GCE

Chemistry (Salters)

Advanced GCE **A2 7887**

Advanced Subsidiary GCE **AS 3887**

Combined Mark Schemes and Report on the Units

June 2006

3887/7887/MS/R/06

Oxford Cambridge and RSA Examinations

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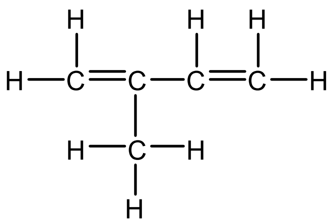
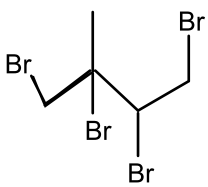
Advanced GCE Chemistry (Salters) (7887)

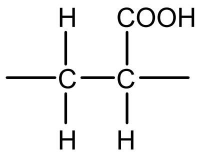
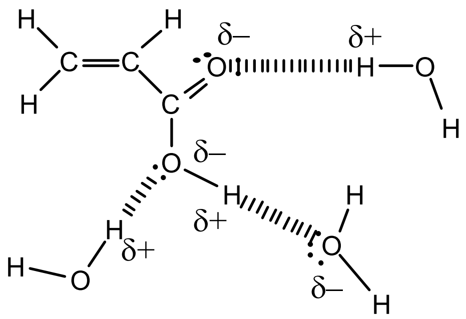
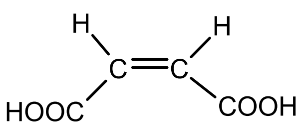
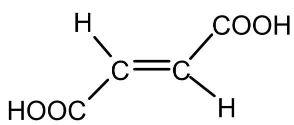
Advanced Subsidiary GCE Chemistry (Salters) (3887)

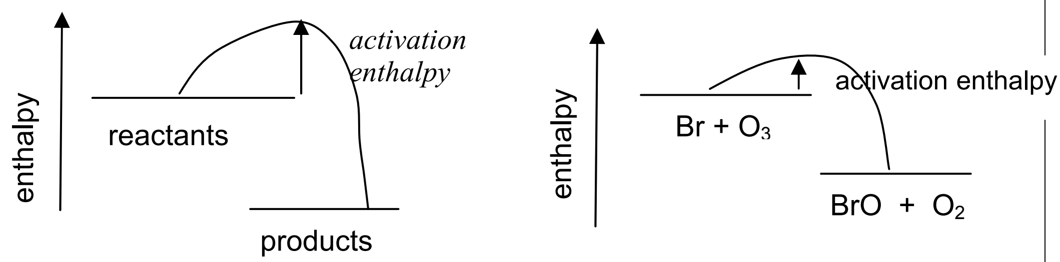
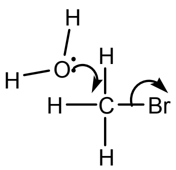
MARK SCHEME ON THE UNITS

Mark Scheme 2848
June 2006

Abbreviations, annotations and conventions used in the Mark Scheme	/ = alternative and acceptable answers for the same marking point ; = 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	alkene/diene	1
1 a ii	 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). *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); completely correct (1) *allow only one double bond reacted, other the same for 2 marks* *allow OH and Br substituted across double bond(s) instead of two bromines* *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) *or* NO_2 breaks down to O atom(1) *(*more) ozone is made <u>because of increased</u> O; (1) *mark second part separately if first part wrong*	2
1 c iii	photochemical smog *or an effect* e.g. breathing difficulties/ toxic/ poisonous (to humans)/ harmful to health *or* greenhouse gas/ global warming	1
	Total	**15**

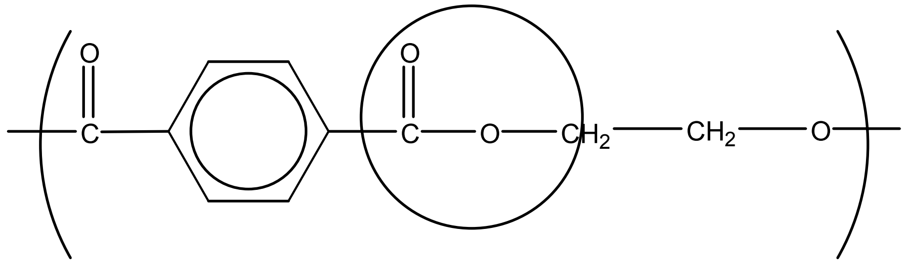
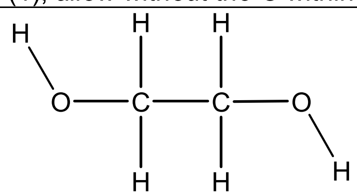
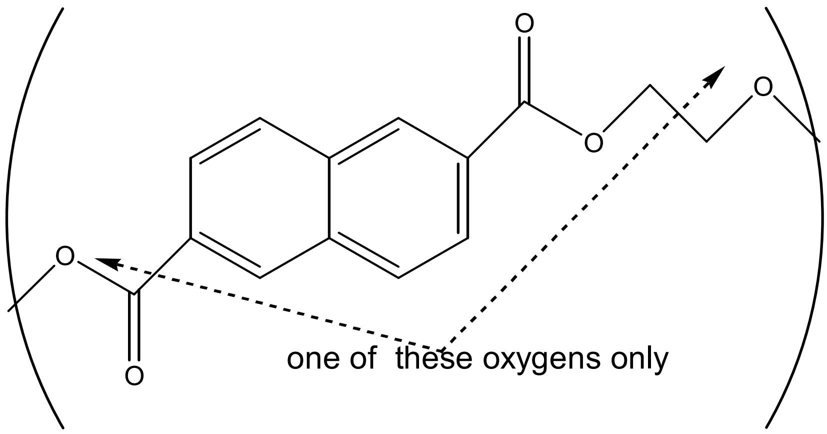
2 a i	 *Allow bracket (and 'n') ignore ambiguous attachments*	1
2 a ii	other monomer must have a double bond/ be unsaturated/ alkene (allow triple bonds) (1); polymer contains (units of) <u>both</u> monomers / polymer is made from <u>different</u> monomers/ <u>different</u> repeating units (1)	2
2 b i	 (any one of these) water drawn correctly – angular (1) lone pairs on the oxygen forming the bond to an H pointing along bond(1) partial charges on the atoms forming the bond (1) O–H–O straight (1) *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); *plus three from* compound A has permanent dipole–(permanent) dipole forces (1); show where these are formed (1) compound B has hydrogen bonds (1); intermolecular forces weaker/ fewer in compound A (ora)(1); QWC: Logical, at least two phrases from the list below used correctly: inter-molecular forces; hydrogen bonds; permanent dipole; instantaneous dipole–induced dipole/ Van der Waals; chains; acid; ester	4 1
2 c ii	  cis trans (1) each; (1) for structures alone with no (or incorrect) names or names alone with no/wrong structures. *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) 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,* *allow weaker bonds – lower frequency for 1 mark*	2
3 c i	it filters/screens/removes (AW) uv (1); *plus two from:* (uv*)* of high energy/frequency/ UVC/UVB 10^{16} Hz/200-320nm (1); 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	 line on right-hand graph with lower activation enthalpy *(allow double hump)* (1) 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 <u>collisions</u> with energy greater than activation energy (1) **pressure/concentration** (of ozone) (1) – more collisions (1) **intensity/amount of uv** (1) greater amount of radiation breaks more O_3 <u>per unit time</u>**/** more photodissociation/ more radicals (1) *QWC* At least two sentences with spelling, punctuation and grammar with only one error in all (1) **see QWC sheet**	5 1
3 d i	$CH_3Br + H_2O$ (1) $\rightarrow$ $CH_3OH + HBr$ (1) *ignore ss*	2
3 d ii	carbon is δ+, bromine δ– (1) (in diagram) polar means electrons shared unequally in the <u>bond</u>/ one <u>atom</u> has a <u>partial</u> positive charge, other <u>partial</u> negative (1) *partial only needs to be mentioned once* bromine has a greater electronegativity than carbon (ora)/ atoms forming bond have different electronegativities (1);	3
3 d iii	 (1) for each curly arrow *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) (1) for state symbols *mark separately (provided aqueous solutions giving solid)*	2
3 d vi	cream/ off white/ <u>pale</u> yellow	1
	Total	**33**

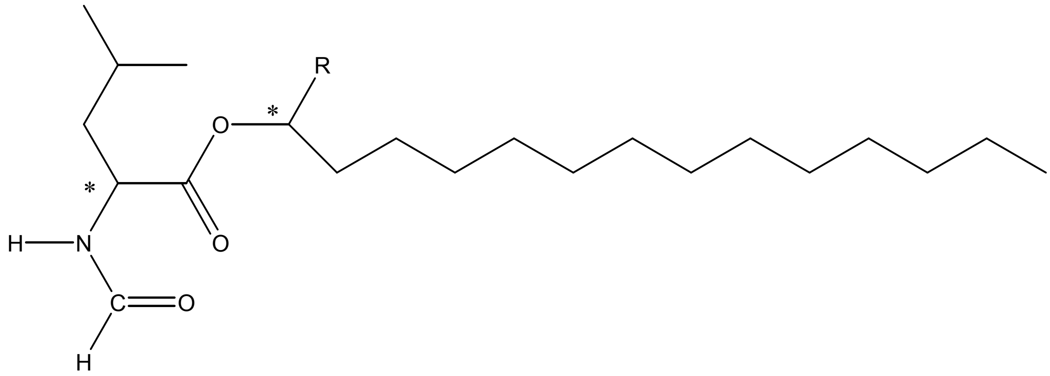
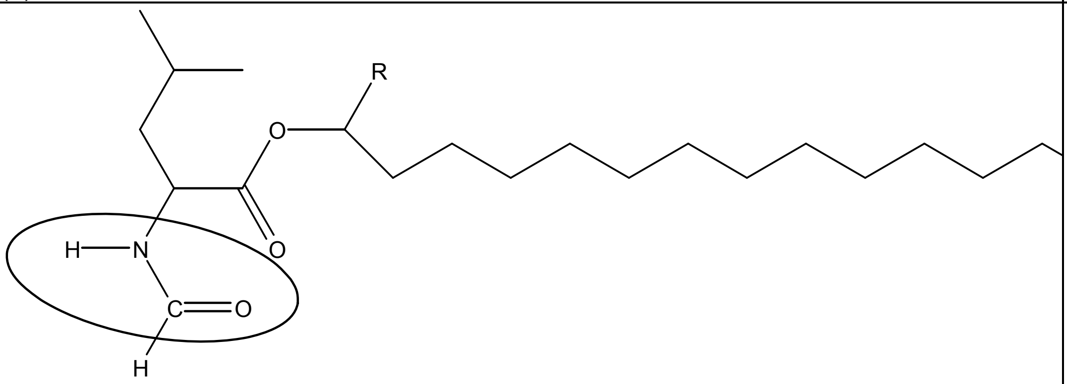
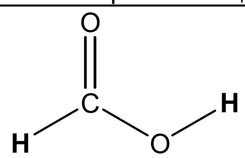
4 a	0 (1); –1 (1); +5 (1) *max one for second two if signs follow numbers*	3
4 b i	sulphur/S *allow sulphur dioxide*	1
4 b ii	3 x 2500 x 64/127 = 3779.5g (2) *omission of one step in calculation scores (1)* 2 sig figs (3800) (1) *mark separately if there is some calculation*	3
4 c i	$2I^- \rightarrow I_2 + 2e^-$ (2) *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) 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 bromine: liquid; brown/red *ignore orange* *four correct scores three; three correct scores two; two correct scores one.*	3
4 f ii	$4p^5$ $5p^5$ (1) for 4 and 5 (with some appropriate letter and superscript number) (1) for p^5 *or one mark for one completely correct* *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) at least two rows alternating in one plane (1) indication that this continues in third dimension *can be in words*(1) *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

