OCR
RECOGNISING ACHIEVEMENT

GCE

# Chemistry (Salters)

Advanced GCE **A2 7887**

Advanced Subsidiary GCE **AS 3887**

# Mark Schemes for the Units

# June 2006

**3887/7887/MS/R/06**

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**CONTENTS**

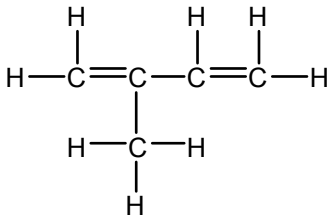
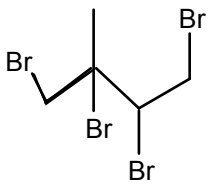
**Advanced GCE Chemistry (Salters) (7887)**

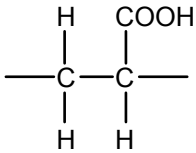
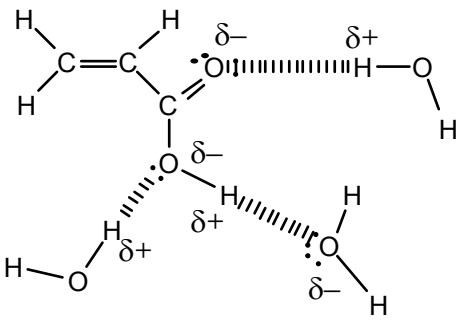
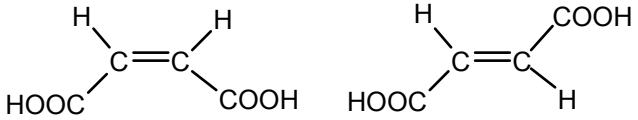
**Advanced Subsidiary GCE Chemistry (Salters) (3887)**

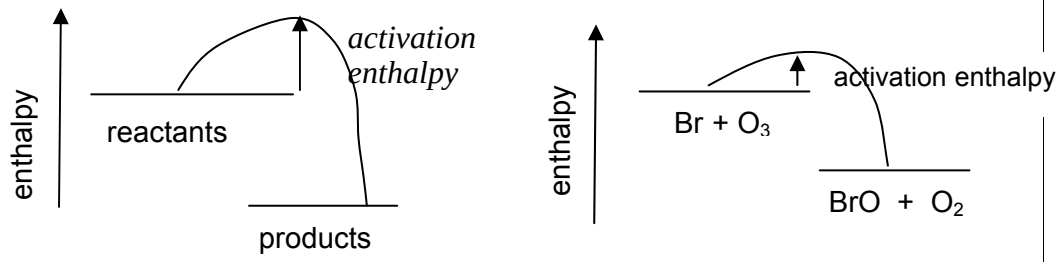
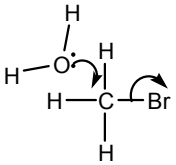
**MARK SCHEME ON THE UNITS**

# Mark Scheme 2848
# June 2006

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

| Question | Expected Answers | Marks |
|---|---|---|
| 1 a i | alkene/diene | 1 |
| 1 a ii |  <br>a four carbon chain with double bonds in correct places (1); completely correct (1) | 2 |
| 1 a iii | (2-)methylbut(a)diene 'methylbut' or but(a)diene (1); completely correct (2).<br>*ignore gaps and numbers*. | 2 |
| 1 b i | turn it colourless/decolorise (1) NOT clear *Ignore starting colour* | 1 |
| 1 b ii | (methane is) saturated/ no double bond/an alkane/ not unsaturated/ no unsaturated bonds (1) | 1 |
| 1 b iii |  saturated skeleton (even if Br at ends instead of C) (1);<br>completely correct (1)<br>*allow only one double bond reacted, other the same for 2 marks*<br>*allow OH and Br substituted across double bond(s) instead of two bromines*<br>*fully saturated full structural formula scores 1 mark* | 2 |
| 1 b iv | electrophilic (1); addition (1) *three chosen scores max 1 etc.* | 2 |
| 1 c i | $O_3 \rightarrow O_2 + O$ *ignore 'hv'* | 1 |
| 1 c ii | hydrocarbons provide an alternative to equation 1.2 (AW)/ the NO catalyst is removed; (1) so less ozone is broken down (1)<br><br>*or* $NO_2$ breaks down to O atom(1) *(*more) ozone is made <u>because of increased</u> O; (1)<br><br>*mark second part separately if first part wrong* | 2 |
| 1 c iii | photochemical smog<br><br>*or an effect* e.g. breathing difficulties/ toxic/ poisonous (to humans)/ harmful to health<br><br>*or* greenhouse gas/ global warming | 1 |
| | **Total** | **15** |

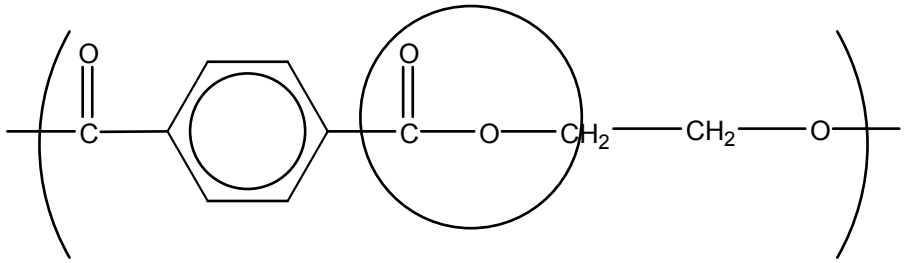
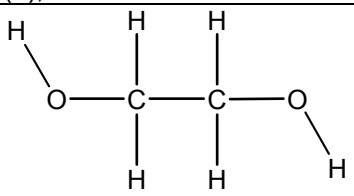
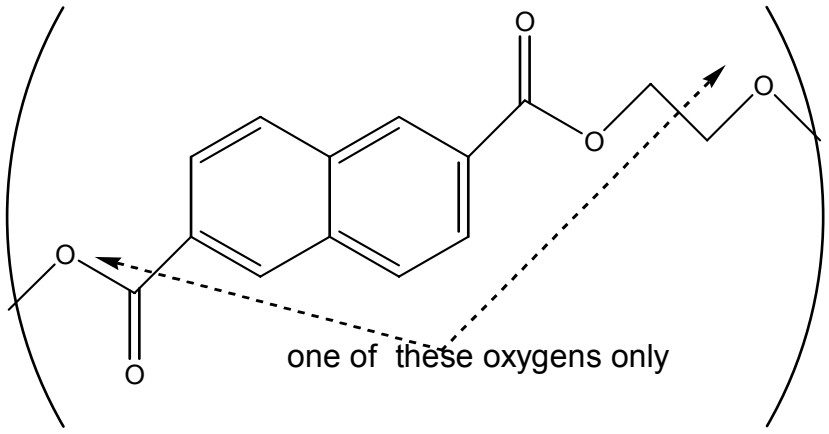
| | | |
|---|---|---|
| 2 a i |  <br>*Allow bracket (and 'n') ignore ambiguous attachments* | 1 |
| 2 a ii | other monomer must have a double bond/ be unsaturated/ alkene (allow triple bonds) (1);<br>polymer contains (units of) both monomers / polymer is made from different monomers/ different repeating units (1) | 2 |
| 2 b i |  (any one of these)<br>water drawn correctly – angular (1)<br>lone pairs on the oxygen forming the bond to an H pointing along bond(1)<br>partial charges on the atoms forming the bond (1)<br>O–H–O straight (1)<br>*If hydrogen bonding shown to incorrect hydrogen, max first two marking points.* | 4 |
| 2 b ii | hydrogen bonds/ stronger imf hold paint to solvent/ hold molecules/ chains (NOT particles) together/make the paint more viscous (AW) | 1 |
| 2 c i | chains can move over each other more easily (1);<br>*plus three from*<br>compound A has permanent dipole–(permanent) dipole forces (1);<br>show where these are formed (1)<br>compound B has hydrogen bonds (1);<br>intermolecular forces weaker/ fewer in compound A (ora)(1);<br><br>QWC: Logical, at least two phrases from the list below used correctly:<br>inter-molecular forces; hydrogen bonds; permanent dipole; instantaneous dipole–induced dipole/ Van der Waals; chains; acid; ester | 4<br><br>1 |
| 2 c ii |  <br>cis trans<br><br>(1) each; (1) for structures alone with no (or incorrect) names or names alone with no/wrong structures.<br>*ignore ambiguous attachments and structures not fully displayed* | 2 |
| 2 c iii | (No,) no double bond/AW | 1 |
| | **Total** | **16** |

