OCR
RECOGNISING ACHIEVEMENT

GCE

Chemistry (Salters)

Advanced GCE **A2 7887**

Advanced Subsidiary GCE **AS 3887**

Mark Schemes for the Units

June 2008

3887/7887/MS/R/08

Oxford Cambridge and RSA Examinations

OCR (Oxford Cambridge and RSA Examinations) is a unitary awarding body, established by the University of Cambridge Local Examinations Syndicate and the RSA Examinations Board in January 1998. OCR provides a full range of GCSE, A level, GNVQ, Key Skills and other qualifications for schools and colleges in the United Kingdom, including those previously provided by MEG and OCEAC. It is also responsible for developing new syllabuses to meet national requirements and the needs of students and teachers.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by Examiners. It does not indicate the details of the discussions which took place at an Examiners' meeting before marking commenced.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

CONTENTS

Advanced GCE Chemistry (Salters) (7887)

Advanced Subsidiary GCE Chemistry (Salters) (3887)

MARK SCHEME ON THE UNITS

2848 Chemistry of Natural Resources

<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Marks</th><th>Additional Guidance</th></tr>
<tr><td>1</td><td>a</td><td>i</td><td>Elimination (1)</td><td>1</td><td>Any clear indication scores mark – i.e.: ringed.
More than one indicated scores zero.</td></tr>
<tr><td></td><td></td><td>ii</td><td><table><tr><th>reagent</th><th>conditions</th></tr><tr><td>sulphuric acid (1)</td><td>Heat/ reflux (1);
concentrated (1)</td></tr><tr><td>alumina/ silica/
pumice/ porous pot (1)</td><td>Heat (1);
with (ethanol) vapour (1)</td></tr></table></td><td>3</td><td>Allow answer irrespective of whether written as reagent or condition.
Allow correct formula for reagent.
Sulphuric acid AND alumina con reagent mark (but can still score subsequent marks).
Clear alternatives i.e. sulphuric acid OR alumina scores the mark.

Allow c. for concentrated.
Aqueous negates concentration mark.

Heat and concentration marks may only be awarded if candidate has written an appropriate reagent, even if they have made a small mistake
e.g.: sulphuric without acid, or wrong formula (like AlO)</td></tr>
<tr><td></td><td>b</td><td></td><td>Crude oil will run out/ is a finite resource/ (may become) scarce / is non-renewable (1);

Ethanol can be made by fermentation/ from plants / from a renewable resource / is sustainable (1)</td><td>2</td><td></td></tr>
<tr><td></td><td>c</td><td></td><td>Addition (1)</td><td>1</td><td>Not additional</td></tr>
<tr><td></td><td>d</td><td></td><td>Enthalpy of products higher than that for reactants (1);

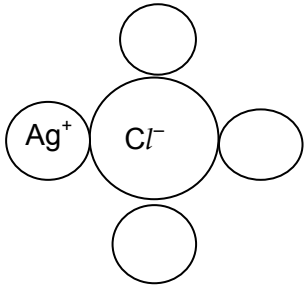
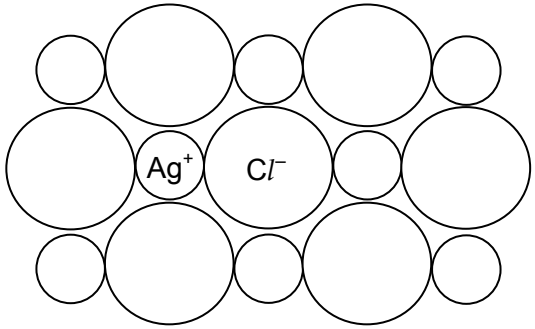
Suitable curve (for uncatalysed reaction) (1);
Second suitable curve (single hump) (for catalysed reaction) with lower maximum than uncatalysed reaction (1);
Activation enthalpy labelled twice (1) ;</td><td>5</td><td>Please use annotations on diagram in appropriate place. Mark all points separately

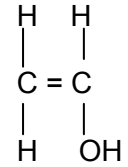
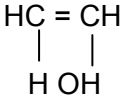
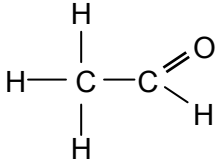
Curves must have a maximum above product line.
Curves do not need to be labelled.

Allow double headed arrows on E_a, E_c or clear indication of energy difference.
If double humped curve drawn, then E_c label can be on</td></tr>
</table>

Question			Expected Answers	Marks	Additional Guidance
			Enthalpy change for reaction labelled with single headed arrow(1)		either hump. **Do not** allow double headed arrow for ΔH Arrow for Δ*H* must be from reactant to product
	e	**i**	Less (chain) branching / fewer side chains in hdpe than in ldpe (1); (Chains) in hdpe can pack closely together/ stronger forces of attraction (between chains)/ more (chains) fit in a given space *(ORA*) (1)	2	**Do not** allow fewer side groups **Do not** allow higher / greater/ more intermolecular forces
		ii	(This occurs in) areas / regions /places (of the polymer) (1); Chains are (more) ordered/ organised/ closely packed/ chains more aligned/ chains side by side (1);	2	1st marking point can be written or shown in a diagram Ignore isotactic Allow molecule but **not** polymer for chain Chain or molecule must be used in answer
		iii	hdpe is less flexible/ more rigid/more brittle / has a higher melting point /greater tensile strength (ORA) (1); because stronger intermolecular forces (ORA) (1); prevent chains sliding over one another (ORA) (1)	3	Mark points separately Ignore boiling point **not** just strong(er) **Do not** allow higher / more intermolecular forces/ greater **Do not** allow molecular forces 3rd marking point requires an answer referring to relative movement of one chain compared to another
			Total	**19**	

Question			Expected Answers	Marks	Additional Guidance
2	a		$KClO_4$ (s) → KCl (s) + 2 O_2 (g) Equation (1); three state symbols (1)	2	Mark state symbols separately provided they match the substances shown
	b		Redox (1)	1	Any clear indication scores mark – i.e.. ringed. More than one indicated scores zero
	c		$KClO_3$ +5 (1); KCl -1(1)	2	Allow one mark for 5+ **and** 1-
	d	i	$2Cl^- \rightarrow Cl_2 + 2e^-$ $Cl^- \rightarrow Cl_2$ (1); Adding electrons and balancing (1)	2	Allow $2Cl^- - 2e^- \rightarrow Cl_2$ Allow multiples in balancing 2nd mark is for the completely correct equation
		ii	(Chloride ion) loses electrons/ (chlorine's) oxidation state has increased or quotes correct values(1)	1	**Do not** allow chlor**ine** loses electrons
		iii	Any *ONE* from: bleach (1); purifying water (1); water treatment (1); making PVC (1); making solvents (1); disinfectant (1); making hydrochloric acid (1); killing bacteria (1) extraction of bromine (1)	1	**Do not** allow just "in swimming pools" **Do not** allow cleaning or cleaning water **Do not** allow just "making plastics" Allow 'sterilising'
	e	i	$3H_2O$	1	
		ii	So that the chlorine and sodium hydroxide are close / because chlorine forms at one electrode and sodium hydroxide at the other AW (1)	1	Allow correct formulae
	f	i	$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ Equation (1); State symbols (1)	2	Completely correct equation ie without spectator ions scores one mark Mark state symbols separately –must have idea of precipitation (aq) + (aq) → (s)
		ii	White (1)	1	Ignore changes of colour on standing

