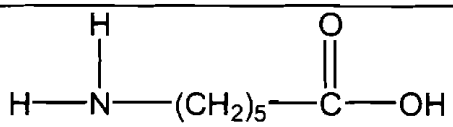
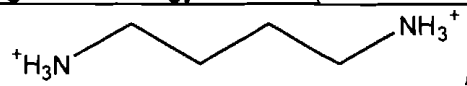
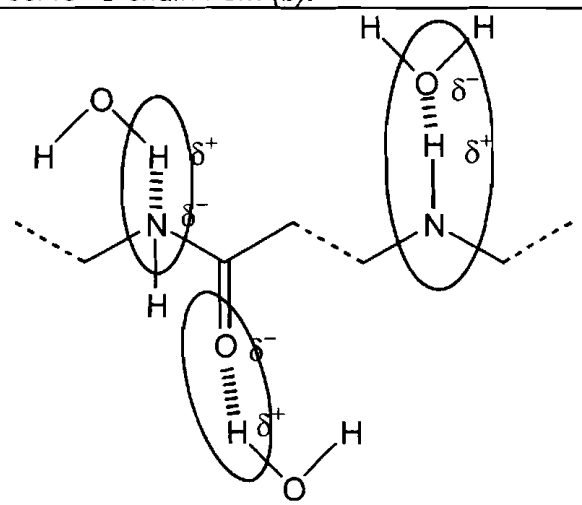
Abbreviations, annotations and conventions used in the Mark Scheme	/	=	alternative and acceptable answers for the same marking point
	;	=	separates marking points
	NOT	=	answers which are not worthy of credit
	( )	=	words which are not essential to gain credit
	____	=	(underlining) key words which **must**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

Question	Expected answers	Marks
1 (a)	Improve properties / demand greater than nature can supply / reduce cost (1).	1
1 (b)	 -COOH *allow –COCl* (1); $-NH_2$ (1) **ONE** of the groups must have the $(CH_2)_5$ for the second mark.	2
1 (c) (i)	1,4-diaminobutane diaminobutane *allow butyl/butan(e)diamine* (1); 1,4 (1). *ecf*, 1,6-diaminohexane for 1 mark	2
1 (c) (ii)	Any **two** from the following **four** points: lower T_g/ T_m/ strength/ rigidity ora (2). NOT b.p. nor density.	2
1 (d) (i)	3×10^4 / 198 (1); 150–152 (1) *ecf for* M_r.	2
1 (d) (ii)	(Secondary) amide (1) NOT peptide.	1
1 (d) (iii)	There will be greater number of hydrogen bonds (1); between chains (1); greater energy needed (to enable chains to move/flow) (1).	3
1 (e) (i)	 *may not be skeletal* (1);  (1). *ecf for C chain from (b).*	2
1 (e) (ii)	 Any one of the three atom arrangements above (1); Correct partial charges (1).	2
	Total	**17**

