

ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

- Please ensure that you use the final version of the Mark Scheme. You are advised to destroy all draft versions.
- Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks (½) should never be used.
- The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.
 - x = incorrect response (errors may also be underlined)
 - ^ = omission mark
 - bod = benefit of the doubt (where professional judgement has been used)
 - ecf = error carried forward (in consequential marking)
 - con = contradiction (in cases where candidates contradict themselves in the same response)
 - sf = error in the number of significant figures

4. The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.

5. In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), mark the first answer(s) given up to the total number required. Strike through the remainder. In specific cases where this rule cannot be applied, the exact procedure to be used is given in the mark scheme.

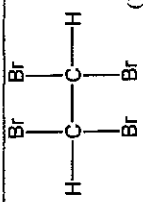
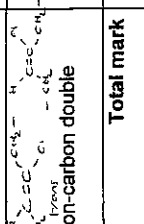
6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)

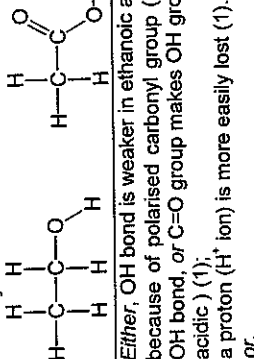
7. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.

8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct and answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

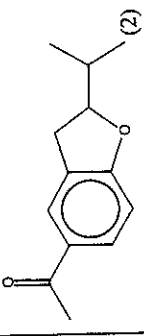
Abbreviations, annotations and conventions used in the Mark Scheme	/ = alternative and acceptable answers for the same marking point : = separates marking points NOT = answers which are not worthy of credit () = words which are not essential to gain credit — = (underlining) key words which must be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument
--	---

Question	Expected answers	Marks
1 (a)	$2\text{Br}^-(\text{aq}) + \text{Cl}_2(\text{aq}) \rightarrow 2\text{Cl}^-(\text{aq}) + \text{Br}_2(\text{aq})$ formulae correct (1); balanced (1); State symbols (1) accept $\text{Cl}_2(\text{g})$ and $\text{Br}_2(\text{g})/(\text{l})/(\text{s})$. To vapourise/remove the bromine (1).	3
1 (b)	Br 0 S +4 Br -1 S +6, 1 mark each, sign needed; For S, no positive signs scores 1 mark out of the possible 2;	1
1 (c) (i)	Br 0 S +4 Br -1 S +6, 1 mark each, sign needed; For S, no positive signs scores 1 mark out of the possible 2; accept charges after numbers.	4
1 (c) (ii)	S (or SO_2) (1); Then explanation: loses (gives) electrons (1); or Br_2 gains electrons/is reduced (1); or in terms of oxidation state change i.e. S oxidation state/number increases or Br oxidation state/number decreases (1).	2
1 (c) (iii)	$\text{Br}^- \quad \text{H}^{\delta+} \quad \text{O}^{\delta-}$ $\quad \quad \quad \quad \quad \quad $ $\quad \quad \quad \text{H} \quad \quad \quad \text{H}$ Interaction between Br and H of water (1) Br and H atoms may be just drawn next to each other, correct charges on Br and H, allow if noδs given (1).	2
1 (d)	Toxicity, or corrosive nature/harmful to humans, (1) NOT irritant / volatility	1
Total mark		13

