Rewarding Learning

ADVANCED
General Certificate of Education
2022

Chemistry

Assessment Unit A2 1
assessing
Further Physical and Organic Chemistry

[ACH14]

MONDAY 30 MAY, MORNING

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. The document 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.

COVID-19 Context

Given the unprecedented circumstances presented by the COVID-19 public health crisis, senior examiners, under the instruction of CCEA awarding organisation, are required to train assistant examiners to apply the mark scheme in case of disrupted learning and lost teaching time. The interpretation and intended application of the mark scheme for this examination series will be communicated through the standardising meeting by the Chief or Principal Examiner and will be monitored through the supervision period. This paragraph will apply to examination series in 2021–2022 only.

Section A

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

Section B

11 **(a)** **(i)** $k = 4.96 \times 10^{-4}$ [1] $mol^{-1} dm^3 s^{-1}$ [1] [2]

(ii)

Experiment	$[H_2O_2]$ /mol dm^{-3}	$[H^+]$ /mol dm^{-3}	$[I^-]$ /mol dm^{-3}	Initial rate of reaction /mol dm^{-3} s^{-1}
1				
2				4.96×10^{-6} [1]
3			0.075 [1]	
4			0.00625 [1]	

[3]

(b) **Indicative Content**

- prepare a range of samples of different concentrations of iodine
- calibrate the colorimeter (using an appropriate filter and a blank solution)
- record the absorbance of each solution of known concentration
- draw a calibration curve of absorbance against concentration
- place reaction mixture in colorimeter and record the absorbance at different times
- use the calibration curve to convert absorbance to concentration
- plot concentration of iodine against time
- rate = gradient of tangent at t = 0s

Band	Response	Mark
A	Candidates must use appropriate specialist terms using at least **7 points** of indicative content. They must use good spelling, punctuation and grammar and the form and style are of an excellent standard.	[5]–[6]
B	Candidates must use appropriate specialist terms using at least **5 points** of indicative content. They must use satisfactory spelling, punctuation and grammar and the form and style are of a good standard.	[3]–[4]
C	Candidates must use at least **3 points** of indicative content. They use limited correct spelling, punctuation and grammar and the form and style are of a basic standard.	[1]–[2]
D	Response not worthy of credit.	[0]

[6]

(c) **(i)** both H_2O_2 and I^- are in rate equation/H^+ not in rate equation [1]

(ii) ions attracted to each other/oppositely charged ions are present [1]

(iii) iodate(I) [1]

AVAILABLE MARKS: 14

AVAILABLE MARKS

12 (a) (i) $\Delta S = 26.9 - (32.7 + 102.5)$
$\Delta S = 26.9 - 135.2$
$\Delta S = -108.3$ ($J\,K^{-1}\,mol^{-1}$) [2]

(ii) $\Delta G = \Delta H - T\Delta S$ [1]

(iii) $\Delta G = -602 - (298 \times -0.1083)$
$\Delta G = -602 + 32.2734$
$\Delta G = -569.727 = -570\,kJ\,mol^{-1}$ [3]

(iv) ΔG is negative/less than 0 [1]

(b) (i) the enthalpy change when one mole of an ionic compound is converted to gaseous ions [2]

(ii) $-602 + \Delta_{latt}H = 657 + 249 + 2189 + 148$
$-602 + \Delta_{latt}H = 3243$
$\Delta_{latt}H = +3845\,kJ\,mol^{-1}$ [2]

(iii) $O^{-}(g) + e^{-} \rightarrow O^{2-}(g)$ [1]
endothermic as there is repulsion between negative ion and electron [1] [2]

(c) (i) **A** = lattice enthalpy (of magnesium oxide) [1]
B = hydration enthalpy of magnesium ions [1] [2]

(ii) magnesium oxide (virtually) insoluble in water/the oxide ion reacts with water to form hydroxide ions/no hydration enthalpy for the oxide ion [1] 16

