



*Rewarding Learning*

**ADVANCED**  
**General Certificate of Education**  
**2014**

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## **Chemistry**

**Assessment Unit A2 1**

*assessing*

Periodic Trends and Further Organic,  
Physical and Inorganic Chemistry

**[AC212]**

**FRIDAY 23 MAY, MORNING**

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**MARK  
SCHEME**

## General Marking Instructions

### Introduction

Mark schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

### The purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of students in schools and colleges.

The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes, therefore, are regarded as part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

## Section A

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

[2] for each correct answer

[20]

**Section A**

**AVAILABLE  
MARKS**

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**20**

## Section B

11	MgO	slight reaction	10–13	ionic
	Al <sub>2</sub> O <sub>3</sub>	no reaction	–	ionic
	SiO <sub>2</sub>	no reaction	–	covalent
	P <sub>4</sub> O <sub>10</sub>	vigorous	0–2	covalent
	SO <sub>3</sub>	vigorous	0–2	covalent
	Cl <sub>2</sub> O <sub>7</sub>	vigorous	0–2	covalent

[–1] for each mistake

[8]

8



[2]

(ii) filter  
retain filtrate

[1]

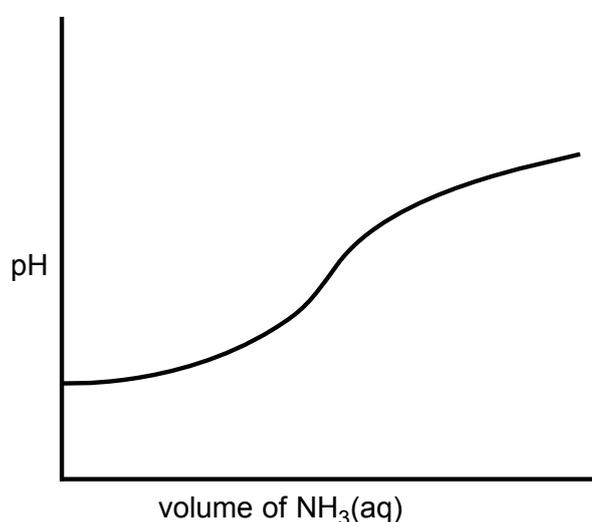
[1] [2]

(b) ammonium cyanide formed on cooler part of tube  
hence exothermic

[1]

[1] [2]

(c) (i)



[3]

Accept reverse curve if x-axis is 'volume of HCN'

(ii) there is no vertical section on the titration curve  
hence no (distinct) colour change

[1]

[1] [2]

(d) addition of OH<sup>–</sup>  $\text{NH}_4^+ + \text{OH}^- \rightarrow \text{NH}_3 + \text{H}_2\text{O}$   
addition of H<sup>+</sup>  $\text{CN}^- + \text{H}^+ \rightarrow \text{HCN}$   
explanation of buffering

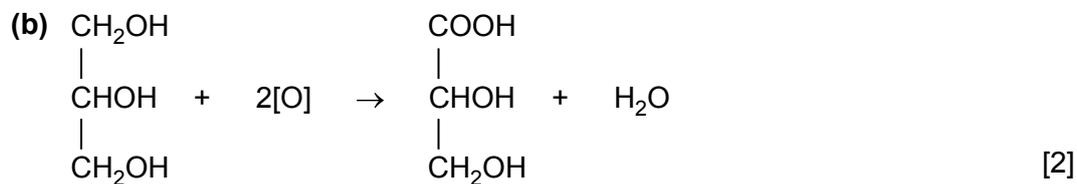
[1]

[1]

[1] [3]

14

- 13 (a) (i) tartronic acid + mesoxalic acid [2]
- (ii) glyceraldehyde + glyceric acid [2]
- (iii) glyceraldehyde + dihydroxyacetone + mesoxalic acid [2]
- (iv) glycerol + glyceraldehyde + glyceric acid + dihydroxyacetone [2]

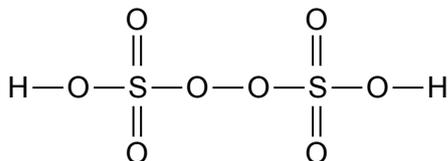


- (c) 2,3-dihydroxypropanoic acid [2]

AVAILABLE  
MARKS

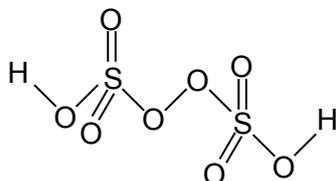
16

14 (a)



