7 Dissolving in oceans ***One from:*** ✓ 8 $N_2O \rightarrow N_2 + O$ 9 $N_2O + O \rightarrow 2NO$ 10 $N_2O + O \rightarrow N_2 + O_2$ ***QWC** for linking a correct description of a process to its reaction equation. (Hence they should have mp 5 with eqn 8, OR mp 6 with either eqn 9 or eqn 10 OR mp4 with eqn 11 OR example not in article with relevant equation)*	6	**Please use a full range of annotations on answer in appropriate places.** **ALLOW** method of formation / removal not in article: FORMATION (one from, in place of mp 1-3): • N_2 and O_2 from air combining at high temperatures in either thunderstorms or vehicle engines • Making hexanedioic acid in nylon production • Fossil fuel power stations from reactions of NO at high temperatures REMOVAL (in place of one of 5-7): • In stratosphere, N_2O combines with O_3 to from N_2 and O_2 **ALLOW** other correct methods of formation and removal of N_2O in place of 1-3 or 5-7. To score mp 1 – 6, the formation or removal must be described in words, not just given as an equation. **IGNORE** eqns 9 and 10 if combined as shown in article. **ALLOW** equation for one of the processes not in the article. **ALLOW** : Eqn 11 $10H^+ + 2NO_3^- + 8e^- \rightarrow N_2O + 5H_2O$ Please indicate QWC mark using red cross or green tick on the right of the pencil icon on the answer screen. Linking for QWC needs to be of the form: ‘as shown in the equation’, the equation immediately following the description or equation linked as a footnote by an asterisk.
			Total	**20**	