13 (a) (i) $C_6H_6 + Br_2 \rightarrow C_6H_5Br + HBr$ [1]
$CH_2CHCH_3 + Br_2 \rightarrow CH_2BrCHBrCH_3$ [1] [2]

(ii)

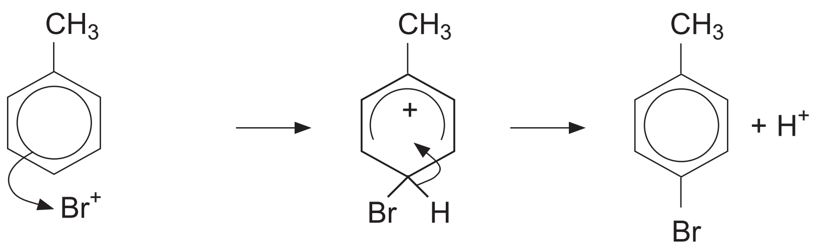
	Reaction of bromine with benzene	**Reaction of bromine with propene**
Name of mechanism	electrophilic substitution [1]	electrophilic addition [1]
IUPAC name of product	bromobenzene [1]	1,2-dibromopropane [1]

[4]

(iii) pi delocalised electron ring/system in benzene [1]
gives enhanced stability [1] [2]

(b) (i) reagent: chloromethane [1]
catalyst: aluminium chloride [1] [2]

(ii) $FeBr_3 + Br_2 \rightarrow FeBr_4^- + Br^+$

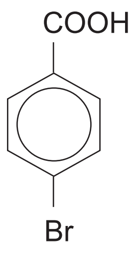


$FeBr_4^- + H^+ \rightarrow FeBr_3 + HBr$ [5]

(iii) radical substitution [1]

(iv) acidified potassium dichromate(VI) [1]
heat [1] [2]

(v)

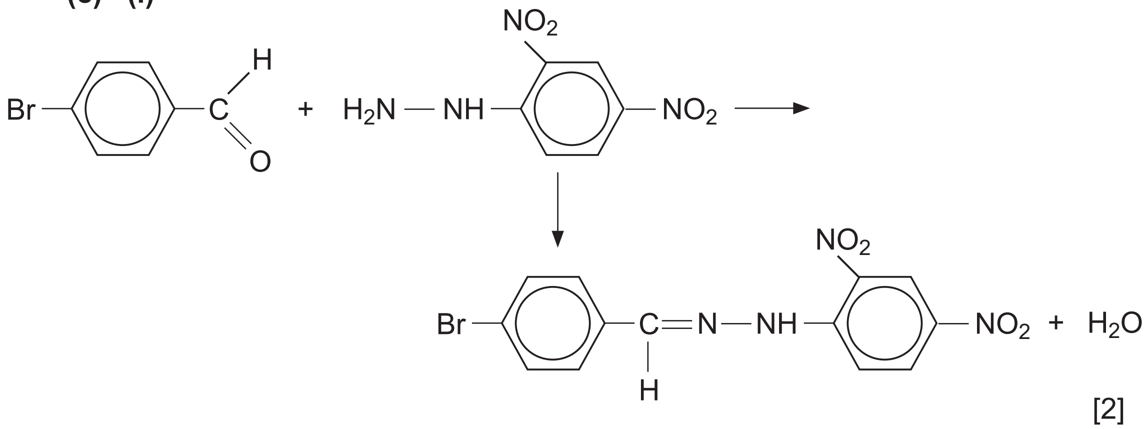


[1] 4-bromobenzoic acid [1]

[2]

AVAILABLE MARKS

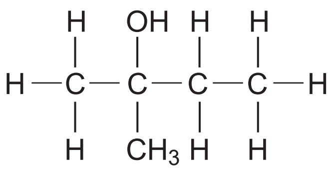
(c) (i)



[2]

(ii) determine melting point [1]
compare to data book [1] [2] 24

14 (a) (i)

