

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

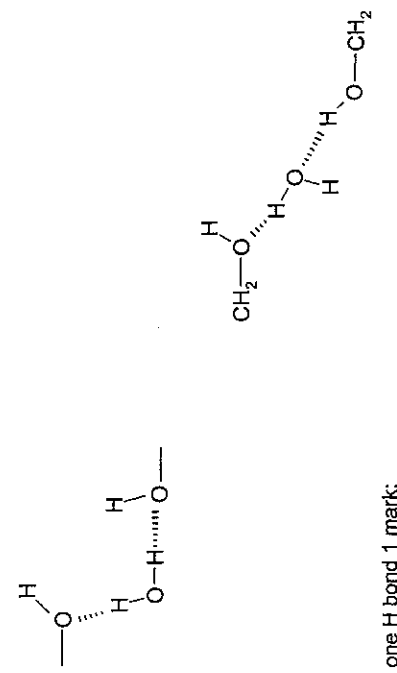
Abbreviations, annotations and conventions used in the Mark Scheme:

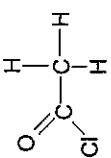
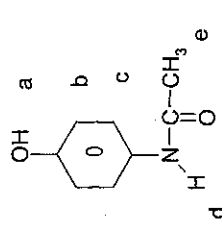
- / = alternative and acceptable answers for the same marking point
 ; = separates marking points
 NOT = answers not worthy of credit
 () = words which are not essential to gain credit
 (underlining) = key words which must be used
 ecf = allow error carried forward in consequential marking
 AW = alternative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

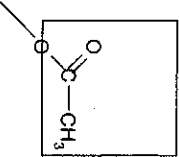
Question 1	Expected Answers	Marks
a(i)	$Mg + S \rightarrow MgS$	1
a(ii)	redox	1
b	carbon content is about right/ at 0.5%; but phosphorus content is too high/ blow time would need to be longer for phosphorus, so unsuitable.	2
c(i)	(too much) causes the steel to: become brittle/ snap/ become more difficult to shape (ORA)	1
c(ii)	Carbon monoxide is toxic/poisonous (ignore harmful)	1
d	Silicon with oxygen: $Si + O_2 \rightarrow SiO_2$ (1); Formation of slag: $SiO_2 + CaO \rightarrow CaSiO_3$ (1)	2
e	To prevent oxygen/ air and water/moisture getting to the steel / Forms a protective barrier between the steel and air and water;	1
f	Chromium reacts with air or oxygen/ is oxidised / a layer of chromium (III) oxide is formed (if only formula quoted should be correct); this oxide is impermeable to air (oxygen and water) / oxide layer quickly reforms if surface scratched/ stops steel from oxidising	2
g(i)	$1.38 \times 10^{-2} / 4 = 3.45 \times 10^{-3}$ moles	1
g(ii)	$3.45 \times 10^{-3} \times 52 = 0.179g$ answer(1) ; units(1)	2
g(iii)	units independent mark $0.179 \times 100\% (1) = 11.9\% / 12.0\%$ 1.50	2
	Answer to 3 sf rounded correctly (1) ecf	1
	Total	16

Question 2	Expected Answers	Marks
a	$0.8 - (-0.76) = 1.56V$ must have units	1
b	(high resistance) voltmeter / potentiometer in workable circuit; salt bridge; strip of silver metal and strip of zinc metal; each dipping into a solution of appropriate ions* ; (298K /25°C), 1mol dm ⁻³ (if temperature quoted must be correct) *charges on ions must be correct /soluble salt should be used	5
c	silver electrode has more positive potential E^{\ominus} /better oxidising agent/ zinc gives up electrons more readily than silver (comparison should be implied)	1
d	(ignore reference to electron flow) $2Ag^+ + Zn \rightarrow 2Ag + Zn^{2+}$ species (1); balancing (of correct species) (1)-linked	2
	Total	9