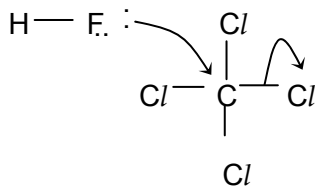
Question			Expected Answers	Marks	Additional Guidance
		iii	 ions either way round (1)	1	One Ag and one Cl must have correct charges
		iv	*For example:*  Four oppositely charged ions around each type of ion in a layer (1)	1	Ignore labelling on ions Minimum is four small circles surrounding large circle and four large circles surrounding small circle.
	g		Pieces have a smaller total surface area than powder ORA (1); Fewer <u>collisions</u> ORA (1); per second / lower frequency AW (1)	3	**3rd mark dependent on 2nd** but candidate may gain this marking point if candidate has implied collision (i.e.: hit/ bump). **Reaction not acceptable.** Do not allow 'less chance of collision' instead of 'less frequent collisions'.
			Total	**19**	

Question			Expected Answers	Marks	Additional Guidance
3	a			1	Double bond must be shown ie allow CH_2=CHOH Allow misalignment of bonds ie: 
	b	i		1	
		ii	Aldehyde (1)	1	Allow alkanal Allow minor spelling errors
		iii	(Potassium/ sodium) dichromate / correct formula (1); acidified / (Sulphuric) acid / H_2SO_4 / H^+(1); Heat / distil (1)	3	Ignore dichromate oxidation state if dichromate written in words (allow minor spelling error). Ignore formula if correct name is given. Allow reflux for heat Only allow heat mark if dichromate given as reagent
		iv	Ketone (1)	1	Allow alkanone Allow minor spelling errors

Question			Expected Answers	Marks	Additional Guidance
	c		1. Hydrogen bonding (between poly(ethenol) chains)(1);	5	**Please use annotations on answer in appropriate place.** Ignore hydrogen bonding between poly(ethenol) and water or water and water. **If answer is referring to pd pd credit is still available for points 2 to 5**
			2. Lone pair on oxygen/ oxygen atom small and electronegative (1); 3. (bonds to) hydrogen with δ^+ charge/ H polarised in O–H bond (1);		Points 2 and 3 are for description of H bonding which may be in the context of water. Not H is electropositive Allow lone pair on O and Hδ^+ from a diagram.
			4. (Hydrogen) bonding between chains is strong (1);		Allow "molecules" but not "polymers" for chains
			5. Not enough energy is available to break these (hydrogen) bonds / water cannot disrupt these bonds(1)		
			QWC: Sentences are logical, correct use in context of at least two terms below: Hydrogen bonds; chains; polar; electronegative; dipole; partial charge; lone pair	1	Please indicate QWC mark using red cross or green tick on to the right of the [1] on the answer screen.
			Total	13	

Question			Expected Answers	Marks	Additional Guidance
4	a	i	Any two from: Contamination of water supplies by soil / rock / fragments / slurry / chemicals; Flooding; Waste <u>rock</u> causing an eyesore / disposal problems; Destruction of wildlife <u>habitats</u>/ ecosystems; Noise pollution	**2**	Must be waste rock **not** material Not quarry causes an eyesore.
		ii	One from: filter water; collecting run off water treat water (to remove harmful chemicals); backfill mine with waste; utilise waste rock ; landscape the area after mining has finished / re-establish habitats; erect noise reduction screens	**1**	Answer must match one of the answers given in (i) and needs to be in the context of mining. eg road building, foundations for houses If candidate is very close to being awarded the mark in a(i) and sensible answer follows this, then award mark.
	b	i	p (block) (1)	**1**	Allow P
		ii	$5p^2$ 5(1); p^2 (1)	**2**	Mark separately
		iii	+4 (1) <u>loss/ use</u> of four outer shell electrons / two s subshell electrons and two 5p subshell electrons *or other specific group or period comparison* (1)	**2**	**Do not** allow 4+ Allow -4 and <u>gaining</u> four electrons / group or period comparison 2nd mark depends on the numerical part of the oxidation state being 4, so they can gain this if sign follows number in earlier part of question.

Question			Expected Answers	Marks	Additional Guidance
	c	i	9.70 x 0.050 (1) /1000 and evaluate (= 4.85×10^{-4}) (1)	2	No ecf for 9.7/1000 or 0.05/1000 only A correct answer on its own scores all marks
		ii	Answer to (c) (i) (4.85×10^{-4})	1	
		iii	In 250 cm^3, moles = answer to (c) (ii) x 10 = A (A = 4.85×10^{-3}) (1) Mass tin = A x 119 (= 4.85×10^{-3} x 119 = 0.577g) (1) % = A x 119 x 100 / 0.95 (= 0.577 x 100 / 0.95 = 60.75) (1)	3	Not multiplying by 10 but rest correct gains two marks. Allow 60.7 to 60.8% / 61% (2sf) / 61.1% (from rounding to 0.58 midway through calculation) ecf from c(i) A completely correct answer on its own scores all marks
			Total	14	

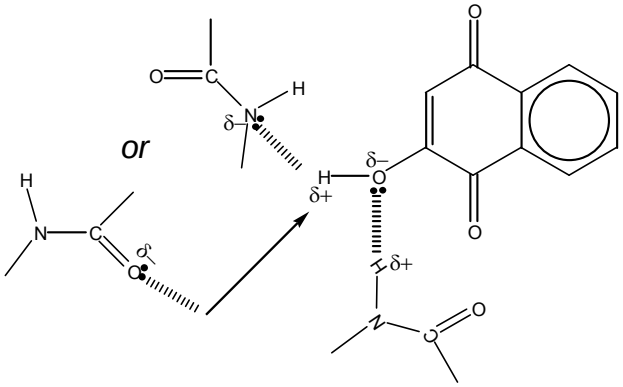
Question			Expected Answers	Marks	Additional Guidance
5	a		Chlorofluorocarbon (1)	1	Ignore minor spelling errors
	b		Blowing agents/ cleaning agents / solvents / refrigerants (1)	1	Allow coolant in refrigerator / air conditioner / refrigeration **Do not** allow refrigerators
	c	i	Dichlorodifluoromethane	1	Ignore 1s, dashes, commas and minor spelling errors. **Do not** allow difluordichloromethane
		ii	 Curly arrow from any lone pair to C (1) Curly arrow from any one C- C*l* bond to C*l* or from H-F bond to F (1)	2	Do not allow single headed arrows **However,** if a candidate draws 2 single headed arrows to the correct positions then award 1 mark. Curly arrow must be carefully drawn starting from the lone pair or bond and ending on an atom Mark separately
	d	i	In the troposphere bonds too strong to be broken / (there is) too little energy to break bonds/ cause photodissociation(1); In the stratosphere UV breaks bonds / photodissociates CFC (1); (to form) chlorine atoms/ chlorine radicals/ C*l* (1) Radicals catalyse the breakdown of ozone AW(1) **QWC**: in any two sentences: spelling (*one error allowed*), punctuation and grammar correct	4 1	**Please use annotations on answer in appropriate place** Answer **must** refer to bonds **Not** high energy for uv or just breaks down. **Do not** allow mark if fluorine radicals **and** chlorine radicals are formed Answer **must** have the idea of recycling or regenerating the radical. Can be shown in equations. Please indicate QWC mark using red cross or green tick on to the right of the [1] on the answer screen.