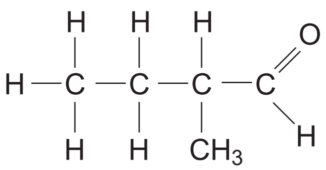
Structural formula	Classification	IUPAC name
		2-methylbutan-1-ol [1]
	secondary [1]	
 [1]		2-methylbutan-2-ol [1]
		3-methylbutan-2-ol [1]

[5]

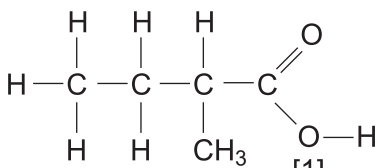
(ii) a sample which rotates the plane of plane polarised light [2]

(iii) 2-methylbutan-1-ol pentan-2-ol 3-methylbutan-2-ol [2]

(iv) 2-methylbutan-1-ol [1]

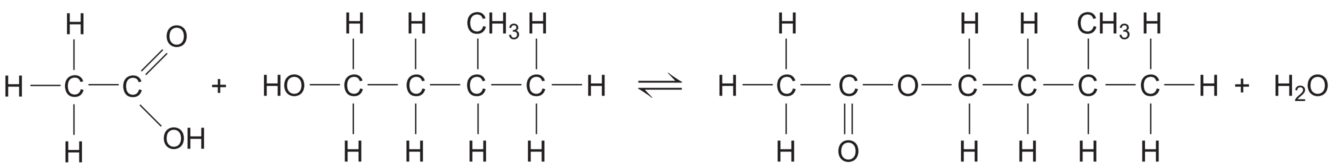


or



[1] [2]

(b) (i)



[2]

(ii) indicative content:

- place the impure distillate in a separating funnel
- add sodium carbonate/sodium hydrogencarbonate solution
- stopper and shake
- release pressure
- separate the layers
- add anhydrous magnesium sulfate/sodium sulfate/calcium chloride
- until the liquid is clear/no longer cloudy
- decant the liquid/filter off solid

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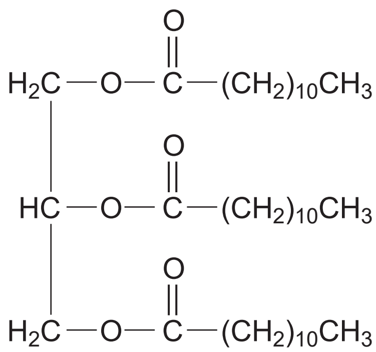
[6]

(c) (i)

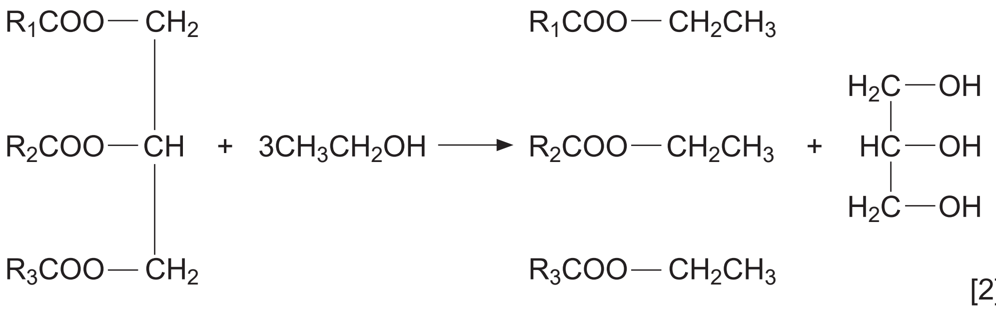


[1]

(ii) glyceryl trilaurate has a high RFM/RMM [1]
strong van der Waals' forces between molecules [1] [2]

(iii) a reaction where the alkyl group of an ester is exchanged with the alkyl group of an alcohol [2]

(iv)



[2]