| | | |
|---|---|---|
| 3 a i | $CH_3Br \rightarrow CH_3 + Br$ *allow dots* | 1 |
| 3 a ii | homolytic/ homolysis *ignore photodissociation* | 1 |
| 3 b i | 290 / 6.02 x $10^{23}$ (1); multiplying by 1000 and evaluating (4.82 x $10^{-19}$ J)(1) *no ecf* | 2 |
| 3 b ii | $v = E/h$ = (ans to (i))/$h$ (4.82 x $10^{-19}$/6.63 x $10^{-34}$ )(1)<br>correct evaluation (7.27 x $10^{14}$ Hz )(1) | 2 |
| 3 b iii | Greater/higher (1); C–Cl stronger than C–Br *ignore reasons* (1) *mark separately*,<br>*allow weaker bonds – lower frequency for 1 mark* | 2 |
| 3 c i | it filters/screens/removes (AW) uv (1); *plus two from:*<br>(uv*)* of high energy/frequency/ UVC/UVB $10^{16}$ Hz/200-320nm (1);<br>which causes skin cancer/ harms skin/damages DNA (1); affects crops (1) damages eyes(1); damages immune system (1); growth of phytoplankton (1) | 3 |
| 3 c ii | Br + $O_2$ | 1 |
| 3 c iii | $O_3 + O \rightarrow 2O_2$ /$O_2 + O_2$ | 1 |
| 3 c iv | reactants and catalyst in same phase/state | 1 |
| 3 c v |  <br>line on right-hand graph with lower activation enthalpy *(allow double hump)* (1)<br>activation enthalpy/energy/$E_a$ labelled twice (1) *allow double headed arrow*. | 2 |
| 3 c vi | **temperature** (1) – molecules have more energy/ move faster (1); more collisions with energy greater than activation energy (1)<br>**pressure/concentration** (of ozone) (1) – more collisions (1)<br>**intensity/amount of uv** (1) greater amount of radiation breaks more $O_3$ per unit time/ more photodissociation/ more radicals (1)<br><br>*QWC* At least two sentences with spelling, punctuation and grammar with only one error in all (1) **see QWC sheet** | 5<br><br>1 |
| 3 d i | $CH_3Br + H_2O$ (1) $\rightarrow CH_3OH + HBr$ (1) *ignore ss* | 2 |
| 3 d ii | carbon is $\delta$+, bromine $\delta$– (1) (in diagram)<br>polar means electrons shared unequally in the bond/ one atom has a partial positive charge, other partial negative (1) *partial only needs to be mentioned once*<br>bromine has a greater electronegativity than carbon (ora)/ atoms forming bond have different electronegativities (1); | 3 |
| 3 d iii |  <br>(1) for each curly arrow<br>*left-hand arrow can be straight but must start from part of one lone pair* | 2 |
| 3 d iv | nucleophile/nucleophilic | 1 |
| 3 d v | $Ag^+$ (aq) + $Br^-$ (aq) $\rightarrow$ AgBr (s) (1)<br>(1) for state symbols *mark separately (provided aqueous solutions giving solid)* | 2 |
| 3 d vi | cream/ off white/ pale yellow | 1 |
| | **Total** | **33** |

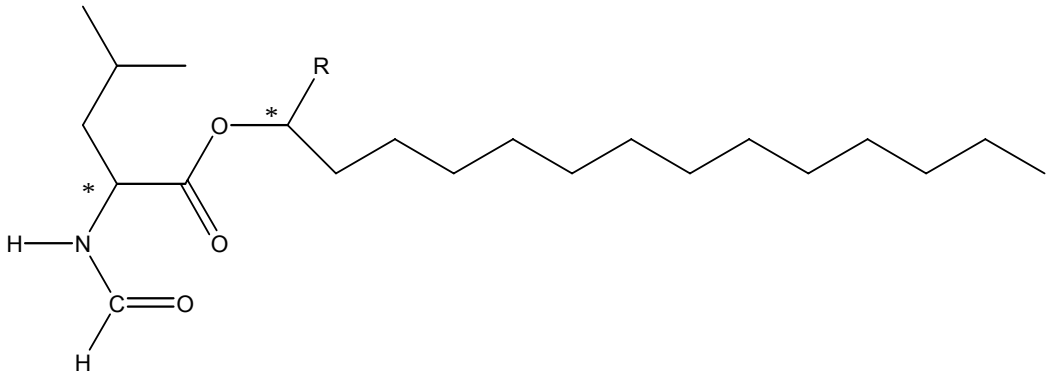
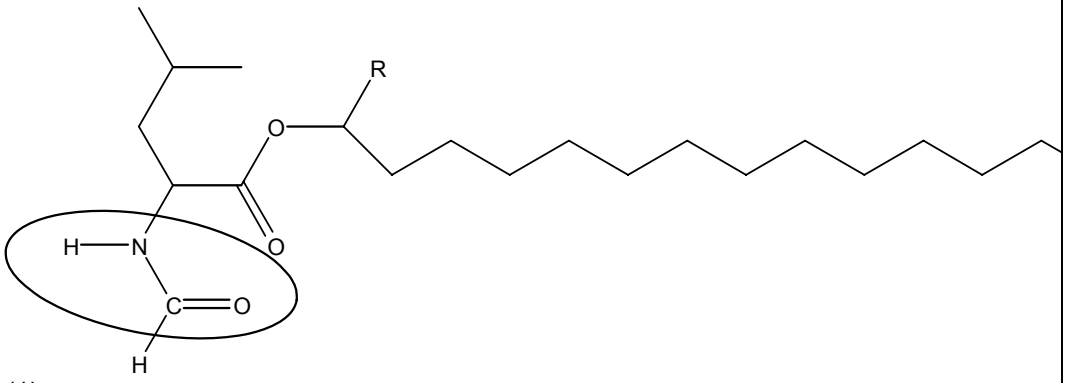
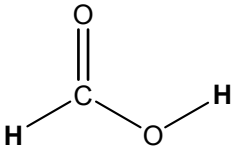
| | | |
|---|---|---|
| 4 a | 0 (1); –1 (1); +5 (1) *max one for second two if signs follow numbers* | 3 |
| 4 b i | sulphur/S *allow sulphur dioxide* | 1 |
| 4 b ii | 3 x 2500 x 64/127 = 3779.5g (2)<br>*omission of one step in calculation scores (1)*<br>2 sig figs (3800) (1) *mark separately if there is some calculation* | 3 |
| 4 c i | $2I^- \rightarrow I_2 + 2e^-$ (2)<br>*first mark for* $2I^- \rightarrow I_2$; *second mark for balancing equation with electrons* | 2 |
| 4 c ii | I/iodine (in $IO_3^-$) *allow* $IO_3^-$/iodate (1) | 1 |
| 4 d | iodine is soluble in kerosene/organic/ hydrocarbon/ non-polar solvents (1)<br>more (than in water) (1) *must be a comparison for second mark* | 2 |
| 4 e i | 0.023 x 0.1moles I (1); 0.0023 x 127 = 0.29(2) g (1) *ecf* | 2 |
| 4 f i | iodine: solid; grey/black<br>bromine: liquid; brown/red *ignore orange*<br>*four correct scores three; three correct scores two; two correct scores one.* | 3 |
| 4 f ii | $4p^5$ $5p^5$<br>(1) for 4 and 5 (with some appropriate letter and superscript number)<br>(1) for $p^5$ *or one mark for one completely correct*<br>*IGNORE correct extra subshells* | 2 |
| 4 f iii | $Br_2 + 2I^- \rightarrow I_2 + 2Br^-$ (2) idea of bromine reacting with iodide (1); | 2 |
| 4 f iv | it should not get hot/avoid fires *IGNORE keep pressurised etc.* | 1 |
| 4 g | ions indicated as $Na^+$, $I^-$ (1)<br>at least two rows alternating in one plane (1)<br>indication that this continues in third dimension *can be in words*(1)<br>*allow second two marks if ions wrongly labelled* | 3 |
| 4 h | hydrated/hydration *IGNORE hydrous* | 1 |
| | **Total** | **26** |

# Mark Scheme 2849
# June 2006

| | | |
|---|---|---|
| **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 |

