

Alcohols & Halogenoalkanes

Mark Scheme 1

Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	Chemistry Lab Skills 1
Sub Topic	Alcohols & Halogenoalkanes
Booklet	Mark Scheme 1

Time Allowed: 66 minutes

Score: /55

Percentage: /100

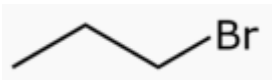
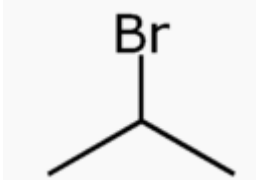
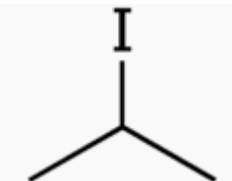
Grade Boundaries:

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

Question Number	Acceptable Answers	Reject	Mark
1(a)	<p>Ethanol dissolves (both) halogenoalkanes (and silver nitrate)</p> <p>To allow the halogenoalkane and water/silver nitrate to mix</p> <p>To allow reactants to mix</p> <p>OR</p> <p>Ethanol is a co-solvent</p> <p>ALLOW</p> <p>Ethanol has polar and non-polar parts/is a polar and non-polar solvent/ dissolves ionic and covalent substances</p> <p>IGNORE</p> <p>Halogenoalkanes are insoluble in water</p>	<p>Just 'to provide the same reaction conditions'</p> <p>Just 'ethanol is a solvent'</p>	1

Question Number	Acceptable Answers	Reject	Mark
1(b)	<p>P and Q bromine/Br/C₃H₇Br/bromoalkane</p> <p>ALLOW AgBr (1)</p> <p>R iodine/I/C₃H₇I/bromoalkane</p> <p>ALLOW AgI (1)</p> <p>Penalise halide ion(s) only once</p> <p>Penalise X₂ only once</p>	<p>Bromine and chlorine</p>	2

Question Number	Acceptable Answers	Reject	Mark
1(c)(i)	<p>CH₃CH₂⁺ / C₂H₅⁺</p> <p>ALLOW</p> <p>Structural, displayed, skeletal formulae.</p> <p>Allow charge anywhere on fragment, including outside brackets.</p>	<p>Absence of charge / C₂H₅⁻ / C₂H₅⁻</p> <p>ethane ion</p>	1

Question Number	Acceptable Answers	Reject	Mark
1(c)(ii)	<p>P $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ (1)</p> <p>Q $\text{CH}_3\text{CHBrCH}_3$ (1)</p> <p>R $\text{CH}_3\text{CHICH}_3$ (1)</p> <p>ALLOW</p> <p>Displayed or skeletal formulae for any or all parts</p> <p>P </p> <p>Q </p> <p>R </p> <p>TE for incorrect halogen(s) in 2(b)</p> <p>Penalise the same error in structural/displayed/skeletal formulae once only.</p> <p>Special cases</p> <p>P $\text{CH}_3\text{CHBrCH}_3$, Q $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$, and R $\text{CH}_3\text{CH}_2\text{CH}_2\text{I}$ (1)</p> <p>P $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$, Q $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$, and R $\text{CH}_3\text{CH}_2\text{CH}_2\text{I}$ (1)</p>		3

(Total for Question 1 = 7 marks)

Question Number	Acceptable Answers	Reject	Mark
2(a)(i)	Risk of inhalation / breathing in / risk of going into nose/mouth (1) Weigh in a fume cupboard OR Wear a face mask (1) IGNORE risk of spillage/gloves/safety glasses Mark independently		2

Question Number	Acceptable Answers	Reject	Mark
2(a)(ii)	First mark (why are they needed) (Anti-bump granules) prevent the liquid mixture shooting out / splattering/spurting/spitting/explosive boiling/violent boiling/sudden boiling/ promote smooth/calm/even boiling OR they prevent the mixture superheating /localised boiling OR prevent large bubbles forming Second mark (How they work) (Provide)(rough) surface/small holes/nucleation sites OR promote (small) bubble formation OR facilitate/promote heat/energy transfer ALLOW facilitate/promote smooth/ uniform/even heating	Just: 'prevent explosion' OR Just 'boiling too fast/strongly' OR Just to stop bumping OR Just to prevent boiling OR Just so reaction proceeds smoothly anything to do with rate of reaction	2