Question			Expected Answers	Marks	Additional Guidance
		ii	It filters / removes / screens / absorbs / prevents / blocks / shields (AW) uv (1); *Plus two from:* (UV) of high energy/ frequency/ UVC / UVB 10^{16} Hz / 200-320 nm (1); which causes skin cancer/ harms skin/ damages DNA/cell mutation (1); Damages eyes (1); Damages immune system (1); Affects crops (1)	3	**Do not** allow protects from UV **Do not** allow high intensity radiation
	e	i	C–F bonds / they are stronger (than C–C*l* bonds) (1); *Either* UV/ radiation does not have enough energy/ is not high enough frequency to break C–F bond (1) *Or* F atoms are smaller than C*l* atoms / bonding electrons are closer to the F nucleus (1)	2	**Do not** allow holds onto electrons more strongly 2nd mark consequential on first Must be referring to a size effect.
		ii	(467/ 6.02 x 10^{23}) $\times$ 1000 and evaluate (= 7.757/ 7.76 / 7.8 $\times$ 10^{-19} J) (2) 467 x 1000 (1) or 467/ 6.02 x 10^{23} (1)	2	One mark is for converting 467 from kJ to J i.e. multiply by 1000 the other mark is for dividing by 6.02 $\times$ 10^{23} (the Avogadro constant) A completely correct answer on its own scores all marks
		iii	Answer to (e) (i) / 6.63 x 10^{-34} (1) = 1.17 x 10^{15} (1) 3 sf (1)	3	**Do not** allow second mark for evaluating any other expression e.g. Answer to (e)(i) x 6.63 x 10^{-34} Allow sf mark for any 3 sig fig answer that follows from any calculation A completely correct answer on its own scores all marks including the sf mark

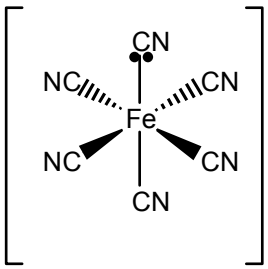
Question			Expected Answers	Marks	Additional Guidance
	f		CFCs take a long time to migrate to the stratosphere/ stay in the troposphere for a long time(AW) (1); CFCs still left in old fridges / other appropriate equipment (1)	2	Ignore references to catalytic cycle takes a long time Stay in the atmosphere for a long time is not enough
	g	i	Low boiling point / non toxic / volatile / liquefies under pressure / gas at room temperature (1)	1	Allow not flammable **Do not** allow answers in terms of breakdown in troposphere
		ii	Hydrocarbons obtained from crude oil / by fractional distillation (1); HFCs are manufactured in several steps/ fluorine or fluorine compounds (not HFCs) are expensive to produce / fluorine or fluorine compounds require expensive safety precautions (1)	2	Could use 'manufacture' for 'produce' - but must have this idea to score mark.
			Total	25	

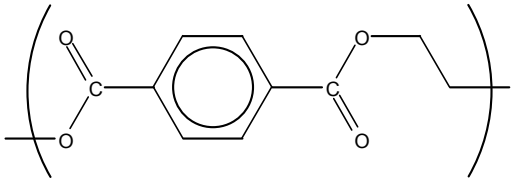
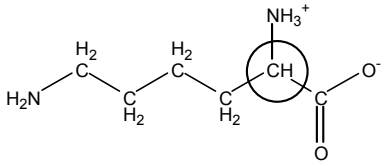
2849 Chemistry of Materials

Question	Expected Answers	Marks
1 (a)	Minimum is $CH_3(CH_2)_2COOH$ (1).	**1**
1 (b) (i)	Minimum is $CH_3(CH_2)_2COOCH_3$ (1) *ecf if wrong acid*	**1**
1 (b) (ii)	Concentrated sulphuric acid (1); (heat under) reflux (1).	**2**
1 (c)	$CaCO_3 + 2CH_3(CH_2)_2COOH \rightarrow Ca(CH_3(CH_2)_2COO)_2 + H_2O + CO_2$ formulae of salt formed or (1) *ecf if wrong acid* in 1(a), *allow if written as ions/any correct molecular formula*; rest correct (1) *allow this mark if salt written as* $CH_3(CH_2)_2COOCa$ etc.	**2**
1 (d) (i)	$H_3C—CH_2—CH_2OH$ $H_3C—\underset{\displaystyle OH}{\underset{\vert}{CH}}—CH_3$ 1 mark each	**2**
1 (d) (ii)	$H_3C—\underset{\displaystyle OH}{\underset{\vert}{CH}}—CH_3$ *because* identifies two peaks as: C= O–C(**H)**-R (1); E= R–C**H**$_3$ (1). *or* recognises: 3 groups of Hs (1); with ratio 6:1:1 / but propan-1-ol has 4 groups of Hs AW (1); *or* *recognises* E= R–C**H**$_3$ (1). *and* peak has a high intensity and so there are two R–C**H**$_3$ groups(1); *or* *recognises* there is no peak at 1.4 (1); which indicates no R–C**H**$_2$–R group (1).	**2**
	Total mark	**10**

Question	Expected Answers	Marks
2 (a)	Primary: order/sequence of amino acids (in chain) (1); secondary: shape taken up by protein chain, *e.g.*. helix/sheet (1); tertiary: further folding to give overall shape (1); heat keratin under reflux (1); with moderately conc. acid (1). QWC *see separate sheet for detailed information for awarding this mark* (1)	**6**
2 (b)	Five from: *a* beaker and cover (1); *b* paper, spot of mixture on line (1); *c* solvent below spot (1); *d* leave until solvent front near top, dry/remove (1); *e* spray with/use ninhydrin (and heat) (1); *f* compare spots with standards/R_f values measured (1).	**5**
2 (c) (i)	(Strong) peak around 1720 cm^{-1} indicates **C=O** /ketone (1); (broad) peak at about 3400 cm^{-1} indicates **OH** /alcohol/hydroxyl (1).	**2**
2 (c) (ii)	Increases/faster/more vigorous *accept* gains (1); molecular/bond vibrations/vibrational energy (1); *or* move to a higher (1) vibrational level (1).	**2**
2 (d) (i)	Add (neutral) iron(III) (chloride) (solution) (1); purple colour *(any shade, including lilac)* forms (1).	**2**
2 (d) (ii)	 *One example only required.* **The marks can only be gained for one particular hydrogen bond** bond (1); lone pair (1); partial charges (1).	**3**
2 (e) (i)	1st order (1); Constant half-life (1.0×10^6 s) AW (1).	**2**
2 (e) (ii)	Rate = k x $[H_2O_2]$ (1). *Ecf*	**1**
2 (e) (iii)	$6.24 \times 10^{-6} = k \times 9.00$; $k = 6.24 \times 10^{-6} / 9.00$ (1); $k = 6.93 \times 10^{-7}$ (1); *Ignore sig figs* s^{-1} (1); *Ecf for 2nd order from (ii) 7.70 x 10^{-8} mol^{-1} dm^3 s^{-1}* *If use 4.50 for $[H_2O_2]$ and get 1.387/1.39 x 10^{-6} then give (1).*	**3**
	Total mark	**26**

