2853 Chemistry: Polymers, Proteins and Steel

January 2004

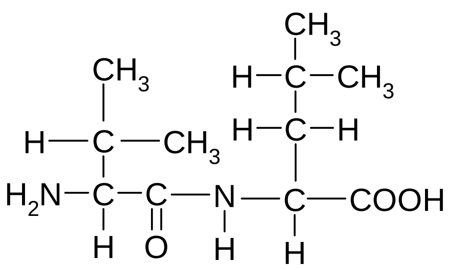
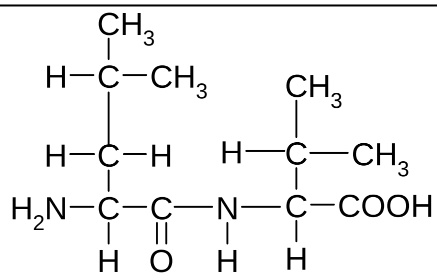
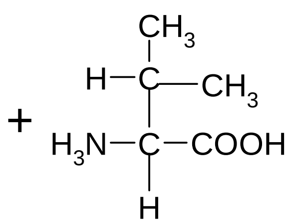
Mark Scheme

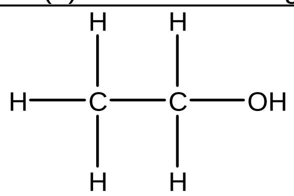
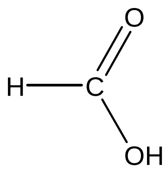
The following annotations may be used when marking:

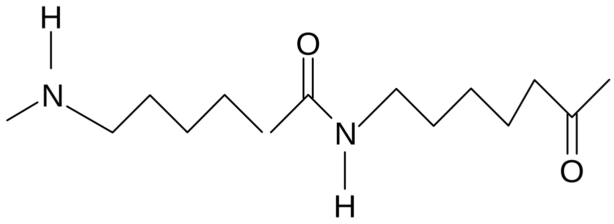
X	=	incorrect response (errors may also be underlined)
^	=	omission mark
bod	=	benefit of the doubt (where professional judgement has been used)
ecf	=	error carried forward (in consequential marking)
con	=	contradiction (in cases where candidates contradict themselves in the same response)
sf	=	error 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 <u>must</u> be used
ecf	=	allow error carried forward in consequential marking
AW	=	alternative wording
ora	=	or reverse argument

Question	Expected Answers	Marks
1a	2 from: benzene ring; carboxyl/carboxylic acid; amine	2
bi	mirror image	1
bii	optical	1
biii	It has a chiral centre/asymmetric carbon/ carbon attached to four different groups;	1
ci	**A.Only molecules of a specific shape work** **Plus 4 from** B.enzyme has an active site; C.with a specific shape; D.because of its tertiary structure/way it folds; E.folding depends on the sequence of amino acids; F.H bonds /electrostatic forces hold (substrate &) enzyme together; G.substrate/reacting molecule fits into enzyme (active site)/ complementary shape/enzyme substrate complex formed; **Discussion of denaturing scores 4 max**	5
cii	Phenol	1
d	 or  Only amide link needs to be full structural Amide link(1); Rest;	2
e	 (1) (or NH_3Cl) H^+ is removed (from solution) Accept: acts like a buffer/ a base/accepts a proton/ COO^- reacts with H^+	2
		15

Question	Expected Answers	Marks
2a	Ethyl methanoate =2 yl and oate =1	2
bi	1.2 = R-CH_3 (1) 3.6 = O-CH_2-R (1) 4.5 =R-OH (1) No R groups 2 max	3
bii	 Product **Y** (1) ethanol (1)	2
biii	 Product **Z** (1) methanoic acid (1) **NB Allow 2 marks if bii and iii reversed but otherwise completely correct**	2
c	M_r ester= 74 (1) Amount of ester= 8.87 /74 (1) = 0.120 mol ecf Multiplication by 1000/500 to give concentration(1) Accept reverse working	3
di	All points plotted correctly 2 marks 1 error = 1mark 2 errors = 0 Smooth curve through points 1 mark	3
dii	2 half lives marked correctly on the graph (1); time labelled correctly (1); Allow 1 mark for one half life correctly drawn and labelled	2
diii	Constant <u>half life</u>	1
div	Draw a tangent to the curve; At t=0/ the start; Find gradient owtte	3
e	$\frac{4.60 \times 10^{-5}}{0.240}$ (1)= 1.92×10^{-4} (1) units s^{-1} (1)	3
	Total	24