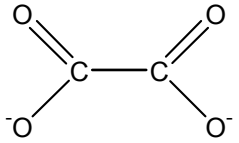
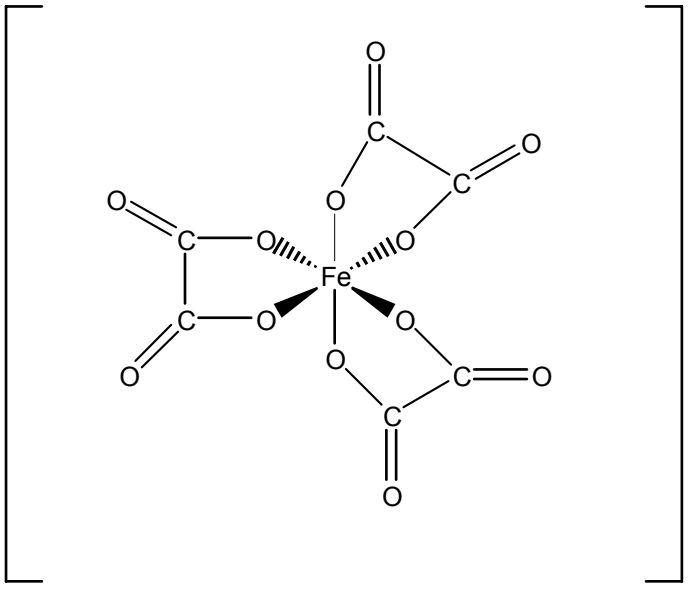
| Question | Expected Answers | Marks |
|---|---|---|
| 1 a i |  <br>(1); *allow without the C within the ring.* | 1 |
| 1 a ii |  <br>*all bonds must be shown* (1). | 1 |
| 1 b | Burning/combustion (1);<br>Energy produced can be used/reducing landfill (1).<br>*or*<br>recycling AW(1);<br>oil resources saved AW/reducing landfill (1).<br><br>Do NOT allow cracking, but allow reducing landfill. | 2 |
| 1 c | (Below $T_g$) chains do not have enough **energy** (may describe in terms of vibration or motion of chains) (1);<br>to **move over/slide over one another** (1);<br>**force applied** to change shape of polymer will cause 'frozen' chains to break AW (1). | 3 |
| 1 d i |  <br><br>Ester linkage correct (1);<br>rest correct (1) *ignore brackets*. | 2 |
| 1 d ii | Intermolecular forces between chains are greater/stronger NOT 'MORE'(1);<br>chains are able to get closer (because of the flat ring system) (1). | 2 |

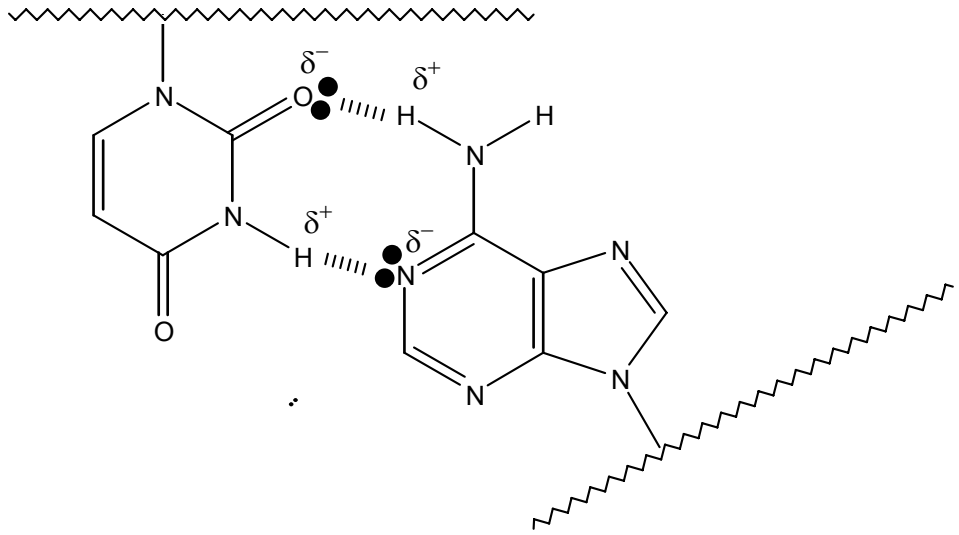
| | | |
|---|---|---|
| 1 e i | $K_C = \dfrac{[\mathbf{B}] \times [H_2O]^2}{[\mathbf{A}] \times [C_2H_5OH]^2}$<br>[Products]/[Reactants] (1);<br>Indices correct (1). | 2 |
| 1 e ii | Equilibrium position moves in endothermic direction/left since forward reaction is exothermic AW (1);<br>$K_c$, decreases (1) *ecf here for second mark*. | 2 |
| 1 e iii | Conc. sulphuric acid / c. $H_2SO_4$ (1);<br>Heat/warm (under reflux)/reflux (1) | 2 |
| | **Total** | **17** |

| | | |
|---|---|---|
| 2 a |  (1). | 1 |
| 2 b |  (1). | 1 |
| 2 c i | (Moderately) concentrated acid/alkali /any named strong acid or alkali except concentrated sulphuric acid (1);<br>Heat under reflux/ reflux but NOT heat alone (1). | 2 |
| 2 c ii | Mass spectroscopy (1). | 1 |
| 2 c iii | ***One mark each for points in bold*** *and then any* ***three*** *others up to a total of 6 marks:*<br>Pencil line near bottom of paper *if drawn in pencil allow line*;<br>spot small sample of hydrolysis mixture on line;<br>**solvent in beaker below sample**;<br>**cover beaker with lid/film**;<br>leave until solvent front nears top of paper;<br>remove and dry paper;<br>**spray paper with locating agent/ninhydrin**;<br>correct spot seen/$R_f$ measured AW. | 6 |
| 2 c iv |  <br>Correct structure (1);<br>Only two types of hydrogen/may be shown in structure:<br>COO**H (**at 13.0) (1);<br>**H** –C=O (at 10.0) / uses relative intensities to suggest only one other H is present (1). | 3 |

| | | |
|---|---|---|
| 2 c v | $H^+$ (aq) can be lost by acid/alcohol (1);<br>forming an anion AW (1);<br>*marks can be gained by writing equations or by discussing extent of dissociation*;<br>acidity/equilibrium position depends on stability of anion (1);<br>equilibrium position further to right for acid/charge spread out more/delocalisation in carboxylate ion AW (1);<br><br>If the C=O group is recognised as enabling the $H^+$ ion to dissociate more easily they can have 1 mark. | 4 |
| 2 d i | Infrared frequencies are absorbed by molecules causing bonds to <u>vibrate</u> (faster) AW (1);<br>different bonds/functional groups give peaks at different frequencies (1);<br>C=O 1735–1750 $cm^{-1}$ (1);<br>C–O 1050–1300 $cm^{-1}$ (1). | 4 |
| 2 d ii | Hydroxyl/alcohol/OH group (1);<br>O–H peak/absorption at 3200–3600 $cm^{-1}$ (1). | 2 |
| | **Total** | **24** |

| | | |
|---|---|---|
| 3 a | $H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O$<br>correct formulae of substances (1);<br>balanced correctly with electrons on left (1). | 2 |
| 3 b i | ***Three*** *marks for the points in* ***bold*** *and any* ***three*** *from* ***four****:*<br><br>Use of pipette for measuring hydrogen peroxide (1);<br>use of burette for manganate(VII) (1);<br>(Use of burette and pipette but with solutions switched is 1 mark only)<br>addition of sulphuric acid (1) *NOT hydrochloric/nitric acid*;<br>to conical flask with hydrogen peroxide (1);<br>**slow addition at end point/dropwise/drop by drop/slowly/carefully** (1);<br>**to pink/purple colour** (if reverse addition then allow colourless but NOT pink) (1);<br>**repeat to give at least two concordant readings** (1).<br><br>*QWC*<br>*At least two readable and clear sentences with no more than one spelling, punctuation or grammatical error* (1). | 6<br><br>1 |
| 3 b ii | Moles of $MnO_4^-$ = (18.2/1000) x 0.0200 (1);<br>moles of $H_2O_2$ = **2.5** x (18.2/1000) x 0.0200 (1) *ecf*; *mark is for the 2.5* ratio<br>concentration = 0.910 mol $dm^{-3}$ (1) *ecf*;<br>*answer to 3 sig. figs*. (1). | 4 |
| 3 b iii | $M_r$ of $H_2O_2$ = 34 (1);<br>mass of $H_2O_2$ in 100 $cm^3$ of water = 34 x 0.91 x 100/1000 = 3.1 g<br>*or*<br>max moles of $H_2O_2$ allowed in 100 $cm^3$ of water = 3.0/34 = 0.088 mol<br>therefore NO (1) *ecf from* (iii) *and* $M_r$ of $H_2O_2$. | 2 |
| 3 c i | $2H_2O_2$ (aq) $\rightarrow$ $2H_2O$ (l) + $O_2$ (g)<br>*formulae correct, balanced and state symbols correct* (1). | 1 |
| 3 c ii | (Glass =) heterogeneous because two phases/states AW (1);<br>(Transition metal ions =) homogeneous because only one phase/state AW (1). | 2 |
| 3 c iii | Measure volume of oxygen by syringe/over water (1);<br>plot graph of volume of $O_2$ *versus* time (1);<br>find gradient at time = 0 (1). | 3 |
| 3 c iv | Rate of decomposition = $k$ x $[H_2O_2]$ (1);<br>= 2.0 x $10^{-6}$ (x 2.0) mol $dm^{-3}$ $s^{-1}$ = 4.0 x $10^{-6}$ mol $dm^{-3}$ $s^{-1}$ *ecf* (1). | 2 |
| | **Total** | **23** |