Question	Expected Answers	Marks
3 (a) (i)	$Fe \rightarrow Fe^{2+} + 2e^-$ (1).	**1**
3 (a) (ii)	$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$ reactants and product correct (1); balanced with electrons (1).	**2**
3 (a) (iii)	Iron(II) hydroxide / $(Fe(OH)_2$ (1) *if* Fe^{3+} given in part (i) *then allow* iron(III) hydroxide / $(Fe(OH)_3$.	**1**
3 (a) (iv)	Arrow from **P** to **Q** within iron (1).	**1**
3 (b)	organic polymer offers 'barrier' protection/prevents air/water from reaching metal (1); zinc is more reactive than iron AW (1) *comparison with 'steel'*; loses electrons/oxidised (instead of iron)/ 'sacrificial' protection (1).	**3**
3 (c) (i)	(First permanent) pink colour (1).	**1**
3 (c) (ii)	Moles of manganate(VII) = **35 x 0.0100 / 1000** = 3.50×10^{-4} (1); moles of Fe(II) = **5** x $3.50 \times 10^{-4} = 1.75 \times 10^{-3}$ (1) *for correct ratio*; moles of Fe(III) in rust sample = **10** x $1.75 \times 10^{-3} = 1.75 \times 10^{-2}$ (1); mass of Fe(III) in rust **56(55.9)** x $1.75.00 \times 10^{-2} =$ 0.98(0.977) g (1) % = 0.98 x 100/1.80 = 54, **54.3** *or* **54.4** (1). *4 marks for 54 or 54.??*	**5**
	Total mark	**14**

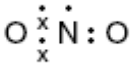
Question	Expected Answers	Marks
4 (a) (i)	+3 (*allow* 3+) (1).	**1**
4 (a) (ii)	 Octahedral arrangement of ligands (1); C bonded to Fe for all ligands (1). *Ignore charge on ion.*	**2**
4 (b) (i)	Ligand exchange/complex formation/ligand substitution/displacement (1).	**1**
4 (b) (ii)	K_{stab} = $[[Fe(CN)]_6^{4-}] / [Fe^{2+}] \times [CN^-]^6$ products (1); reactants (1).	**2**
4 (b) (iii)	Enthalpy change/Heat of reaction/whether exothermic or endothermic (1).	**1**
4 (b) (iv)	green precipitate/solid/suspension (1); $Fe^{2+}(aq) + 2OH^-(aq) \rightarrow Fe(OH)_2(s)$ *allow included water molecules* formulae and balanced (1); correct state symbols (1).	**3**
4 (b) (v)	oxidising agent required for $[Fe(CN)_6]^{4-}$ (aq)/needs to be oxidised/loses electrons (1); $E^\ominus$ for chlorine/chloride is more positive than $E^\ominus$ for iron complexes (1); chlorine (is a suitable oxidising agent) (1).	**3**
4 (c)	some/certain frequencies/energies (/orange/red) are absorbed from white light (1); blue light is transmitted/reflected (1).	**2**
4 (d)	*Any **two** marking points:* Effective dose (1); toxic dose/toxicity *not poisonous or harmful* (1); side reactions (1); how it is excreted from body/how long does it stay in the body (1); formulation (1).	**2**
	Total mark	**17**

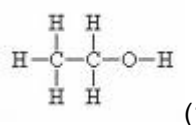
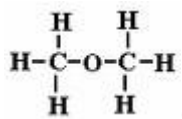
Question	Expected Answers	Marks
5 (a) (i)	 allow -CO and O- An ester group correct (1); rest correct (1).	2
5 (a) (ii)	**Condensation**: small molecule/water eliminated in reaction *do not allow water is removed* (1); **addition**: no molecule is eliminated/two molecules joined together forming one larger molecule AW/double bond saturated/opens up AW (1).	2
5 (b)	PET has permanent dipole-permanent dipole forces (1); which are stronger (1); than the instantaneous dipole-induced dipole forces in poly(ethene) *allow* temporary dipoles/van der Waals forces (1).	3
5(c) (i)	Polymers become brittle/rigid (1).	1
5 (c) (ii)	Chains have less (kinetic) energy (1); so cannot move/slide over each other (easily) (1); when a force/energy is applied chains break (1).	3
5 (d)	1,5-diaminopentane/pentyl-1,5-diamine 1 mark for pentyl/pentane (1); 1 mark for rest correct, 1,5-diamino- / -1,5-diamine (1).	2
5 (e) (i)	 (1).	1
5 (e) (ii)	Alkaline (1); because of extra amine group (1).	2
5 (e) (iii)	NH_2CH_2/CH_4N (1); charge ($^+$) (1).	2
5 (f) (i)	Fe(II) ion $3s^2\ 3p^6\ 3d^6$ Fe(III) ion $3s^2\ 3p^6\ 3d^5$ 1 mark for correct **number of electrons** for both (14 and 13) (1); 1 mark for correct **configuration** for both (1).	2
5 (f) (ii)	Iron has two oxidation states, Fe(II) and Fe(III)/variable oxidation state (1); Provide an alternative reaction route (1); reactions are faster than the original reaction/lower E_a (1). *OR* *any **three** from:* Fe(II) can reduce one reactant (1); to form (one of the products and) Fe(III) (1); Fe(III) can (oxidise the other reactant to) reform Fe(II) (1); reactions are faster than the original reaction/lower E_a (1).	3
	Total mark	**23**

2850 Chemistry for Life

Question			Expected Answers	Marks	Additional Guidance
1	a	i	Auto ignition/pre-ignition of fuel/fuel igniting before/without spark/on compression/before correct place in cycle AW	1	NOT doesn't autoignite or low octane number NOT 'spark' in engine; NOT ignites twice Description of auto-ignition fine NOT car autoignites or autoignition outside of engine
		ii	High octane number decreases/lowers/reduces tendency to autoignite ORA	1	Must be linked NOT just a measure of/tendency to autoignition(ite)
		iii	(2-)**methylpropan-1-ol** (2)methyl(1); propan-1-ol(1); ignore dashes, commas etc; skeletal(1);	3	NOT any 'dimethyl' or numbers other than 2 ALLOW 1-propanol for second mark Allow recognisable variations of sp of methyl
	b	i	Increases surface area/allows greater (amount) of adsorption of reactant	1	NOT answers in terms of passage of gases through support NOT easier to bind to
		ii	Reactants (and catalysts) (1); Note: only scored if linked to states/phases Different state/phase(1);	2	ALLOW named examples eg reactants are gases but catalysts are solids ASSUME 'they' refers to catalysts answers in terms of a biological explanation zero marks
		iii	Simplest /lowest/smallest ratio(1); of (different)atoms / elements (in a compound)(1);	2	ALLOW simplest formula/ (1); NOT basic; NOT simplest form on own, but OK if simplest form of formula ALLOW references to simplest number of moles of an element/simplest molar ratio for first mark Note 2nd mark only allowed providing idea of ratio is in first statement
		iv	M_r of $C_6H_{10}O_5$ =162(1); 1000000/162(ecf) = 6200(6173, 6170, 6172) (1);	2	ALLOW 6172.8(4) 1000000/162 on own does not score second mark
			Total	12	