3a i	$H_2N\ CH_2\ CH_2\ CH_2\ CH_2\ CH_2COOH$ Any form of structure correct functional groups(1) ; correct number of carbons between functional groups, (aliphatic should have correct number of H's)(1)	2
aii	 Correct sequence of groups as shown (1) 5 carbon linkages either side (1) ecf from above Allow condensed structure	2
bi	Acyl chloride	1
bii	Condensation polymerisation; A small molecule (HCl) is eliminated (when monomers join) **not water**	2
c	more hydrogen bonds in nylon-6,6; strongest / intermolecular forces/hydrogen bonds between functional groups; shorter (hydro)carbon chains in nylon-6,6 (or monomer 2) / more functional groups in nylon-6,6 ORA; carbon chains between functional groups /in both monomers are the same length in nylon-6,6/functional groups line up more regularly ORA; therefore more energy is required to separate the chains/overcome the intermolecular forces when it melts;	4
	Total	11

Question	Expected Answers	Marks
4a	**Make up to known volume with water;** **Add acid (must be sulphuric if named);** ***Alternative: Make up to a known volume with <u>dilute</u> acid scores 2*** **Until first <u>permanent pink</u> colour - not with indicator**; **3 from** Filter solution; Wash with water; Dilute stock solution; Pipette sample; Add MnO_4^- from a burette Repeat **QWC** 2 consecutive sentences **grammatically** correct with **no** spelling mistakes.	6 +1
b	$MnO_4^- + 5Fe^{2+} + 8H^+ \rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$ Equation (1); Balancing (not electrons) (1)	2
c	*M*r $FeSO_4$ =152 (1); Mass of $FeSO_4$ =106.4g (1); Percentage = 106.4 /1000 x 100% (1) = 11% Answer rounded to 2 sf (1) Ecf throughout	4
di	Octahedral shape; Water molecules bonded via oxygen atoms only (no ambiguous attachments)	2
dii	Lone pair/non bonding pair of electrons	1
diii	6	1
ei	(Dirty) green (1); precipitate (1)	2
eii	$Fe^{2+}(aq) + 2OH^-(aq) \rightarrow Fe(OH)_2(s)$ Balanced equation (1) State symbols (1) (ignore spectators)	2
eiii	Oxidation has taken place/ reacts with oxygen (precipitate) turns red/brown; Fe^{3+}/(hydrated) iron III oxide / iron III hydroxide formed	3
f	Hexadentate/ polydentate	1
gi	<u>Ligand</u> exchange/displacement/substitution Allow nucleophilic substitution	1
gii	$K_{stab} = \dfrac{[Fe(edta)^{2-}]}{[Fe(H_2O)_6^{2+}]\,[edta^{4-}]}$ products /reactants (1) square brackets – charges must be inside concentration brackets(1)	2
	Total	28

Question	**Expected Answers**	**Marks**
5ai	$Cd \rightarrow Cd^{2+} + 2e^{-}$	1
aii	It is less positive/ more negative than the nickel electrode	1
b	**Hydrogen electrode dipping into H^{+} ions;** **Strip of cadmium dipping into a solution of cadmium ions;** **(High resistance) voltmeter/potentiometer in a workable circuit;** **2 from** Salt bridge; Soaked in potassium nitrate/ sodium nitrate ; Standard conditions:298K/25^{0}C, 1moldm^{-3}, 1 atm **not open hydrogen electrode**	5
ci	$Fe^{3+} + e \rightarrow Fe^{2+}$ 0.77V (1); $Zn^{2+} + 2e \rightarrow Zn$ - 0.76V (1) sign with 2 correct values (1)	3
cii	1.53V ecf using sensible answers from c(i)	1
ciii	Zn/ Zn^{2+} to Fe^{3+}/Fe^{2+} Zinc is the most negative / electrons flow from most negative to most positive Ecf from c(i)	1
	Total	12