[2]

or



- (b) alkaline [1]  
strong base + (weak acid) [1] [2]
- (c) sulfur from +7 to +6 [1]  
iodine from -1 to 0 [1]  
sulfur is reduced and iodine is oxidised [1] [3]
- (d) (i) take samples at set time intervals [1]  
quench the reaction mixture/add water (to stop the reaction) [1]  
Either Titrate against standard  $\text{Na}_2\text{S}_2\text{O}_3$  (aq)  
or Add  $\text{AgNO}_3$ (aq) and weigh precipitate  
or Colorimetry  $\text{I}_2$  [1]  
plot graph of  $[\text{I}^-]/[\text{I}_2]$  against time [1]  
measure gradient to find rate [1]  
to a maximum of [5] [5]
- Quality of written communication [2]
- (ii) persulfate is first order [1]  
iodide is first order [1] [2]
- (iii) rate =  $k[\text{S}_2\text{O}_8^{2-}][\text{I}^-]$  [2]
- (iv) order is the sum of the (individual) orders = 2 [1]
- (v)  $0.18 = k \times 0.05 \times 0.05 = k \times 25 \times 10^{-4}$   
 $k = 72$  [1]  
 $[\text{ ] s}^{-1} = k[\text{ ]} \times [\text{ ]}$   
 $k = [\text{ ]}^{-1} \times \text{s}^{-1} = \text{mol}^{-1}\text{dm}^3 \text{s}^{-1}$  [1] [2]

AVAILABLE  
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- 15 (a) (i)** e.g. the enthalpy change for a reaction is independent of the route taken, provided the initial and final conditions are the same. [2]
- (ii)**  $2\text{NH}_3 + 1\frac{1}{2}\text{O}_2 \rightarrow \text{N}_2 + 3\text{H}_2\text{O}$  -766
- $3\text{H}_2\text{O} \rightarrow 3\text{H}_2 + 1\frac{1}{2}\text{O}_2$  + 3 × 286
- $2\text{NH}_3 \rightarrow \text{N}_2 + 3\text{H}_2$   $\Delta H = -766 + 858 = +92$  kJ  
molar value = +46 kJ [2]
- (b)** bonds broken = 6N—H = 6 × 388 = +2328  
bonds formed = 1N≡N + 3H—H = 944 + 3×436 = 944 + 1308  
= -2252  
 $\Delta H = +2328 - 2252 = +76$   
molar value = +38 kJ [2]
- (c)** entropy change =  $(191.6 + 3 \times 130.7) - 2 \times 192.8$   
= 191.6 + 392.1 - 385.6  
= +198.1 JK<sup>-1</sup>mol<sup>-1</sup>  
molar value = 99.05 JK<sup>-1</sup>mol<sup>-1</sup> [2]
- (d) (i)**  $\Delta G = \Delta H - T\Delta S$  [1]
- (ii)** processes are spontaneous/feasible when free energy change is negative [1]
- (iii)**  $\Delta H = T\Delta S$  38000 = T × 99.05      or      46000 = T × 99.05  
T = 383.6 K or 110.6 °C      or      T = 464 K or 191 °C [2]
- (e) (i)** ammonium nitrate leads to growth of vegetation  
vegetation eventually dies  
removes oxygen from the water [3]
- (ii)** artificial [1]
- (iii)** known/controlled concentrations of NPK/easier to store/spread [1]
- (iv)** no harmful chemicals/cheap/free/less soluble/less easily leached [1]
- (v)** use limited amounts on fields/do not apply when raining/do not apply near streams/rivers [1]  
analyse river samples for nitrate levels [1] [2]

AVAILABLE  
MARKS

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- 16 (a) (i) cholesterol impure [1]
- (ii) the sample is not cholesterol [1]
- (b) (i) mono is one [1]  
hydric is an -OH group [1] [2]
- (ii) secondary because carbon with OH group is attached to two other carbons [1]
- (c) (i) A hydrogen (and nickel catalyst) [1]  
B potassium dichromate and acid [1]  
C lithal/lithium aluminium hydride [1] [3]
- (ii) large hydrocarbon structure prevents solubility [1]  
C=O and -OH group can both form hydrogen [1]  
bonds with water [1]  
The O and H of OH can both form H-bonds with water [1]  
whereas only the O of C=O can do so [1] [3]
- (iii)
- $$\begin{array}{c} \diagup \\ \text{C}=\text{O} \\ \diagdown \end{array} + \text{NH}_2\text{NH}-\text{C}_6\text{H}_3(\text{NO}_2)_2 \rightarrow \begin{array}{c} \diagup \\ \text{C}=\text{NNH}-\text{C}_6\text{H}_3(\text{NO}_2)_2 \\ \diagdown \end{array} + \text{H}_2\text{O}$$
- [3]
- (d) (i) cholesteryl ethanoate/acetate [1]
- (ii)  $\text{ROH} + \text{CH}_3\text{COOH} \rightleftharpoons \text{CH}_3\text{COOR} + \text{H}_2\text{O}$  [2]
- (iii) concentrated sulfuric acid [1]
- (iv) ethanoyl chloride [1]  
 $\text{ROH} + \text{CH}_3\text{COCl} \rightarrow \text{CH}_3\text{COOR} + \text{HCl}$  [2] [3]

AVAILABLE  
MARKS

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Section B

100

Total

120