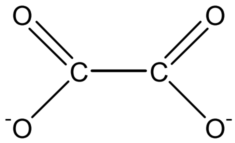
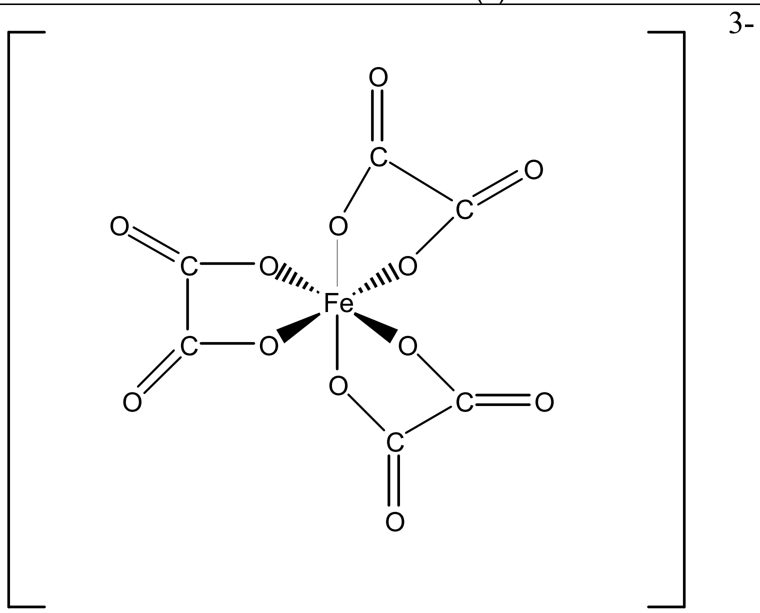
Question	Expected Answers	Marks
1 a i	 (1); *allow without the C within the ring.*	1
1 a ii	 *all bonds must be shown* (1).	1
1 b	Burning/combustion (1); Energy produced can be used/reducing landfill (1). *or* recycling AW(1); oil resources saved AW/reducing landfill (1). Do NOT allow cracking, but allow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

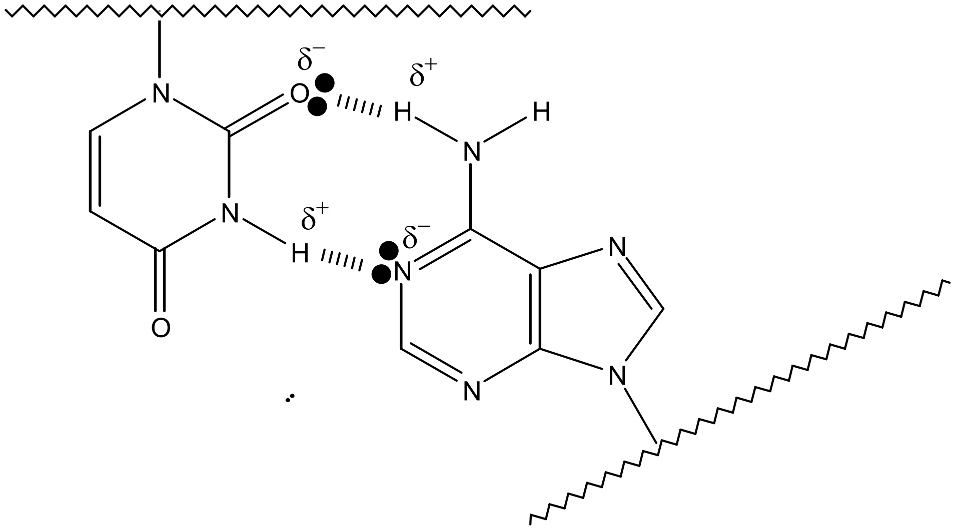
1 e i	$$K_C = \frac{[\mathbf{B}] \times [H_2O]^2}{[\mathbf{A}] \times [C_2H_5OH]^2}$$ [Products]/[Reactants] (1); Indices correct (1).	2
1 e ii	Equilibrium position moves in endothermic direction/left since forward reaction is exothermic AW (1); K_c, decreases (1) *ecf here for second mark*.	2
1 e iii	Conc. sulphuric acid / c. H_2SO_4 (1); 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); 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:* Pencil line near bottom of paper *if drawn in pencil allow line*; spot small sample of hydrolysis mixture on line; **solvent in beaker below sample**; **cover beaker with lid/film**; leave until solvent front nears top of paper; remove and dry paper; **spray paper with locating agent/ninhydrin**; correct spot seen/R_f measured AW.	6
2 c iv	 Correct structure (1); Only two types of hydrogen/may be shown in structure: COO**H (**at 13.0) (1); **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); forming an anion AW (1); *marks can be gained by writing equations or by discussing extent of dissociation*; acidity/equilibrium position depends on stability of anion (1); equilibrium position further to right for acid/charge spread out more/delocalisation in carboxylate ion AW (1); 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); different bonds/functional groups give peaks at different frequencies (1); C=O 1735–1750 cm^{-1} (1); C–O 1050–1300 cm^{-1} (1).	4
2 d ii	Hydroxyl/alcohol/OH group (1); O–H peak/absorption at 3200–3600 cm^{-1} (1).	2
	Total	**24**

3 a	$H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O$ correct formulae of substances (1); balanced correctly with electrons on left (1).	2
3 b i	***Three*** *marks for the points in* **bold** *and any* ***three*** *from* ***four****:* Use of pipette for measuring hydrogen peroxide (1); use of burette for manganate(VII) (1); (Use of burette and pipette but with solutions switched is 1 mark only) addition of sulphuric acid (1) *NOT hydrochloric/nitric acid*; to conical flask with hydrogen peroxide (1); **slow addition at end point/dropwise/drop by drop/slowly/carefully** (1); **to pink/purple colour** (if reverse addition then allow colourless but NOT pink) (1); **repeat to give at least two concordant readings** (1). *QWC* *At least two readable and clear sentences with no more than one spelling, punctuation or grammatical error* (1).	6 1
3 b ii	Moles of MnO_4^- = (18.2/1000) x 0.0200 (1); moles of H_2O_2 = **2.5** x (18.2/1000) x 0.0200 (1) *ecf*; *mark is for the 2.5* ratio concentration = 0.910 mol dm^{-3} (1) *ecf*; *answer to 3 sig. figs*. (1).	4
3 b iii	M_r of H_2O_2 = 34 (1); mass of H_2O_2 in 100 cm^3 of water = 34 x 0.91 x 100/1000 = 3.1 g *or* max moles of H_2O_2 allowed in 100 cm^3 of water = 3.0/34 = 0.088 mol therefore NO (1) *ecf from* (iii) *and* M_r of H_2O_2.	2
3 c i	$2H_2O_2\,(aq) \rightarrow 2H_2O\,(l) + O_2\,(g)$ *formulae correct, balanced and state symbols correct* (1).	1
3 c ii	(Glass =) heterogeneous because two phases/states AW (1); (Transition metal ions =) homogeneous because only one phase/state AW (1).	2
3 c iii	Measure volume of oxygen by syringe/over water (1); plot graph of volume of O_2 *versus* time (1); find gradient at time = 0 (1).	3
3 c iv	Rate of decomposition = k x $[H_2O_2]$ (1); = 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); 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	$Fe^{3+}(aq) + 3OH^{-}(aq) \rightarrow Fe(OH)_3(s)$ correct formula for $Fe(OH)_3$ (1); balanced equation as above (1) *ignore spectator ions if balanced*; correct state symbols (1).	3
4 b i	 (1).	1
4 b ii	Ligand exchange/complex formation/ligand substitution/Ligand displacement (1).	1
4 b iii	Any **two** points from **three**: d Electron energy levels are split / d electrons are excited (1); by particular frequencies/wavelengths of light/radiation in visible region(1); hence colour transmitted is light NOT absorbed, in this case green/ complimentary colour is seen (1).	2
4 b iv	6 (1); number of lone pairs/dative bonds/coordinate bonds/bonds (1); around central cation/ion/*allow* Fe atom (1).	3
4 b v	 3 ligands around Fe in correct shape (1); All 6 O atoms bonded to central cation (1).	2
	Total	**15**

5 a i	Lone pair of electrons on N (1); can accept proton/hydrogen ion/H^+ (1).	2
5 a ii	Water (1).	1
5 a iii	 *one mark for both hydrogen bonds* (1); *one mark for both lone pairs* (1); *partial charges correct* (1). 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* Smaller chain length/M_r (1); different bases (1) DO NOT ACCEPT 'COMPLEMENTARY BASES'; RNA has single chain (1); Different sugar in chain (1).	2
5 b ii	Hydrogen bonds between DNA strands break (1); 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 ; = 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	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. Thermal stability of carbonates/nitrates(qualified) Any one of (1)	1
1 b iii	Moles of CaO = 0.80/56 (1); {0.014} ecf (calculations *via* mass of CO_2 score above mark) volume of gas = 0.80/56 x 24{0.34} (dm^3)(1); → cm^3 (1); sf, mark independently(1) 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);] three sets of electrons/areas of electron density (NOT bonds)(1); around (each) carbon(1);(do not penalize 'bonds' here) repel as far as possible(1); NOT atoms repel. NOT 'as much as possible' 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); to form small(er)/short/unsaturated/(more) useful molecules(1); Specific names and substances OK but NOT particles	2
1 c iv	References to alternative pathway with lower E_a/meaning of heterogeneous catalysis can score 1 MARK then Reactants adsorbed(1); (absorb on surface CON) bonds weaken/break(1); new bonds form(1); Products leave/desorb(1) (any three or all four) <u>Separate last marking</u> point for role of carbon as below Carbon blocks surface/reactants cannot get on to surface AW(1) using 'substrate/enzyme kinetics ideas' maximum 4	1 3/4 1
1 c v	Contains pores/tunnels/sieve/honeycomb/channels/holes(1); 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)** Corrections: **loss** of electrons(1); **low** pressure/(high)**vacuum**(1)/ (**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} NOT different A_r's	2
2 b ii	Very few ^{14}C (atoms) in ethanol from oil/no. significantly decreased(1); they have decayed/many half-lives passed (1); happened over millions/thousands of years/very long time/longer than 6000yrs(1) (allow reverse argument and AW)	3
2 c	(Coloured/bright/white) NOT black (con) <u>lines</u>(1); on a black/dark background(1);lines getting closer(1) NOT bands 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); Equation correct(1) ecf wrong cation formed e.g. Cs to Cs^{2+} gaseous(1) 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); In Cs attraction to nucleus less/ shielding by inner shells(1) easier to remove electron/less energy needed (1) ora discussion in terms of energy levels fine 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) 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); different mass <u>no</u>./no. of neutrons(1) molecules zero	2
d	${}^{129}_{67}I \rightarrow {}^{129}_{68}Xe + {}^{0}_{-1}\mathbf{e}$ Mark as: correct symbol for beta particle(1); ignore any (–) on beta particle represented as 'decay'(1); all correct (1)	3
	Total	**16**

4 a	correct no. of non-bonding electrons on left N and O atom (1); 6 electrons(any) between N atoms(1); 2 electrons of same symbol between right N and O atoms(1); correct symbols and no. across whole molecule(1) 	4
4 b i	energy to break bonds 2 x 481 + 2 x 167 (+1296)(1); energy given out on bond formation 2 x 945 + 498 (–2388)(1); correct processing sign from working(1); –1092(kJ mol^{-1}) scores 4 (allow four marks for –546 also) ecf on first two marks 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) 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); 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 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 ^{o}C and 3000 kPa/30 atm** (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** (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 **TABLE DOES NOT 'COUNT' AS DIAGRAM**		
a	Carbon black: benefits: strengthens rubber; increases abrasion resistance, cut and tear resistance; increases lifetime; increases resistance to light; **NEED THREE BENEFITS** ACCEPT ALTERNATIVES		**1**
b	Oils and resins: 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; **NEED THREE BENEFITS** ACCEPT ALTERNATIVES		**1**
c	Anti-ageing chemicals: extend life by giving resistance to heat; fatigue; weathering; exposure to ultraviolet light; **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. Do not mark past this point 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 '$\rightarrow$' 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 <u>and</u> poly(isoprene) Structure of butadiene <u>and</u> poly(1,3-butadiene) Structure of 2-methylpropene <u>and (NB)</u> its polymer Structures to compare *cis* and *trans* isomers Structures of butadiene <u>and</u> phenylethene (styrene) Structures <u>of at least two</u> accelerators for vulcanisation 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.