Question Number	Acceptable Answers	Reject	Mark
<p>2(a)(iii)</p>	<p>Read the whole answer first</p> <p>First mark</p> <p>In the top of the still head/3</p> <p>EITHER thermometer holder/4/cork (containing a thermometer/8)</p> <p>(IGNORE position of thermometer unless incorrect)</p> <p>OR 6/stopper (1)</p> <p>Second mark</p> <p>The still head/3 is in the top of the flask/5</p> <p>OR</p> <p>The condenser/7 OR delivery tube/2 is connected to the side arm (1)</p> <p>Third mark</p> <p>The condenser/7 OR delivery tube/2 delivers to a beaker/test tube/ measuring cylinder/flask (1)</p> <p>Rescue mark</p> <p>Selection of items 3, 5, 2 or 7, and 4/6/8 (1)</p> <p>All marks may be shown on diagram</p>	<p>delivers to gas syringe /graduated flask</p> <p>Item 1</p>	<p>3</p>

Question Number	Acceptable Answers	Reject	Mark
2(b)(i)	<p>A greater mass /more sodium dichromate((VI)) is used / a greater portion/concentration of sodium dichromate((VI))</p> <p>OR more/excess oxidizing agent/oxidant (1)</p> <p>(More) concentrated/50% sulfuric acid (is added) (1)</p> <p>Just 'more concentrated reactants' (1)</p> <p>IGNORE needs to be completely oxidized</p>	Just 'more reactants'	2

Question Number	Acceptable Answers	Reject	Mark
2(b)(ii)	<p>The water must flow up the condenser/ from bottom to top/down to up</p> <p>AND</p> <p>If it does not, it will trickle down one side/will not fill</p> <p>OR</p> <p>air bubbles may form/air blockage</p> <p>OR</p> <p>less effective/efficient cooling/condensing ALLOW no cooling/condensing</p> <p>OR</p> <p>causes loss of reactants/products/reaction mixture</p>		1

Question Number	Acceptable Answers	Reject	Mark
2(b)(iii)	<p>First mark</p> <p>(A condenser is needed because the organic) mixture/chemicals/materials/reactants/ products/ alcohol/propanal</p> <p>is/are volatile / would boil away/escape (while heating)</p> <p>IGNORE</p> <p>Prevent gas escaping (1)</p> <p>Second mark</p> <p>Clear description of condensing process, for example:</p> <p>Volatile products/ vapours/gases condense/form liquids (on the cooled glass surface) (which drip/go back into the reaction flask)</p> <p>ALLOW</p> <p>Ensure complete oxidation (1)</p>		2

<i>Question Number</i>	Acceptable Answers	Reject	Mark
2(c)(i)	<p>Both are (clear) colourless liquids</p> <p>ALLOW</p> <p>No colour liquid</p> <p>IGNORE</p> <p>Smell</p> <p>OR Oil like</p> <p>OR Transparent</p> <p>OR Formulae</p>	<p>Colourless solutions</p> <p>Any other colours</p>	1

Question Number	Acceptable Answers	Reject	Mark
2(c)(ii)	<p>Test for propanal</p> <p>(Boil with) Benedict('s)/Fehling('s) (solution) Allow 'Fheling(s)'</p> <p>ALLOW (almost) correct description of Benedicts/Fehlings eg alkaline copper sulfate (1)</p> <p>red precipitate/solid (forms) (1)</p> <p>OR</p> <p>Tollens' reagent</p> <p>ALLOW (almost) correct description of Tollens reagent eg ammoniacal silver nitrate (1)</p> <p>silver mirror (forms) (1)</p> <p>Rescue marks</p> <p>'Silver mirror test' (forms silver mirror) 1max</p> <p>Acidified potassium/sodium dichromate goes green/blue 1max</p> <p>2,4-DNH/Brady's (reagent) forms yellow/orange precipitate/solid 1max</p> <p>Test for propanoic acid</p> <p>Add to sodium carbonate /hydrogencarbonate solution</p> <p>OR Any (metal) carbonate/hydrogen carbonate</p> <p>ALLOW Magnesium / Mg (1)</p> <p>Fizzing / bubbles /effervescence/gas turns limewater milky (1)</p> <p>OR</p> <p>Alcohol (any) with concentrated sulfuric acid (1)</p> <p>gives fruity/gluey smell (1)</p> <p>Rescue marks</p> <p>Add sodium fizzing occurs / bubbles form / effervescence 1max</p> <p>OR Add PCl₅/phosphorus(V) chloride/phosphorus pentachloride. Steamy (ALLOW White) fumes (form) 1max</p>		4

