Rewarding Learning

**ADVANCED**
**General Certificate of Education**
**2017**

# Chemistry

## Assessment Unit A2 1

*assessing*

Periodic Trends and Further Organic, Physical and Inorganic Chemistry

**[AC212]**

**TUESDAY 13 JUNE, AFTERNOON**

# 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 the 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 the 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

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

## Section B

AVAILABLE MARKS

**11 (a)**

| | MgO | $Al_2O_3$ | $P_4O_{10}$ | $MgCl_2$ |
|---|---|---|---|---|
| **type of bonding** | ionic | ionic | covalent | ionic |
| **approximate pH of aqueous solution, if formed** | 8–10 | insoluble/7 | 0–3 | 6–7 |

([–1] for each mistake) [4]

**(b) (i)** $MgO + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2O$ [1]

**(ii)** $Al_2O_3 + 2NaOH + 3H_2O \rightarrow 2NaAl(OH)_4$ [1]

**(iii)** $P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4$ [1]

**(iv)** $PCl_5 + H_2O \rightarrow POCl_3 + 2HCl$ [1]
or
$PCl_5 + 4H_2O \rightarrow H_3PO_4 + 5HCl$

**(c) (i)** The enthalpy change when one mole of an ionic compound is converted to gaseous ions. [2]

**(ii)** $-170 = 2489 + (-1891) + 2Cl^-$
$2Cl^- = -170 - 2489 + 1891 = -768$
$Cl^- = -384$ (kJ $mol^{-1}$) [2] 12

**12 (a) (i)** $Bi_2(CO_3)_3 + 6HCl \rightarrow 2BiCl_3 + 3H_2O + 3CO_2$ [2]

**(ii)** Equilibrium moves to the right [1]
Removing the additional water [1] [2]

The sodium hydroxide removes the hydrochloric acid [1]
Equilibrium moves to the right (to replace the hydrochloric acid) [1] [2]

**(b)**

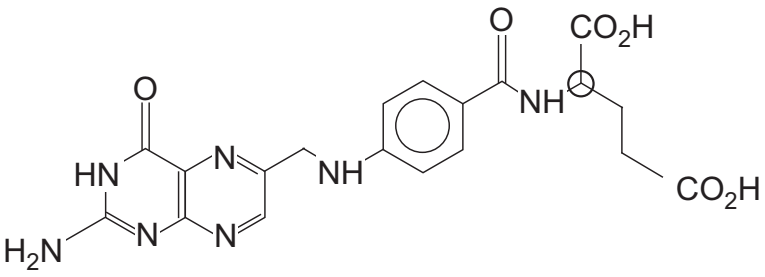
| | $2SO_2(g)$ | + $O_2(g)$ | $\rightleftharpoons$ | $2SO_3(g)$ |
|---|---|---|---|---|
| Initial | 2 | 1 | | 0 |
| Final | 0.50 | 0.25 | | 1.50 |
| Conc. | 0.25 | 0.125 | | 0.75 |

$K_c = (0.75)^2/(0.25)^2(0.125) = 72$ [3]
Units = $mol^{-1}$ $dm^3$ [1] [4] 10

**13 (a) (i)** Respiration – increases concentration of $CO_2$
Photosynthesis – decreases the concentration of $CO_2$
Solubility (some $CO_2$ dissolves in water) decreases its concentration [3]

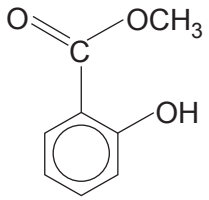
**(ii)** They absorb [1] infrared radiation [1] [2]