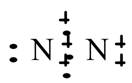
List of possible illustrations

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

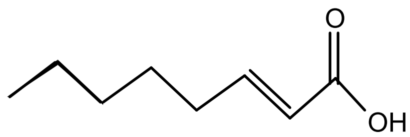
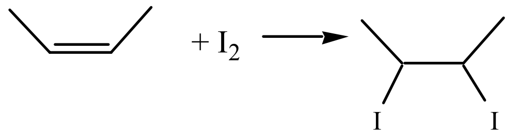
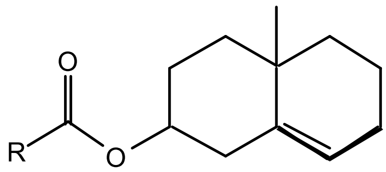
[Max. 14 marks]

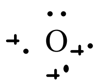
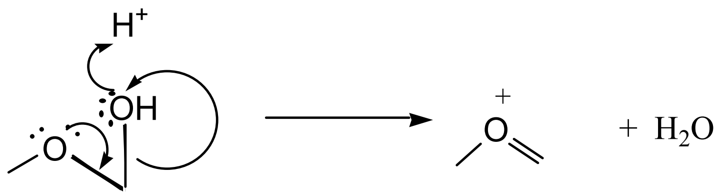
Mark Scheme 2854
June 2006

Abbreviations, annotations and conventions used in the Mark Scheme	/	= alternative and acceptable answers for the same marking point
	;	= 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

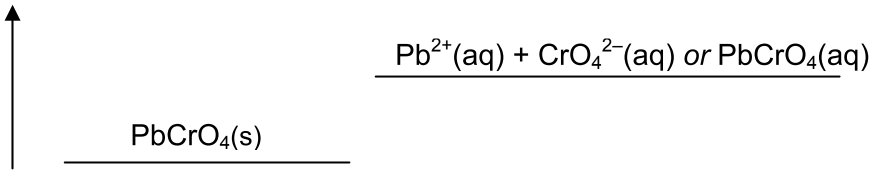
Question	Expected Answers	Marks
1 a	0 (1); +2 (1) NOT 2+	2
1 b i	(Forward) reaction is endothermic (1); Equilibrium (position) moves to oppose change/ Increased temperature moves equilibrium (position) in endothermic direction(1); i.e. in direction consistent with stated endo/exo of forward reaction(1);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

1 i	ionic (1); <u>strong</u> electrostatic forces/bonds (lead to high melting point) (1); (dissolves because) <u>ions</u> are hydrated/ <u>ions</u> form (ion-dipole) bonds/ <u>ions</u> attract water moleules (1); conducts because (free) <u>ions</u> can <u>move</u> (1) ALLOW any of these with wrong structure type, also: covalent – strong bonds *or* hydrogen bonds to water 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) (1) for correct structural formula or 8C acid with wrong double bond	2
2 c i	 (1) for both iodines reacting; (1) for completely correct *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) Iodine no. = 1524 (*ecf*) x 100/328 = 465 (1) for correct use of factor of 6 or 12 or use of (100/328) x (254 or 127) (1) for correct answer (1) for 3sf *mark separately provided some working.*	3
2 d	meaning of *cis* - both groups on same side of C=C (AW) (1); fact that there is more than one *cis* group (1) *mark separately*	2
2 e	 (1) correct ester formula (skeletal) anywhere; (1) ester group on correct carbon (*allow non-skeletal ester group for this mark*)	2
2f	*Four from* *A Imf in cholesterol:* id-id/non-polar/only one polar group; B *Imf in water:* hydrogen bonds; 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; D *Imf between cholesterol and octan-1-ol:* forms imfs with octan-1-ol/ octan-1-ol non-polar 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) *mark separately IGNORE starting colour*	2
3 c i	 5 electrons from oxygen (1); bonds (1); lone pair (only if one) (1) ALLOW "+"	3
3 c ii	120 (± 5) *no ecf* (1) Idea of groups of electrons (AW) (1); repelling and getting as far apart as possible *both ideas necessary* (1) *mark separately even if angle wrong*	3
3 d i	 (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.* A Form B absorbs (certain frequencies of) visible light; B (when) electrons excited (to higher energy-level); C Form B is more delocalised/larger chromophore/ larger conjugated system/ more conjugated (NOT extra double bond) (*ora for Form A*) D because of alternating single and double bonds joining (benzene) rings (*ora for Form A*) E Form B needs less energy to excite electrons (*ora for Form A*)/visible light has lower energy than u.v.; F energy level difference measures frequency/wavelength absorbed/ $(\Delta)E = hv$; *max 2 if emission of light (rather than transmission) is implied* QWC 2 sentences, SPAG correct (one error allowed) *See notes*	4 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.* <55 °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 (1) for prods - reacts; (1) for correct multiples; (1) for answer with sign *ecf only if clear.*	3
4 b ii	*Two from:* More molecules (formed); Gas molecules (formed, from solid); more ways of arrangement/ more disorder	2
4 b iii	$\Delta S_{surr} = -\Delta H/T$ = 70000/298 = –234.8 (*allow –230 [2sf]*) 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* * i.e. do not credit ΔS_{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* $= \sqrt{(7.5 \times 10^{-6})} = 2.74 \times 10^{-3}$ pH = 2.6/ 2.56 (1) *ecf from calculated value*	2
4 e i	Addition of H^+ moves (equilibrium position) to left (1) (removing H^+ and) maintaining/ restoring pH/ $[H^+]$ (1); *ora for added OH^-* mention of adding A^- or HA is CON This works because both [HA] and $[A^-]$ are large/roughly equal/$[A^-]$ <u>much (AW)</u> 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* $= 7.5 \times 10^{-4} \times 0.5 = 3.75 \times 10^{-4}$ (1) *ecf from given wrong formula provided it involves all quantities.* pH = 3.4 (1) *ecf from calculated value*	3
4f	*max two points for each technique - must be in pairs (describe* and *explain)* *mark separately within pairs except as shown. Best scoring pair to count for each.* ***mass spec***. highest <u>mass</u>/molecular/parent ion/M^+ peak(1); gives M_r/ (relative) molecular mass (*allow "mass of molecule") is* 192 (1) *or* fragments/{peaks at M_r – 45/ M_r – 17}(1); showing presence of –COOH/ –OH (1)*depends on fragment mark* ***ir*** (absorption at) 2500 – 3200 (1); (–)O(–)H in <u>acid</u> (1) *or* 3200 – 3600 (1); (–)O(–)H in <u>alcohol</u> (1) NOT 3600 - 3640 *or* 1700 – 1725 (1); C=O (1) ***nmr*** 4 (allow 3) peaks (1) *deduce from ratios if shown, but ignore wrong values in ratios*; four/three (proton) environments *deduce from explanation of ratio if necessary*(1) *or* peak at 9 – 15 (1); –COOH/–OH *in <u>acid</u> (1) *or* 2.4 (1) $CH_{(2)}$ (1) *or* 0.5 – 4.5(1); –OH* in <u>alcohol</u>/ROH(1) * formula not just name QWC Logical. Correct use of *three of* the following terms (2) Correct use of *two of* the following terms (1) 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 2
	Total	**30**

5 a	oxidation state of chromium NOT of chromate (numbers other than 6, +6 are CON)	1
5 b	Pb^{2+} (aq) + CrO_4^{2-} (aq) $\rightarrow$ $PbCrO_4$(s) 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); *description (or labels on diagram) including:* (electron) energy <u>levels</u> (1); (electron) falling (1); energy <u>change</u> related to frequency wavelength /(Δ)$E = hv$ (1)	4
5 e iii	cadmium (1); cadmium-sulphide (1) *no ecf on second mark*	2
5 f	 (1) for line above printed line (ignore other lines IF correctly labelled) (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* (2) completely correct (1) if $PbCrO_4$ shown as divisor.	2
5 g ii	Yes, because $[Pb^{2+}(aq)] \times [CrO_4^{2-}(aq)]$/product of concentrations/1×10^{-8} (1); *(NOT $K_{sp} = 1 \times 10^{-8}$)* greater than K_{sp}/2.5×10^{-14} (1) *or* calculated $[CrO_4^{2-}(aq)]$ from K_{sp} (1); compare with 1×10^{-4} (1)	2
5 g iii	lead chromate (1) solubility product will be exceeded first/ least soluble/ smaller K_{sp} (1) *depends on first*	2
	Total	**21**

Report on the Units
June 2006

CONTENTS

Advanced GCE Chemistry (Salters) (7887)

Advanced Subsidiary GCE Chemistry (Salters) (3887)

REPORTS ON THE UNITS

Chief Examiner's report

Once again it is great to report an increased number of candidates and Centres at both AS and A2. Standards were maintained across both AS and A2 with a slight increase in the proportion of A grades awarded at A-level.

All Principal Examiners reported excellent work from many candidates. A larger proportion than usual seem to have let themselves down, however, by poor examination technique and inadequate preparation.

Standards were maintained in coursework both at AS and A2. At AS, a smaller proportion of Centres were out of tolerance and had to be moderated down. However, at A2 the proportion was larger than in 2005. The Principal Moderator hopes that these Centres will take advantage of the INSET training on Coursework in the Autumn.

INSET dates for Autumn 2006

Get ahead *– raising standards through examination feedback*
A full day course aimed at improving candidate performance by giving feedback from the June 2006 session on the written papers and coursework.
Course dates and codes Wednesday 18 October 2006, London (CCHR501); Thursday 2 November 2006, Coventry (CCHR502); Thursday 7 December 2006, London (CCHR503).
Fee £120 including refreshments, lunch and course materials.

Get ahead *– improving candidate performance in experimental skills and investigation*
A full day course providing an in-depth study of experimental coursework and investigations, with detailed information on choice of investigation and marking. **Note** There will be considerable overlap with course CCHR5 so attendance at both courses is not recommended.
Course date and code Tuesday 21 November 2006, London (CCHR601).
Fee £120 including refreshments, lunch and course materials.

Places may be booked on these courses using the booking form at the back of this report; we are unable to accept telephone bookings. Please quote the course code in any correspondence.

2848 – Chemistry of Natural Resources

General Comments

Candidates' marks covered a wide range, from single figures to the early 80s, although marks above 70 were rare. There was no indication that candidates had a problem with the length of the paper, as answer spaces that were left blank (of which there was an unusually high number) indicated a lack of knowledge and understanding rather than a time constraint.

Good attempts were made at most calculation questions, with candidates setting out their answers sufficiently clearly, and stating what was being calculated at each stage, to allow them to gain credit (and to gain marks *via* the 'error carried forward' rules if they had made a mistake). Most candidates scored well on questions requiring them to draw a diagram.

Marks were generally much lower on questions that required candidates to name an organic compound, show a reaction mechanism, discuss the effects of intermolecular forces or write a chemical equation. A limiting factor for many candidates was their poor literacy skills, with many showing a weak grasp of the appropriate use of technical vocabulary.

Comments on Individual Questions

1 This was a high scoring question for many candidates.

(a) (i) Most answered this correctly, although 'methyl' was a very commonly seen incorrect answer.

(ii) This was generally answered well, with the most common mistake being a structure with too many hydrogen atoms, leading to some carbon atoms having five bonds to them.

(iii) Few candidates scored both marks, although many did get one for 'methylbut'.