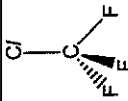
Question	Expected answers	Marks
2 (a) (i)	$\text{CaO} + 3\text{C} \rightarrow \text{CO} + \text{CaC}_2$ formulae correct (1) balanced (1)	2
2 (a) (ii)	Use of equation (as written) to write correct mole ratios/ 3:1 (1) i.e. 3 mole C gives 1 mole calcium carbide (ecf, from (i)) $M_r(\text{CaC}_2) = 64$ (1); 1 t gives 64/36 t (1) or equivalent; Answer = 1.78 t (1) Give the full 4 marks if answer correct. Allow full marks ecf from (i) needed (1).	4
2 (b)	Large amount of energy needed for heating or high temperature needed (1).	1
2 (c) (i)	There are four marking points all 1 mark: Addition of water in tap funnel or similar; to calcium carbide in flask (1 mark only if both water & calcium carbide are in flask); delivery tube, + no leaks + not sealed; collection over water.	4
2 (c) (ii) 1.	Water molecule is a proton/ H^+ /hydrogen ion (1) donor (1)	2
2 (c) (ii) 2.	OH^- (1) accept $\text{Ca}(\text{OH})_2$.	1
2 (c) (iii) 1.		1
2 (c) (iii) 2.	1,1,2,2-tetrabromoethane 1 mark for name and 1 mark for correct numbers. Allow ecf on name.	2
2 (c) (iv)	Electrophilic (1) accept electrophile; addition (1)	2
2 (c) (v)	Triple bond has a greater electron density (allow negative charge) than double (1), this mark is for a comparison; bromine molecule more polarised by triple bond or electron deficient/electrophilic bromine attracted more strongly (1).	2
2 (d) (i)	This is a Greenhouse gas or gas absorbs infrared/heat (1); leads to global warming/example of effect (1).	2
2 (d) (ii)	Calcium hydroxide is an alkali (1); enters water or leaches into the water system or enters soil (1); 120 degrees (± 2.5) (1)	2
2 (e) (i)	Correct cis (1); and correct trans (1); no need for labels. 	1
2 (e) (ii)	structures have restricted rotation about carbon-carbon double bond (1).	3
Total mark		29

Question	Expected answers	Marks
3 (a) (i) 1.	Acidified (1); dichromate (1) or, specific names/formulae given.	2
3 (a) (i) 2.	Heat (under reflux) (1) accept reflux, NOT high temperature.	1
3 (a) (ii)	$\text{CH}_3\text{COCH}_2\text{C}_2\text{H}_5$	1
3 (b) (i)	1 mark for each, if full structures (accept $-\text{OH}$, the O must be correctly attached to at least one of the two structures). 	2
3 (b) (ii)	Either, OH bond is weaker in ethanoic acid (1); because of polarised carbonyl group (or, $\text{C}=\text{O}$ pulls electrons from OH bond, or C=O group makes OH group behave differently/ more acidic) (1); or, a proton (H^+ ion) is more easily lost (1). or, in terms of equilibria of carboxyl group and ions (1); with the carboxyl ion being more stable than alkoxy group (1); and therefore greater $[\text{H}^+]$ present (1). or, ion formed from ethanoic acid is more stable than the ion formed from ethanol (1); in ethanol the the negative charge is located on the O (1); but in ethanoic acid the charge is spread out over the O-C-O group (1).	3
3 (c)	Ethanoic acid has an O-H group (1); (the frequency) occurs in the region 2500-3200 cm^{-1} (1); not present in spectrum of ethanal/only in acid/ may be inferred (1). or consider 1700 cm^{-1} region (1); and slightly different C=O frequencies (1) (i.e. 1700-1725 cm^{-1} carboxylic acid & 1720-1740 cm^{-1} ethanal); for aldehyde and acid (1). If other bond frequencies are given, maximum of 1 mark. Any 2 points from 4: (Reactants or products) wasted or lot of reactant needed (1); product separation (1); separation by fractional distillation needs high temperatures (1); storage or getting rid of unwanted products (1).	2
3 (e) (i)	Solid / solid or liquid (1).	1
3 (e) (ii)	Rate increases (1).	1
3 (e) (iii)	Yield decreases (1).	1
3 (f) (i)	d-block (1).	1
3 (f) (ii)	Catalyst is in same (1); phase (state) as reactants (1).	2

3 (f) (iii)	Correct shape for uncatalysed reaction (1 peak) and for catalysed (2 peaks) (1); ignore starting & ending points of these curves; correct labels for activation enthalpies (1); lower activation enthalpy for catalysed reaction (1); correct label for intermediate (1); correct label for enthalpy change of reaction (1); <u>single</u> product line lower than <u>single</u> reactant line (1).	6
3 (g) (i)	$M_r(\text{CaCO}_3) = 100.1(1)$, accept g.; moles = $0.1/100.1 = 9.99 \times 10^{-4}$ mol accept 1.0×10^{-3} etc. (1).	2
3 (g) (ii)	2.00×10^{-3} mol, ecf (1).	1
3 (g) (iii)	$(2.00 \times 10^{-3}) \times 1000/20$ or concentration = moles/volume (1); = $0.100 \text{ mol dm}^{-3}$ (1) ecf; Correct sig. figs. for this part only: 2/3 (1).	3
Total mark		32