Question			Expected Answers	Marks	Additional Guidance
2	a		0.37 only	1	
	b	i	Any two from; 4/number of isotopes; (relative) mass of isotopes/number of neutrons; relative abundance of different isotopes/88 is the most abundant	2	NOT 5 isotopes; NOT relative atomic mass NOT answers in terms of intensity or how intense the isotopes are! Ignore references to Sr-85 Look out for implied 4 isotopes
		ii	$\frac{(0.50 \times 84) + (10.0 \times 86) + (7.00 \times 87) + (82.5 \times 88)}{100} = 87.7$ isotope x amount added(1); divided by 100(1); 3 sig figs(mark separately)	3	Separate sig fig mark on basis of some sort of calculation shown. 87.7 on answer line scores all three
	c		**Equation:** $Sr + 2H_2O \rightarrow H_2 + Sr(OH)_2$ (1); **Similarity**: same no, of outer electrons/both form 2+ ions/in same group(1) **Increased reactivity:** SIZE; Sr larger atom/more shells/outer electrons further away from nucleus (1) NUCLEAR ATTRACTION: lower/less/ or more shielding (1) LOSS OF ELECTRONS: easier/less energy needed (1)	5	ALLOW $Sr + H_2O \rightarrow H_2 + SrO$ for equation, ignore any ss Equation must be for Sr Any reference to properties are similar in the same period **negate** similarity mark NOT attraction to protons unless nucleus mentioned
	d	i	Strongly deflected; negligible mass; stopped by aluminium foil Three correct = 2; two correct = 1;	2	Extra answers negate a correct answer ie 4 ticked boxes with 3 correct and 1 wrong scores one: 4 ticked boxes and two correct two wrong scores zero
		ii	$^{90}_{38}Sr \rightarrow {}^{0}_{-1}e + {}^{90}_{39}Y$ top line(1); bottom line(1);Y ecf on Z(1);	3	ALLOW β in place of e; Ignore minus on e^- ; if particle wrong/wrong side CON1(max 2); CON 1 mark if nos.on RHS; fractional mass CONs top line mark
		iii	Same group/forms 2+ ion/similar chemistry(1); can replace the Ca (in bones /teeth)(1)	2	ALLOW like calcium absorbed or deposited in bones/teeth for second but 'like' not enough for first mark NOT 'displace'
	e		Both arrows going down(1); blue bigger than red(1)	2	Arrows should at least start (or finish) on (BOD) line
	f	i	$SrCO_3$	1	
		ii	Strontium oxide(1); carbon dioxide(1);	2	If formulae only given must be correct. Ignore if named.
			Total	23	

Question			Expected Answers	Marks	Additional Guidance
3	a		CO(1); SO_2(1);	2	ALLOW NO_2 NOT NOx; SOx;COx or N_2O ALLOW one mark if only named(both correct)
	b	i	$2NO + O_2 \rightarrow 2NO_2$ all correct(1)	1	ALLOW multiples or half Don't allow spectators
		ii	$4NO_2(g) + O_2(g) + 2H_2O(l/g) \rightarrow 4HNO_3(aq)$ Correct formulae(1); Balancing as written/multiples or half(1); states(1);	3	NOTE (l) or (g) for water state Do not give formula mark if extra products/reactants
	c	i	In group 5/V of PT(1)	1	Allow 7 electrons, 2 in first shell (therefore 5 in 2nd) Allow explanation of between C and O Allow new group numbering system Do not allow mark if argument based on diagram
		ii	 Above **with**…; two lone pairs on LH oxygen(1); three lone pairs on RH oxygen	2	Must be in pairs Oxygen electrons must NOT be dots.
		iii	Dative (covalent) bond	1	Allow description of "dative"
	d		92,92(1); 143,145(1); 92,94(1) ie each column	3	
	e		$M_r ptO_2$ = 271(1); 239/271(1); x100(1);	3	88(88.19 or 88.2) scores all three
	f	i	${}^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}\mathbf{He} + {}^{1}_{0}n$ He ecf proton no.(1); Top line(1); bottom line ecf(1);	3	NOTE if neutron wrong CON 1 mark
		ii	Overcome repulsion(1); between positively charged nuclei.(1);	2	
			Total	21	

Question			Expected Answers	Marks	Additional Guidance
4	a		(Energy released/enthalpy change) when <u>one</u> <u>mole</u> of substance/fuel/compound (not atoms)(1); complete combustion/complete oxidation/burnt in excess oxygen(1); at 298K (25C) and 1 atmosphere pressure/standard conditions/standard temp & pressure(1)	3	ALLOW both general and specific answers ie one mole of substance or one mole of fuel Energy/enthalpy <u>required</u> CON 1
	b		<table><tr><th>Isomer</th><th>Name</th></tr><tr><td>$CH_3CH_2CH_2CH_2CH_3$</td><td>pentane</td></tr><tr><td>$CH_3CH(CH_3)CH_2CH_3$</td><td>(2-)methylbutane</td></tr><tr><td>$C(CH_3)_4$</td><td>(2,2)-dimethylpropane</td></tr></table>	3	One mark for each correct name, ignore dashes, commas Numbers if included must be correct ALLOW 2-<u>di</u>methylpropane for third mark
	c	i	 (1);  (1);	2	ALLOW –OH Bond must be between correct atoms eg C-O
		ii	Ether(1);	1	ALLOW alkoxy(alkane)
		iii	$C_2H_6O + 3O_2 \rightarrow 2CO_2 + 3H_2O$ formulae(1); Balancing(1);	2	Usual multiples etc Balancing depends on correct reactants and products
	d	i	Breaking bonds takes in energy/endothermic(1); Making gives out energy/exothermic(1) more out than in/release more than used/difference negative AW(1);	3	Anything which refers to a different number of bonds being made than broken cons third mark No ecf from first to second <u>or</u> third mark
		ii	**Hydrocarbons:** (breaking) same number(1); and type of bonds/C-H, C-C / all C-H(1); **C_2H_6O:** breaking different bonds/different bond enthalpies involved(1); different number/2C-0 bonds in ether one in ethanol/1 OH in ethanol and not in ether(1); **Bonds formed** same for <u>either</u> isomer sets(1);	5	In hydrocarbons "<u>same</u> (NOT similar) bonds" gets 2nd mark. Answers could be general or quote specific bonds. Credit should be given where <u>an</u> example of a specific bond is used eg 'in hydrocarbon isomers all C atoms are joined to H atoms' (AW) should be given credit for marking point two Do <u>not</u> give number mark by implication
			Total	19	

2852/01

Discuss, with the use of examples, the main differences between α- and β-decay and explain how nuclear fission reactions differ from natural radioactive decay.

Differences between α– and β-decay			Chem	Eval
1	**(a)**	α–decay involves loss of a <u>He nucleus or 2 protons and 2 neutrons</u> <u>and</u> β- involves loss of an electron;	1	
	(b)	β-decay converts a neutron into an electron and a proton	1	
	(c)	α–decay new nucleus has lower proton and lower mass number	1	
	(d)	β-decay: proton number increases, mass stays the same	1	
	(e)	Clear statement: gives one example of <u>both</u> α and β-decay (not from an equation)	1	
2	Differences with nuclear fission reactions **COMPARED TO NATURAL RADIOACTIVE DECAY**			
	(a)	fission reactions are started by bombarding with neutrons.	1	
	(b)	products of fission are two nuclei/atoms of similar mass	1	
	(c)	products of natural decay are a large nucleus and small particles	1	
	(d)	compared to natural decay fission is a chain reaction / gives out a large amount of energy	1	

Explain the role of hydrogen nuclei and helium nuclei in the synthesis of elements in stars. Give a detailed explanation of the nuclear changes that happen when lithium forms in stars.