| | | |
|---|---|---|
| 4 a i | Oxidation of Fe(II) ions/Fe(II) ion loses electron/ Fe(II) converted to Fe(III) (1);<br>by oxygen/air (1). | 2 |
| 4 a ii | $[Fe(H_2O)_6]^{3+}$ / *allow* hexaaqu(a/o)iron(III) *or* describe the complex correctly (1). | 1 |
| 4 a iii | $Fe^{3+}(aq) + 3OH^-(aq) \rightarrow Fe(OH)_3(s)$<br>correct formula for $Fe(OH)_3$ (1);<br>balanced equation as above (1) *ignore spectator ions if balanced*;<br>correct state symbols (1). | 3 |
| 4 b i |  <br>(1). | 1 |
| 4 b ii | Ligand exchange/complex formation/ligand substitution/Ligand displacement (1). | 1 |
| 4 b iii | Any **two** points from **three**:<br>d Electron energy levels are split / d electrons are excited (1);<br>by particular frequencies/wavelengths of light/radiation in visible region(1);<br>hence colour transmitted is light NOT absorbed, in this case green/ complimentary colour is seen (1). | 2 |
| 4 b iv | 6 (1);<br>number of lone pairs/dative bonds/coordinate bonds/bonds (1);<br>around central cation/ion/*allow* Fe atom (1). | 3 |
| 4 b v |  <br>3 ligands around Fe in correct shape (1);<br>All 6 O atoms bonded to central cation (1). | 2 |
| | **Total** | **15** |

| | | |
|---|---|---|
| 5 a i | Lone pair of electrons on N (1);<br>can accept proton/hydrogen ion/$H^+$ (1). | 2 |
| 5 a ii | Water (1). | 1 |
| 5 a iii |  <br><br>*one mark for both hydrogen bonds* (1);<br>*one mark for both lone pairs* (1);<br>*partial charges correct* (1).<br>If only one interaction shown but all three components are correct then give 2 marks. | 3 |
| 5 a iv | Double helix (1). | 1 |
| 5 b i | ***Two** from the following four points*<br><br>Smaller chain length/$M_r$ (1);<br>different bases (1) DO NOT ACCEPT 'COMPLEMENTARY BASES';<br>RNA has single chain (1);<br>Different sugar in chain (1). | 2 |
| 5 b ii | Hydrogen bonds between DNA strands break (1);<br>DNA divides so that each strand acts as a template for new strand AW (1). | 2 |
| | **Total** | **11** |

# Mark Scheme 2850
# June 2006

| | | |
|---|---|---|
| | / = alternative and acceptable answers for the same marking point<br>; = separates marking points<br>NOT = answers which are not worthy of credit<br>( ) = words which are not essential to gain credit<br>____ = (underlining) key words which **must** be used to gain credit<br>ecf = error carried forward<br>AW = alternative wording<br>ora = or reverse argument | |
| **Question** | **Expected Answers** | **Marks** |
| 1 a | 3(1); 6(1); | 2 |
| 1 b i | Base/alkali(ne)/basic | 1 |
| 1 b ii | Reactivity (of elements/metals)/ease of ion formation/solubility of hydroxides(qualified)/atomic radius/density/$A_r$/mass no NOT b/mpt.<br>Thermal stability of carbonates/nitrates(qualified) Any one of (1) | 1 |
| 1 b iii | Moles of CaO = 0.80/56 (1); {0.014} ecf<br>(calculations *via* mass of $CO_2$ score above mark)<br>volume of gas = 0.80/56 x 24{0.34} ($dm^3$)(1); → $cm^3$ (1); sf, mark independently(1)<br>343 on own scores 3. 340 on own scores all four. | 4 |
| 1 c i | Arene(1); alkene(1); cycloalkane(1); alkane(1) | 4 |
| 1c ii | 115–130$^o$(1);]<br>three sets of electrons/areas of electron density (NOT bonds)(1);<br>around (each) carbon(1);(do not penalize 'bonds' here)<br>repel as far as possible(1); NOT atoms repel. NOT 'as much as possible'<br>planar/flat(1) (DIAGRAMS –check text first, but can score latter mark ) | 5 |
| 1 c iii | Breaking up (NOT cracking) large/long chain molecules(1);<br>to form small(er)/short/unsaturated/(more) useful molecules(1);<br>Specific names and substances OK but NOT particles | 2 |
| 1 c iv | References to alternative pathway with lower $E_a$/meaning of<br>heterogeneous catalysis can score 1 MARK then<br>Reactants adsorbed(1); (absorb on surface CON)<br>bonds weaken/break(1); new bonds form(1);<br>Products leave/desorb(1) (any three or all four)<br><u>Separate last marking</u> point for role of carbon as below<br>Carbon blocks surface/reactants cannot get on to surface AW(1)<br>using 'substrate/enzyme kinetics ideas' maximum 4 | 1<br><br>3/4<br><br><br><br>1 |
| 1 c v | Contains pores/tunnels/sieve/honeycomb/channels/holes(1);<br>similar size as (water) molecules AW(1) | 2 |
| | **Total** | **26** |

| | | |
|---|---|---|
| 2 a i | Mistakes: ionized by **gaining electrons**(1); **high /pressure** in curved part of apparatus( (allow **mass)**<br><br>Corrections: **loss** of electrons(1); **low** pressure/(high)**vacuum**(1)/<br><br>(**mass/charge ratio)** if three possibilities given max. 2 if one wrong | 4 |
| 2 a ii | $C_{70}$ bod '70'(1); ignore any charges | 1 |
| 2 b i | Two(1);additional/extra Neutrons in $^{14}C$(1) (ora for $^{12}C$)(1) allow 'it' for $C_{14}$<br><br>NOT different $A_r$'s | 2 |
| 2 b ii | Very few $^{14}C$ (atoms) in ethanol from oil/no. significantly decreased(1);<br><br>they have decayed/many half-lives passed (1);<br><br>happened over millions/thousands of years/very long time/longer than 6000yrs(1)<br><br>(allow reverse argument and AW) | 3 |
| 2 c | (Coloured/bright/white) NOT black (con) lines(1); on a black/dark background(1);lines getting closer(1) NOT bands<br><br>Diagram can get all marks but needs explanation or shading for first two | 3 |
| | **Total** | **13** |

| | | |
|---|---|---|
| 3 a i | $Cs(g) \rightarrow Cs^{+}\{g\} + e^{-}$ formation of $Cs^{+}$(1);<br>Equation correct(1) ecf wrong cation formed e.g. Cs to $Cs^{2+}$<br>gaseous(1)<br>can have – $e^{-}$ on left' : ignore correct nuclear symbols: 'X' scores two | 3 |
| a ii | Outermost electron/shell gets further from nucleus in Cs/more shells(1);<br>In Cs attraction to nucleus less/ shielding by inner shells(1)<br>easier to remove electron/less energy needed (1)<br>ora discussion in terms of energy levels fine<br>BOD 'rings' Nuclear charge lower <u>used</u> in answer CON | 3 |
| b | Moles Cs 80.6/133(0.61)(1);Moles O 19.4/16(1.21)(1); (Allow ecf's) $CsO_2$(1)<br>$Cs_2O$ need to track back to decide if worth one or two | 3 |
| c i | Group number same/AW(1) as number of outer electrons(1) | 2 |
| c ii | Same atomic no./no. of protons/(atoms of) same element(1);<br>different mass <u>no</u>./no. of neutrons(1) molecules zero | 2 |
| d | $^{129}_{67}I \rightarrow {}^{129}_{68}Xe + {}^{0}_{-1}\mathbf{e}$<br>Mark as: correct symbol for beta particle(1); ignore any (–) on beta particle<br>represented as 'decay'(1);<br>all correct (1) | 3 |
| | **Total** | **16** |

