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General Certificate of Education
2011

Chemistry

Assessment Unit A2 2

assessing

Analytical, Transition Metals, Electrochemistry and Further Organic Chemistry

[AC222]

FRIDAY 27 MAY, AFTERNOON

MARK SCHEME

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Section A

	AVAILABLE MARKS
1 D	
2 B	
3 B	
4 C	
5 D	
6 B	
7 B	
8 B	
9 D	
10 C	
[2] for each correct answer [20]	20
Section A	**20**

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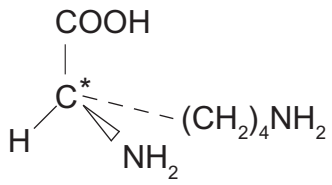
Section B

AVAILABLE MARKS

11 **(a)** **(i)** ability to rotate plane [1]
of plane polarised light [1] [2]

(ii)



correct structure (3D) [1]
asymmetric carbon labelled correctly [1] [2]

(b) zwitterion/ionic [1]
strong attractions between oppositely charged ions/molecules [1] [2]

(c) $H_2N(CH_2)_4CH(NH_2)COO^-$ [1]

(d) $H_2N(CH_2)_4CH(NH_2)CONH(CH_2)_4CH(NH_2)COOH$/
$H_2N(CH_2)_4CH(NH_2)CONHCH(CH_2)_4NH_2$
|
COOH [2]

(e) **(i)** distance travelled by solute
divided by distance travelled by solvent (front) [1]

(ii) more soluble in water/stationary phase [1]
than mobile phase/solvent [1] [2]

(f)

	N	C	H	O
	10.5	36.1	5.3	48.1
÷RAM	0.75	3.01	5.3	3.01
÷0.75	1	4	7	4

empirical formula = $C_4H_7O_4N$ (each error [−1], cet) [3]

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AVAILABLE MARKS

12 **(a)** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$ [1]
half-filled d subshell stable [1] [2]

(b) moles Al = 25/27 = 0.926
moles Cr_2O_3 = 100/152 = 0.658
2 moles Al = 1 mole Cr_2O_3 therefore Cr_2O_3 in excess
1 mole Al = 1 mole Cr
0.926 mole Al = 0.926 mole Cr
mass Cr = 0.926 × 52 = 48.15 g
% yield = 42.5 × 100/48.15 = 88.3%
Award [3] for correct answer.
Each error [−1], carry error through [3]

(c) $K_2Cr_2O_7 + H_2SO_4 \rightarrow K_2SO_4 + 2CrO_3 + H_2O$ [2]
unbalanced [−1]

(d) **(i)** $Cr^{2+} + Ag^+ \rightarrow Cr^{3+} + Ag$ [1]

(ii) 0.8 −(−0.41) = (+)1.21 (V) [1]

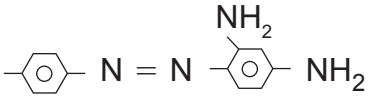
(e) **(i)** ethanol/alcohol [1]

(ii) purple/violet [1]
$K_2SO_4.Cr_2(SO_4)_3.24H_2O$ [1] [2]

(f) **(i)** $C_6SN_2H_8O_2$ [1]

(ii) sodium nitrite and hydrochloric acid [1]

(iii) ≤10 °C [1]
diazonium ion decomposes above this [1] [2]

(iv) H_2NSO_2  NH_2

structure [2], each error [−1] [2]

(v) highly conjugated/delocalised [1]
electronic energy levels close together [1]
(electron transitions) absorb visible light [1] [3]

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AVAILABLE MARKS

13 (a) CH_3COO^+ [1]

(b) (i) ratio 2 : 3 : 3 or 3 : 2 : 3 [1]
$CH_3 : CH_2 : CH_3$/no. of Hs in each environment [1] [2]

(ii) high value quartet near electronegative O
lowest CH_3 from CH_2CH_3
intermediate singlet proximity to COO
all three [2]
errors [−1] [2]

(iii) (quartet) due to split by three chemically equivalent H (n + 1) [1]

(iv) no H on adjacent atom (to split signal) [1]

(c) (i) $CH_3COOH + NH_3 \rightarrow CH_3COONH_4$ [1]

(ii) $CH_3COONH_4 \rightarrow CH_3CONH_2 + H_2O$ [1]

(iii) acid: CH_3COOH [1]
alkaline: CH_3COONa [1] [2]