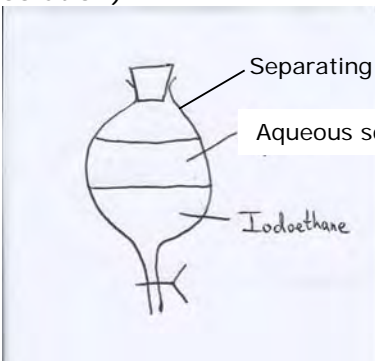
(Total for Question 2 = 17 marks)

Question Number	Acceptable Answers	Reject	Mark
3(a)	Reaction is (extremely) exothermic IGNORE Vigorous Violent Reactive Dangerous Explosive		1

Question Number	Acceptable Answers	Reject	Mark
3(b)(i)	Condenser doesn't fill properly/airlock forms ALLOW inefficient condensation/inefficient cooling/air bubbles form IGNORE Reference to the time taken for condensation	No condensation	1

Question Number	Acceptable Answers	Reject	Mark
3(b)(ii)	(Error) (left hand side of apparatus) open at the top / no stopper at the top and (Effect) (vapours of) iodoethane / product / reaction mixture will escape ALLOW "evaporate" for "escape" IGNORE Gas(es) / fumes will escape Reactants /ethanol escaping References to missing thermometer		1

Question Number	Acceptable Answers	Reject	Mark
3(c)	Remove/Neutralize/React with phosphoric acid/ H_3PO_3 ALLOW Remove/Neutralize/React with HI/acid IGNORE References to "excess" (acid)	Any other specific acid	1

Question Number	Acceptable Answers	Reject	Mark
3(d)	<p>All marks standalone</p> <p>Marking point 1 Separating funnel/ tap funnel/ dropping funnel (1)</p> <p>Marking point 2 Diagram of a funnel with tap and stopper OR Diagram of a funnel with tap and a definite neck capable of taking a stopper (1)</p> <p>Marking point 3 Two layers with lower layer labelled as iodoethane and top layer as aqueous solution) (1)</p> 	Filter funnel with or without stopper	3

Question Number	Acceptable Answers	Reject	Mark
3(e)	Go clear/cloudiness will disappear ALLOW Less cloudy IGNORE colourless	Any specified colour	1

Question Number	Acceptable Answers	Reject	Mark
3(f)	Decanted/poured off/(teat) pipette/ filtered through glass wool IGNORE Just "filtered"		1

Question Number	Acceptable Answers	Reject	Mark
3(g)	(re)distillation ALLOW Fractional distillation IGNORE references to a specified temperature range		1

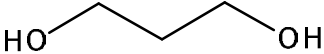
Question Number	Acceptable Answers	Reject	Mark
3(h)	(Iodide ions) are oxidized and (form iodine) ALLOW (Iodide ions) turn into iodine IGNORE references to the colour or state of the iodine product		1

(TOTAL FOR QUESTION 3 = 11 MARKS)

Question Number	Acceptable Answers	Reject	Mark
4(a)(i)	Rate of reaction between solids is slow OR Difficult for two solids to react easily ALLOW Both (acid(s) and reagent) are solid IGNORE reference to any need for heating	"Dissolves" for "reacts"	1

Question Number	Acceptable Answers	Reject	Mark
4(a)(ii)	<p>Marking point 1 Sodium/potassium carbonate and solution/aqueous/water OR Sodium/potassium hydrogencarbonate and solution/aqueous/water (1)</p> <p>Marking point 2 Effervescence/Fizzing/Bubbles (1)</p> <p>MP2 conditional on MP1</p> <p>ALLOW MP2 for effervescence etc. for any carbonate/hydrogencarbonate given as reagent</p> <p>OR Marking point 1 Named alcohol + named strong acid (1)</p> <p>Marking point 2 Fruity smell (1)</p> <p>MP2 conditional on MP1</p>	Sodium/Na Indicators	2

Question Number	Acceptable Answers	Reject	Mark
4(b)	$(-) \text{HO} - \overset{\text{O}}{\parallel} \text{C} - \text{CHBr} - \text{CHBr} - \overset{\text{O}}{\parallel} \text{C} - \text{OH}$ <p>OR Displayed formula</p> <p>IGNORE Position of the bond to the hydrogen of the OH group</p>	Additional products	1

Question Number	Acceptable Answers	Reject	Mark
4(c)(i)	 <p>Ignore bond lengths, bond angles, and bond between O and H</p>	Bond clearly to the hydrogen of the OH group e.g. -HO	1