| | | |
|---|---|---|
| 4 a | correct no. of non-bonding electrons on left N and O atom (1);<br>6 electrons(any) between N atoms(1);<br>2 electrons of same symbol between right N and O atoms(1);<br>correct symbols and no. across whole molecule(1)<br>  | 4 |
| 4 b i | energy to break bonds 2 x 481 + 2 x 167 (+1296)(1);<br>energy given out on bond formation 2 x 945 + 498 (–2388)(1);<br>correct processing sign from working(1);<br>–1092(kJ $mol^{-1}$) scores 4 (allow four marks for –546 also) ecf on first two marks<br>1092 on <u>own</u>(2); 1092 with working 2 or 3 (latter if process gives - ) | 4 |
| 4 b ii | Shorter/ smaller/very short/ bond in NO(1) | 1 |
| 4 c | More moles of products/molecules/particles(1)<br>allow idea of more ways two different molecules mix NOT temp | 1 |
| 4 d i | oxygenates/oxygenated fuels | 1 |
| 4 d ii | Alcohols (ignore references to primary, secondary etc) | 1 |
| 4 d iii | (Fuel) pre-igniting(AW) (1); Octane number/rating (1) ; | 2 |
| 4 e i | $4CH_3NO_2 + 3O_2 \rightarrow 2N_2 + 6H_2O + 4CO_2$ formulae of reactants(1);<br>products(1);(appropriate, e.g. 2 $1^1/_2$, etc.) balancing(1) | 3 |
| 4 e ii | $N_2 + O_2$ from air(1) look to give this as long as air mentioned); react/combine/combust/$N_2$ oxidised/burns/bonds(1);NOT join/fuse<br>in high temp./heat/spark(of engine )(1); ignore refs. to 'incomplete ' | 3 |
| | **Total** | **20** |

# Mark Scheme 2852/01
# June 2006

## Chemistry

| | | | |
|---|---|---|---|
| **Give an account of the chemistry of the reactions involved in the formation of natural and synthetic rubber, identifying the similarities and differences between the reactions.** | | | |
| **1** | **Chemistry of polymerisation** | | |
| **a** | **Statement:** Natural rubber: **isoprene polymerises** (to give poly(isoprene)). | **1** | |
| **b** | Synthetic rubbers use **emulsion polymerisation**: **in water with surfactant** (at 5 °C) | **1** | |
| **c** | Natural rubber is mainly ***cis*** and synthetic rubber contains a mixture of ***cis*** **and** ***trans***. | **1** | |
| **2** | **Similarities and differences** | | |
| **a** | Both reactions are **addition polymerisation** | **1** | |
| **b** | Diene polymerisation is not simple addition, **two double bonds** open to form polymer with **one double bond** in repeating unit. | **1** | |
| **c** | Many synthetic polymers are **copolymers of a diene and an alkene**; | **1** | |
| **d** | Butyl rubber is a **saturated hydrocarbon**. | **1** | |

| | | | |
|---|---|---|---|
| **Discuss how the structures of natural and vulcanised rubber determine their properties and describe how vulcanising rubber leads to an improvement in its properties for use in tyres.** | | | |
| **3** | **Structure of natural rubber** | | |
| **a** | ***Cis*** has groups on **same side** of **double bond** | **1** | |
| **b** | Chains line up when stretched to form **crystalline regions** so that rubber is **stronger when stretched**. | **1** | |
| **4** | **Process of vulcanisation** | | |
| **a** | **Vulcanising/heating/curing** with sulphur **very slow**. | **1** | |
| **b** | Explanation of **role of accelerator**: accelerator has an **atom of sulphur** in its molecule that **initiates/speeds up the reaction.** | **1** | |
| **c** | **accelerators** act as **catalysts** | **1** | |
| **5** | **Props of vulcanised rubber** | | |
| **a** | Contains cross links of sulphur. **Statement or label on diagram** | **1** | |
| **b** | Vulcanised rubber is **hard/durable/strong(AW) and does not flow/soften** at higher temperatures | **1** | |
| **c** | Chains cannot **slide over each other** in vulcanised rubber | **1** | |

| | | | |
|---|---|---|---|
| **Describe the chemistry involved in recycling used tyres to produce commercially important products, including activated charcoal and phenol, and discuss how this recycling conserves non-renewable resources.** | | | |
| **6** | **Production of phenol** | | |
| **a** | **Pyrolysis oils** contain **benzene** (compounds) | **1** | |
| **b** | **Cumene process**: **benzene** vapour and **propene** passed over a **phosphoric(V) acid catalyst at 250 °C and 3000 kPa/30 atm**<br>(if scored from equation do not count towards C3) | **1** | |
| **c** | **Cumene is oxidised** in air to form **peroxide** AND peroxide **decomposes** in **dilute acid** to give **phenol and propanone**<br>(if scored from equation do not count towards C3) | **1** | |

| | | | |
|---|---|---|---|
| **7** | Chemistry extra points (**max 2**) | | |
| | A diene is an alkene with 2 double bonds | **1** | |
| | Account of initiation/propagation steps in addition polymerisation | **1** | |
| | *Cis* arrangement in natural rubber increases intermolecular forces | **1** | |
| | Rubber is an elastomer | **1** | |
| | Zinc oxide and stearic acid used in vulcanisation to enhance physical properties | **1** | |
| | Definition of thermoplasticity/thermoplastic material (AW) | **1** | |
| | Disulphide bridges are covalent bonds | **1** | |
| | Unsaturation/double bonds in the polymer enable cross-linking to occur | **1** | |
| | Examples of structures of other compounds produced by pyrolysis. | **1** | |
| | Carbon black properties change depending on the size of its particles | **1** | |

**20 max. 14**

## Evaluation

| | | | |
|---|---|---|---|
| **Illustrate, using appropriate tables or charts, how the suitability of rubber for car tyres has been improved by the use of synthetic rubbers and additives.** | | | |
| **8** | **Synthetic rubbers** | | |
| | **N.B. A DIRECT COPY OF TABLE 2 FROM ARTICLE 1 DOES NOT SCORE BUT THEN 'COUNTS' AS A DIAGRAM** | | |
| **a** | Different table or chart **comparing the properties** of rubber with at least **two named synthetic rubbers** | | **1** |
| **9** | **Additives** | | |
| | **If POINTS ARE NOT MADE IN TABLE MAX. 2**<br>**TABLE DOES NOT 'COUNT' AS DIAGRAM** | | |
| **a** | Carbon black:<br>benefits: strengthens rubber; increases abrasion resistance, cut and tear resistance; increases lifetime; increases resistance to light;<br>**NEED THREE BENEFITS** ACCEPT ALTERNATIVES | | **1** |
| **b** | Oils and resins:<br>benefits: improves processing; improves adhesion of components; improves wet traction; plasticises rubber; allows incorporation of carbon; extends lifetime; reduces tyre cost; reduces tendency of tyre to become brittle/ stops cracking;<br>**NEED THREE BENEFITS** ACCEPT ALTERNATIVES | | **1** |
| **c** | Anti-ageing chemicals:<br>extend life by giving resistance to heat; fatigue; weathering; exposure to ultraviolet light;<br>**NEED THREE EXAMPLES** ACCEPT ALTERNATIVES | | **1** |

