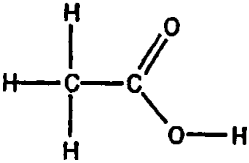
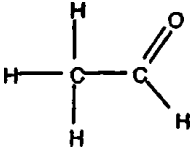
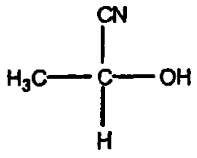
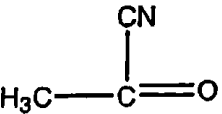
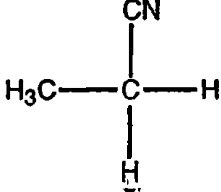
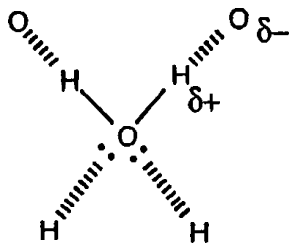
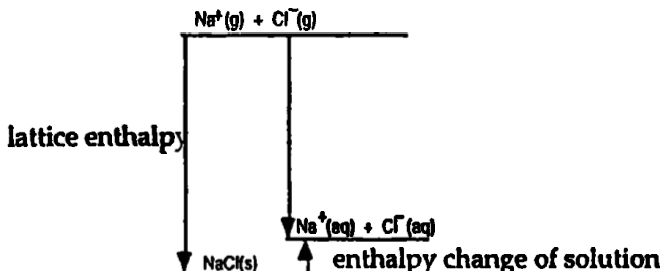
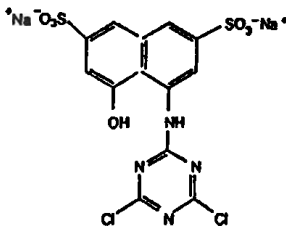
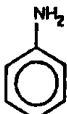
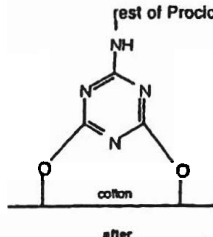


Mark Scheme Page 1 of 5		Unit Code 2854	Session Jan	Year 2003	Version FINAL
Question	Expected Answers				Marks
1 a i	ethanoic acid;(1) (1) Allow -OH 				2
1 a ii	potassium/sodium dichromate;(1) sulphuric acid (allow conc) (1) Allow dichromate, acid, correct formulae of ions or substances				2
1 b i	C-H				1
1 b ii	Water contains O-H bonds;(1) water is present in breath(1)				2
1 b iii	(the atoms in the O-H) bond(s);(1) vibrate;(1) more (vigorously) (1)				3
1 c i	oxidation ALLOW redox				1
1 c ii					1
1 c iii	NaBH ₄				1
1 c iv	 -CN and rest of molecule;(1) -OH(1)   score (1) Allow any clear type of structural formula				2
1 d	1720 – 1740 (NOT other ranges);(1) C=O (1)				2
1 e	Ethanal – M _r worked out (44) (or some reasoning related to fragments;(1) Mention of M ⁺ peak or some indication of how 44 deduced from spectrum;(1) A CH ₃ CO ⁽⁺⁾ or C ₂ H ₃ O ⁽⁺⁾ (or "loss of H");(1) B CHO ⁽⁺⁾ ;(1) positive charges on ions. (1) If ethanol chosen, can score last three marks A as above, B C ₂ H ₅ ⁺ , positive charges QWC: at least two sentences, logical. Correct use of at least two of the following technical terms: (molecular) ion, (relative) mol(ecul)ar mass/RMM/M _r , fragmentation/fragment(s)				6

Mark Scheme Page 2 of 5	Unit Code 2854	Session Jan	Year 2003	Version FINAL
2a i	+3 Allow +3 here but mark "s" and check at 3bii			1
2 a ii	O-H polar (or partial charges shown); (1) H ⁺ formed (1)			2
2 b i	in equilibrium/ partial dissociation/ionisation			1
2 b ii	$K_a = \frac{[H^+][H_2BO_3^-]}{[H_3BO_3]}$ top(1); bottom (1) missing [] scores max 1			2
2 b iii	$[H^+] = \sqrt{K_a[H_3BO_3]}$; (1) = 7.6×10^{-6} ; (1) pH = 5.1 (1) accept "5" if working shown			3
2 b iv	$H_3BO_3(aq) + NaOH(aq) \rightarrow NaH_2BO_3$ (or ions) (aq) + $H_2O(l)$ reactants and products; (1) balancing; (1) state symbols (provided water formed) (1) Accept equations forming other salts.			3
2 c i	pH 8.5 gives $[H^+] = 3.16 \times 10^{-9}$; (1) then either: $\frac{[salt]}{[acid]} = \frac{5.8 \times 10^{-10}}{3.16 \times 10^{-9}}$; (1) = 0.184; (1) Thus 0.018 mol of $H_2BO_3^-$ must be added. (1) or $[salt] = K_a \times [acid]/[H^+]$ (1); = $5.8 \times 10^{-10} \times 0.1/3.16 \times 10^{-9}$ (1) subsumes last mark = 0.018 (1)			4
2 c ii	acid/alkali in eye causes damage/irritation/harm (1); buffers maintain pH/ neutralise (1); in presence of (small amounts of) acid/alkali/at/near 8.5/neutral pH/same pH as eye/ natural pH (1)			3
2 c iii	Indication that acid is H ⁺ /alkali is OH ⁻ (1); (on adding acid) equilibrium moves to left/ buffer accepts H ⁺ /or equation (1); (on adding alkali) equilibrium moves to right/forms H ⁺ to neutralise(AW) (1); Because $[H_3BO_3]$ and $[H_2BO_3^-]$ large, pH remains constant. (1) QWC SPAG: spelling (allow one error), punctuation and grammar correct.			5