Question Number	Acceptable Answers	Reject	Mark
4(c)(ii)	<p>Peak/Absorption/Absorbance/Trough for C=O (only) present in propanedioic acid infrared spectrum</p> <p>ALLOW Peak/Absorption/Absorbance/Trough for C=O absent from propane-1,3-diol infrared spectrum</p> <p>OR</p> <p>O-H peak/absorption/trough for carboxylic acid has a different wavenumber to that for the alcohol</p> <p>OR</p> <p>Different fingerprint region</p>	Line	

(TOTAL FOR QUESTION 4 = 6 MARKS)

Question Number	Acceptable Answers	Reject	Mark
5(a)	Bromine / Br ₂ (1) Redox/ oxidation (1) OR sulfur dioxide / SO ₂ (1) Redox/ reduction (1) ALLOW Redox but no product given scores 1 mark Butanal/ butanoic acid and redox / oxidation scores 1 mark	HBr and redox scores 0. Oxidation/ reduction if no product given	2

Question Number	Acceptable Answers	Reject	Mark
5(b)(i)	To ensure condenser is full of water / to prevent an airlock forming/ to stop air bubbles forming / to stop hot spots forming ALLOW To ensure that all of the condenser surface is covered with cold water/ So that (hot) vapour is next to the coolest water first / So the lower region (of the condenser) is colder / Makes cooling more efficient	To prevent back flow of water Just "So that nothing escapes" Just explanation that condensation occurs Makes cooling faster	1

Question Number	Acceptable Answers	Reject	Mark
5(b)(ii)	<p>There would be escape of flammable liquid / corrosive spray / corrosive acid (spray) /poisonous gas/ toxic gas/ harmful gas</p> <p>IGNORE Prevents boiling over Very exothermic</p> <p>Any named toxic gas is only allowed if it would condense.</p>	<p>Named substance e.g. Br₂ / sulfuric acid without reference to hazard Eg bromine could escape</p> <p>Escape of HBr /SO₂ which are toxic (because they do not condense)</p> <p>Risk of explosion Just "escape of product"</p>	1

Question Number	Acceptable Answers	Reject	Mark
5(c)(i)	<p>(teat) pipette/ syringe (to remove upper aqueous layer)</p> <p>ALLOW decant / description of decanting</p>	<p>To remove lower aqueous layer</p> <p>Add drying agent Add dehydrating agent Just "Use separating funnel" Use a siphon</p>	1

Question Number	Acceptable Answers	Reject	Mark
5(c)(ii)	<p>Separating funnel / tap funnel (1)</p> <p>Run off lower layer (1) ALLOW pipette off upper layer</p>	<p>Run off lower aqueous layer BUT do not penalise if mark in (c)(i) lost for wrong layers.</p> <p>Answers showing candidate is unaware that lower layer is the product</p>	2

Question Number	Acceptable Answers	Reject	Mark
5(d)	<p>To remove / neutralize (excess) acid OR to neutralize unreacted acid OR to remove / neutralize HCl</p> <p>ALLOW To neutralise the solution To remove all the HCl To wash out unreacted acid</p> <p>IGNORE To remove impurities</p>	<p>To eliminate HCl</p> <p>Just "to react with acid"</p> <p>To remove/ neutralise H₂SO₄ (and HCl)</p> <p>To remove HBr</p>	1

Question Number	Acceptable Answers	Reject	Mark
5(e)	<p>S 8 Dry/ remove water from the bromobutane (1)</p> <p>With (anhydrous) calcium chloride / (anhydrous) magnesium sulfate / sodium sulfate/ silica gel</p> <p>ALLOW CaCl₂ / MgSO₄ / Na₂SO₄</p> <p>If name and formula are given both must be correct (1)</p> <p>Step 9 (Filter / decant and then) redistil / distil (1)</p> <p>If only one step is given accept the answer in Step 8 or Step 9</p> <p>ALLOW Description of drying carried out after redistillation max (2)</p>	<p>Dry in an oven/ evaporate to half volume scores 0 for this step.</p> <p>Copper sulfate Concentrated sulphuric acid Calcium hydroxide Metal carbonates Calcium sulfate</p> <p>recondense</p>	3

Question Number	Acceptable Answers	Reject	Mark
5(f)(i)	$(7.5 \times 0.81) = 6.075 / 6.08$ (g) Ignore sf except 1sf	6.07 Wrong units	1