(b) (i) A significant number of candidates scored the mark here for stating 'colourless'.

(ii) Most candidates gained the mark by stating it is saturated.

(iii) The most common outcome here was for candidates to gain one mark for a suitable saturated skeleton. Only the best candidates scored both marks, the most common errors being to include too few bromine atoms or to put them in incorrect positions.

(iv) Many scored both marks, but a surprising minority failed to select two answers, as was indicated in the rubric.

(c) (i) Many candidates failed to score on this question. Those who did attempt it, tended to be confused as to which equations to select. Those candidates who correctly chose **equations 1.1** and **1.2** often failed to write the overall equation correctly and included the NO and NO_2 in their answer.

(ii) This question was well answered by a small percentage of candidates. Many of those who gained no credit failed to realize that the answer was linked back to the equations given earlier.

> **Tip** It is worth reminding candidates that answers to parts (i), (ii) *etc*. of a lettered part question will often make use of their previous answers within that lettered part, or will link back to information included in the stem of that part of the question.

(iii) Most scored the mark here, with a small proportion of candidates confusing tropospheric and stratospheric effects.

2 This question was often reasonably well done, with the exception of those parts that required candidates to explain the effects of intermolecular forces on the properties of materials.

(a) (i) Most scored this mark.

(ii) Many scored one mark for indicating that the second monomer needs to be unsaturated. Gaining both marks was less common, with candidates often failing to put across the idea of different monomers.

(b) (i) Many candidates scored at least two marks. Common reasons for not gaining credit were the incorrect positioning of the lone pair along the hydrogen bond and the 'straight' O–H–O combination.

(ii) Very good candidates scored the mark by giving an accurate description of the effect of the intermolecular forces that are in operation. Weaker candidates gave vague answers, often referring to the acrylic acid, instead of the polymer formed from it, or discussing the interaction of the paint and the paper it was being applied to.

(c) (i) Few candidates scored well here, with hydrogen bonding given as present in both polymers being a common error. Also, some candidates gave an abbreviated answer pd-pd, which gained no credit. Many incorrect responses were centred round an answer involving the difficulty of packing the chains together due to the presence of branching.

> **Tip** Practise identifying the intermolecular forces between various pairs of molecules. Remember not to abbreviate the names of intermolecular forces on the examination paper, particularly when the answer includes a mark for the quality of use and organisation of scientific terms.

(ii) Most gained a mark for showing correct diagrams for the isomers and many went on to get the second mark for *cis* and *trans* too.

(iii) Poor wording of answers often made it difficult to give any credit. Many candidates gave answers that referred to the monomer instead of the polymer formed from it.

3 This question showed a lack of knowledge and understanding of reaction mechanisms and a poor ability in writing chemical equations. Calculations were, however, generally well done.

(a) (i) Most gained this mark.

(ii) Many candidates got the mark for homolytic, with a few incorrectly giving photodissociation.

(b) (i) Many scored both marks for clearly set out and well explained answers. A common mistake was failing to multiply by 1000, which led to some candidates only gaining one mark.

(ii) Again, many candidates gained both marks. Of those who did not, a significant number gained some credit for appropriate working under the application of the error carried forward rule.

(iii) A good number of correct responses were seen, although some misread the question and discussed the comparison of amounts of energy instead of frequency.

(c) (i) Many gained two marks, but few gained the third one for mentioning that it is the *high frequency* uv that is removed.
(ii) Most gained this mark.
(iii) Few scored here, with the answer space often left blank. Of those who did attempt it, many did not write the final equation with the Br and BrO removed.
(iv) This mark was often awarded.
(v) Many candidates scored at least one mark, for showing the right-hand graph with a lower activation enthalpy than the one on the left. Many fewer candidates went on to gain the second mark for correctly labelling of the activation enthalpy on both diagrams.
(vi) Many candidates gained some credit for discussing the effect of increased temperature on the reaction rate, although few gained all the available marks because they only mentioned more successful collisions and did not precisely link the rate change to the fact that more collisions have energy greater than the activation enthalpy. Those who chose increased pressure as their second factor tended to score both of the available marks. A minority of candidates became confused, because of the context of the question, about what was wanted in the answer and tried to give answers in terms of the effects of the uv light. Although credit was given for this in the mark scheme, most answers that took this route were not written with sufficient clarity to lead to marks being awarded.

(d) (i) Although some candidates gained the first mark for the correct left-hand side of the equation, few had any idea of the type of product that would form, making the award of the second mark quite rare.
(ii) Most candidates scored something, often for a correct diagram to illustrate the polar bond. Marks were gained by fewer candidates in the written part of their response, usually due to poor wording. This included confusion over the use of the terms atom and molecule and vague descriptions of the unequal distribution of the electrons, rather than precisely discussing the positioning of the bonding electrons between the two bonded atoms.
(iii) Many candidates failed to attempt this question. Of those who did give an answer, one mark was often scored for the curly arrow showing the movement of a lone pair of electrons from the oxygen to the carbon in the bromomethane molecule. It was rare for any candidate to score both marks.

(iv) Many correct answers were given, even if the previous part of the question had not been attempted.
(v) Good candidates scored both marks. Occasionally a candidate gained one for state symbols if they gave an equation that had a suitable structure, but was not correct. Many failed to give an answer or gave something that was not an ionic equation.
(vi) A significant number of candidates scored the mark in this question.

numerical answers: b(i) 4.82×10^{-19} J; b(ii) 7.27×10^{14} Hz

4 The quality of answers to this question was very varied. Most candidates gained some credit for calculations and values for oxidation states.

(a) Most gained at least two marks, with the mark for the oxidation state of iodine in the iodate(V) ion being awarded less often.

(b) (i) Most got the mark for sulphur.

(ii) Most candidates gained at least one of the two marks for the calculation because they showed a correct method, allowing credit to be given under the application of the error carried forward rule even if they had made one mistake. Most then went on to get the last mark as well, although some good candidates surprisingly gave an answer to three significant figures deliberately (*i.e.* they wrote '3 s.f.' in brackets next to their answer) when the question clearly asked for two significant figures. Some weak candidates gained the final mark for significant figures provided they showed some working for the calculation, even if that working gained no credit.

(c) (i) Few candidates gained both marks, with many trying to give an answer that included iodate(V) ions. Some scored one mark for correctly showing two iodide ions producing an iodine molecule.

(ii) Many gained the mark for stating iodine in iodate, or quoting iodate ions.

(d) The most able candidates easily scored both marks, but most candidates failed to score at all. The majority of candidates did not seem to understand what was being asked and often attempted to write responses that suggested some type of reaction was occurring.

(e) Better candidates often scored two marks, with a common mistake that led to only one mark being scored coming from the use of the value 254 instead of 127.

(f) (i) This was generally well answered, with many candidates scoring at least two marks.

(ii) Most candidates scored at least one mark, either for correctly giving 4 and 5 or for one subshell being completely correct. A pleasing number gained both marks.

(iii) Many candidates misinterpreted this question and gave a response involving the wrong combination of halogens (often chlorine reacting with bromide ions). A significant number of candidates failed to gain any credit here. Some responses gave the reverse equation and many answers were not ionic equations. A significant minority of candidates gave no answer.

(iv) Many gained the mark for mentioning a low temperature, with answers that gained no credit often referring to transporting in lead-lined or steel tanks.

(g) Most candidates scored at least one mark, often for the correct formulae of the two ions. Many went on to score all three marks, although some had difficulties with drawing the three dimensional aspect of the structure.

(h) This was generally well answered, although aqueous or hydrolysis were often seen as incorrect responses.

numerical answers: b(ii) 3800 g   e(i) 0.29 g

2849 – Chemistry of Materials

General Comments

All the examiners thought the standard of the paper appropriate, although several parts of the paper caused much difficulty for candidates, despite being designed to cater for a wide spectrum of abilities. Difficult areas included extended writing involving a redox titration and explanations of the properties of polymers using intermolecular forces. The quality of written communication throughout the paper in many cases was poor. Many candidates lacked an awareness of the length of answer required; there were as many candidates who were far too succinct as there were those who were longwinded, often using inserted sheets to add to the problem. Candidates need to be encouraged to fit their responses into the spaces allowed, hence the need to plan for the extended writing questions. This is where an extra sheet is valuable. The ability to express ideas throughout the paper using appropriate scientific language was again of a poor standard. For example, many were not able to name the apparatus for a titration, whilst in those questions which have a biochemical slant they switched from chemical to biological language.

Candidates were generally more effective in using the Data Sheet and in understanding the differences between n.m.r. and i.r. measurements. Centres have obviously worked hard at this area.

The ability in calculations to use the 'appropriate number of significant figures' was quite poor, most giving their answers to '2 sf' rather than 3, although 1 sf and 2 sf were not uncommon. Most serious candidates tried to set out their working showing symbols, equations and units. However, there were a considerable number of candidates whose scripts were untidy, illegible and, where required, poorly illustrated, with poor explanations and descriptions.

Comments on Individual Questions

1 (a) Most correctly identified the ester but some omitted the O–H bond in the formula of ethane-1,2-diol.

> **Teaching tip**
> Candidates often draw all C–C and C–H bonds in structures but abbreviate functional groups *e.g.* –OH, $–NH_2$, –COOH. They also try to rush diagrams and do not always draw bonds accurately between two atoms. They perhaps need more practice in precision in this area.

(b) Some good answers, but many were rather vague and failed to give a suitable advantage.

> **Misconception**
> 'Cracking' was a common response. Possibly because of the research being carried out to recycle tyres and discussed in the Open-Book paper. It is not relevant here.

(c) Rather disappointing in most cases though many gained the mark for focusing on the fact that chains cannot move over each other so easily at lower temperatures.

> **Misconception**
> Intermolecular forces get stronger as the temperature falls with some citing that polymers become more crystalline at lower temperatures with an equal number suggesting that they become amorphous.
>
> At this level candidates will fare better if they relate low temperatures to lower kinetic energies for the chains, hence the restriction in relative chain movement. An applied force will then cause the 'frozen' chains to break.

(d) Many did not read the question carefully enough and tried to draw the full structural for compound **A**. However, the ester link was common but not the rest of the detail required.

(i) Candidates often switched to structural formulae for some parts of the structure.

(ii) Candidates did not understand the effect of polymer structure on the strength of intermolecular forces between chains. They generally knew they were stronger in PEN but not why, nor were they able to express their ideas clearly enough in some cases.

> **Misconceptions**
> Hydrogen bonding exists between chains in polyesters like PEN.
> Delocalised electrons make it more difficult for a double benzene ring to break.

(e) (i) The commonest error in writing the expression for K_c was that they confused this with the K_a constant discussed in unit 2854. Thus some left out the concentration of water term.

(ii) Some excellent explanations, though a few confused equilibria with rate of reaction. If a mark was lost it was because of the failure to explain the change in the equilibrium position.

(iii) Some forgot that the sulphuric acid needed to be concentrated.

2 (a) It was not always apparent that candidates could interpret skeletal formulae well enough to tell if a carbon was asymmetric or not.

(b) Some confused an amide with an amine whist others tried to add additional C and H atoms.

(c) In part (i) the commonest error was to use concentrated sulphuric acid, whilst most got part (ii) correct with only a very few citing n.m.r.

Despite the question in part (iv) stating 'paper chromatography' many referred to t.l.c. Thus candidates wrote about plates, ultraviolet radiation and iodine. However, generally it was a well answered question, although the standard of diagrams was poor, even though a wide range of interpretation was allowed.

Most candidates were able to use the *Data Sheet* effectively to establish the presence of a –COOH group and a –CHO group. However, some joined them together to form a two carbon molecule, not realising the wider picture. Some thought the acid contained a phenyl group, not realising that a group of H atoms in such a group would also give an n.m.r. peak.

The answers generally to part (v) were most encouraging. Designed to test candidates at the higher levels, some Centres had covered the topic of acid strength in organic compounds really well so that even their weaker candidates gained credit here.