Mark Scheme Page 3 of 5	Unit Code 2854	Session Jan	Year 2003	Version FINAL
3 a i	<i>Two FROM</i> nitrogen unreactive/high E _a ; strong bond between atoms of nitrogen/much energy to break bond/stable molecule/; triple bond (1)			2
3 a ii	<i>TWO FROM</i> to replace nitrogen removed; nitrogen is plant nutrient; nitrogen needed for (plant) growth; nitrogen taken in soluble form/through roots; nitrogen supplied in fertilizers/stored in soil			2
3 b i	another product formed by the (main) <u>reaction</u>			1
3 b ii	0;(1) -3;(1) +2;(1) (<i>max 2 if signs after numbers and "s" recorded in 2 a (i)</i>)			3
3 c	catalyst			1
3 d	<i>M_r values of N₂ (28) and NH₃ (17) stated or used correctly/ 1000/28 = 35.7;(1)</i> <i>Ratio 4/5 stated or used correctly;(1)</i> <i>4/5 x 1/28 x 17 = 0.49 (kg) (1) (0.61/607 (no4/5) scores two without working)</i> <i>Allow 2/3 sf (486). If >3 sf mark "sf" and see 4b(v)</i>			3
3 e i	molecules move faster/more KE (1); more collisions;(1) with energy greater than activation enthalpy/energy/successful collisions (AW);(1) therefore faster (1) <i>QWC 2 sentences, logical, correct use of terms collisions and activation enthalpy/energy (1)</i>			5
3 e ii	Endothermic;(1) increased temperature moves equilibrium position to right/ favours endothermic reaction;(1) because opposes change (AW);(1) more product (1) <i>ecf from exothermic or equilibrium moving wrong way.</i>			4
3 f	(effect of pressure depends on) difference in no. of moles (of gas) on each side of equation (AW);(1) this is small/ 11 molecules to 10.(1)			2
3 g i	400 – 500 °C;(1) 25 – 150 atm;(1) iron (1)			3
3 g ii	<i>One for each advantage and disadvantage.</i> <i>One for each explanation (only when linked to valid advantage/disadvantage)</i> Advantage: low pressure/low temperature – cheaper/safer No need for hydrogen – saves money Water used – cheaper/safer Disadvantage: Slow reaction (at room temperature) – expensive Much nitrogen into co-product – waste/ less efficient NO produced - toxic/expensive to separate			4

Mark Scheme Page 4 of 5	Unit Code 2854	Session Jan	Year 2003	Version FINAL
4 a	UK is warmer			1
4 b i	 <p>one water molecule showing four hydrogen bonds between H and O;(1) two adjacent lone pairs shown on (at least one) oxygen;(1) $\delta+$, $\delta-$ shown either side of at least one hydrogen bond;(1) -H-----O straight (1)</p>			4
4 b ii	CH ₃ -CH ₂ -CH ₂ -CH ₂ -CH ₂ -CH ₃ or more displayed			1
4 b iii	instantaneous dipole - induced dipole(2) "induced dipole/ instantaneous - induced dipole" score (1)			2
4 b iv	THREE from: at any instant, electrons not evenly distributed; (1) causes instantaneous dipole ;(1) which induces dipole in another molecule;(1) attraction between dipoles (1)			3
4 b v	4.18/2.26 = 1.9 times (Accept 2 or 1.85(0)) If >4 sf and "sf" recorded at 3d, do not award mark			1
4 c i				2
4 c ii	the number "14" scores (1); +14 kJmol ⁻¹ with sign and unit scores (2).			2
4 d	Mg ²⁺ smaller/higher charge density than Ca ²⁺ ;(1) more water molecules round Mg ²⁺ ;(1) more bonds formed/ stronger attraction/ more energy released(1).			3

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5 a	Circle round -OH group on structure. <i>ALLOW</i> circle including the ring bearing the -OH			1
5 b	-SO ₃ ⁻ (Na ⁺) <i>IGNORE</i> words which attempt to qualify. <i>NOT</i> -OH			1
5 c i	 <p style="text-align: center;">lack of any group at coupling position (<i>provided some other correct detail added</i>);(1) rest of structure correct (1)</p>			2
5 c ii	NaNO ₂ (1) HCl/H ₂ SO ₄ (<i>NOT conc</i>);(1) below 5 ⁰ C (1) <i>Mark separately. Addition of alkali is "CON" for acid mark</i>			3
5 d i	benzene <i>NOT</i> benzene ring			1
5 d ii	conc (+ <i>one correct acid</i>)(1); nitric and sulphuric acids(1); temp below 55 ⁰ C (1) <i>Mark separately</i>			3
5 d iii	 ;(1) Sn, conc HCl, reflux (1)			2
5 e i	aromatic/ arenes <i>ALLOW</i> benzene(s)/benzene rings			1
5 e ii	electrons are not associated with particular bonds/atoms (<i>NOT atom</i>)/spread out over several atoms/over compound.			1
5 f i	condensation/ <u>nucleophilic</u> substitution			1
5 f ii	 <p style="text-align: center;">rest of Procion structure</p> <p style="text-align: center;">correct points connected;(1) by O atoms (1)</p>			2
5 g i	hydrogen bonding;(1) appropriate H atom specified(1); bonded to appropriate atom on other structure. (1)			3
5 g ii	Direct Red would wash out more easily/ more red colour in Direct Red beaker/ cotton gets paler in Direct red beaker;(1) hydrogen bonds are broken by water/heating/dye hydrogen bonds to water;(1) covalent bonds are not (1) <i>ALLOW (1) of last (2) for "procion bonds stronger" (AW)</i>			3