3	H and He nuclei			
	(a)	Fusion of (4) hydrogen (atoms/nuclei) produces helium (allow from box 1 eqn but not from box 2 eqn (eqn does not then 'score')	1	
	(b)	<u>Statement:</u> heavier/new nuclei/elements form when <u>helium (</u>nuclei) are involved in <u>fusion/nuclear</u> reactions.	1	
4	Formation of lithium			
	(a)	<u>Statement</u>: lithium is formed by fusion reactions of hydrogen and helium (nuclei)	1	
	(b)	<u>Statement</u> formation of <u>lithium</u> involves isotopes/^{3}H/tritium/^{3}He	1	
	(c)	In route 2, an electron causes changes in the nucleus	1	
	(d)	In route 2, an electron fuses with a proton to form a neutron (if 4d awarded 4c also awarded automatically)	1	

Describe, with the use of examples, the main characteristics of fission and fusion reactions. Explain how each type of reaction produces energy and describe how these reactions are controlled. Outline the main advantages and disadvantages of using fission and fusion processes for generating electricity.

5	fission reactions			
	(a)	(allow from annotations on diagram) neutron is absorbed and causes oscillations so that nucleus become unstable	1	
	(b)	(allow from annotations on diagram) nucleus splits into two and emits more/3 neutrons	1	
	(c)	(statement) <u>released neutrons cause</u> further fission leading to a chain reaction	1	
	(d)	Full equation for reaction of U-238 <u>or</u> U-239 <u>or</u> Np-239	1	

6	fusion reactions			
	(a)	requires (constant) high temperature to overcome the repulsion between the nuclei	1	
	(b)	(at high temperatures) nuclei collide with enough energy to fuse the nuclei together	1	
	(c)	statement: deuterium and tritium fuse to form helium, a neutron and excess energy.	1	

Extra chemistry

7		α–decay: usually heavier elements and β- decay: usually lighter elements.	**2 max**
		length of time that a nucleus is radioactive is measured in terms of its half life.	
		α particles are more ionising than β particles or α particles are less penetrating than β particles	
		β plus / positron decay described correctly as a type of β- decay	
		when helium in stars has been used up carbon or other heavier nuclei begin to fuse	
		neutrons start fission reactions because they are not charged and therefore not deflected	

Max 14

	Why energy is released during fusion and fission reactions		Chem	Eval
8	**(a)**	energy is released during fission due to the conversion of some of the nuclear mass into energy		1
	(b)	the product mass (of fusion and/or fission) is less than the reactant mass and energy released is given by $E=mc^2$		1
	Control of the fission process			
9	**(a)**	Moderator slows down neutrons and control rods absorb neutrons		1
	(b)	(Rate of) fission is controlled by lowering and raising control rods		1
	Control of the fusion process			
10	**(a)**	(reactions take place) in a plasma which is positive ions in a sea of electrons.		1
	(b)	Plasma is kept away from walls to keep energy inside so that more energy is released than needed to keep the fuel hot		1
	(c)	tokamak uses magnetic field to keep charged particles away from walls of vessel.		1
	Advantages and disadvantages			
11	**(a)**	Fusion reactions have problems with erosion of carbon tiles OR build up of hydrocarbon films.		1
	(b)	Fusion power station will not be available to generate electricity for 30 years		1
	(c)	Fission reactions produce radioactive waste which stays radioactive for thousands of years OR fusion waste is only radioactive for 50 -100 years		1
	(d)	fusion fuels are abundant / long term AND reaction cannot get out of control because only small amounts of fuel are used.		1

Outline the main challenges that scientists face in developing fusion power stations.

12	**(a)**	(Clear statement) need to be able to control/maintain fusion reactions		1
	(b)	(Clear statement) need to overcome problems of hydrocarbon films on wall tiles of the vessel		1
	(c)	(Clear statement) need to test technology on a power station scale		1
	(d)	(Clear statement) check that materials and structure can withstand years of neutron flows		1

Extra Evaluation

13		lithium can be formed by cosmic rays or supernovae	**2 max**
		plasma is heated by electric currents, microwaves and beams of neutrons	
		U-238 absorbs neutrons and the chain reaction is interrupted	
		In a fusion reaction there is a lower binding energy of the helium nuclei compared to those in deuterium and tritium	
		fission reactor is cooled by molten sodium or carbon dioxide	
		helium produced by fusion is not a harmful product	

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 wordcount** (see below)
- not declaring a **page word-count**
- many sources quoted, with no evidence that they have been used – for example many science errors
- 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 wordcount	
< 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…

- **nuclear reaction in words –** examples of specific nuclear reactions in words
  they can use the word atom if they also use fuse/fusion or fission otherwise they have to use nucleus
- **definitions of fission and or fusion -** atoms split (for fission) is OK atoms fuse (for fusion) is not , nuclei fuse or react is OK but atoms react is not
- **definitions of other terms**
  for example - alpha decay, alpha particle, beta decay beta particle
- **features of nuclear reactions**
  for example **–** fission is caused by nucleus absorbing a neutron, a neutron changes into a proton and an electron for beta decay
- **mass energy equivalence –** in words mass is converted into energy (but not just $E=mc^2$)

[4 marks]

Main Report

C1 Structure of report

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

Examples of reasons why this mark may not be awarded.

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

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

Examples of reasons why this mark may not be awarded.

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

C2 Clear and correct use of language

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

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

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

Examples of reasons why marks may not be awarded.

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

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

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

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

Examples of errors.

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

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

b Correct use of scientific and technical terms where appropriate

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

	List of possible equations and formulae **1 mark for 2 examples, 2 marks for 4 examples**		
	α–and β-decay of Ra α– decay of Pa formation of helium from 4 hydrogen atoms formation of elements from helium:) ^{12}C fusion equations equations for lithium formation fission reaction of U-235 fusion reaction of ^{2}H and ^{3}H Equations for hydrocarbon film build up in tokamak		

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:

If marking points 5a, 5b or 5c are give in a diagram then the diagram does not count as an illustration.

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

	List of possible illustrations 1 mark for 1 example, 2 marks for 2 examples		
	Allow 'illustrative' photos to score (1) max Article 2: Tokamak Cadarache power station diagram of fission reactor diagram to show nuclear fission Any table		

[Max 14 marks]

Examiner:

SAC AS Paper 2852/01 (Open-Book Paper) : May 2008

Centre no:

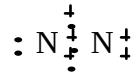
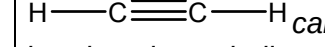
	Script																	
1	α and β decay																	1
2	Differences nuclear fission																	2
3	H and He nuclei fuse																	3
4	Formation of Li																	4
5	Fission reaction characteristics																	5
6	Fusion reactions																	6
7	Extra Chem	**Max 2**																7
	Chemistry	**Max 14**																

a

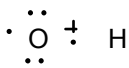
8	Why energy is released																	8
9	Control of fission																	9
10	Control of fusion																	10
11	Advantages and disadvantages																	11
12	Scientist challenges																	12
13	Extra Eval	**Max 2**																13
	Evaluation	**Max 12**																

	R1 sources																	
	R2 appropriate material																	
	R3 annotation																	
	R total																	
	Summary																	
	C1 stucture																	
	C2 spag and technical																	
	C3 formulae and equations																	
	C4 illustrations																	
	C total																	
	Final Total	**Max 45**																