The commonest error was stating that acids lose an H atom rather than an H^+ ion. The C=O group was often given as the cause for the loss of a proton rather than the stability of the carboxylate anion formed. Some also confused the terms 'dissociation' and 'delocalisation'.

(d) (i) Answers tended to be longwinded, with candidates using extra space to discuss topics like how an i.r. spectrometer works yet failing to give details of the absorption peaks in an ester.

Misconception
Electrons gain energy and emit infrared frequencies. This was a common error with many failing to appreciate the idea of 'bonds vibrating faster' through absorption of infrared radiation of the appropriate frequency.

(ii) Some forgot the context of the question and identified the presence of a phenol, amide or an amine.

Teaching tip
Candidates need to be aware of the specification details regarding interpreting spectra. There are a limited number of functional groups listed. Phenols, amines and amides are not included.

3 (a) Few candidates gained both marks. Many forgot that H^+ ions needed to be added as a reactant, and few attempted to incorporate electrons; if they did they were not always on the correct side.

Teaching tip
Candidates need practice in writing ion-electron equations, making sure that the charge and mass on both sides balance.

(b) (i) This was poorly done. Even the ablest candidates often failed to gain more than 2-3 marks.

Most lost marks because of a failure to achieve at least two concordant titres; not using a pipette to measure out the hydrogen peroxide; not adding acid so that the manganate(VII) could operate as an oxidant. In addition many used a beaker rather than a conical flask for the titration, used an acid-base indicator or wrote at length about the use of a white tile and how to read a meniscus (diagrams often incorporated).

The language used was often non-scientific. A burette was referred to as a 'titre' by one group and 'measuring tube/stick' was quite common. Despite the heading at the beginning of this part of the question many failed to concentrate on spelling, punctuation and grammar. Fortunately for them a specific spelling was only penalised once; 'burrette' was not the commonest variation by a long way.

(ii) The commonest errors with the calculation were failure to multiply the moles of manganate(VII) by 2.5 and the significant figures problem. Significant figures were usually given to 2 rather than 3, though 1 and 4 were regularly seen. Some had a difficulty in adjusting for the tenfold dilution factor.

(iii) Virtually all were able to calculate the relative molecular mass of hydrogen peroxide correctly. Few could then go on and use it effectively.

(c) (i) A very familiar GCSE equation was required. The commonest errors were in giving the state of water as (aq) and hydrogen peroxide as (l). However, many of the weaker candidates did gain the mark.

(ii) The understanding of homogeneous and heterogeneous catalysis was nearly always correct.

(iii) A majority managed at least two marks but there were similar problems in using scientific language as experienced in part b(i). The weakest candidates used beakers, buckets of water and took readings too infrequently. Some just wrote ‘plot a graph’ without specifying what was to be plotted. If a gradient was drawn it was not often specified as being at time = 0.

(iv) Generally the rate was well calculated. However, many lost the ecf mark for not showing the rate equation used.

4 (a) (i) Rusting of the tap was a fairly common answer. Oxidation was usually suggested but many could not explain why this was so.

(ii) The idea of a complex ion was not really understood, most recognised it has a Fe(III) species but wrote Fe^{3+} or ‘rust’.

(iii) Few were able to write a correct ionic equation. The mark most commonly awarded was for the state symbols. Candidates often thought the precipitate was iron(III) oxide and also tried to incorporate water molecules in the equation.

(b) (i) Often incorrect answers were given involving the absence of charges and/or C=C bonds.

(ii) Well answered though there were a variety of minor contenders: redox, addition, just plain substitution, nucleophilic and ‘litigation’.

(iii) Some tried to answer this in terms of a chemical reaction in which iron(II) ions were formed (a result of the green colour presumably).
Some inevitably, though not as many as previously, thought that electrons having been excited fell down emitting green light. The better candidates were truly excellent here.

(iv) Very Centre dependent, a few knew this well, including some of the weaker candidates, and were able to gain the three marks. However, the vast majority thought that the coordination number was the number of ligands in the complex or the charge on the ion.

(v) Some excellent diagrams but most were poor. Many failed to appreciate the bidentate nature of the ethanedioate ion, whilst drawing octahedral structures remains a real struggle for most.

Teaching tip
Diagrams of complexes are best drawn showing the atoms donating the electron pairs bonded to the central atom. Then the usual wedge and dashed lines can be used to show the ligands not in the plane of the paper.

5 (a) (i) Some described hydrogen bonding in biological systems, though many recognised that a base accepts protons. However, few appreciated the role of the nitrogen's lone pair of electrons in the process.

Part (ii) was almost always correct.

(iii) Sometimes not enough detail was given in drawing the appropriate hydrogen bonding (another example of poor examination technique); other errors were lone pairs or charges missing or lone pairs not aligned with the H-bonds but at right angles. Internal H-bonding was seen regularly.

(iv) Not always correct; often given as just helix or even pentagon, linear, or tetrahedron.

(b) (i) Well answered, most gaining both marks.

(ii) A wide range of responses; from really excellent chemistry based outlines to the essay based biological style treatise, where many wrote down all they knew about protein synthesis or genetic engineering.

Candidates need to use the mark allocation as a guide to the depth of answer required.

2850 – Chemistry for Life

General Comments

The paper generated a very wide range of performance from candidates, with scores from some very weak candidates in single figures to an encouraging number of candidates scoring in the 60–70+ mark range.

Questions 1 and 2 proved the most challenging and gave the widest spread of marks, with Question 3 and particularly Question 4 being generally the best answered.

There were many straightforward questions on this paper but some questions had been designed to give students an opportunity to apply their understanding, particularly the sequencing of ideas, and not simply regurgitate rote learned material. Understandably these former questions proved the most discriminating and, whilst in some cases the context may not have keyed in the students thinking as intended, such questions are important if the most able candidates are to be given the opportunity to shine.

Tip for teachers
Although there are always a substantial number of marks on the paper for correct responses to fairly standard questions, there will also be opportunity for more able candidates to use their thinking skills. It is worth Centres giving students practise at answering questions on familiar topics from slightly different angles and contexts.

Calculations, in common with recent sessions, were reasonably well dealt with along with the ability to produce balanced equations.

Time did not seem to be an issue.

Comments on Individual Questions

1 The context used for this question spanned ideas from both examinable units and consequently the question was relatively long. The decision to put it first was made because it was thought that candidates would be at their freshest, best able to cope, and would find the later questions relatively straightforward, with less chance of 'running out of steam'.

Part (a) was correctly answered by most candidates, in contrast to part (b)(i), which rarely generated the correct response. This part question was designed to continue the context of control of gases in the head space in packaging, and allow candidates to recall their GCSE chemistry, namely CO_2 is an acidic gas, and therefore CaO is basic.

The mark scheme in b (ii) included a wide range of more general properties, not only chemical patterns, and this mark was consistently scored.
In (b) (iii) common mistakes were to have the fraction giving the amount of CaO the wrong way round, although 'ecf' (error carried forward) marks were awarded if clear working was included.

Tip for candidates
In calculations make sure you clearly show all the stages of your working. It will make it easier for the examiner to give you credit even if you make an early arithmetical slip.

Some students are confused between decimal places and significant figures; nevertheless many candidates obtained the correct answer.

Most candidates scored all four marks on (c)(i), however, the need to put together a logical sequence of ideas in order to score all 5 marks on(c)(ii) tested many students. The most able students usually scoring 4/5 marks with 2 marks (maximum distance apart and 120º) common for the majority. Although lone pairs are not present in the ethane molecule the importance of **all** electron dense regions around a central atom in dictating the shape is still being missed by some candidates. A common wrong answer being a bond angle of 109º, possibly because the candidates treated the 'second pair' of electrons in the double bond as another, fourth, electron pair.

Part (c)(iii) was usually well answered but (c)(iv) seemed quite Centre dependent with candidates from some Centres producing almost the text book answer and others producing spurious answers based on enzyme kinetics. Absorption and adsorption were often confused.

Part (c)(v) scored one mark for a large number of candidates (the idea of the honeycomb/sieve structure of zeolites being met in both *Storylines* and an activity, albeit in the role of separation of branched and straight hydrocarbon molecules), but the second mark proved elusive with the mark scheme allowing any comment suggesting the size of the 'pores/channels' need to be about the dimensions of the water molecule (otherwise it will either pass right through or not be absorbed in the first place.)

Numerical answer (b) (iii) 340cm^3

2 Part (a) was designed to look at mass spectroscopy from a slightly different angle and part (a)(i) had two obvious mistakes. Many candidates correctly identified these mistakes and their corrections (included in the mark scheme was, mass/charge ratio instead of mass, as an alternative pair). Some students did go off on a tangent re-writing whole phrases.

3 (a) (ii) yielded the correct C_{70} for most candidates.

Part (b)(i) was generally correctly answered although some suggested 14 and 12 neutrons and a small but worrying number cited different numbers of protons.
Part (b)(ii) showed up confusion in some candidates' minds about the general nature of radioactive decay. It was hoped that candidates would argue thus: little radioactivity means very few (not 'none') C^{14} atoms left, because many half-lives have passed, because C^{14} atoms in ethanol from oil have been around for a very long time (or the reverse argument). A significant number of candidates got there but many contradicted themselves by suggesting C^{14} atoms in ethanol from grapes had a shorter half-life, or <u>no</u> radioactivity was left in oil-derived ethanol.

Part (C) yielded 2 from 3 for most candidates with the third mark only occasionally scored, being for stating the lines got closer. A few candidates still got absorption and emission spectra mixed up.

The majority of candidates in (a)(i) correctly wrote the equation for the first ionisation of Cs. State symbols were sometimes unclear or wrong and less frequently there was an electron affinity.

Logical and concise sequencing of ideas was again a problem for some candidates in (a)(ii) although most got there in the end.

In part (b) a substantial number of candidates knew they had to find the mole ratio but a significant number inverted the fraction and ended up with Cs_2O receiving 'ecf' marks, again, if the working was clearly shown.

Part (c)(i) was misinterpreted by some candidates since they missed the transition from Cs to Xe, nevertheless a large proportion of candidates realised that the 'simple' explanation required was merely that the number of outer electrons equalled the group number.

Part (c)(ii) was correctly answered by most.

Part (d) required candidates to think a little more about a nuclear reaction. In order to score all three marks they needed to first work out that the process must be beta decay and then put together the correct equation. Pleasingly many candidates were able to think their way through this.

4) In part (a) a large number of candidates produced an appropriate dot-cross diagram, with far fewer candidates than in previous similar questions missing off the non-bonding pairs.
Part (b)(i) produced many completely correct answers with full credit being given to any candidate who halved the final answer to give a value per mole of N_2O. Unfortunately some candidates are still missing signs off their final answer and this can lose them possible 'ecf' marks. If examiners cannot follow the calculation this often also results in an unnecessary loss of marks (see earlier '**Tip for students**').
Part (b)(ii) was usually correctly answered and part (c) yielded more correct answers than recent entropy questions.
Parts (d)(i), (ii) and (iii) were all well answered.
Part (e)(i) produced some strange equations, typically with oxygen missed out as a reactant, but many completely correct responses.
Part (e)(ii) produced several 'quotes' from the text book but unfortunately some candidates were unsure of, or forgot to include, the source of the nitrogen and oxygen.

Numerical answer (b) (i) –1092 kJmol^{-1}

2852/01 – Skills for Chemistry: Open-Book Paper

General Comments

This year, the candidates were presented with two articles about the production of rubber and the recycling of tyres. The chemistry discussed in the reports linked directly to familiar concepts covered in the AS course, for example addition polymerisation, structures and properties of polymers and crude oil as a non-renewable resource.

The standard and presentation of the reports continues to be impressively high. Few reports are handwritten. Most candidates cut and paste diagrams and structures electronically. Where chemical structures were handwritten, there were often errors due to candidates not checking their work carefully (see below).