| | | | |
|---|---|---|---|
| **Describe the chemistry involved in recycling used tyres to produce commercially important products, including activated carbon and phenol, and discuss how this recycling conserves non-renewable resources.** | | | |
| **10** | **Activated carbon** | | |
| **a** | Explanation of **pyrolysis: heating** (to 450–700 $^{o}$C) with **no oxygen** | | **1** |
| **b** | Activated carbon is **highly porous** with a **high surface area** | | **1** |
| **c** | Commercial importance: **removes pollutants** from gas/liquid streams with **one example:** (e.g.) cooker hoods, gas masks, mercury | | **1** |
| **d** | Improved processing **removes the ash** from the carbon using an **acid wash and activating at 900 $^{o}$C** to give a higher quality product | | **1** |
| **e** | Discussion of the importance of **removing mercury** from industrial effluent: **emission levels are regulated** and **clean-up costs** are high | | **1** |
| **11** | **Uses of products** | | |
| **a** | **Hydrocarbons** from pyrolysis (alkanes, alkenes and aromatics) are used as **fuels** | | **1** |
| **b** | Pyrolysis oil / benzene derivatives can be used as a **feedstock** | | **1** |

| 12 | **Conserving non-renewable resources** | | |
|---|---|---|---|
| **a** | Using car tyres as chemical feedstock **conserves crude oil** / fossil fuel reserves | | **1** |
| **b** | Using fuels from pyrolysis **saves non-renewable fuels**/fossil fuels (clear statement) | | **1** |
| **c** | Save peat/coal used for making activated carbon | | **1** |

| 13 | Evaluation extra points (**max. 2**) | | |
|---|---|---|---|
| | Landfill causes environmental spoilage e.g. slow breakdown of rubber/ leaching of harmful substances/ eyesore/ breeding of pests/ fire risk | | **1** |
| | Space for landfill is **limited** | | **1** |
| | Oil from pyrolysis has disadvantages e.g. high sulphur content/low flashpoint | | **1** |
| | Uses of lower grade carbon e.g. plastic pipes/ shoes/ fuel | | **1** |
| | Idea of wasteful to put valuable chemicals in landfill | | **1** |
| | Lists figures for numbers / amounts of tyres disposed of annually | | **1** |

**16 max. 12**

## Research skill in using and acknowledging sources of information

**R1** **List of sources** used which should include the articles in the question paper and at least two additional and *relevant* references.
1 for inclusion of Open Book paper articles (minimum: article 1 + article 2)
1 for TWO other sources, i.e. either or both Salters books + one other, OR two other sources,
1 for specification of the non-Open Book paper sources by page numbers,
section titles, site titles, encyclopaedia sections, search engine criteria, [3 marks]

**R2** **Appropriate material** selected from the question paper and elsewhere to produce a report within the required word limit [1 mark]

Examples of reasons why this mark may not be awarded include:

- **exceeding the word count** (see below)
- not declaring a **page word count**
- many sources quoted, with no evidence that they have been used
- excessive **irrelevant material** (use wavy line in left hand margin)
- inclusion of large amounts of material in **appendices**
- mis-use of sources e.g. repeated **errors** in material selected.

| **Guidance on word count** | |
|---|---|
| < 1050 words | OK |
| > 1050 < 1100 | Lose 1 mark (**R2**) |
| >1100 | Draw line at about 1000.<br>Do not mark past this point<br>Lose 2 marks (**R2** and **C1b**) |
| Words on diagrams/in equations do not count but **excessive use of lengthy text boxes inserted into diagrams should be penalised.** | |

**R3** **Text annotation**
Text annotated where appropriate to acknowledge use of information from the sources listed
*(1 mark for 2 or more relevant annotations)* [1 mark]
**Examiner annotation**: Underline candidate's annotation and write 'A' in the left hand margin for the first two sources seen.

**[Total: 5 marks]**

## Quality of Written Communication

**S** **Summary** Four relevant **CHEMICAL** points which summarise the content of the candidate's own response.

Ideas to look for…

- **chemical reaction or process** (e.g. description of reaction or correct use of words such as oxidation, addition polymerisation, vulcanisation, pyrolysis)
- **chemical terms** (e.g. points made using words such as *cis-trans*, accelerator, catalyst)
- **feature** of a **chemical compound** or **reaction** (e.g. many monomers are dienes/alkenes, polymers are often copolymers)
- discussion of **properties linked to structure** (e.g. cross-links, thermoplastics)

**[4 marks]**

## Main Report

**C1** **Structure of report**

***a*** *Well-structured report with **relevant information** organised **clearly** and coherently **without undue repetition**.* **[1 mark]**

*Examples of reasons why this mark may not be awarded.*

- **jumbled order** or difficult to follow report.
- **undue repetition** (***annotate*** 'R' in left hand margin)
- a report where presentation and organisation of the information is weak enough to make the report difficult to follow.

**b** **Balanced coverage** of the required points. **[1 mark]**

*Examples of reasons why this mark may not be awarded.*

- exceeding the **word count** (see R2) insufficient balance in the coverage of the **bullet points** on the question paper (use the pattern of marks on the grid as a rough guide).

**C2** **Clear and correct use of language**

**a** Legible text, appropriate form and style of writing, grammar, punctuation and spelling accurate so that the meaning is clear. **[2 marks]**

2 **spelling or grammatical errors** lose 1 mark, 4 errors lose both marks.

***Examiner annotation*****:** by underlining error and writing 'S' or 'G' in left hand margin.

*Examples of reasons why marks may not be awarded.*

- Report not written in **continuous prose** e.g. note form or no use of paragraphs.
- Text or language is illegible or **difficult to follow**.

**b** Correct use of **scientific and technical** terms. **[2 marks]**

2 **scientific or technical term** errors lose 1 mark, 4 errors lose both marks.

***Examiner annotation***: by underling error and writing 'T' in the left hand margin.

*Examples of errors.*

- Misuse/omission of **subscripts** or **superscripts** from formulae.
- Gaps in word processed text e.g. omission of '→' from equations.
- **Incorrect terms** used e.g. iodine for iodide.

Note: If the report contains no or **very few scientific terms**, diagrams or equations, one or both marks can be deducted due to insufficient evidence being available to award.

**C3 Good use of equations and structural formulae** [2 marks]

*2 marks for 4 relevant and correct equations or structural formulae;*
*1 mark for 2 relevant and correct equation or structural formula*

**Notes**

- **For** minor errors **e.g. missing subscripts, deduct technical language marks as shown in C2b but allow the equation to count towards marking point C3.**
- If **chemistry or evaluation** marks have been scored exclusively from an unexplained equation then the equation cannot also 'count' towards marking point C3.
- ***Annotate*** script by writing 'E' in the left hand margin.

## List of possible equations and structural formulae

| | **1 mark for 2 examples, 2 marks for 4 examples** | | |
|---|---|---|---|
| | Structure of isoprene and poly(isoprene)<br>Structure of butadiene and poly(1,3-butadiene)<br>Structure of 2-methylpropene and (NB) its polymer<br>Structures to compare *cis* and *trans* isomers<br>Structures of butadiene and phenylethene (styrene)<br>Structures of at least two accelerators for vulcanisation<br>Production of cumene in cumene process/Conversion of cumene to its peroxide/Conversion of peroxide to phenol | | |

**C4 Good use of appropriate illustrations (pictures, diagrams, tables, flow charts, graphs, etc.)** [2 marks]

2 marks for 2 relevant illustrations, well-positioned and labelled or well-linked into text; these may be from the articles in the question paper; 1 mark for 1 such diagram;
*1 mark only if 2 relevant diagrams from articles simply photocopied and pasted in without further annotation or link from the text.*

- ***Annotate*** script by writing 'D' ('Diagram') in the left hand margin.

**Notes**
Illustrations should be **correctly placed** so that they support the flow of the text. One or both marks can be lost if the illustrations are incorrectly placed.