Question	Expected answers	Marks
4 (a)	1 mark for each point in bold, 1 mark for any of the other points listed: Pencil line near bottom of plate; dissolve tremetol in (suitable) solvent; spot small sample of mixture (on line); solvent in beaker below spot; cover beaker with lid/film; leave until solvent front nears top of plate; remove and dry plate; use (UV light or iodine) to locate; 3 different spots. QWC 1 mark for two sentences / 2 bullet points including correct use of two of the following words: plate, solvent, locating agent/or example of and line.	6
4 (b) (i)	Correct circle, allow inclusion of methyl group as well as C=O (1).	1
4 (b) (ii)	Alkene (1) accept carbon-carbon double bond; ether (1); accept benzene ring (1).	2
4 (b) (iii)	Molecular (parent) ion peak (1); is highest mass peak or peak furthest right (1); fragmentation pattern (peaks) (1); can help piece structures together o/wite (1).	4
4 (c) (i)	Elimination (1).	1
4 (c) (ii)	Catalyst of Ni or catalyst (1); and heat/high temperature (1) do not allow heat under reflux; or, Pt/Pd (1); at rtp (1).	2
4 (c) (iii)	 other sensible hydrogenation (terminal C=C only, C=O or benzene) (1) and molecule correct (1). No marks for drawing tremetone.	2
4 (d) (i)	4 point from the following increased $[\text{H}^+]$ /more H^+ (1); H^+ reacts with HCO_3^- (1); (by Le Chatelier's Principle), position of equilibrium in Equation 4.1 moves to right /more H_2CO_3 formed (1); increased $[\text{H}_2\text{CO}_3]$ (1); (by Le Chatelier's Principle), position of equilibrium in Equation 4.2 moves to right/more CO_2 formed. (1).	4

4 (d) (ii)	Equilibrium in reaction 4.1 moves to the right (1); in order to counteract the increased concentration of hydrogencarbonate (1). or HCO ₃ ⁻ will accept H ⁺ /neutralises acid (1); and equilibrium moves to right (1). (Rapid) breathing (1); expels carbon dioxide out of the lungs (1).	2
4 (d) (iii)		2
Total mark		26

Question	Expected answers	Marks
5 (a)	 <p>formulae correct (1); correct tetrahedral shape (1). instantaneous dipole – induced dipole (1) <i>accept van der Waals forces.</i></p>	2
5 (b)	Carbon δ ⁺ (1); rest of F or Cl δ ⁻ (1). (1) only if no δ	2
5 (c) (i)	Polar, because <u>molecule</u> has permanent dipole (moment) (2), or, answer in terms of asymmetry (1) of polar bonds (1), or, dipoles of bonds (1) do not cancel (1).	2
5 (c) (ii)	instantaneous dipole – induced dipole forces (1); <i>accept van der Waals forces</i> permanent dipole - permanent dipole forces (1). or p-d — i-d forces <i>ecf if 'forces' omitted from (b).</i>	2
5 (c) (iii)	instantaneous dipole – induced dipole forces (1); <i>accept van der Waals forces</i> permanent dipole - permanent dipole forces (1). or p-d — i-d forces <i>ecf if 'forces' omitted from (b).</i>	2
5 (d)	non-toxic (1); non-flammable/unreactive (1).	2
5 (e) (i)	$O + O_2 \rightarrow O_3 / 3O_2 \rightarrow 2O_3$ <i>hv</i>	1
5 (e) (ii)	$O_3 \rightarrow O + O_2 / O + O_3 \rightarrow 2O_2$ (1) <i>hv</i> <i>hv</i> used correctly at least once for photolysis, <i>accept uv</i> (1); <i>no mark for hv if used incorrectly at all.</i>	2
5 (f)	Any 5 of the following 7 points: CF ₂ broken down by sunlight (UV); to produce chlorine atoms; chlorine atoms react with ozone; producing C/O radicals; these react with O; to regenerate chlorine atoms; this reaction is very fast (much quicker than in part d (ii)) / chlorine is a catalyst; QWC (ensure text is legible and spelling, grammar and punctuation are accurate, so the meaning is clear) At least two readable and clear sentences with no more than one spelling, punctuation or grammatical error. (1)	6
Total mark		20