



Rewarding Learning

ADVANCED
General Certificate of Education
2011

Chemistry

Assessment Unit A2 2

assessing

Analytical, Transition Metals, Electrochemistry
and Further Organic Chemistry

[AC222]

FRIDAY 27 MAY, AFTERNOON

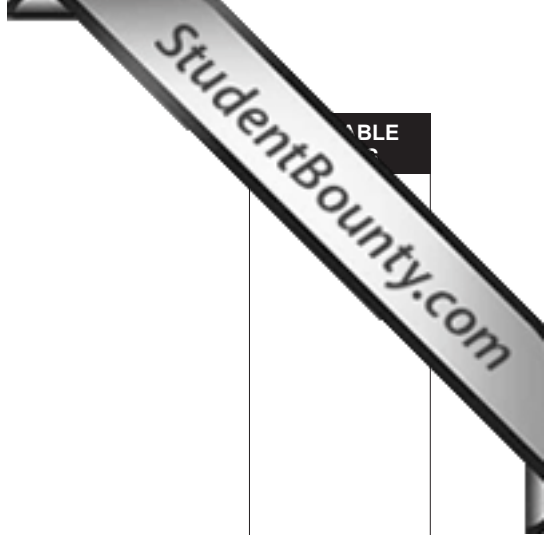
MARK SCHEME

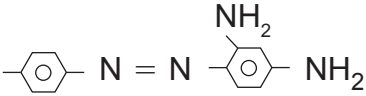
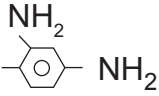
Section A

- 1 D
- 2 B
- 3 B
- 4 C
- 5 D
- 6 B
- 7 B
- 8 B
- 9 D
- 10 C

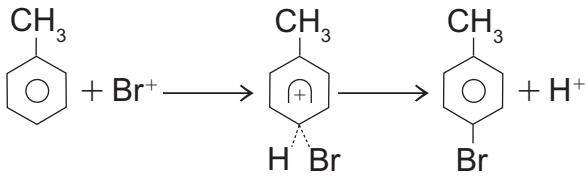
[2] for each correct answer

| | |
|------------------|-----------|
| [20] | 20 |
| Section A | 20 |
| | |



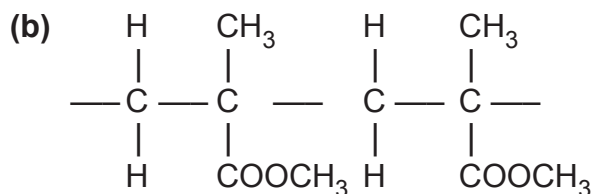
- 12 (a) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$ [1]
half-filled d subshell stable [1] [2]
- (b) moles Al = $25/27 = 0.926$
moles $Cr_2O_3 = 100/152 = 0.658$
2 moles Al = 1 mole Cr_2O_3 therefore Cr_2O_3 in excess
1 mole Al = 1 mole Cr
0.926 mole Al = 0.926 mole Cr
mass Cr = $0.926 \times 52 = 48.15$ g
% yield = $42.5 \times 100/48.15 = 88.3\%$
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]
 $K_2SO_4 \cdot Cr_2(SO_4)_3 \cdot 24H_2O$ [2]
- (f) (i) $C_6SN_2H_8O_2$ [1]
(ii) sodium nitrite and hydrochloric acid [1]
(iii) $\leq 10^\circ C$ [1]
diazonium ion decomposes above this [1] [2]
- (iv) H_2NSO_2  $N=N$  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]

- 13 (a) CH_3COO^+ [1]
- (b) (i) { ratio 2:3:3 or 3:2:3 [1]
 $\text{CH}_3:\text{CH}_2:\text{CH}_3/\text{no. of Hs in each environment}$ [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) $\text{CH}_3\text{COOH} + \text{NH}_3 \rightarrow \text{CH}_3\text{COONH}_4$ [1]
- (ii) $\text{CH}_3\text{COONH}_4 \rightarrow \text{CH}_3\text{CONH}_2 + \text{H}_2\text{O}$ [1]
- (iii) acid: CH_3COOH [1]
 alkaline: CH_3COONa [1] [2]
- (d) (i) A: P_4O_{10} [1]
 B: LiAlH_4 [1] [2]
- (ii) $\text{RNH}_2 + \text{CH}_3\text{COCl} \rightarrow \text{CH}_3\text{CONHR} + \text{HCl}$ [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) $[\text{Ni}(\text{H}_2\text{O})_6]^{2+} + 3\text{en} \rightarrow [\text{Ni}(\text{en})_3]^{2+} + 6\text{H}_2\text{O}$ [2]
 unbalanced [1]
- (iii) increase in entropy [1]
 4 particles to 7 particles [1] [2]

- 14 (a) $\text{Fe}^{2+}: 1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$ [1]
 $\text{Fe}^{3+}: 1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$ [1] [2]
- (b) molecules adsorbed/attached to surface [1]
 weakens bonds/alignment/bonds formed with surface [1]
 lowers activation energy [1] [3]
- (c) (i)  [3]
- 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) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$ [1]
- (f) (i) thiocyanate ions/hydroxide ions/ $\text{NH}_3(\text{aq})$ [1]
 blood red/rust/brown [1]
 solution/ppt [1] [3]
- (ii) 1 mole $\text{MnO}_4^- = 5$ moles Fe^{2+}
 2 moles $\text{MnO}_4^- = 5$ moles $\text{C}_2\text{O}_4^{2-}$
 $\Rightarrow 3$ moles $\text{MnO}_4^- = 5$ 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 $\text{MnO}_4^- = 8.05 \times 10^{-4} \times \frac{5}{3}$
 $= 1.34 \times 10^{-3}$ in 25.0 cm^3
 Concentration $\text{MnO}_4^- = 1.34 \times 10^{-3} \times 40 = 0.0536$
 $= 0.054 \text{ mol dm}^{-3}$
 Award [4] directly for correct answer
 Each error [-1], carry error through [4]

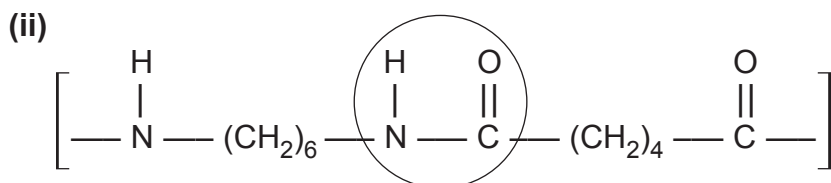
| | | | |
|------------|--|--------------------------------|-----|
| 15 (a) (i) | Ziegler | Philips | |
| | 50–75° | 150–180° | [1] |
| | 1–10 atms./low | 30–40 atms. | [1] |
| | TiCl ₄ /aluminium (Ziegler catalyst) | Cr ₂ O ₃ | [1] |
| | | | [3] |

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



Structure [2]

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



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]

Section B

100

Total

120

17