2853 Polymers, Proteins and Steel

June 2004

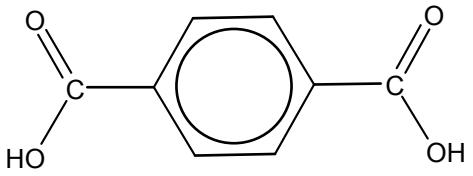
Mark Scheme

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:

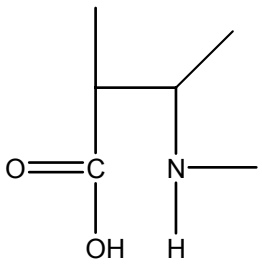
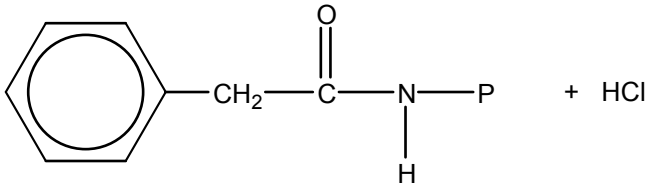
/	=	alternative and acceptable answers for the same marking
;	=	separates marking points
NOT	=	answers not worthy of credit
( )	=	words which are not essential to gain credit
___ (underlining)	=	key words which must be used
ecf	=	allow error carried forward in consequential marking
AW	=	alternative wording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

Question	Expected Answers	Marks
1a(i)	 1 mark for each carboxylic acid correctly attached to the benzene ring	2
a(ii)	Many/lots of monomers /molecules (accept long chain molecule) joined together; Small molecule/water/HCl is eliminated/ monomers have reactive groups at either end	2
b(i)	Permanent dipole – permanent dipole	1
b(ii)	Only interaction from C of carbonyl group on one chain to O on another ; $C^{\delta+}$ correctly labelled on one chain $O^{\delta-}$ labelled on the other chain.	2
c	M_r repeating unit = 192 (1); No of repeating units = $\frac{384000}{192}$ = 2000 (ecf)	2
d	3 from: (Sorting out plastics) then melting/heating and remoulding or gives a specific use; Incineration /burning to produce energy/heat; Cracking/breaking down chains (to produce feedstock); Hydrolyse /converting back to monomers and repolymerising	3
		Total: 12
2a(i)	Order = 2; As [NO(g)] doubles and $[O_2(g)]$ kept constant rate quadruples/compares B and D or A and C	2
a(ii)	Order = 1; As $[O_2(g)]$ doubles and [NO(g)] kept constant rate doubles /compares A and B or C and D	2
a(iii)	Rate = k $[NO(g)]^2$ $[O_2(g)]$ =2marks 3 PARTS CORRECT=2 2 PARTS CORRECT=1 ecf from (i) and (ii)	2
a(iv)	3 ecf from (iii)	1
b	First order: conc vs time graph - descending curve (1); roughly constant half life (1); rate vs conc - straight line positive slope (1); through origin (1)	4
		Total : 11

Question	Expected Answers	Marks
3a(i)	$K_c = \frac{[NO]^2}{[N_2][O_2]}$ [products] /[reactants] =1 powers =1	2
a(ii)	Equilibrium lies over to the left / reactants side	1
a(iii)	K_c will be higher; Equilibrium moves in favour of endothermic reaction/to take in energy; Plus 1 from: Temperature in car engine is higher; Equilibrium has shifted to the right/ because NO formed	3
b(i)	$Fe + 2H^+ \rightarrow Fe^{2+} + H_2$ equation(1) balancing (no electrons) (1)	2
b(ii)	Fe_2O_3 (1) . xH_2O (1) dependent on a formula of iron oxide	2
b(iii)	2 from: painting/coat with zinc oxide; greasing/oiling/ waxing; underseal; galvanising/ coat in zinc; chrome plating	2
c	Any 2: Iron is a non renewable/ finite resource; Saves energy/extraction costs/non- renewable fuel; Named environmental issue - eg saves landfill space	2
d	Magnesium or zinc; Has a more negative electrode potential ; Plus 2 from: will lose electrons (more readily); it is a stronger reducing agent; gets oxidised/reacts/corrodes in preference must be implied/ more reactive/ correct equation; replaced when worn away	4