**(b)** It is present at a much higher concentration/more of it (in the atmosphere) [1] 6

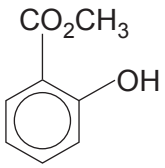
| | | | | AVAILABLE MARKS |
|---|---|---|---|---|
| **14** | **(a)** | A measure of disorder (randomness) | [1] | |
| | **(b)** | **(i)** They are elements (in their standard state) | [1] | |
| | | **(ii)** $\Delta H - 822 = 3(-242)$<br>$\Delta H = 96$ (kJ $mol^{-1}$) | [2] | |
| | | **(iii)** $\Delta S = (2 \times 0.03) + (3 \times 0.19) - (0.09 + 3 \times 0.13)$<br>$= 0.06 + 0.57 - (0.09 + 0.39)$<br>$= 0.63 - 0.48$<br>$= 0.15$ (kJ $mol^{-1}$ $K^{-1}$) | [2] | |
| | | **(iv)** $T\Delta S = \Delta H$ or $T = 96/0.15 = 640$ K (or 367 °C) | [2] | |
| | | **(v)** The activation energy is too high | [1] | 9 |
| **15** | **(a)** | **(i)** Asymmetric: A carbon which has four different atoms or groups attached | [1] | |
| | | **(ii)** Optically active: A sample which rotates the plane [1] of plane polarised light [1] | [2] | |
| | | **(iii)**  | [1] | |
| | **(b)** | **(i)** $C_{19}H_{19}N_7O_6$ | [1] | |
| | | **(ii)** $0.0061/441 = 1.38 \times 10^{-5}$ | [2] | |
| | **(c)** | **(i)** It has two –COOH groups | [1] | |
| | | **(ii)** $pK_a = 4.65$<br>$K_a = 2.24 \times 10^{-5}$<br>$[H^+]^2 = (2.24 \times 10^{-5}) \times (1 \times 10^{-5}) = 2.24 \times 10^{-10}$<br>$[H^+] = 1.5 \times 10^{-5}$<br>pH = 4.8 | [3] | 11 |

AVAILABLE MARKS

**16 (a) (i)**



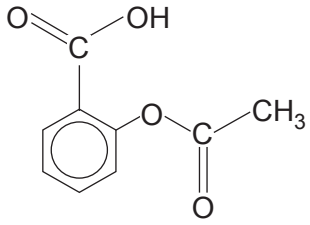

or




[1]

**(ii)** methyl salicylate [1]

**(iii)**

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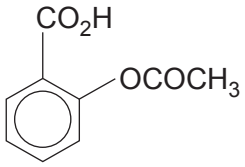


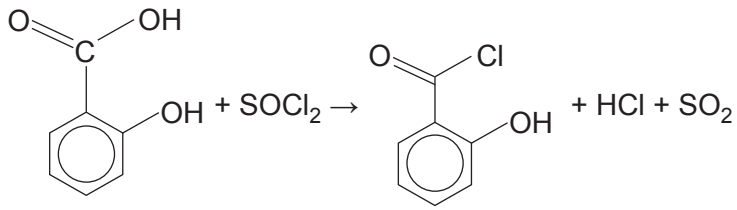

[1]

**(iv)** Ethanoyl chloride [1]
reacts at room temperature/reaction goes to completion [1] [2]

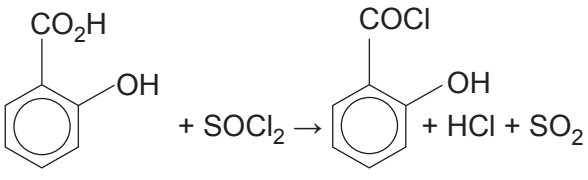
**(b) Removal of acidic impurities using a separating funnel:**
Distil/place the impure distillate in the separating funnel. [1]
The addition of sodium carbonate/sodium hydrogen carbonate solution. [1]
{ The stopper in place.
Shake the apparatus.
Release the pressure at regular intervals. } [1]
or Run off the lower layer.
**Drying**
(Place the impure product in a suitable container.)
Add anhydrous magnesium sulfate/sodium sulfate/calcium chloride [1]
Until the liquid is clear/no longer cloudy.
Decant/filter off the liquid. } [1] [5]

Quality of written communication [2]

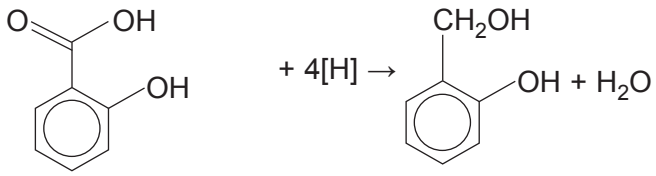
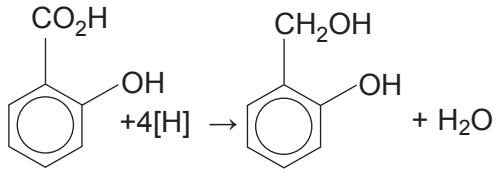
**(c) (i)** Thionyl chloride:

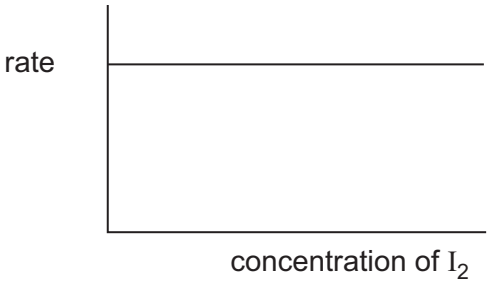


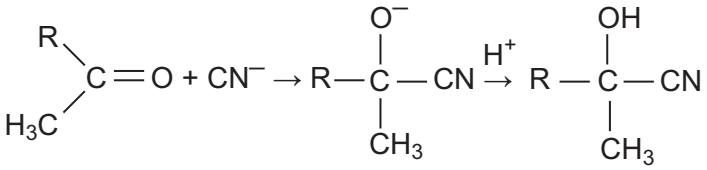
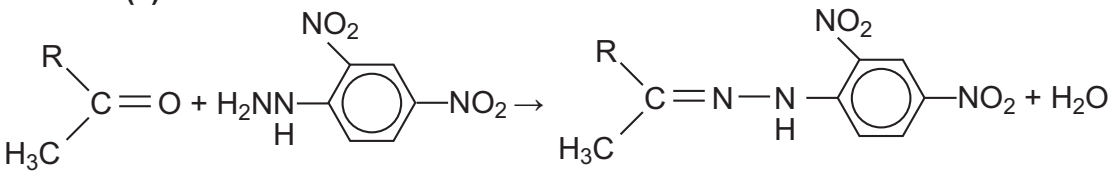

or




(does not react with the phenolic OH but accept if correctly replaced) [2]

| | | | AVAILABLE MARKS |
|---|---|---|---|
| | **(ii)** Lithal | | |
| |   | | |
| | or | | |
| |   | | |
| | | [2] | 16 |
| **17** | **(a)** Palmitic acid has straight chains/Oleic is bent due to the double bond [1]<br>Therefore greater van der Waals forces in palmitic acid [1] | [2] | |
| | **(b)** **(i)** Addition of a hydrogen molecule across C=C . | [1] | |
| | **(ii)** Nickel | [1] | |
| | **(iii)** 1 mole cervonic acid = 6 moles $I_2$<br>328 g cervonic acid = 1524 g $I_2$<br>100 g cervonic acid = 465 g $I_2$ | [3] | |
| | **(c)** Fats are a source of energy/insulation<br>Saturated fats: increase (LDL) 'bad' cholesterol<br>greater risk of heart disease<br>Unsaturated fats: maintain (HDL) 'good' cholesterol<br>reduce (LDL) 'bad' cholesterol<br>reduce heart disease<br>(LDL = Low-density lipoprotein, HDL = High-density lipoprotein) | [3] | 10 |

| | | | | AVAILABLE MARKS |
|---|---|---|---|---|
| 18 | (a) | (i) | Add excess/large amount of water [1] | |
| | | (ii) | Take samples at different times [1]<br>titrate with standard alkali/sodium hydroxide [1]<br>use phenolphthalein/methyl orange [1]<br>Plot volume (conc) against time [1]<br>Take tangents [1]<br>allow for the $H^+$ catalyst with $OH^-$<br>or allow for the $I_2$ with $OH^-$<br>or add $NaHCO_3$ for acid<br>or add $Na_2S_2O_3$ for iodine } [1] [4] | |
| | | (iii) |  [1] | |
| | (b) | (i) | Rate = $k[H_2PO_2^-][OH^-]^2$ [2] | |
| | | (ii) | 3rd Order [1] | |
| | | (iii) | $2.4 = k \times 0.1 \times 0.1^2$<br>$k = 2.4/0.001 = 2.4 \times 10^3$ [1]<br>unit = $mol^{-3}\ dm^9\ cm^3\ min^{-1}$ [1] [2] | |
| | | (iv) | Disadvantages: May pollute water/contamination of water leading to eutrophication [1]<br>More expensive (with comparison) [1] | 13 |

| | | AVAILABLE MARKS |
|---|---|---|
| **19** **(a)** Pentanedial/pentan-1,5-dial [1] | | |
| **(b)** It can form hydrogen bonds with water [1] | | |
| **(c)** **(i)** Blue → red [1] | | |
| **(ii)** $Cu^{2+} \rightarrow Cu^{+}$ [1] | | |
| **(d)** **(i)** $HO(CH_2)_5OH + 2[O] \rightarrow OHC(CH_2)_3CHO + 2H_2O$ | | |
| or | | |
| $HOCH_2(CH_2)_3CH_2OH \rightarrow OHC(CH_2)_3CHO + 2H_2O$ [1] | | |
| **(ii)** Heat [1] | | |
| **(iii)** Orange to green [1] | | |
| **(e)** **(i)**  [3] | | |
| **(ii)**  [2] | | |
| **(iii)** Determine the melting point and compare to known data. [1] | | 13 |
| **Section B** | | **100** |
| **Total** | | **120** |