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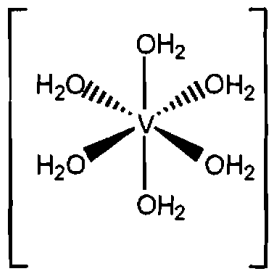
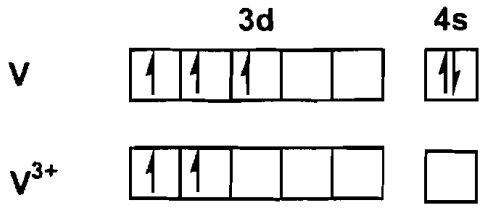
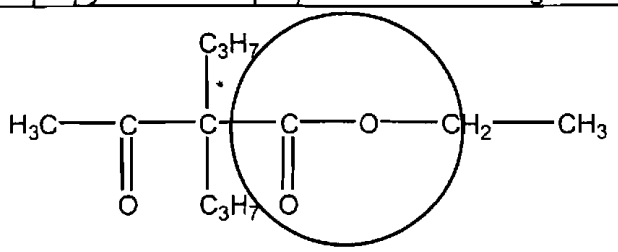
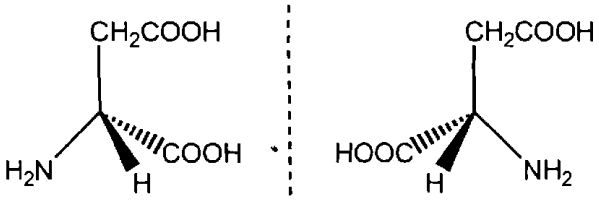
Question	Expected answers	Marks
2 (a) (i)	+5 (1) *accept* 5+.	1
2 (a) (ii)	hydrogen electrode (1); detailed drawing not required but should have H_2 gas and $H^+(aq)$. a half-cell made from Pt (or C) dipping into a solution VO_2^+ and VO^{2+} ions (1); conditions given as 1 mol dm^{-3} /1M concentrations, 1 atmosphere pressure and 298 K (1); salt bridge dipping in solutions(1); voltmeter correctly connected (1).	5
2 (b) (i)	0.74 V (1).	1
2 (b) (ii)	B /V^{2+} / V^{3+} (*may give more detail of half-cells*) because it has the more negative/less positive electrode potential AW in terms of reducing agent/oxidizing agent or electron transfer (1).	1
2 (c) (i)	$V^{3+} + e \rightleftharpoons V^{2+}$ (1).	1
2 (c) (ii)	$V^{2+} + VO_2^+ + 2H^+ \rightarrow V^{3+} + VO^{2+} + H_2O$ Correct vanadium species in both reactants and products (1); equation given balanced correctly (1).	2
2 (d) (i)	 Octahedral arrangement of ligands (1); O in H_2O bonded to V for all ligands (1). *Ignore charge on ion.*	2
2 (d) (ii)	 Correct arrangement for V (1); correct arrangement for V^{3+} (1).	2
2 (d) (iii)	Ligands cause/interact with d orbital/energy levels AW (1); to split into two groups / $E = h\nu$ or in words (1); visible light/frequencies absorbed to excite electrons (1); rest of visible light transmitted as colour AW (1).	4
	Total	**19**

Question	Expected answers	Marks
3 (a)	2-propylpentanoic acid *pentanoic acid* (1) *2-propyl* (1) *allow* 2-propan(e) or propyl-2-/; *Dipropylethanoic/dipropanethanoic acid gains 1 mark.*	2
3 (b)	 *Allow if only COO/both attached C atoms is/are circled.*	1
3 (c) (i)	Prevent loss of product **D**/volatile reactants/gases (1).	1
3 (c) (ii)	(Fractional) distillation (1).	1
3 (c) (iii)	Add dilute hydrochloric/sulphuric/ acid (1). NOT conc.	1
3 (c) (iv)	(Potassium) ethanoate/ $CH_3COO^-(K^+)$ (1).	1
3 (d)	C_2H_5OH (1); Any **two** from **three**: relative molar mass = 46 (1); since peak furthest right is due to molecular ion(*may be shown on diagram*) (1); any one use of fragmentation pattern e.g. peak at 29, due to ethyl group /difference between peaks at 29 and 45 = 16, suggests O present (1).	3
3 (e)	chemical shift from spectrum / type of proton / relative intensity 1.0 / CH_3 / 9 1.4 / CH_2 / 8 2.2 / $O{=}CCH_3$ / 3 3.7 / $CH_2OC{=}O$/ $CH_3OC{=}O$ / 2 two types of proton correctly identified (1); all four correct gains second mark (1); correct relative intensities (1).	3
3 (f)	(Broad) peak around 2500–3200 cm^{-1} (1) indicates **OH** (in carboxylic acid) (1); (Strong) peak around 1700–1725 cm^{-1} (1) indicates **C=O** (in carboxylic acid) (1).	4
3 (g)	*Any **two** of the following points:* Solids are easier to administer; taste/smell reduced; not acidic; not corrosive; easier to make sure correct dosage, more soluble in water *(1 mark for each point).*	2
	Total	**19**