Candidates generally follow the **Notes for Guidance** on page 2 of the question paper. However, there continues to be a large number of candidates who lose marks by failing to follow this guidance. Specifically, this commonly applies to skills of referencing, text annotation and the inclusion of appropriate equations, formulae and diagrams to support their answers. Candidates who do not follow the guidance commonly lose both research and communication marks, which compose up to one third of the total marks for the papers. Candidates need to note that web addresses should be given in full (URLs). In simple terms, this means that the address should end in *xxx.htm* or *xxx.html* or *xxx.shtml* or *xxx.asp*, all of which would lead to a specific page on the site. Additionally, for the 'detail' of sources mark, the address should be accompanied by the name of both the web site and the page, to enable tracking of the page.

Many candidates show very effective research skills, capturing relevant information and diagrams from texts and the internet. Best practice involves using information to support the chemical content of the report. Candidates who include a lot of extra 'technical' information (e.g. about tyre specifications, technology, industrial processes etc.) do not gain extra marks and are 'wasting' their word count.

There was evidence this year of poor planning and use of time or words by many candidates. Many candidates gave too much emphasis in their reports to the first bullet point, leaving insufficient words or time to properly address the later bullets. Similarly, the last bullet was also more poorly attempted than the others, implying a 'rush' to finish the report. As the last bullet carried 10 of the available 26 marks for Chemistry and Evaluation, this led to poor scores for many candidates.

> **Teacher's tip**
> Students should plan their word count for each bullet by dividing up the 1000 words roughly into how many words will be used per bullet, based on the marks available. Each section can then be tackled more manageably in terms of both time and space in the report. Students should be encouraged to tackle 'a bullet a night' during the available two weeks to allow time for proof reading, bibliographies *etc*.

Another outcome of poor planning is shown when sentences are 'lifted' from the articles rather than used to make clearly argued points. Candidates who draw their responses directly from the texts of the articles without any selection or interpretation cannot clearly address the bulleted tasks.

A significant proportion of candidates continue to attempt to evade the word count rules. Commonly, this happens by understating the word count or by some candidates over-annotating their diagrams with large amounts of text in text boxes. In both cases, examiners penalise words in excess of 1000 by taking off research and communication marks (R2 and C1) as well as drawing a line at 1000 words. No points made after that line score, leading to a significant reduction in the marks available for the candidates.

Teacher's tip
Words in equations and labels on diagrams do not count towards the word count. However, such labels should be limited to a single word or phrase. Use of text boxes in diagrams containing sentences or bullet points of additional information are against the spirit of the paper will be penalised by the examiner as additional word count. This could result in the last sections of the report being disqualified from scoring.

Across the whole mark range candidates scored lower on Evaluation than on Chemistry, this led to the evaluation marks and the communication marks being the main discriminators for the paper this year. Many low evaluation scores were caused by too little time and words being left to do justice to the last bullet point.

Comments on Individual Questions

Bullet point 1
This bullet asked candidates to discuss the formation of rubbers and to highlight the similarities and differences between natural and synthetic rubbers. There were six marks available for this section from a total of 26 for the bullets overall. From a total word count of 1000, it would be reasonable to expect that candidates should use about 200 words to cover this bullet. Most candidates spent far too long discussing the first bullet, showing poor planning. This left them with too few words to properly address the later points, particularly bullet 4 which should have formed almost half the report as it carries 10 marks.

Other points relating to bullet 1:

- Most scored well. Candidates find ‘give an account’ tasks relatively straightforward.
- There were a large number of technical errors in equations and structures. Commonly, the ‘*n*’ before monomers or ‘*n*’ subscript in a polymer were missing in equations. Also bonds in structures were often drawn carelessly to the ‘H’ atoms in CH_2 groups. Such errors counted as ‘technical errors’ and lost marks for communication under C2b.
- Candidates copied out material from the articles, which only gives access to the lower grade marking points. They were asked to compare the similarities and differences between rubbers. Many did not clearly do this.

Teacher's tip
Set this paper as a homework task. Ask the students to tackle the first bullet point only. Mark it for technical errors and look to see that they have planned to cover the information in about 200 words. Look also for a clear comparison of similarities and differences rather than ‘copied’ extracts. Use the outcome as a teaching tool to show the importance of proper planning and attention to correct use of structures.

Bullet point 2

This section linked closely to bullet 1 but led on to the process of vulcanisation. The bullet specifically asked candidates to discuss properties linked to structure. Some candidates supported their work by referenced chemical detail taken from the course books – this earned them marks. Again, copying out the articles only gives partial access to the marks.

Teacher's tip
Students should cross-check the course text book for each chemical concept mentioned in the bullets (*e.g.* structure and properties of polymers). Additional chemical points can easily be scored by including a brief outline of the underlying chemistry.

Some candidates provided extra chemical information that had been researched from other sources, such as the full structures of vulcanised rubber. This is exemplary; research should be focussed on the chemical content of the articles. Candidates who include 'technical' research *e.g.* flow charts for industrial processes of vulcanisation, do not gain additional marks as such information is not relevant to the bullet task.

Bullet point 3
This was intended to be very straightforward. Candidates needed to produce charts or tables to summarise the benefits of using synthetic rubbers and of using additives. However, marks were lost because so many merely copied out **Table 2** from **Article 1**. Copying sections in this way does not earn marks; marks were only awarded where there was evidence that the candidate had processed the information *e.g.* by producing an original table. A straight copy of **Table 2** counted for a diagram mark in communication C4, but did not earn any marks in the main report. Some gave the information as 'prose'. Information presented as prose gained only partial credit.

Bullet point 4
This bullet carried the largest mark allocation. The marking points mainly counted towards the 12 evaluation marks available in the mark scheme. Marks were generally poor for this section for the following reasons.

- Many candidates had not planned their word count properly, so had 'run out of words' and needed to condense this bullet into too few words. At 10 marks, this bullet should have been given about 400 words of the report.
- Some candidates appeared to have 'rushed' this section. Clear points in the articles had not been 'lifted' into the reports.
- In discussing the use of 'non-renewable resources' the language used was often too vague to score. Candidates find it more difficult to make evaluation points clearly. For example 'recycling tyres saves non-renewable resources' is a rewording of the bullet (no marks). More detail was needed such as 'using carbon from tyres to make activated carbon saves coal and peat which are non-renewable'.

Teacher's tip
<u>Students should use as many equations/structures/diagrams from the original articles as possible</u> – these often score chemistry or evaluation points as well as going towards the 'equation and diagram' marks (C3 and C4). Remember they are 'word count free' – they do not 'count' towards the word count.

Remember to include any important information in separate sentences above the equation – if marking points are scored directly from an equation, that equation does not 'count' towards the equation mark.

Research (marking points R1 to R3)

This is a **five mark section that every candidate can gain**. Candidates' scores tend to be Centre dependent. Some Centres clearly train their candidates very well to follow the **Notes for Guidance** on page 2 of the paper. However, too many candidates lost marks by doing at least one of the following:

- failing to provide a list of sources;
- failing to include in the list the two articles in the paper. It is important to note that the articles should be referenced in full. 'The Open-Book paper' does not score this mark;
- failing to include page numbers or chapter/section titles for sources other than the Open-Book paper articles, or statements of website titles or authors or content;
- failing to annotate the text in their reports.

The requirement to apply some simple rules in this part of the assessment is stated quite clearly in the **Notes for Guidance** in the paper.

See 'general points' at the beginning of this report for more information about referencing of websites.

Summary

The four marks available are for making four clear chemical points, but were very rarely gained in full. It often appears that candidates write the summary in a very hurried manner, implying that they consider it to be of minor value to their main report. In fact, the reverse is true – these four marks are nearly 10% of their total score and, if earned, can tip them firmly into the next grade up. Candidates score more highly if they have redrafted their summaries several times and have worked to tighten the chemical points they have made.

The two commonest errors in summaries this year were:

- including evaluation points, rather than chemical points *e.g.* about recycling or using additives in tyres rather than focussing on the chemical reactions in the report.
- Using vague sentences *e.g.* ‘rubbers are all made from polymers’ rather than ‘most polymerisation reactions to form rubbers are addition reactions’. It is important that students judge the level of their points – they need to be ‘AS level’ not ‘GCSE’.

Summary tips for students

- ❖ Write **chemical** points in clear statements at **AS level standard.**
- ❖ Describe reactions using **chemical terminology**.
- ❖ Write points that cover the **chemical reactions** in your report
- ❖ **Redraft** your summary in rough until you are sure you have made at least four clear points with definite **chemical content**. Don’t ‘rush’ your summary at the last minute.

Communication (marking points C1 to C4)

This area gave a spread of marks across the candidates. Those who were careful to check their reports for spelling and technical accuracy, and who included formulae, equations and diagrams scored high marks. Examiners again commented that some reports had clearly been submitted without a spell check being carried out. Candidates need to allow enough time to thoroughly check their reports before submission. Again, the lack of care shown by some candidates implies that they consider this area less important than the main report. However, these 10 marks give almost a quarter of the total score of the paper. Common errors and omissions included…

- Candidates who had spent too much time on bullet 1, and too little on bullet 4, lost marks under C1.
- For C2a, spelling and punctuation marks are deducted for two errors. Hence, mis-spelling or typos of two words leads to 1 mark being lost (4 errors = no marks!). Many candidates spell words wrongly that are given in the report, many of which would be identified if the candidate ran a spell check.
- Technical errors in equations often lost both C2b marks (see discussion of bullet 1). Again, candidates need to check that they copy structures carefully.
- A surprising number of candidates did not use enough diagrams, formulae or equations to score the easy C3 and C4 4 marks.

2852/02 – Skills for Chemistry: Experimental Skills

General Comments

The overall standard of candidates' work was similar to last year.

Most Centres used assessment activities chosen from the OCR coursework guidance booklet. The most popular of these were 'Finding out how much acid is in a solution', 'Comparing the enthalpy of combustion of different alcohols', and 'The determination of the solubility of calcium hydroxide'. Some Centres used activities that were of lower demand such as the use of an acid-base titration without the need to make up a standard solution or to dilute one of the solutions. This limited the ability of candidates to access the higher mark levels. Where a Centre designed activity is used, instructions given to candidates and a detailed mark scheme should be supplied with the moderation sample.

Very few Centres submitted candidates' work for moderation chosen from more than two different activities. For an increasing number of candidates, work from a single activity was submitted for moderation.

Most Centres submitted the expected evidence such as a tick list of practical techniques to support the marks awarded for the manipulation strand of the implementing skill area and the Centre Authentication Form (CCS160) with the work sent for moderation.

Some Centres continued to use an older set of marking descriptors rather than the new descriptors contained within the 2nd Edition of the OCR publication, '*Teacher Support: Coursework Guidance' for teaching from September 2004*. This sometimes resulted in the award of higher marks than would have been the case if the correct descriptors had been used.

Some Centres annotated candidates' work by indicating where descriptors had been met in particular parts of the text by using symbols such as 5a or 8b. While this may be a useful strategy for identifying where specific points within a set of descriptors have been met, it can also lead to an inappropriate award of marks where the meeting of a single point is taken as evidence of meeting the whole of the requirements at a particular descriptor level. A much better way to ensure the secure award of marks, and to assist the moderation process, is for brief comments to be added at the end of each section, or on the candidate cover sheet, to indicate where and why a descriptor had not been met which therefore explains the reason for the award of a lower mark.

Most Centres were aware of the hierarchical nature of the coursework descriptors and applied them effectively. There are still a significant number of Centres, however, who do not apply the descriptors in a hierarchical manner but use a form of 'best fit' approach. This often results in a generous application of the marking descriptors.

In a significant minority of Centres higher marks were awarded when key criteria at a lower level had not been met. Centres which used a 'tick list' of the key descriptors to match against candidates' work avoided this problem.

In some cases, the annotation of candidates' work was very brief, with few or no comments on cover sheets. This also increased the tendency for there to be a generous application of the coursework descriptors.