Question Number	Acceptable Answers	Reject	Mark
5(f)(ii)	<p>Look at final answer. 67% scores 3 marks; answers with 3sf rounding to 67 score 2 marks. If this is incorrect follow this scheme:</p> <p>METHOD 1</p> <p>Mol butan-1-ol = $(6.075/74)$ $= 0.0820945$ (1)</p> <p>maximum mass 1-bromobutane = $(0.0820945 \times 137) = 11.246959$ g (1)</p> <p>% yield = $((7.5/11.24659) \times 100)$ $= 66.85)$ $= 67\%$ to 2 sf (1)</p> <p>OR METHOD 2</p> <p>$7.5/137 = 0.0547445$ mol (bromobutane) (1)</p> <p>$6.075/74 = 0.0820945$ mol butan-1-ol (1)</p> <p>% yield = $((0.05474455) \times 100 / 0.0820945)$ $= 66.85)$ $= 67\%$ to 2 sf (1)</p> <p>Also TE from one step of the calculation to the next and TE on 4f(i) unless yield > 100%.</p> <p>Use of 6.08 gives 0.082161 mol, 11.256216 g bromobutane, final answer 67%</p> <p>11.3g bromobutane gives 66%.</p>	<p>Percentages calculated from volumes with no conversion to mol or mass.</p> <p>$6.075/7.5 \times 100 = 81\%$ scores 0</p> <p>67.0 (This is 3sf)</p>	3

Total for Question 5 = 15 marks

Question Number	Acceptable Answers	Reject	Mark
6(a)(i)	Ammonia / NH ₃	Ammonium / NH ₄ ⁺	1

Question Number	Acceptable Answers	Reject	Mark
6(a)(ii)	Bromide / Br ⁻ If name and formula are given both must be correct	Bromine, Br ₂ , Br Iodide, I ⁻ , Chloride, Cl ⁻	1

Question Number	Acceptable Answers	Reject	Mark
6(a)(iii)	Precipitate does not dissolve / no change / remains ALLOW Precipitate insoluble/ Precipitate is partially soluble / sparingly soluble TE from (a)(ii) for chloride dissolves / iodide does not dissolve	"Resolved" for "dissolved" Precipitate becomes paler/ colour does not change	1

Question Number	Acceptable Answers	Reject	Mark
6(a)(iv)	NH ₄ Br / NH ₄ ⁺ Br ⁻ ALLOW correct formula even if charge missing on ion in (ii) TE on incorrect halide anion or halide ion with incorrect negative charge if formula otherwise correct No TE on a formula with a metal cation Ignore name even if incorrect	NH ₃ Br	1

Question Number	Acceptable Answers	Reject	Mark
6(b)(i)	C=C bonds absent / alkene absent IGNORE "it is an alkane" / contains C-C/ It is saturated/ is a saturated hydrocarbon	Just "double bonds absent"	1

Question Number	Acceptable Answers	Reject	Mark
6(b)(ii)	(Fumes are)HCl/ hydrogen chloride ALLOW Hydrochloric acid (1) (Formula) (-) OH /O-H ALLOW C-OH (1)	OH ⁻ /alcohol/ (-) CH ₂ OH COOH C _n H _{2n+1} OH	2

Question Number	Acceptable Answers	Reject	Mark
6(b)(iii)	Fizzing/ bubbles/ effervescence (of colourless gas)/ (sodium/ it) dissolves/ (sodium/ it) disappears/ white solid forms ALLOW White precipitate forms Gas evolved which pops with a lighted splint/ which ignites IGNORE Gets warmer/ Heat is evolved/ temperature rises/ vigorous reaction Vapour forms Sodium sinks/floats	References to coloured gas or coloured fumes white solid disappears / dissolves Just "solution is colourless"	1

Question Number	Acceptable Answers	Reject	Mark
6(b)(iv)	<p>(Identity) Methanol / CH₃OH OR Displayed/skeletal formula (1)</p> <p>(Justification) (only) alcohol with M_r = 32 / methanol has M_r = 32 / CH₃OH = 32/ right hand peak has mass 32/ right hand peak has M_r of methanol</p> <p>NOTE Allow mark for any mention of 32 in conjunction with methanol.</p> <p>OR Other use of mass spec data: Peak at <i>m/e</i> 15 is for CH₃(⁺) and 32-15=OH(⁺) OR 32 – (mass of) OH = CH₃(⁺) OR Peak at 31 is for CH₃O(⁺)/ CH₂OH(⁺)</p> <p>IGNORE Negative or missing charges on peaks (1)</p> <p>Second mark depends on identification of methanol.</p>	<p>Correct name with wrong formula or vice versa.</p> <p>Highest peak has M_r of methanol</p> <p>Just "Peak at <i>m/e</i> 15 is for CH₃(⁺) "</p> <p>Peak at 29 is for COH / CHO</p>	2

Total for Question 6 = 10 marks