Question 3	Expected Answers	Marks
a	Flask or tube with mixture of liver and hydrogen peroxide; Workable method of collection of gas (syringe or over water) no seals no leaks; calibrated collection vessel –(burette, measuring cylinder, gas syringe)	3
b(i)	Double	1
	gets multiplied by 4	1
b(ii)	first order	1
c(i)	rate = $k[H_2O_2]$ [catalase] 4 parts correct -3 marks 3 parts correct -2 marks 2 parts correct -1 mark ecf from b(ii)	3
c(ii)	2 ecf from c(i)	1
d	4 from: Tertiary structure altered/unfolds; because intermolecular forces/ bonds are broken (if temperature raised too much); these are disulphide bond/hydrogen bonds /ionic attractions; thus shape of active site/specific cleft is altered /deformed; so substrate does not fit (allow substrate and enzyme are not complementary)	4
	Total	14

Question 5	Expected Answers	Marks
a	(polymer) made by linking together many/ lots aw; amino acid molecules	2
b	(joining must be stated or implied)	2
c(i)	secondary structure (1) : coiling of chains primary structure (1) : order of amino acids	3
c(ii)	alanine:alanine - instantaneous dipole induced dipole aspartic acid: serine - hydrogen bonding cysteine:cysteine - covalent bonding	2
d(i)	-NH ₃ ⁺ OOC (1) (1)	2
d(ii)	 <p>one H bond 1 mark; other H bond and shape of water molecule 1 mark</p> <p>3 from: Washing causes the hydrogen bonds (between helices) to be broken; Heating/ drying causes the evaporation of water /water to be lost; hydrogen bonds between the water molecules and helices/hair fibres are broken; New hydrogen bonds made between the hair fibres/ helices; In a different place.</p>	3
Total		14

Question 4	Expected Answers	Marks
a	amide/peptide	1
b(i)	amine	1
b(ii)	Hydrolysis	1
c(i)	Full structural formula: functional group(1); rest (1); (second mark is dependent on first)	2
c(ii)		1
c(iii)	ethanoyl chloride	1
c(iv)	hydrogen chloride accept hydrochloric acid NOT HCl	1
d(i)	 <p>no specific order</p> <p>ade (1); b (1); c(1) all protons in benzene ring as one environment scores 1</p>	3
d(ii)	a:b:c:d:e 1:2:2:1:3 refer to labelling in d(i) 5 correct scores 3 4 correct scores 2 3 correct scores 1	3
e	7.5/2.5 = 3 half lives (1) / (1/8 remains scores 1) 100% → 50% → 25% → 12.5% (1)	2
Total		15

Question 6	Expected Answers	Marks
a(i)	Water (named)	1
a(ii)	condensation (polymerisation)	1
b	<div style="text-align: center;">  </div> <p>O should join immediately to bond outside box</p> <p>structure completely correct scores 2; one ester linkage correct scores 1 structure correct without ester linkage shown as full structural 1</p>	2
c	<p>5 from:</p> <p>Cotton has stronger intermolecular forces than cellulose triethanoate (ORA); H bonds in cotton; (Permanent) dipole- (Permanent) dipole in cellulose triethanoate; Cotton chains pack regularly / more orderly (ORA); (packing clearly implied) Cellulose triethanoate has bulky side groups/ Cotton more linear/ smaller side groups; Chains in cotton unable to move relative to each other; Cotton can form H bonds to water (ORA)</p> <p>QWC : SPAG - At least consecutive sentences(grammatically correct). Maximum of one spelling mistake in these sentences</p>	5+1
d	$\text{Fe(s)} + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{FeSO}_4(\text{aq}) + \text{H}_2(\text{g})$ <p>equation correct (1); state symbols correct(1) - consequential The ability to change oxidation state</p>	2
e	The ability to change oxidation state	1
f(i)	6	1
f(ii)	Octahedral	1
f(iii)	They have a lone pair, which is donated to central metal atom/used to form a dative / coordinate bond/(covalent) bond	2
f(iv)	<p>red/brown (1); ppt/ solid(1)</p> <p>$\text{[Fe(H}_2\text{O)}_6\text{]}^{3+}(\text{aq}) + 3\text{OH}^-(\text{aq}) \rightarrow \text{[Fe(H}_2\text{O)}_3(\text{OH})_3\text{]}(\text{s}) + 3\text{H}_2\text{O}(\text{l})$</p>	5
	<p>Correct underlined species(1);correct state symbols of underlined species (1); Balanced equation completely correct(1); Allow correct equation without hydrated species</p>	
	Total	22