There were a reduced number of cases in this session where the marks awarded by the Centre were too generous and outside of the tolerance allowed by OCR. There were 66 Centres (13%) in this category compared to 79 Centres (17%) in the June 2005 session.

Teacher support booklets

Two booklets have been published by OCR to support teachers in setting and assessing coursework.

'*Teacher Support: Coursework Guidance*' provides guidance on all aspects of coursework, including exemplar assessment activities and associated detailed mark schemes to match the new assessment descriptors in the 3rd edition of the Chemistry (Salters) specification.

'*Teacher Support: Exemplar Coursework Guidance Units 2852/02 and 2855/01*' provides examples of candidates work with a commentary on appropriate assessment of this work using the assessment descriptors in the 3rd edition of the Chemistry (Salters) specification. These booklets contain answers to many frequently asked questions about coursework in this specification.

Comments on Individual Skill Areas

Planning

The descriptors provide a precise guidance about the quality of the risk assessment and the sources consulted in devising a plan at levels 5, 8 and 11. Centres need to more carefully distinguish between the requirements at the different levels for these two features of the plan when awarding marks for this skill area.

There was a significant increase in candidates 'cutting and pasting' web addresses to describe sources they had consulted. It is expected that candidates will include a short description of the content of the web site in addition to the web address to satisfy the descriptors at level 11.

Common problems in planning included:

Titrations

- Use of inappropriate equipment
- Choice of an inappropriate indicator
- No calculation of required amount of sodium carbonate
- No description of how to make up the sodium carbonate solution
- No equation for the reaction
- No distinction between trial and accurate titrations
- No comments on why the procedure will be accurate
- Sources consulted not included or lacking sufficient detail such as page number
- Inappropriate risk assessment of dilute acid described as corrosive rather than irritant
- Insufficient explanation of the choice of concentration of sodium carbonate solution or dilution factor of acid

Enthalpy of combustion

- No indication of how the water volume is measured
- Poor choice of water volume *e.g.* 25 cm^3 or 1000 cm^3
- Heating water for a fixed time rather than for a fixed temperature change
- Heating water to a high temperature
- No stirring of water
- No comments on why the procedure will be accurate
- Sources consulted not included or lacking sufficient detail
- Brief risk assessment covers only one alcohol
- Insufficient explanation of why a temperature rise of between 10 and 20 ^{o}C is chosen

Implementing

Some Centres awarded marks which did not accurately match the descriptor requirements for the recording strand of this skill area, because they were solely based on the manipulation strand.

In the activity, '*Comparing the enthalpy change of combustion of different alcohols'*, it is expected that candidates will record all temperature measurements and not simply the temperature change.

Recording data from titrations

In assessment activities that involve titrations, candidates should record all burette readings, not just titres, and should record their readings to two decimal places, where the second figure may be a 0 or 5, in order to access the higher mark levels. The marks awarded in this skill area should reflect any omissions in recording data from titrations. It is also expected that candidates will use units of cm^3 rather than 'mls'.

In the '*Acid rain*' activity, candidates must record appropriate readings to find the mass of sodium carbonate in order to meet the descriptors at level 8. This was frequently missed out.

Analysing

Candidates are expected to explain the steps of their calculations. If, for example, candidates use a formula to link variables such as concentration and volume of a solution, they should indicate what the symbols in the formula refer to.

Candidates must calculate the concentration of both solutions in the activities involving a titration. Often one of the concentrations was assumed instead of being calculated.

If candidates carry out the activity '*Comparing the enthalpy of combustion of different alcohols*', they need to explain the steps in their calculation for one alcohol, even if they subsequently use a spreadsheet for other alcohols.

In the activity, '*Comparing the enthalpy of combustion of different alcohols*', many candidates did not include a minus sign in front of the values that they had calculated. In drawing conclusions from this activity, some candidates were confused about the exothermic and endothermic nature of bond breaking and bond making processes.

Calculation of average titres

Candidates are required in assessment activities involving a titration to calculate an average titre. They should clearly show how they do this by writing down and adding together all of the appropriate titres and dividing this total by the number of titres.

Candidates are required to clearly describe the outcome of their calculations rather than assuming that this is evident from the figures within a calculation.

Evaluating

Overall, candidates tended to do less well in this skill area than in the other three. Marks awarded by Centres did not always reflect this and the application of the coursework descriptors was often rather generous. The main reason continues to be that candidates include insufficient information about limitations of the experimental process or about those features of the procedure that were important in ensuring accurate and reliable data. Some Centres gave higher marks than was appropriate for brief comments on limitations of experimental procedure. Most limitations described using most appropriate detail are required to meet the descriptors at level 8.

Calculation of uncertainty associated with measurements

When considering the uncertainties associated with data, it is expected that candidates will calculate a value associated with a single representative measurement that they have recorded for each type of measurement. Some Centres may wish to teach their candidates how to calculate the uncertainty associated with the difference between two measurements such as a temperature change and this is equally acceptable.

2854 – Chemistry by Design

General Comments

Many candidates showed a good understanding of the very varied and synoptic Chemical Ideas in this unit; some were limited by their lack of examination technique. Candidates answered well on spectroscopy and many explained the origins of colour effectively. Answers on buffer solutions and solubility were more mixed and the question on structure and bonding caused many problems. Calculations were often well done and quality of written communication in longer answers was quite good. There were few empty spaces.

Comments on Individual Questions

1 This provided quite an easy start for most candidates. Most scored on part (a) and on (b)(i), though in part (b)(ii) marks were sometimes lost by inaccurate expression. Key words were 'molecules' (or particles), 'colliding' and 'activation enthalpy', though answers that talked about the activation enthalpy being 'overcome' seldom gained full credit. Part (c) raised few problems. Some candidates did not understand the thrust of part (d) and some answered on a small scale: 'matches' or 'flints'. Part (e) was usually well done, as was part (f), though there was a small but significant minority who thought that the pressure they had (correctly) stated in part (i) was 'not very high'. Part (g) was well done as was part (h), most candidates realising that they had to mention that we eat the plants (or something similar). Part (i) was surprisingly badly done and some attention needs to be paid to this area. A significant minority of candidates failed to name the type of bonding correctly – metallic or hydrogen bonding being popular. This made scoring further marks difficult. Others described ionic bonding in terms of intermolecular forces or failed to mention that it was the <u>ions</u> that were hydrated. Relatively few said that the ions <u>moved</u> in describing conductivity and some said that ionic substances had free electrons.

Numerical answers: (a) 0, +2; (c)(ii) 1.3×10^{-6}

2 This was one of the harder questions for many candidates. Many failed to score full marks in part (a) and quite a number put the double bond at the opposite end to the carboxylic acid group in part (b). Part (c)(i) was usually correct but most failed to give the starting colour in part (c)(ii), and quite a few tripped up with the perennial misuse of 'clear'. The calculation of the iodine number in part (c)(iii) was tricky but well laid-out answers were able to gain partial credit and many did. Significant figures let a few down, but fewer than usual. In part (d), candidates found it hard to express themselves fluently. In part (e) a large number failed to realise that a skeletal formula was required, though most got the structure right. Part (f) was often quite well done, though again clarity of expression was sometimes lacking. An easy point that was usually missed is that both cholesterol and octan-1-ol are virtually non-polar and hence dissolve in each other.

Numerical answer: (c)(iii) 465

3 This question was quite well done. Part (a) was surprisingly poor with very few referring to the effect of hydrogen ions on the equation given. Part (b) was usually good. Parts (c)(i) and (d) were of high demand but the better candidates did well here. Part (c)(ii) was more routine and was often answered well. Part (e) had several marking points that are often seen on this paper and many candidates did well. The extra part was relating the larger chromophore in **form B** to the absorption of visible light. Those who answered in terms of wavelengths rather than frequency often got confused and a handful confused **form A** and **form B** half-way through their answer, with unfortunate loss of marks. Fewer cases of 'emission' of light were seen than in previous sessions. The quality of written communication mark was usually scored but candidates are advised to write in short sentences for such parts. Part (f) was reasonably done, though parts (iii) and (iv) were found harder than expected.

4 This long question attracted some good marks from many candidates. Most scored in part (a), though "ecf" had often to be used through part (b) and many fell into the 'kJ trap'. Quite a number answered both parts (ii) and (iv) in terms of thermochemistry, rather than entropy. Parts (c) and (d) were usually well done, indicating a good understanding of weak acids and pH. Part (e) was reasonably done, though relatively few scored the high-level mark for realising that a buffer solution only works because the concentration of both acid and conjugate base are high. Some contradicted a previously correct answer by adding A^- instead of alkali. The buffer calculation in part (e) (ii) was often well done. It was pleasing to see the quality of many answers to part (f). Some failed to give enough detail, for example not saying that the 'peak of highest mass' of value 192 corresponded to the M_r of citric acid. Most wrote in correct chemical terminology and scored the two quality of written communication marks.

Numerical answers: (b)(i) +540; (b)(iii) +305 J K^{-1} mol^{-1}; (d)(ii) 2.6; (e)(ii) 3.4

5 This question was found hard by some candidates who had previously done well, and *vice versa*. It did test a variety of basic chemical points. Most scored on part (a), provided they mentioned that the 'VI' referred to the oxidation state of chromium, not 'it' or 'chromate'. Many tried to write a full equation in part (b), and often not very successfully. Part (c) was very variable but most scored both marks in part (d) and the mark in part (e)(i). Part (e)(ii) was usually well done, though many failed to draw a sufficiently detailed diagram of the energy levels in an atom and some failed to relate the energy change to the frequency. Almost every candidate correctly identified cadmium for the first mark in part (e)(iii) but there were a good proportion of 'cadmium sulphate', 'cadmium sulphur' or 'cadmium yellow' for the systematic name. Part (f) was often well done. Those who decorated the diagram with extra data lost marks if this was incorrect. Many scored on part (g)(i), but in part (g)(ii), the commonest error was to name the ionic product as K_{sp} which contradicted this mark. Others compared the numbers incorrectly as they were confused by the negative indices. In part (iii) there were many wrong suggestions (*e.g.* 'sodium chromate') as well as 'barium chromate'. Those who identified lead chromate nearly always scored the mark for the reason as well.

2855 – Individual Investigation

General Comments

The standard of candidates' work was similar to last year. Some of the investigations seen during moderation were of a very high standard, but there was also considerable variation between Centres.

Investigations covered a range of topics but reaction kinetic studies continue to be the most dominant group, both overall and within many Centres. Some candidates chose investigations that were insufficiently demanding or had too little scope and this limited the marks that could be available. A few candidates continue to choose to investigate the synthesis of organic compounds. Investigations of this kind generate little data and often result in low marks.

Investigations into kinetics systems were in some cases little more than extensions of standard practical procedures and had little originality since they set out to find out something which was already well known. This approach may be perceived as a 'safe' option for candidates but it tends to encourage a rather sterile approach to investigations and severely reduces the opportunity for candidates experience a real sense of scientific exploration.

A minority of candidates chose investigations that were of relatively low demand. It is expected that there will be a clear and identifiable progression in candidate performance from GCSE through Experimental Skills assessment at AS level to the Individual Investigation at A2 level.

The overall approach to writing a report on the practical work should also show a clear progression from GCSE through AS to A2 investigations. It is expected that candidates will satisfy the points highlighted in the detailed mark schemes used in AS assessments and build upon this to explain and justify their approach using ideas taken from both the AS and A2 parts of the specification. Specific examples of the need to satisfy AS coursework descriptors are included in the sections on the four skill areas below.

In some cases, the limited scope of the investigation suggested that far less time had been spent on the practical work than the 15 to 20 hours indicated within the specification. This invariably reduces the marks available to candidates.

Some Centres used an out-of-date mark scheme which led to the award of inappropriate marks.