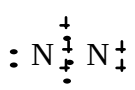
## List of possible illustrations

| | **1 mark for 1 example, 2 marks for 2 examples** | | |
|---|---|---|---|
| | **Allow 'illustrative' photos to score (1) max**<br>Cross-links and no cross-links in rubber<br>Structure of a car tyre<br>Table of properties of natural and synthetic rubbers<br>Table of additives and their advantages<br>Table of rubber composition in a tyre | | |

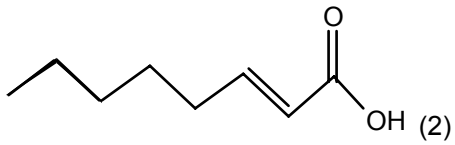
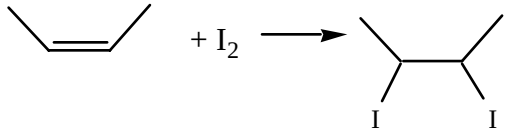
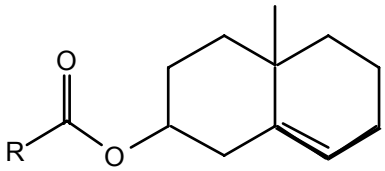
**[Max. 14 marks]**

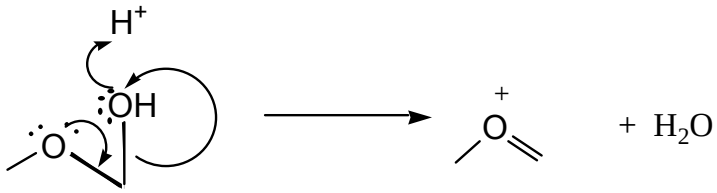
# Mark Scheme 2854
# June 2006

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

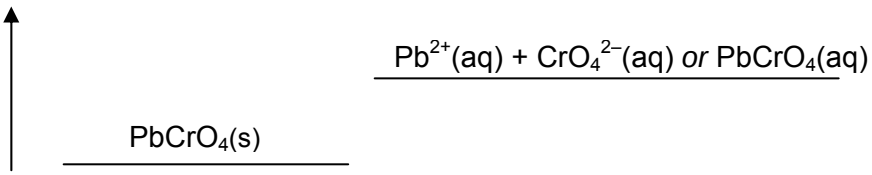
| Question | Expected Answers | Marks |
|---|---|---|
| 1 a | 0 (1); +2 (1) NOT 2+ | 2 |
| 1 b i | (Forward) reaction is endothermic (1);<br>Equilibrium (position) moves to oppose change/ Increased temperature moves equilibrium (position) in endothermic direction(1);<br>i.e. in direction consistent with stated endo/exo of forward reaction(1); | 3 |
| 1 b ii | Fewer molecules/particles collide (1);<br>with energy greater than activation energy/enthalpy (1) | 2 |
| 1 c i | $K_p = pNO^2/pN_2 \times pO_2$(2)<br>All correct except for ONE of the following scores (1):<br>• NO not squared<br>• concentrations shown (ALLOW square brackets with 'p')<br>• wrong way up<br>No credit if + signs | 2 |
| 1 c ii | $pNO^2 = (K_{(p)} / 1 \times 10^{-5}) \times 0.2 \times 0.8$ (1);<br>$pNO = 1.3/1.26 \times 10^{-3}$ (1) (*allow up to four sf*)<br>{$1.6 \times 10^{-6}$ (no square root) scores (1) without working}<br>*ecf from c(i) (unless + signs used) but not from first mark* | 2 |
| 1 d | electricity (1) | 1 |
| 1 e | Nitrogen fixing (AW) bacteria (NOT nitrifying/denitrifying)<br>/root nodules/ leguminous plants (1) | 1 |
| 1 f i | 25–300 atm (1) | 1 |
| 1 f ii | safety: danger of explosions/release of gases (1)<br><br>cost: running compressor/ maintaining pressure/thick walls of plant (1) | 2 |
| 1 g |  allow  <br>triple bond (1); lone pairs (1); bond strong/hard to break (1) | 3 |
| 1 h | Fertilise (AW) plants/<br>plants require nitrogen (compounds) qualified e.g. for growth/to live/be healthy/ make proteins (1);<br>we/animals eat plants/ contribute to food chain/ value of crop (1) | 2 |

| | | |
|---|---|---|
| 1 i | ionic (1); strong electrostatic forces/bonds (lead to high melting point) (1);<br>(dissolves because) ions are hydrated/ ions form (ion-dipole) bonds/ ions attract water moleules (1);<br>conducts because (free) ions can move (1)<br><br>ALLOW any of these with wrong structure type, also:<br>covalent – strong bonds *or* hydrogen bonds to water<br>metallic – strong bonds | 4 |
| | **Total** | **25** |

| | | |
|---|---|---|
| 2 a | $C_{22}H_{32}O_2$ (1) for C and O (1) for H; $C_{21}H_{31}COOH$ scores (1) | 2 |
| 2 b |  (2)<br>(1) for correct structural formula or 8C acid with wrong double bond | 2 |
| 2 c i |  <br>(1) for both iodines reacting; (1) for completely correct<br>*need not be skeletal (can be 2,3 – iodobutane)* | 2 |
| 2 c ii | orange/brown/purple to colourless/ paler colour (1) | 1 |
| 2 c iii | 6 x 254 g of iodine (per 328 g DHA)<br>Iodine no. = 1524 (*ecf*) x 100/328 = 465<br>(1) for correct use of factor of 6 or 12 or use of (100/328) x (254 or 127)<br>(1) for correct answer<br>(1) for 3sf *mark separately provided some working.* | 3 |
| 2 d | meaning of *cis* - both groups on same side of C=C (AW) (1);<br>fact that there is more than one *cis* group (1) *mark separately* | 2 |
| 2 e |  <br>(1) correct ester formula (skeletal) anywhere;<br>(1) ester group on correct carbon (*allow non-skeletal ester group for this mark*) | 2 |
| 2f | *Four from*<br>*A Imf in cholesterol:* id-id/non-polar/only one polar group;<br>B *Imf in water:* hydrogen bonds;<br>C *Imf between water and cholesterol*: cholesterol cannot break water's imf/does not form (m)any hydrogen bonds/forms weaker imf/ forms id-id;<br>D *Imf between cholesterol and octan-1-ol:* forms imfs with octan-1-ol/ octan-1-ol non-polar<br>E *Description:* cholesterol <u>more</u> soluble in octan-1-ol/ large amount/concentration of cholesterol in octan-1-ol (little in water)/ large $K_{ow}$ | 4 |
| | **Total** | **18** |

| | | |
|---|---|---|
| 3 a | Form B, $H^+$ move equilibrium to right (1) | 1 |
| 3 b i | phenol | 1 |
| 3 b ii | purple/violet/mauve/pink colour (1) with (neutral) iron(III) (chloride) (1)<br>*mark separately IGNORE starting colour* | 2 |
| 3 c i |  <br>5 electrons from oxygen (1); bonds (1); lone pair (only if one) (1)<br>ALLOW "+" | 3 |
| 3 c ii | 120 (± 5) *no ecf* (1)<br>Idea of groups of electrons (AW) (1); repelling and getting as far apart as possible<br>*both ideas necessary* (1) *mark separately even if angle wrong* | 3 |
| 3 d i |  <br>(1) (i.e. lowest arrow) (1) (1) *mark separately* | 3 |
| 3 d ii | electrophilic (1); elimination (1) *mark separately* | 2 |
| 3 e | *Four from the following points.*<br>A Form B absorbs (certain frequencies of) visible light;<br>B (when) electrons excited (to higher energy-level);<br>C Form B is more delocalised/larger chromophore/ larger conjugated system/ more conjugated (NOT extra double bond) (*ora for Form A*)<br>D because of alternating single and double bonds joining (benzene) rings (*ora for Form A*)<br>E Form B needs less energy to excite electrons (*ora for Form A*)/visible light has lower energy than u.v.;<br>F energy level difference measures frequency/wavelength absorbed/ ($\Delta$)$E = hv$;<br>*max 2 if emission of light (rather than transmission) is implied*<br><br>QWC 2 sentences, SPAG correct (one error allowed) *See notes* | 4<br><br><br><br><br><br><br>1 |
| 3 f i | any reference to colour | 1 |
| 3 f ii | conc nitric acid(1) conc sulphuric acid(1) *conc (ACCEPT "c.")needs to be mentioned once, otherwise (1) for* both *acids.*<br><55 $^{o}$C (1) | 3 |
| 3 f iii | electrophile/ic | 1 |
| 3 f iv | (1-)nitrobenzene | 1 |
| | **Total** | **26** |