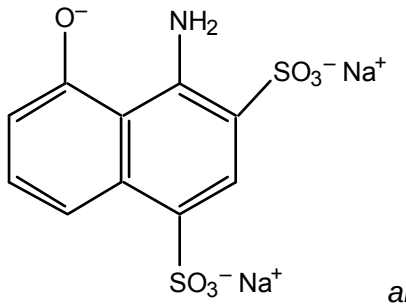
2854 Chemistry by Design

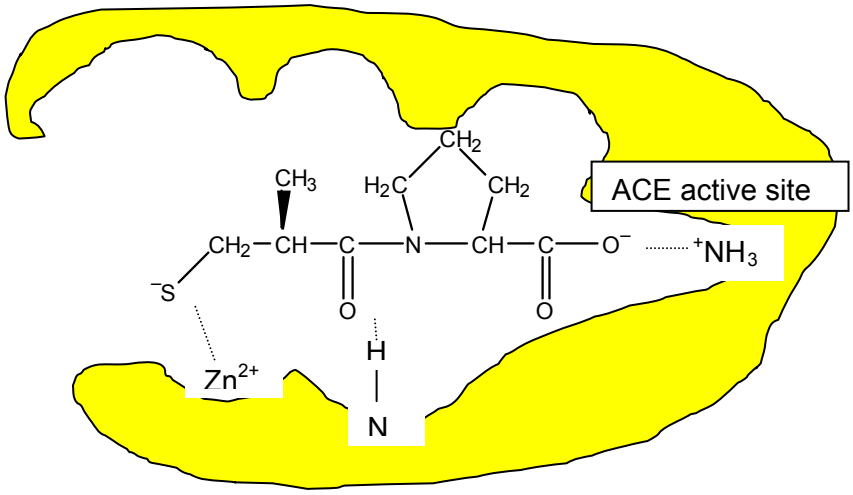
Question	Expected Answers	Marks
1 (a) (i)	$N_2(g) + O_2(g) \rightarrow 2NO(g)$ equation *allow halved* (1); state symbols (1) *mark separately provided state symbols describe a viable gaseous reaction* *Allow formation of N_2O, NO_2, N_2O_3, N_2O_4, N_2O_5*	**2**
1 (a) (ii)	nitrogen monoxide/ nitrogen(II) oxide/ nitric oxide (1) *ecf from formula in a(i)*	**1**
1 (b) (i)	 allow  triple bond (1) lone pairs *allow if separated, as long as on same side of N* *allow all crosses or all dots* (1)	**2**
1 (b) (ii)	triple bond (1); is strong/hard to break/ much energy required to break/ large activation energy/enthalpy (1) *not 'stable'*	**2**
1 (c) (i)	$C_2H_2 + 2e^- +$ **$2H^+$** (1) $\rightarrow$ **C_2H_4** (1)	**2**
1 (c) (ii)	 *can be bent* (1) 180 *mark separately: allow even if bond angle not indicated precisely; ignore units: ignore description of shape* (1)	**2**
1 (d) (i)	high boiling/ non-volatile liquid (1); on solid support/ powder/ tube (1); *mark separately, second mark must be in* context *of stationary phase.* oven/thermostat /heater at a const temp.(1); retention <u>time</u> / <u>time</u> take to travel through (1) QWC – At least two sentences *allow one error in spelling, punctuation and grammar*	**4** **1**
1 (d) (ii)	moles N_2 s^{-1} = 1.3 x 10^{-5}/(28 x 3) = 1.5 x 10^{-7} *allow 1.5476, 1.548, 1.55* (1) for correct use of 28; (1) for correct use of 3. (1) for correct evaluation of an expression using 1.3 x 10^{-5}	**3**
1 (e) (i)	rate faster at higher temp (ora)(1); more <u>molecules/ particles</u> collide with energy > E_a (ora)/ have successful collisions (ora)(1); <u>equilibrium</u> (position) lies to left at high temps (ora)/ yield (of ammonia) drops(1); exothermic (forward) reaction (ora)(1); balance/ compromise between rate and equilibrium (1) *ignore cost; no ecf* QWC Logical, correct use of three of terms below (2) Logical, correct use of two of terms below (1) *rate, molecules, collisions, equilibrium, position (of equilibrium), exothermic/ endothermic, forward/ back reaction, yield, activation energy/enthalpy*	**5** **2**

Question	Expected Answers	Marks
1 (e) (ii)	(high) pressure (if no. quoted must be 25 atm or more) (1); high energy/ electricity/fuel cost (to compress gas) (1) *not to do with plant costs*	**2**
1 (f) (i)	$\underline{p^4H_2\ pCO_2}$ *allow* round *brackets and* $pH_2{}^4$ *etc, square brackets with 'p'.* $p^2H_2O\ \ pCH_4$ If not completely correct allow 1 mark for: • correct with square brackets only • reciprocal of correct expression • one power incorrect *no marks for plus signs*	**2**
1 (f) (ii)	$(0.004)^4\ \ 0.002/\ 0.05^3$ (1) *ecf from f(i)* = 4/4.1/4.096/4.10 x 10^{-9}(1)*ecf from 1st mark* atm^2 (1) *ecf from f(i) or f(ii) first mark no marks for plus signs in* K_p	**3**

Question	Expected Answers	Marks
2 (a) (i)	$C_6H_8O_6$ *in any order*	**1**
2 (a) (ii)	top OH in structure *allow –OH circled* ***tick on diagram, mark in right place***	**1**
2 (b) (i)	H in lower right OH *allow OH ringed* ***tick on diagram, mark in right place***	**1**
2 (b) (ii)	 (1); *a charge is CON;* unpaired electron (1) *ignore free, lone, single*	**2**
2 (b) (iii)	*(*electrons) are spread over several (more than two) atoms/ spread over part or whole of molecule/ ion/structure/ spread over bonds (1);	**1**
2 (b) (iv)	–1, –2 (1) *allow signs after numbers here*	**1**
2 (b) (v)	ascorbic acid is oxidised/ oxidation state (of oxygen) goes down/ oxygen/ OH/ radical is reduced (1) OH/ oxidant/ oxidising agent is destroyed/ removed/ turned into water (1)	**2**
2 (c)	Increase it	**1**
2 (d) (i)	$[H^+]$ $[A^-]$/ [HA]	**1**
2 (d) (ii)	$[H^+] = \sqrt{(7.9 \times 10^{-5} \times 0.1)}$ (1) $= 2.81 \times 10^{-3}$. pH = 2.55/2.6 *ecf from first mark if* $[H^+]$ *is a result of a visible calculation*	**2**
2 (d) (iii)	$[H^+] = 3.98/ 4.0/ 4 \times 10^{-8}$ (1) [salt]/[acid] $= 7.9 \times 10^{-5}/ 3.98 \times 10^{-8} = 2000(/1)$ *allow 1975, 1980, 1984 - 1985* (1) *ecf from first mark*	**2**
2 (e) (i)	(no), no benzene ring/ aromatic ring (AW)	**1**
2 (e) (ii)	***allow marking points from e(ii) in e(iii) and vice versa*** It absorbs in blue/ green/ blue-green/ complementary colour (1) *not "absorbs all other colours* reflects/transmits (NOT emits) red (1)*"*	**2**
2 (e) (iii)	electrons are excited/ move to higher energy levels (1); $(\Delta)E = hv$ / frequency absorbed related to energy gap (AW) / (frequency) absorbed is in the visible (1) *emission or discussion in terms of d orbitals, max one for this part.*	**2**
		20