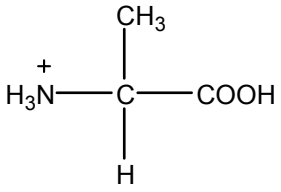
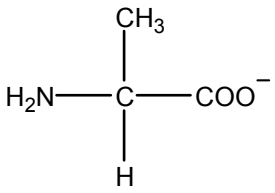
e	2 uses 2 properties from (use should be appropriate to property) and different in each case.
	paper clip (1); - drawn into wires(1);
	construction (1); - strength (1);
	drill (1);-high melting point/ strong(1);
	cutlery(1);-resistant to corrosion/hard(1);
	underground pipes(1); -strength (1);
		4

		Total: 22

4a	4 from: DNA consists of two(polynucleotide) chains/strands; In a <u>double</u> helix; *Each strand/chain/backbone is made of deoxyribose/sugar and phosphate groups (idea of a chain) NOT ribose; *Each chain has <u>attached bases</u>; *Bases linked by hydrogen bonding; *Specific/complementary bases are paired/e.g. A-T C-G (between chains) **Points labelled * can be gained from a <u>clearly</u> labelled diagram** Confusion with a chain of amino acids scores 3 max	4
b	An amino acid would be missing	1
c	1 mark for carboxylic acid group; 1 mark for amine group; 	2
d(i)	ONLY Acyl chloride group circled	1
d(ii)	 1 mark 1 mark	2
		Total:10

Clarification on the DNA answer- They must indicate that at AT C and G are bases for the last marking point . **A pairs with T and C pairs with G is not enough** (which is likely to be the case if they have just drawn a diagram)

Question	Expected Answers	Marks
5a(i)	3 d^9	1
a(ii)	It forms at least one ion/Cu^{2+} in which the d subshell/orbital ; Is partially /incompletely filled	2
b	1 mark for both nitrogen atoms circled; 1 mark for all 4 O- circled	2
c(i)	6×10^{-5}	1
cii	6.00×10^{-5} x 63.5(1) x 1000/25(1) x 1000 (1) 152mg dm^{-3} (1) **must be 3 sf for mark** allow ecf throughout	4
d	(Make up solutions) of known concentration of Cu^{2+} ; **3 from:** of different concentrations; suitable range; Choose suitable filter; Calibrate colorimeter/zero with water; measure absorbance/transmittance; Plot a calibration curve; read absorbance of sample; **plus** read value from graph At least 2 consecutive sentences with only **one spelling mistake**	5 + 1
e	2 from: catalysts; variable oxidation state; paramagnetic; high density; high mpt/bpt	2
		Total:18

Question	Expected Answers	Marks
6a(i)	Name of reagent: hydrochloric acid/ sodium hydroxide allow sulphuric acid; Conditions: Moderately concentrated (4-6M) ; reflux (must have sensible reagent)	3
a(ii)	Must have diagram with at least 1 label to score full marks : 4 from: Covered beaker; Paper with spot of solution above solvent; At end four spots; Develop with ninhydrin/iodine/copper nitrate; Compare to controls/work out R_f values	4
b	Amino acid: glycine; Explanation: does not have chiral/asymmetric carbon atom/carbon atom attached to four different groups owtte;	2
c(i)	Lysine alanine glutamic acid → Decreasing pH All correct = 1 Recognition that NH_2 is basic/ proton acceptor; Recognition that COOH is acidic/ proton donor; Comparison of numbers of these groups on all 3 amino acids	4
c(ii)	 (1) Cl^- and Na^+ = 1 dependent on correct structures  (1) H_2O (1)	4
		Total:17