

Chemistry of Materials

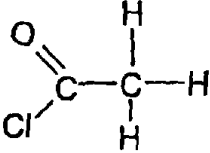
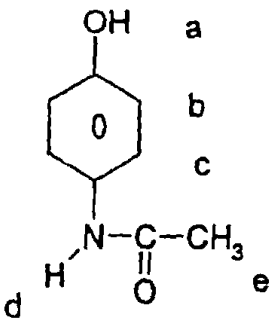
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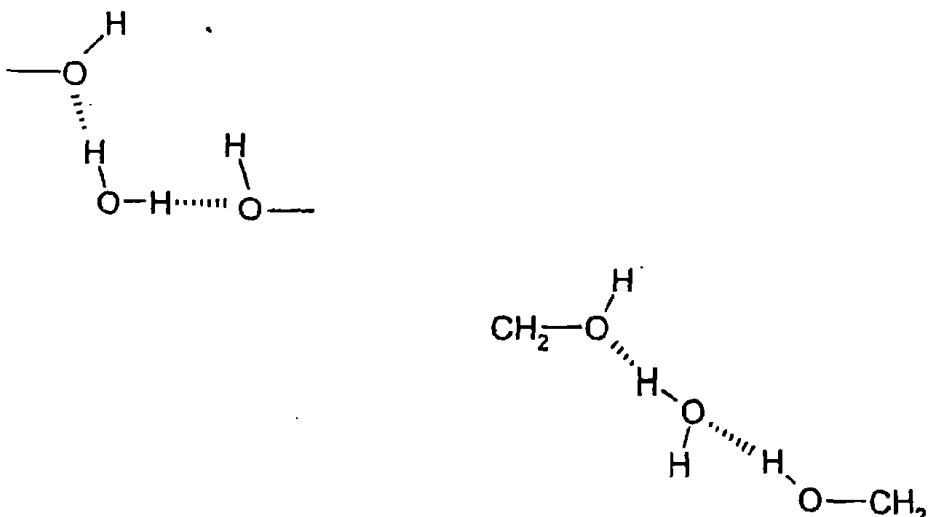
Question 1	Expected Answers	Marks
a(i)	$Mg + S \rightarrow MgS$	1
a(ii)	redox	1
b	carbon content is about right/ at 0.5%; but phosphorus content is <u>too high</u> / blow time would need to be longer for phosphorus, so unsuitable.	2
c(i)	(too much) causes the steel to: become brittle/ snap/ become more 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) / <u>oxide layer</u> 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) units independent mark	2
g(iii)	$\frac{0.179}{1.50} \times 100\%$ (1) = 11.9% / 12.0% Answer to 3 sf rounded correctly (1) ecf	2
	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 <u>more readily</u> than silver (comparison should be implied) (ignore reference to electron flow)	1
d	$2Ag^+ + Zn \rightarrow 2Ag + Zn^{2+}$ species (1); balancing (of correct species) (1)-linked	2
	Total	9

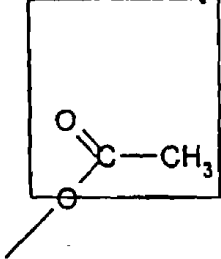
Question 3	Expected Answers	Marks
a	Flask or tube with mixture of liver and hydrogen peroxide; Workable method of collection of gas (syringe or over water) no seals no leaks; calibrated collection vessel –(burette, measuring cylinder, gas syringe)	3
b(i)	Double	1
	gets multiplied by 4	1
b(ii)	first order	1
c(ii)	rate = $k[\text{H}_2\text{O}_2]$ [catalase] 4 parts correct -3 marks 3 parts correct -2 marks 2 parts correct- 1mark 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 <u>shape</u> of active site/ <u>specific cleft</u> is altered /deformed; so substrate does not fit (allow substrate and enzyme are not complementary)	4
	Total	14

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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); <u>(second mark is dependent on first)</u>	2
		
c(ii)	ethanoyl chloride	1
c(ii)	hydrogen chloride accept hydrochloric acid NOT HCl	1
d(i)	 <p style="text-align: center;">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% → <u>12.5%</u> (1)	2
Total		15