AVAILABLE MARKS

26

	AVAILABLE MARKS

15 (a) (i) hydrogen bonds [1]
between the –COOH groups in adjacent molecules require substantial energy to break [1]
(2nd mark dependent on the first) [2]

(ii) moles of succinic acid = 58.0/118 = 0.492 M [2]

(b) (i) $K_a = \dfrac{[H^+][HOOCCH_2CH_2COO^-]}{[HOOCCH_2CH_2COOH]}$ [1]

(ii) $K_a1 = 10^{(-4.3)} = 5.012 \times 10^{-5}$

$\dfrac{[H^+]^2}{0.100} = 5.012 \times 10^{-5}$

$[H^+]^2 = 5.012 \times 10^{-6}$

$[H^+] = 2.239 \times 10^{-3}$

$pH = -\log_{10}(2.239 \times 10^{-3}) = 2.65$ [3]

(c)

	$C_6H_{10}O_4$	$2H_2O$	$\rightleftharpoons$	$C_4H_6O_4$	$2CH_3OH$
initial	2.0	5.0		0	0
	–0.6	–1.2		+0.6	+1.2
equilibrium	1.4	3.8		0.6	1.2

$K_c = \dfrac{[C_4H_6O_4][CH_3OH]^2}{[C_6H_{10}O_4][H_2O]^2} = \dfrac{(0.6)(1.2)^2}{(1.4)(3.8)^2} = 0.042738 = 0.043$ [4]

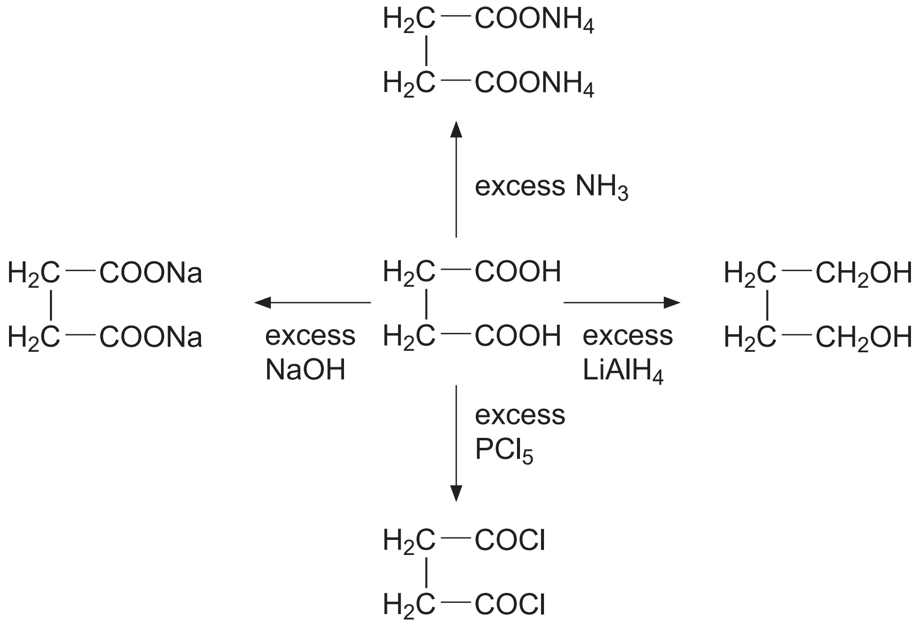
(d) $[H^+] = 10^{(-4.80)} = 1.585 \times 10^{-5}\,mol\,dm^{-3}$

$[CH_3COO^-] = \dfrac{K_a \times [CH_3COOH]}{[H^+]} = \dfrac{1.74 \times 10^{-5} \times 0.100}{1.585 \times 10^{-5}} = 0.1098\,mol\,dm^{-3}$

moles in 250 cm^3 = 0.1098/4 = 0.02745

mass of sodium ethanoate = 0.02745 × 82 = 2.25 g [4]

(e)



[4]

	AVAILABLE MARKS
	20
Section B	**100**
Total	**110**