

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

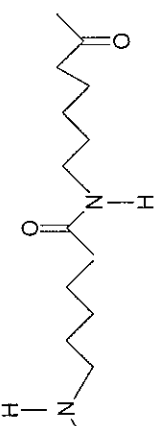
2853 Chemistry: Polymers, Proteins and Steel

January 2004

Mark Scheme

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	$ \begin{array}{c} \text{CH}_3 \\ \\ \text{H}-\text{C}-\text{CH}_3 \\ \\ \text{H}_2\text{N}-\text{C}-\text{C}-\text{COOH} \\ \quad \\ \text{H} \quad \text{O} \end{array} $ or $ \begin{array}{c} \text{CH}_3 \\ \\ \text{H}-\text{C}-\text{CH}_3 \\ \\ \text{H}_2\text{N}-\text{C}-\text{C}-\text{COOH} \\ \quad \\ \text{H} \quad \text{O} \end{array} $ Only amide link needs to be full structural Amide link(1); Rest;	2
e	$ \begin{array}{c} \text{CH}_3 \\ \\ \text{H}-\text{C}-\text{CH}_3 \\ \\ \text{H}_3\text{N}-\text{C}-\text{COOH} \quad (1) \\ \\ \text{H} \\ \text{(or NH}_3\text{Cl)} \\ \text{H}^+ \text{ is removed (from solution)} \\ \text{Accept: acts like a buffer/ a base/accepts a proton/ COO}^- \text{ reacts with H}^+ \end{array} $	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)	3
bii	No R groups 2 max $ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{C}-\text{OH} \\ \quad \\ \text{H} \quad \text{H} \end{array} $	2
biii	Product Y (1) ethanol (1) $ \begin{array}{c} \text{O} \\ \\ \text{H}-\text{C}-\text{OH} \end{array} $	2
c	Product Z (1) methanoic acid (1) NB Allow 2 marks if bii and iii reversed but otherwise completely correct 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 All points plotted correctly 2 marks 1 error = 1 mark 2 errors = 0 Smooth curve through points 1 mark 2 half lives marked correctly on the graph (1); time labelled correctly (1); Allow 1 mark for one half life correctly drawn and labelled Constant half life Draw a tangent to the curve. At t=0 the start; Find gradient owite	3
di	$ \frac{4.60 \times 10^{-5}}{0.240} (1) = 1.92 \times 10^{-4} (1) \text{ units s}^{-1} (1) $	3
dii	Total	24

3a i	$\text{H}_2\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$ 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 Acyl chloride	2
bi	Condensation polymerisation;	1
bii	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/functionals 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 dilute acid scores 2* Until first permanent pink 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	$\text{MnO}_4^- + 5\text{Fe}^{2+} + 8\text{H}^+ \rightarrow 5\text{Fe}^{3+} + \text{Mn}^{2+} + 4\text{H}_2\text{O}$ Equation (1); Balancing (not electrons) (1)	2
c	$M_r \text{FeSO}_4 = 152 (1)$; Mass of $\text{FeSO}_4 = 106.4\text{g} (1)$; Percentage = $106.4 / 1000 \times 100\% (1) = 11\%$ Answer rounded to 2 sf (1)	4
di	Ec f throughout 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	$\text{Fe}^{2+} (\text{aq}) + 2\text{OH}^- (\text{aq}) \rightarrow \text{Fe}(\text{OH})_2 (\text{s})$ 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	Ligand exchange/displacement/substitution Allow nucleophilic substitution	1
gii	$K_{\text{stab}} = \frac{[\text{Fe}(\text{edta})]^-}{[\text{Fe}(\text{H}_2\text{O})_6^{2+}][\text{edta}^{4-}]}$ products /reactants (1) square brackets – charges must be inside concentration brackets(1)	2
Total		28

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