Question	Expected answers	Marks
4 (a) (i)	Stereoisomerism/optical (isomerism) (1).	1

4 (a) (ii)	(Molecule has) an asymmetric carbon atom / chiral centre / carbon bonded to four different atoms/groups / mirror image is non-superimposable (1);  Correct 3D structural formula for one enantiomer(1); mirror image (1).	3
4 (b) (i)	850 ± 25 (1) years for 1st reading; 850 ± 25 years for 2nd reading and 3rd reading not greater than 925 (1) *units need to be present for at least one of the readings to gain both marks;* suitable construction on graph to show calculation of half-life (1).	3
4 (b) (ii)	Half-life is constant (1).	1
4 (b) (iii)	Rate = *k* x [L-aspartic acid]; [L-aspartic acid] (1); Rate = *k* (1).	2
4 (b) (iv)	s^{-1} /yr^{-1}/$time^{-1}$ (1).	1
4 (b) (v)	*k* is the rate of reaction (1).	1
4 (c)	Zwitterion (1).	1
4 (d) (i)	$K_c = \frac{[\text{ion F}] \,.\, [H^+]}{[\text{ion E}]}$ 'ion' not necessary for mark (1).	1
4 (d) (ii)	$[H^+]^2 = 1.38 \times 10^{-4} \times 0.50$ (1); $[H^+] = 8.30$ *or* 8.31×10^{-3} mol dm^{-3} (1); 2 or 3 sig. figs (1).	3
4 (e)	Order/sequence of amino acids (in protein chain) (1); shape taken up by protein chain e.g. folding of chains AW (1); the (extra) COOH/COO^- in aspartic acid (1) ; forms/increases the hydrogen bonding/ ion- dipole forces/interactions with water (molecules) (1); charged groups on side/R groups of substrates (may give example $-NH_3^+$ / COO^- groups) (1); can attract charged groups/(may give example $-NH_3^+$ / COO^- groups) in the active sites/AW of enzymes (1). *Accept polar side chains for charged groups but 1 mark not 2.* *QWC* *See next page* (1).	7
	Total	**24**

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Question	Expected answers	Marks
5 (a)	Any answer relating to railway tracks, points, frogs etc.(1).	1
5 (b) (i)	To remove sulphur (1).	1
5 (b) (ii)	Blowing oxygen through (1); turns the carbon to carbon dioxide *accept* carbon monoxide (1).	2
5 (c) (i)	Acidic (oxide) (1).	1
5 (c) (ii)	$6CaO + P_4O_{10} \rightarrow 2Ca_3(PO_4)_2$ correct formula for P_4O_{10} / P_2O_5 (1); correct formula for CaO rest correct (1).	3
5 (c) (iii)	Correct amount of P added later AW (1).	1
5 (d)	To remove (dissolved) oxygen (1).	1
5 (e)	Analysing mixtures of steels/ sorting out different steels/ removing non steel materials/rust from the scrap/cleaning steel/contains unwanted elements (1).	1
	Total	**11**

Guidelines for the Award of S(P)AG QWC marks in Salters paper 2849 Jan 2006

1 **The QWC mark is graded at 'E/U', and it is therefore expected that the majority of candidates will be awarded this mark.**

2 Award the mark if there is only one error in spelling, (punctuation) or grammar in **any two relevant sentences**. A repeated mis-spelling of the same word would count as one error; a repeated grammatical error (*e.g. no verb*) would count each time.

3 Ignore all but the most blatant errors involving commas, because their use varies with individual preference.

4 There should be at least two sentences in the answer. These should start with a capital letter but do not penalise lack of full stops at the end.

5 Allow bullet points, provided each point is a sentence (or more), *i.e.* not note form. Bullet points need capitals at the start but not full stops at the end.

6 Give the benefit of the doubt where unsure; especially avoid penalising obscure grammatical points.