Question 5	Expected Answers	Marks
a	(polymer) made by linking together many/ lots aw; amino acid molecules (joining must be stated or implied)	2
b	secondary structure (1) : coiling of chains primary structure (1) : order of amino acids	2
c(i)	alanine:alanine - instantaneous dipole induced dipole aspartic acid: serine - hydrogen bonding cysteine:cysteine - covalent bonding	3
c(ii)	$\begin{array}{cc} \text{-NH}_3^+ & \text{OOC} \\ (1) & (1) \end{array}$	2
d(i)	 <p>one H bond 1 mark; other H bond and shape of water molecule 1 mark</p>	2
d(ii)	3 from: <u>Washing</u> causes the hydrogen bonds (between helices) to be <u>broken</u> ; <u>Heating/ drying</u> causes the evaporation of water /water to be lost; hydrogen bonds <u>between the water molecules and helices/hair fibres</u> are broken; New hydrogen bonds made <u>between the hair fibres/ helices</u> ; In a different place.	3
Total		14

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Question 6	Expected Answers	Marks
a(i)	Water (named)	1
a(ii)	condensation (polymerisation)	1
b	<div style="text-align: center;">  <p>O should join immediately to bond outside box</p> </div> <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: Cotton has <u>stronger</u> 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</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)	<ul style="list-style-type: none"> ♦ red/brown (1); ppt/ solid(1) ♦ $\underline{[\text{Fe}(\text{H}_2\text{O})_6]^{3+}}(\text{aq}) + \underline{3\text{OH}^-}(\text{aq}) \rightarrow \underline{[\text{Fe}(\text{H}_2\text{O})_3(\text{OH})_3]}(\text{s}) + 3\text{H}_2\text{O}(\text{l})$ <p>Correct <u>underlined</u> species(1);correct state symbols of <u>underlined</u> species (1); Balanced equation completely correct(1); Allow correct equation without hydrated species</p>	5
Total		22

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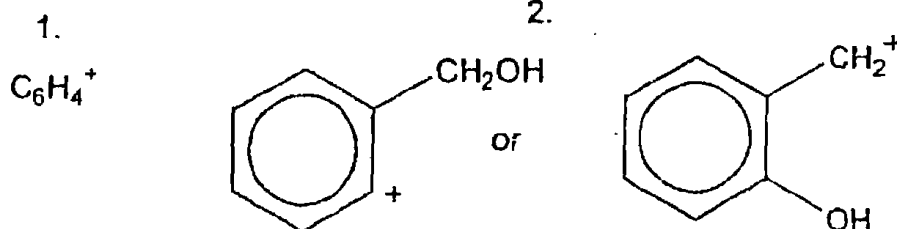
- (a) (i) Colourless/yellow (1 mark); to purple (1 mark). [2]
 (ii) It contains a phenolic -OH group (1 mark). [1]

- (b) Vacuum filtration flask with side-arm (1 mark);
 Buchner funnel with paper (1 mark);
 arrow to water pump (1 mark);
 no leaks in apparatus (1 mark). [4]

- (c) (i) Hydrogen bonding (1 mark). [1]
 (ii) Interaction shown between O of water and H of acid or phenol, or H of water and an O of acid or phenol (1 mark); -O-H group and O atom in line (1 mark); shape of water correct (1 mark). [3]

- (d) (i) 124 is the highest mass where there is a peak, or 124 is the molecular ion peak (1 mark). [1]

(ii)



1 mark for correct molecular formula in 1; 1 mark if structure of 2 is correct; 1 mark if both are shown as positive ions. [3]

- (iii) 1680-1750 cm^{-1} (1 mark); carbonyl or C=O (1 mark). [2]

- (iv) (Warm) with acidified (1 mark);
 (potassium or sodium) dichromate (1 mark); turns green (1 mark). [3]

(e) Two points from:

Toxicity; trials with animals; stability on storage; trials with humans to determine any side-effects; size of overdose. [2]

Total 22 marks

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3 (a) (i)	Selenium or uranium (1).	1
3 (a) (ii)	$3d^8, 4s^2$ accept $4s^2 3d^8$ 10 electrons added (1); the rest correct (1).	2
8 (b) (i)	Carbon dioxide is a 'greenhouse gas' or equivalent description in terms of the absorption of energy (1); causes global warming (1). <i>If second mark is gained but not the first, allow description of an effect of global warming for the first mark e.g. sea levels may rise due to melting polar ice caps.</i>	2
8 (b) (ii)	Carbon dioxide evolved in burning (is replacing) AW (1); the carbon dioxide photosynthesised (<i>may be described, 'takes in carbon dioxide' is not sufficient</i>) by the plants (1) ora.	2
8 (c) (i)	(Molecules/bonds) vibrate/ bonds stretch (1); faster/more/higher energy (1). <i>These marks are linked.</i>	2
8 (c) (ii)	Different bonds vibrate at specific frequencies / vibrations are quantised / energy levels are discrete or quantised (1).	1
8 (c) (iii)	Size of peak / amount of energy (or IR AW) absorbed is proportional to the amount of carbon dioxide (1).	1
Total mark		21