(d) (i) A: P_4O_{10} [1]
B: $LiAlH_4$ [1] [2]

(ii) $RNH_2 + CH_3COCl \rightarrow CH_3CONHR + HCl$ [1]

(iii) determine melting point/description of apparatus
heat slowly
record temperature when melting starts and stops/range
compare to tables
Any four [4]

Quality of written communication [2]

(e) (i) two coordinate (dative) bonds
formed by lone pairs [2]

(ii) $[Ni(H_2O)_6]^{2+} + 3en \rightarrow [Ni(en)_3]^{2+} + 6H_2O$ [2]
unbalanced [1]

(iii) increase in entropy [1]
4 particles to 7 particles [1] [2]

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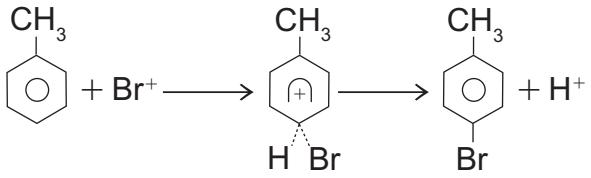
AVAILABLE MARKS

14 **(a)** Fe^{2+}: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$ [1]
Fe^{3+}: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$ [1] [2]

(b) molecules adsorbed/attached to surface [1]
weakens bonds/alignment/bonds formed with surface [1]
lowers activation energy [1] [3]

(c) **(i)**



Each error [−1] [3]

(ii) 2-bromo-1,4-dimethylbenzene [2]
Each error [−1]

(d) **(i)** oxygen forms bond with Fe^{2+} [1]
carried around the body [1] [2]

(ii) CO combines irreversibly [1]

(e) $[Fe(C_2O_4)_3]^{3-}$ [1]

(f) **(i)** thiocyanate ions/hydroxide ions/NH_3(aq) [1]
blood red/rust/brown [1]
solution/ppt [1] [3]

(ii) 1 mole MnO_4^- = 5 moles Fe^{2+}
2 moles MnO_4^- = 5 moles $C_2O_4^{2-}$
⇒ 3 moles MnO_4^- = 5 moles FeC_2O_4
Number of moles iron(II) ethanedioate $= \frac{32.2 \times 0.025}{1000}$
$= 8.05 \times 10^{-4}$
Number of moles $MnO_4^- = 8.05 \times 10^{-4} \times \frac{5}{3}$
$= 1.34 \times 10^{-3}$ in 25.0 cm^3
Concentration $MnO_4^- = 1.34 \times 10^{-3} \times 40 = 0.0536$
$= 0.054$ mol dm^{-3}
Award [4] directly for correct answer
Each error [−1], carry error through [4]

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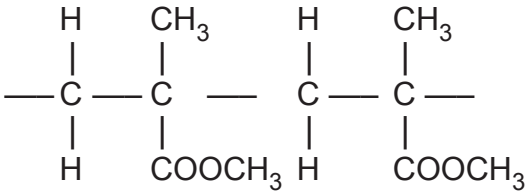
		AVAILABLE MARKS

15 (a) (i)

Ziegler	Philips	
50–75°	150–180°	[1]
1–10 atms./low	30–40 atms.	[1]
$TiCl_4$/aluminium (Ziegler catalyst)	Cr_2O_3	[1] [3]

(ii) rigid and high softening temperature [1]
little branching [1]
pack close together/crystalline/strong intermolecular forces [1] [3]

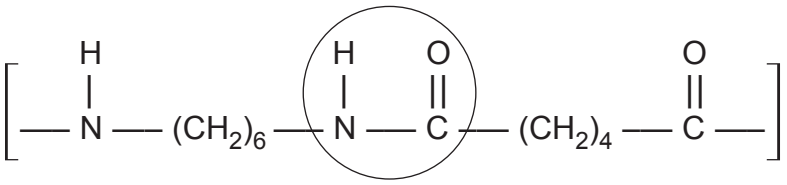
(b)



Structure [2]

(c) (i) (polymerisation involves) loss of water/small molecule [1]

(ii)



structure [2]
peptide link [1] [3]

(d) polyesters are biodegradable [1]
as they can be hydrolysed [1] [2]

(e) (i) sequence of amino acids [1]

(ii) lock and key/active site [1]
lowers activation energy/lower energy pathway [1] [2] 17

Section B 100

Total 120