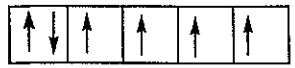
The following annotations may be used when marking:

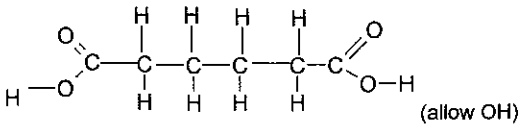
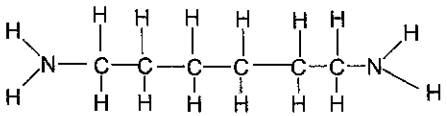
X	=	incorrect response (errors may also be underlined)
^	=	omission mark
bod	=	benefit of the doubt (where professional judgement has been used)
ecf	=	error carried forward (in consequential marking)
con	=	contradiction (in cases where candidates contradict themselves in the same response)
sf	=	error in the number of significant figures

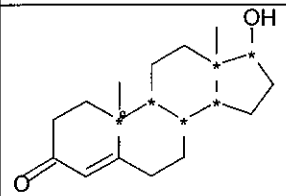
Abbreviations, annotations and conventions used in the Mark Scheme:

/	=	alternative and acceptable answers for the same marking point
;	=	separates marking points
NOT	=	answers not worthy of credit
( )	=	words which are not essential to gain credit
___ (underlining)	=	key words which must be used
ecf	=	allow error carried forward in consequential marking
AW	=	alternative wording
ora	=	or reverse argument

2853/01 Mark Scheme June 2003

1 a(i)	 fully correct (2) total of 6 electrons in 3d 4s scores (1)	2
a(ii)	It forms (stable) ions in which the (3)d shell/orbitals; is incompletely/partially filled. **Ion must be mentioned to score both marks**	2
a(iii)	2 from: variable oxidation state; coloured compounds; paramagnetic; catalytic behaviour; high melting points; high boiling point; high density	2
b	Ligand(allow nucleophilic); substitution/ displacement/ exchange.	2
c(i)	$MnO_4^- + 5Fe^{2+} + 8H^+ \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$ (1) correct species ; balancing (without electrons) (1)	2
c(ii)	3.48×10^{-4}	1
c(iii)	3.48×10^{-4} (ecf from c(ii)) x 5 (1) = 1.74×10^{-3} moles ecf from c(i)	1
c(iv)	1.74×10^{-3} (ecf from c(iii)x 56 (1) $\frac{1.74 \times 10^{-3} \times 56}{0.78} \times 100\% = 12\% / 12.5\%$ (1) ecf	2
	Total	14

2 a	Order/sequence(1); in which amino acids (are joined together).	2
b(i)	$H_2NCH_2CONHCH(CH_3)COOH$ or $H_2NCH(CH_3)CONHCH_2COOH$ peptide link; remainder correct	2
b(ii)	CONH group only circled	1
c(i)	Secondary/2°	1
c (ii)	hydrogen bond	1
c(iii)	From H attached to N on one fold; to O double bonded to C on another fold (Charge should be correct if used)	2
d(i)	Reflux; with moderately concentrated/ (4-6M) sulphuric acid/ hydrochloric acid/acid /alkali	2
d(ii)	In each case: Number of carbons with correct number of H's (1) functional groups (1) FULL STRUCTURAL  (allow OH)  Correct formulae not full structural scores 1 each	4
e(i)	Any 3 from dissolve/make a solution; in minimum amount (AW) ; of hot solvent (not reflux); cool; 1 from: filter; wash; dry.	4
e(ii)	determine melting point; sharp if pure/compare to expected value	2
	Total	21

3 a	alcohol/ hydroxyl			1
b(i)	Ester			1
b(ii)	either $CH_3CH_2CH_2COOH$ butanoic acid	or $(CH_3CH_2CH_2CO)_2O$ butanoic anhydride	or $CH_3CH_2CH_2COCl$ butanoyl chloride	2
b(iii)	conc H^+ ; reflux . (must correspond to above)	Anhydrous; reflux (must correspond to above)	Anhydrous; room temperature/cold (must correspond to above)	2
c	Substrate molecules of a different shape do not fit Any 4 from; Enzyme has an active site; Which has a specific shape; because of its tertiary structure/way it folds; folding depends on the sequence of amino acids ; Substrate/reacting molecule can fit into active site/can fit together/complementary shapes; Weak bonds/ H bonds hold enzyme & substrate together/enzyme substrate complex formed; Discussion of denaturing scores 4 max. **QWC mark At least 2 consecutive sentences with spelling, punctuation and grammar correct.**			5+1
d(i)	First			1
d(ii)	Testosterone is vastly in xs/amount of enzyme is minute; so all the active sites will have substrate molecules attached/ are saturated; The rate of reaction does not depend on the substrate/testosterone concentration or depends on enzyme concentration or enzyme is rate limiting factor or rate reaches a max. regardless of the conc. of the testosterone.			3
e	type of proton O-H (1) CH(OH) (1)			2
f(i)	 1 mark each (2max)			2
f(ii)	carbon atom attached to 4 different groups			1
	Total			21

4 a	Larger surface area	1
b	$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$ [products] divided by [reactants](1). K_c and Powers outside square brackets (1)	2
c(i)	$2.09X\ 0.142X\ (1.36)^3 = [NH_3]^2$ correct rearrangement original formula or correct substitution(1) 0.864 moldm^{-3} (1) answer to 3sf (1) ecf from b only if upside down (0.413)	3
c(ii)	There would be no change	1
d	The equilibrium constant would decrease; because: the equilibrium moves in favour of the endothermic reaction; to side of reactants/the left;	3
	Total	10

5 a(i)	Correct shape (octahedral) using correct notation (1); all water molecules **bonded via oxygen atoms** (unambiguous)	2
a(ii)	6	1
b	It has 6; lone pairs or forms 6 bonds; these are dative	2
c(i)	Standard electrode potential for Cu^{2+}/Cu is more positive ORA; 2 from Copper is formed; Copper is reduced ORA/ Cu^{2+} accepts electrons from Fe ORA/iron is a better reducing agent ORA $Cu^{2+} + Fe \rightarrow Cu + Fe^{2+}$	3
c(ii)	0.78V	1
d	Difference between the two energy levels corresponds to visible light; (allow in context of emission for 1 mark) frequencies /light not absorbed/complementary colour; is transmitted	3
e	4 from: suitable filter; zero colorimeter (with water); prepare solutions of known; different concentration; suitable range; measure absorbance of these; plot graph; **and** measure absorbance of groundwater sample and read off concentration from calibration curve	5
f(i)	$[Cu(H_2O)_6]^{2+}(aq) + 2\,OH^-(aq) \rightarrow [Cu(H_2O)_4(OH)_2](s) + 2H_2O(l)$ $Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$ correct underlined species; correct state symbols underlined species. Completely correct balanced equation;	3
f(ii)	▪ ppt dissolves/a solution is formed; ▪ which is deep (AW) blue ; ▪ $[Cu(NH_3)_4(H_2O)_2]^{2+}$ / $[Cu(NH_3)_4]^{2+}$ ligands and number correct(1); charge based on suitable species ie NH_3 must be included max 6 ligands (1)	4
	Total	24