Question	Expected Answers	Marks
3 (a)	Cl^-	**1**
3 (b)	(7.7/100) x 35/ 96 (2) (= 2.8 x 10^{-2}) (1) for correct expression with one term missing. (*2.8 x 10^{-2} on its own does not score.)* *allow calculation of 92.3% ande subtraction from 35.*	**2**
3 (c) (i)	[Ba^{2+}(aq)] [SO_4^{2-} (aq)] {(aq) not essential} (2) *one charge omitted or incorrect or [$BaSO_4$] divisor scores (1)*	**2**
3 (c) (ii)	1 x 10^{-10}/ 2.8 x 10^{-2} (1); = 3.6 x 10^{-9} (1) *no ecf* 2sf (provided some calc) (1)	**3**
3 (d) (i)	lattice (enthalpy/energy) (of barium sulphate) *ignore 'formation' or negative sign*	**1**
3 (d) (ii)	+18 (2) 18 or –18 scores (1)	**2**
3 (e)	loss of two outer shell electrons (1); leads to full shell/ noble gas structure/ more stable structure/ electrons easily lost/ low I.E. (1); strontium has fewer shells/ energy levels than barium (1); strontium ion's hydration enthalpy is more negative/ larger* than that for barium (1); **allow 'smaller' only if 'more negative' is clearly implied* greater charge density/ greater attraction of water (molecules) (1)	**5**
3 (f)	*4 from: (lettered points are for reference only and need not be labelled on scripts)* **A.** ΔS_{tot} must be +ve for dissolving (1); **B.** ΔH +ve makes ΔS_{surr} negative/ $\Delta S_{surr} = -\Delta H/T$ (1); **C.** $\Delta S_{tot} = \Delta S_{sys} + \Delta S_{surr}$ (1) **D.** ΔS_{sys} must be +ve (1); **E.** (many) substances in solution are more disordered/ have more ways of arranging ions than in the solid (1)	**4**
3 (g) (i)	+6 (1); –2 (1); *(1) overall if signs after numbers*	**2**
3 (g) (ii)	$SO_4^{2-} + 10H^+ + 8e^- \rightarrow H_2S + 4H_2O$ e^- plus H_2O (whatever number of each) (1) one of $4H_2O$, $8e^-$ or $10H^+$ (1) completely correct (1)	**3**
		25

Question	Expected Answers	Marks
4 (a)	*three from:* ether; (sodium) sulphonate; (primary) amine; phenol (hydroxy(l)) *ignore alkene*	**3**
4 (b) (i)	O^- (or O^-Na^+) on both phenol groups (1) rest of structure unchanged (can omit Na^+) (2) {(1) if error in one group, *though may be repeated on both sides*} *ignore ambiguous attachments*	**3**
4 (b) (ii)	*Accept* either "yes, chromophore/delocalisation changed" or "no, chromophore/delocalisation unchanged" *not just 'structure' changed/unchanged*	**1**
4 (c)	$-SO_3^-$ (Na^+) (1) mention of ion (1); forms ion-dipole bonds with water (*subsumes previous mark*)/ hydrated (AW)(1) *ignore hydrogen bonds to water*; compensate for/ replace/ overcome hydrogen bonds broken between water molecules (1) *if –OH or –NH_2 named, just 'hydrogen bonds with water' may be scored.*	**4**
4 (d) (i)	diazonium	**1**
4 (d) (ii)	 *allow OH, no Na^+, H bonded at coupling point, rings with 'delocalised circles'*	**1**
4 (d) (iii)	coupling (1); electrophilic (1) substitution (1) ***award anywhere in either part***	**3**
4 (e) (i)	hydrogen bonding	**1**
4 (e) (ii)	any two correct hydrogen bonds *ie from any O or N to any H on OH or NH_2 on the other molecule* (2) one correct, one wrong (1) ignore extra correct bonds; extra wrong bonds are CON ***please tick on structure and mark in right place***	**2**
4 (f) (i)	(1-) bromobenzene *allow gap*	**1**
4 (f) (ii)	ammonia (1); (sodium/ potassium) hydroxide (1) *allow water or correct formulae*	**2**
		22

<table>
<tr><th>Question</th><th>Expected Answers</th><th>Marks</th></tr>
<tr><td>5 (a) (i)</td><td>hydrolysis</td><td>1</td></tr>
<tr><td>5 (a) (ii)</td><td>1. dative/ covalent/ coordinate (bond)/ metal-ligand bond (not ion-dipole);
2. hydrogen (bonding); 3. ionic</td><td>3</td></tr>
<tr><td>5 (b)</td><td>peptides hydrolysed/ broken down in stomach /gut/ by digestion
not just “in body” or “before they reach...”</td><td>1</td></tr>
<tr><td>5 (c) (i)</td><td>ring around the C, O and N atoms can include other bonds but not other atoms</td><td>1</td></tr>
<tr><td>5 (c) (ii)</td><td> 

three (dotted) lines correct (2); two dotted lines correct (1) ignore other detail except more dotted lines</td><td>2</td></tr>
<tr><td>5 (c) (iii)</td><td>no (relevant)/ different peptide bond /correct bond missing/
only part of/ not same pharmacophore (1);
binds to/ stays on active site/ not easily hydrolysed (1);
blocks substrate (AW) (1)</td><td>3</td></tr>
<tr><td>5 (c) (iv)</td><td>
<table>
<tr><th></th><th>bond</th><th>absorption/cm^{-1}</th></tr>
<tr><td>shared peak</td><td>C=O,
C–H,
C–O</td><td>1630-1700/1700-1725,
2850-2950,
1050-1300</td></tr>
<tr><td>peak in angiotensin only</td><td>N–H,
 
/arene
C–H on arene</td><td>(ca) 3500, 1450–1650

3000 - 3100</td></tr>
</table>
(1) for each bond and absorption or (1) for both bonds</td><td>2</td></tr>
<tr><td>5 (c) (v)</td><td>
<table>
<tr><th>shift</th><th>proton</th><th>ratio (1)</th></tr>
<tr><td>1.2</td><td>CH$_3$–C/R–CH$_3$ (AW) (1)</td><td>3</td></tr>
<tr><td>1.4</td><td>C–(CH$_2$)-CH$_2$–C/
R–(CH$_2$)–CH$_2$–R (AW)
(1)</td><td>4</td></tr>
</table>
</td><td>3</td></tr>
<tr><td>5 (c) (vi)</td><td>optical (isomerism) (1); chiral carbon/ four <u>different</u> groups around a carbon (1); (object and mirror image) non-superimposable/ different (1)
mark separately</td><td>3</td></tr>
</table>

Question	Expected Answers	Marks
5 (c) (vii)	computer/ molecular modelling/ X-ray diffraction *ignore extra suggestions*	1
		20

Grade Thresholds

Advanced GCE Chemistry (Salters) (3887/7887)
June 2008 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	a	b	c	d	e	u
2848	Raw	90	60	52	44	36	29	0
	UMS	120	96	84	72	60	48	0
2849	Raw	90	70	63	56	49	42	0
	UMS	90	72	63	54	45	36	0
2850	Raw	75	60	53	46	40	34	0
	UMS	90	72	63	54	45	36	0
2852A	Raw	90	74	68	62	56	51	0
	UMS	90	72	63	54	45	36	0
2852B	Raw	90	74	68	62	56	51	0
	UMS	90	72	63	54	45	36	0
2854	Raw	120	90	81	72	64	56	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 (ie 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	19.4	38.4	57.6	74.5	87.2	100	10100
7887	29.8	54.7	74.5	88.5	96.9	100	6952

17052 candidates aggregated this series

For a description of how UMS marks are calculated see:
http://www.ocr.org.uk/learners/ums_results.html

Statistics are correct at the time of publication.

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

OCR Customer Contact Centre

14 – 19 Qualifications (General)
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@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

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553