| | | |
|---|---|---|
| 4 a i | It has 3 COOH/carboxyl groups / 3 exchangeable protons | 1 |
| 4 a ii | carbon dioxide/$CO_2$/gas | 1 |
| 4 b i | = (3 x 70) + (3 x 210) + 200 – 300 – 200 = +540<br>(1) for prods - reacts; (1) for correct multiples; (1) for answer with sign<br>*ecf only if clear.* | 3 |
| 4 b ii | *Two from:* More molecules (formed); Gas molecules (formed, from solid);<br>more ways of arrangement/ more disorder | 2 |
| 4 b iii | $\Delta S_{surr} = -\Delta H/T$ = 70000/298 = –234.8 (*allow –230 [2sf])*<br>540(*ecf from 4 b i* ) – 235 (1*) = +305 J $K^{-1}$ $mol^{-1}$ (1) for number *(for ecf must be correctly calculated from working shown)*; (1) for sign and units *allow +310 and answer in kJ units*<br>* i.e. do not credit $\Delta S_{surr}$ until units are clear. | 3 |
| 4 b iv | It is spontaneous/will occur (at 298 K) *or AW in terms of context (e.g. 'sherbet does fizz') must correspond with sign of b iii (assume bare number is positive)* | 1 |
| 4 c | in equilibrium/ not fully dissociated/ionised *NOT solely in terms of proton donation* | 1 |
| 4 d i | $K_a = [H^+] \times [A^-]/[HA]$ (2); *(1) for no [ ] or wrong way up)* | 2 |
| 4 d ii | $[H^+] = \sqrt{(K_a \times M)}$ (1) *stated, with numbers substituted, or implied*<br>$= \sqrt{(7.5 \times 10^{-6})} = 2.74 \times 10^{-3}$<br>pH = 2.6/ 2.56 (1) *ecf from calculated value* | 2 |
| 4 e i | Addition of $H^+$ moves (equilibrium position) to left (1)<br>(removing $H^+$ and) maintaining/ restoring pH/ $[H^+]$ (1); *ora for added* $OH^-$<br>mention of adding $A^-$ or HA is CON<br>This works because both [HA] and $[A^-]$ are large/roughly equal/$[A^-]$ much (AW) greater than $[H^+]$/ plenty of $A^-$ to act as a 'sink' (1) | 3 |
| 4 e ii | $[H^+] = K_a \times [HA]/[A^-]$ (1) *stated, substituted or implied*<br>$= 7.5 \times 10^{-4} \times 0.5 = 3.75 \times 10^{-4}$ (1) *ecf from given wrong formula provided it involves all quantities.*<br>pH = 3.4 (1) *ecf from calculated value* | 3 |
| 4f | *max two points for each technique - must be in pairs (describe* and *explain)*<br>*mark separately within pairs except as shown. Best scoring pair to count for each.*<br>***mass spec***. highest mass/molecular/parent ion/$M^+$ peak(1);<br>gives $M_r$/ (relative) molecular mass (*allow "mass of molecule") is* 192 (1)<br>*or* fragments/{peaks at $M_r$ – 45/ $M_r$ – 17}(1);<br>showing presence of –COOH/ –OH (1)*depends on fragment mark*<br>***ir*** (absorption at) 2500 – 3200 (1); (–)O(–)H in acid (1)<br>*or* 3200 – 3600 (1); (–)O(–)H in alcohol (1) NOT 3600 - 3640<br>*or* 1700 – 1725 (1); C=O (1)<br>***nmr*** 4 (allow 3) peaks (1) *deduce from ratios if shown, but ignore wrong values in ratios*;<br>four/three (proton) environments *deduce from explanation of ratio if necessary*(1)<br>*or* peak at 9 – 15 (1); –COOH/–OH *in acid (1)<br>*or* 2.4 (1) $CH_{(2)}$ (1)<br>*or* 0.5 – 4.5(1); –OH* in alcohol/ROH(1) * formula not just name<br><br>QWC Logical. Correct use of *three of* the following terms (2)<br>Correct use of *two of* the following terms (1)<br>peak, (relative) molecular mass/$M_r$, molecular/parent ion, fragment(s), absorption/absorbed etc., bond (in ir context), (proton) environment, (chemical) shift, proton (except in 'proton nmr'), wavenumber/ $cm^{-1}$ | 6<br>2 |
| | **Total** | **30** |

| | | |
|---|---|---|
| 5 a | oxidation state of chromium NOT of chromate<br>(numbers other than 6, +6 are CON) | 1 |
| 5 b | $Pb^{2+}$ (aq) + $CrO_4^{2-}$ (aq) $\rightarrow$ $PbCrO_4$(s)<br>Equation (1); state symbols (1) *provided two ions give lead chromate* | 2 |
| 5 c | polymorphism | 1 |
| 5 d | C (1); yellow is reflected (1) *second mark depends on first* | 2 |
| 5 e i | iron(III) oxide *ignore gaps and brackets* | 1 |
| 5 e ii | suitable *diagram* showing lines getting closer at higher energy (*minimum three levels*) (1) (lines horizontal or circular);<br>*description (or labels on diagram) including:*<br>(electron) energy levels (1);<br>(electron) falling (1);<br>energy change related to frequency wavelength /($\Delta$)$E$ = $hv$ (1) | 4 |
| 5 e iii | cadmium (1); cadmium-sulphide (1) *no ecf on second mark* | 2 |
| 5 f |  <br>(1) for line above printed line (ignore other lines IF correctly labelled)<br>(1) for correct labelling of line (depends on first) | 2 |
| 5 g i | $K_{sp}$ = $[Pb^{2+}$ (aq)] $[CrO_4^{2-}$ (aq)] *state symbols not required*<br>(2) completely correct<br>(1) if $PbCrO_4$ shown as divisor. | 2 |
| 5 g ii | Yes, because $[Pb^{2+}$ (aq)] x $[CrO_4^{2-}$ (aq)]/product of concentrations/1 x $10^{-8}$ (1);<br>*(NOT $K_{sp}$ = 1 x $10^{-8}$ )*<br>greater than $K_{sp}$/2.5 x $10^{-14}$ (1)<br><br>*or* calculated $[CrO_4^{2-}$(aq)] from $K_{sp}$ (1); compare with 1 x $10^{-4}$ (1) | 2 |
| 5 g iii | lead chromate (1)<br>solubility product will be exceeded first/ least soluble/ smaller $K_{sp}$ (1)<br>*depends on first* | 2 |
| | **Total** | **21** |

**Advanced GCE Chemistry (Salters) 3887/7887**
**June 2006 Assessment Series**

## Unit Threshold Marks

| Unit | | Maximum Mark | a | b | c | d | e | u |
|---|---|---|---|---|---|---|---|---|
| **2848** | Raw | 90 | 63 | 54 | 46 | 38 | 30 | 0 |
| | UMS | 120 | 96 | 84 | 72 | 60 | 48 | 0 |
| **2849** | Raw | 90 | 61 | 54 | 47 | 41 | 35 | 0 |
| | UMS | 90 | 72 | 63 | 54 | 45 | 36 | 0 |
| **2850** | Raw | 75 | 58 | 50 | 43 | 36 | 29 | 0 |
| | UMS | 90 | 72 | 63 | 54 | 45 | 36 | 0 |
| **2852A** | Raw | 90 | 73 | 67 | 61 | 55 | 49 | 0 |
| | UMS | 90 | 72 | 63 | 54 | 45 | 36 | 0 |
| **2852B** | Raw | 90 | 73 | 67 | 61 | 55 | 49 | 0 |
| | UMS | 90 | 72 | 63 | 54 | 45 | 36 | 0 |
| **2854** | Raw | 120 | 90 | 79 | 69 | 59 | 49 | 0 |
| | UMS | 120 | 96 | 84 | 72 | 60 | 48 | 0 |
| **2855** | Raw | 90 | 76 | 68 | 60 | 52 | 44 | 0 |
| | UMS | 90 | 72 | 63 | 54 | 45 | 36 | 0 |

## Specification Aggregation Results

Overall threshold marks in UMS (*i.e.* after conversion of raw marks to uniform marks)

| | Maximum Mark | A | B | C | D | E | U |
|---|---|---|---|---|---|---|---|
| **3887** | 300 | 240 | 210 | 180 | 150 | 120 | 0 |
| **7887** | 600 | 480 | 420 | 360 | 300 | 240 | 0 |

The cumulative percentage of candidates awarded each grade was as follows:

| | A | B | C | D | E | U | Total Number of Candidates |
|---|---|---|---|---|---|---|---|
| **3887** | 19.8 | 39.8 | 59.2 | 75.0 | 87.8 | 100.0 | 9171 |
| **7887** | 28.5 | 52.3 | 72.8 | 87.6 | 96.7 | 100.0 | 6637 |

For a description of how UMS marks are calculated see;
www.ocr.org.uk/OCR/WebSite/docroot/understand/ums.jsp

Statistics are correct at the time of publication.

**OCR (Oxford Cambridge and RSA Examinations)**
**1 Hills Road**
**Cambridge**
**CB1 2EU**

**OCR Information Bureau**

**(General Qualifications)**
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Facsimile: 01223 552627
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