The quantity and quality of annotation of candidates' work by teachers varied considerably between Centres. In some cases comments focused on the general performance of candidates rather than relating performance to the coursework descriptors. In a minority of cases, annotation of candidates' work and comments on cover sheets were very brief and these Centres found the award of appropriate marks much more difficult. Effective application of the mark descriptors is helped considerably if brief comments are included on the candidates' work or cover sheet to indicate where particular descriptors have not been met since this explains the award of a lower mark.

Some Centres annotated candidates' work by indicating where descriptors had been met in particular parts of the text by using symbols such as 5a or 8b. While this may be a useful strategy for identifying where specific points within a set of descriptors have been met, it can also lead to an inappropriate award of marks where the meeting of a single point is taken as evidence of meeting the whole of the requirements at a particular descriptor level. A much better way to ensure the secure award of marks, and to assist the moderation process, is for brief comments to be added at the end of each section, or on the candidate cover sheet, to indicate where and why a descriptor had not been met which therefore explains the reason for the award of a lower mark.

Most Centres were aware of the hierarchical nature of the coursework descriptors and applied them effectively. There are still a significant number of Centres, however, who do not apply the descriptors in a hierarchical manner but use a form of 'best fit' approach. This often results in a generous application of the marking descriptors. In a significant minority of Centres higher marks were awarded when key criteria at a lower level had not been met.

There were an increased number of cases in this session where the marks awarded by the Centre were too generous and outside of the tolerance allowed by OCR. There were 80 Centres (17%) in this category compared to 50 Centres (12%) in the June 2005 session.

New teacher support booklets

Two booklets are published by OCR to support teachers in setting and assessing coursework.

'*Teacher Support: Coursework Guidance*' provides guidance on all aspects of coursework, including examples of suitable assessment activities and the new detailed assessment descriptors in the 3rd edition of the Chemistry (Salters) specification.

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These booklets contain answers to many frequently asked questions about coursework in this specification.

Comments on Individual Skill Areas

Planning

Candidates need to satisfy both strands of the descriptor requirements to be awarded marks at any level of performance. In some investigations candidates included a great deal of experimental detail but little theoretical background while in other cases they included much background but little experimental detail. It is expected at the higher mark levels that the chemical ideas used in the report will focus on the particular investigation undertaken rather than be presented as a general context.

Some candidates started their report with a hypothesis. This rarely helped the written report and often distracted the candidate and reduced the quality of the overall investigation. Some candidates gave very vague aims which lowered the clarity of the report. Candidates may well find it helpful to revisit their aims towards the end of their investigation to ensure that they have covered what they set out to investigate.

To meet the descriptors at level 11, candidates are expected to explain and to justify the choices they have made in developing their plan. A strategy that did seem to help some candidates was the inclusion of sub-headings taken from the general marking descriptors such as 'Explanation of why this plan will help ensure my results are accurate and reliable'. In examples of good practice, come candidates commented on the number of points necessary to produce a useful graph, the reason for repeating or not repeating experiments and the range of data collected in the context of their specific investigation.

The quality of the risk assessment and the referencing of resources consulted during planning is expected to increase to meet the more demanding descriptors at levels 5, 8 and 11. At level 11, it is also expected that risk assessments will be comprehensive, realistic and selective and will, for example, pay attention to the concentration of solutions used. At level 11 the plan should include a reference section in which individual references are given in sufficient detail that another candidate could find them and are linked by a simple numbering system to specific sections in the main body of the text.

There was a further significant increase this session in the use by candidates of the internet to look up supporting chemical ideas and to help devise the experimental plan. At level 11, it is expected that candidates when referencing their use of internet sites will describe the content of the site as well as providing a detailed web address that could be used to access the information.

Some useful planning strategies

The use of a preliminary experiment to determine appropriate amounts of materials or conditions can be a useful strategy that informs the rest of the investigation.

Where candidates set out to find out how much of a component is in a set of samples such as vitamin C or aspirin, it is helpful if they can obtain external benchmarking of their data by using a second method of analysis, by using one sample whose composition they know about or by analysis before and after adding a known amount of the component to a sample under investigation.

Sufficient time should be given to candidates so that they can prepare their plan in detail, including an effective risk assessment, before they begin practical work.

Implementing

It is expected that written evidence will be provided by the Centre to support the mark awarded in the manipulating strand of this skill area. This can take form of comments or a tick list of generic skills and abilities demonstrated by candidates during their practical work. A significant number of Centres did not include this expected documentation.

The data recorded by candidates was sometimes incomplete and lacked appropriate units. All the raw data obtained by the candidate should be included in their report and not just averages. When a titration is carried out, for example, all burette readings should be recorded, not just titres. The standards applied when awarding marks in the recording strand of manipulation should at least be those used at AS level. The lack of any units attached to data, for example, means that a maximum mark of four is available in this skill area.

Quality of recorded data

The data should be of appropriate quality in order to access the higher mark levels. If, for example, candidates find that titration values are very low, they should make appropriate adjustments to the dilution of the solutions and repeat the titration so that higher values can be achieved before moving on to another aspect of their investigation. If the investigation involves the collection of a gas, candidates should ensure that the time intervals at which the volume is recorded do not mean that most of the gas is produced in the first few intervals. If a candidate is using a water bath to carry out an experiment at an elevated temperature then they should record the beginning and end temperature during the period of use. A time recorded from a stop watch of 2 minutes 15.28 seconds does not show the chemical maturity expected at level 11.

Analysing

Most candidates processed the data which they had collected in an appropriate format by carrying out calculations or drawing graphs. In a significant number of cases, however, calculations were not well explained and some Centres did not take sufficient account of this when awarding a mark in this skill area.

Computer generated graphs caused some problems for candidates because they were too small or they did not have a fine enough grid for results to be read off accurately. Sometimes, a hand drawn graph or a line on computer generated graph points can lead to greater control and accuracy.

Candidates are also expected to draw relevant conclusions from their raw or processed data linked to the chemical ideas and understanding that had been described in the plan. This was generally much less well done than the processing of data, often being descriptive rather than evaluative, and some Centres awarded higher marks than were warranted by rather superficial comments. This is one of the key areas for improvement in many Centres.

Drawing conclusions

In examples of good practice, some candidates identified general trends in the data which they had collected or picked our clear outcomes. They then went on to calculate differences within the data set or differences from expected behaviour. This quantitative approach allowed them to comment with authority on the fine detail of the results they had collected.

Evaluating

This tended to be the lowest scoring skill area for many candidates. Many candidates calculated the uncertainty associated with some, but not all, of the types of measurements they had recorded. In investigations that involved recording times with a stop watch or stop clock, it was quite rare for candidates to estimate the uncertainty associated with this type of data. In some investigations the uncertainty associated with data is complicated because the conclusions are based on the best-fit straight lines on graphs. One way of dealing with this issue is by including error bars on the graphs.

Candidates are also required to identify key limitations of their experimental procedures. This was often done much less well with candidates tending to make general statements about the overall accuracy of their investigation instead and this significantly reduced the mark that was appropriate overall for this skill area. This is a further key area for improvement in many Centres.

Many candidates suggested at the end of their report changes they would make to the way they had carried out their investigation if they were to repeat it, but they did not always indicate how or why these changes would help produce more accurate or reliable data. The use of sub-headings to prompt responses that would meet the needs of the descriptors seemed to work well in some Centres.

Comments on the relative significance of uncertainties associated with measurements and limitations of experimental procedures

In examples of good practice, some candidates commented in detail on each aspect of their experimental methods, identifying specific points that caused them to have a lack of confidence in their data. This allowed them to consider the relative significance of both these limitations and the uncertainties associated with measurements so that they could decide on which areas should be most usefully developed further to improve their investigation in the future.

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.

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Email: training@ocr.org.uk

Booking form

Your completion and submission of this booking form is taken as your acceptance of our terms and conditions. Please complete all sections. We will write to you regarding your booking status no later than 14 days before the course date. For special access needs please contact us at the above address/numbers. If a late booking can be accepted i.e. 7 days before the course date, a surcharge of £35† will be incurred. No refund will be given if a late booking is cancelled.

Delegate details

1 **Surname** ....

Mr/Mrs/Ms/Miss/Dr/Other ....

Forename ....

Dietary need* (please circle) Vegetarian/Vegan/Nut-free/Dairy-free/Gluten-free/Halal/Kosher

* Please refer to our terms and conditions relating to dietary and special access needs. Contact us direct regarding latter.

2 **Surname** ....

Mr/Mrs/Ms/Miss/Dr/Other ....

Forename ....

Dietary need* (please circle) Vegetarian/Vegan/Nut-free/Dairy-free/Gluten-free/Halal/Kosher

Organisation details

National Centre No. ☐☐☐☐☐ (this 5 digit number must be provided)

Centre name ....

Full Centre address ....

.... **Postcode** ....

Tel No. (include STD code) .... Fax No. ....

Email ....

NB: Your email address may be used to send you information about OCR Training, Mill Wharf Training and current OCR consultation projects. If you do not wish to be contacted for this purpose please leave the line blank.

Course details

Course code (please specify **exact** code from the booklet) ....

Course title ....

Course date .... Course location ....

Code/date/location of 2nd preference* ....

....

* See terms and conditions

Additional information e.g. workshop choice (if applicable) ....

Financial details

.... **delegate(s) x £** .... **= £** .... († including £35 per delegate if booking within seven days of course - see terms and conditions)

Purchase Order No. .... Approved ....

1 I enclose a **cheque** ☐ (✔) All cheques should be made payable to 'OCR'

2* **Please invoice** ☐ (✔)

* Option for OCR centres only

3 Please debit my **Credit Card** ☐ (✔) **Expiry Date** ☐☐☐☐

Mastercard ☐ Switch ☐ Visa ☐ Eurocard ☐ Delta ☐

Card Number ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ Security code ☐☐☐

Signature .... **Date** ....

For official use only: Free / 84 / 94 / 110 / 120 / 150 / 160 / 180 / 190 LBF: £ M06

Terms and conditions

By submitting your booking, you are agreeing to:

1. The booking process

- Bookings are taken on a first come first served basis and must be **in writing**. (Provisional and telephone bookings cannot be accepted.)
- Complete **all** relevant sections of the form. Purchase orders alone cannot be accepted without attached booking forms
- We will **confirm your place by letter**. If you have not heard from us 14 days before the course, contact us to check we have received your booking
- If your chosen date is full, we will place you on a waiting list and contact you should a place arise or an extra date be organised
- We try to meet special and dietary needs stated however we cannot guarantee to meet all requests.

2. Payment process and early booking discount

- The **special offer of £10 early booking discount** applies to post-September full priced courses only and excludes any courses of £50 or less
- Bookings for charged courses will be accepted only if accompanied by the full fee, an official body has agreed to be invoiced or payment has been made by credit card (to include the 3 digit security code).

3. Cancellations and late bookings

- You must give **14 days' written notice** to qualify for a full refund. If you cancel within this time or fail to attend for any reason, you must pay the advertised fee
- **Non attendance** at **free courses** without providing 14 days' written notice will incur a **£50 non attendance charge**
- You can notify us of substitutions to original nominees on free or paid courses at any time without charge
- We cannot normally accept bookings within seven days of the course date
- If a late booking ie within seven days of the course date can be accepted, a **late booking surcharge** of £35 will automatically be levied. No refund will be possible if a late booking is cancelled.

4. Cancellation of courses by OCR

- OCR reserves the right to amend or cancel a course at any time without liability for any travel or other cost incurred by the delegate. We strongly recommend you take out travel insurance if you pre-book travel tickets in case of cancellation
- OCR will not refund the course fee or other costs should you book a course place in error and fail to provide adequate cancellation notice
- OCR will make such adjustments as are reasonable to the Disability Discrimination Act.

OCR (Oxford Cambridge and RSA Examinations)
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OCR Information Bureau

(General Qualifications)
Telephone: 01223 553998
Facsimile: 01223 552627
Email: helpdesk@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

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