Published Mark Schemes for GCE AS Chemistry

Summer 2009

Issued: October 2009

MARK SCHEMES (2009)

Foreword

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 16 and 18-year-old 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 a 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.

The Council hopes that the mark schemes will be viewed and used in a constructive way as a further support to the teaching and learning processes.

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Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2009

Chemistry

Assessment Unit AS 1

assessing

Module 1: Basic Concepts in Physical and Inorganic Chemistry

[AC111]

WEDNESDAY 3 JUNE, MORNING

MARK SCHEME

Section A

1 A

2 B

3 C

4 A

5 D

6 A

7 D

8 C

9 B

10 B

[2] for each correct answer [20] 20

Section A **20**

Section B

11 (a)

Molecule	Attractive force
Ammonia	Hydrogen bonds
Hydrogen chloride	Dipole-Dipole
Methane	Van der Waals

[1] each [3]

(b) More/longer/fixed Hydrogen bonds (between the water molecules) [1]
give ice a more open structure (and so a lower density) [1] [2]

(c)

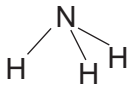


Diagram [1]
Repulsion between electron pairs [1]
Mention of **four** pairs or comment on lone pair [1] [3] 8

12 (a)

	Number of protons	Number of electrons	Number of neutrons
Neon-20	10	10	10
Neon-21	10	10	11
Neon-22	10	10	12

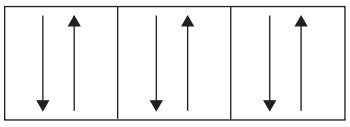
[–1] for each mistake [2]

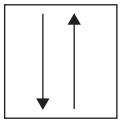
(b) $$\frac{(20 \times 90.92) + (21 \times 0.26) + (22 \times 8.82)}{100}$$

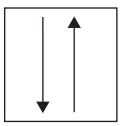
= 20.18
[–1] for each mistake [2]

(c) Carbon-12 isotope [1]

(d)

2p 

2s 

1s 

Subshell labels [1] electronic arrangement [1]
[–1] for each mistake [2]

(e)

s orbital p orbital
[1] each [2] 9

13 (a) $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$
[2], [–1] for each mistake [2]

(b) A solution of known concentration [1]

(c) (2 x 20)/1000 = 0.04 mole
(0.1 x 18.6)/1000 = 0.00186 mole
0.0186
0.04 – 0.0186 = 0.0214
(0.0214/2) x 100 = 1.07(g)
(1.07/1.12) x 100 = 95.5%
[–1] for each mistake [6]

(d) phenolphthalein/methyl orange [1]
from colourless [1] to pink/from red [1] to yellow [1] [3] 12

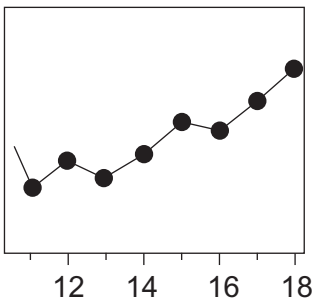
14 (a) (i) Atomic number [1]

(ii) Their (outer) electrons are in the d-subshell [1]

(b) (i) Melting point increases to silicon [1]
then decreases (to argon) [1] [2]

(ii) Atomic radius decreases across the period [1]
Shielding remains the same but nuclear charge increases [1] [2]

(iii)



General rise across the period [1]
Fall between Groups 2 and 3 [1]
Fall between Groups 5 and 6 [1] [3] 9

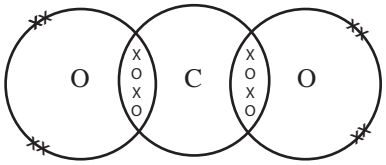
15 **(a)** **(i)** Pair(s) of electrons shared between (two) atoms [1]

(ii) Diamond: Carbon atoms joined to 4 others [1] tetrahedrally [1]
Graphite: hexagonal rings of carbon atoms [1] in layers [1] [4]

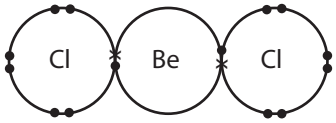
(iii) Free electrons [1] are able to move [1] around the layers [2]

(iv) Strong (covalent) bonds [1] throughout the giant (tetrahedral) structure [1]

(b) **(i)**



[–1] for each mistake [1]



[–1] for each mistake [1]

(ii) Octet rule: eight electrons in the outer shell (when bonded) [1]
Be (has less than 8) in beryllium chloride/has only 4 electrons in its outer shell [1] [2] 12

16 **(a)** **(i)** Sodium: nichrome wire [1]/(conc HCl) blue flame [1]/yellow [1]
Chloride: (make a solution) silver nitrate [1] white precipitate [1]
or dissolve in HNO_3 [1] (solution) [5]

Quality of written communication [2]

(ii) $Na^+ \cdot \underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}: \rightarrow Na^+ \times \underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}:^-$ [4]

(b) **(i)** In the solution the ions are free to move, (they cannot move in the solid) [1]

(ii) Chlorine atoms are both oxidised (0 to +1) [1] and reduced (0 to –1) [1] this is disproportionation [1] [3]

(iii) Colourless solution [1]
turns yellow [1] [2]

(iv) $Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$ [1]

	(c)	**(i)** $H_2SO_4 + NaCl \rightarrow NaHSO_4 + HCl$ (–1 if Na_2SO_4)	[2]	
		(ii) Steamy fumes/purple vapour/yellow solid/fizzing/heat evolved/ grey-black solid/ rotten egg smell/choking gas (SO_2) any **two**, [1] each	[2]	22
17	**(a)**	Level 2 to level 1 [1] indication of downwards [1]	[2]	
	(b)	An electron leaves the atom/energy levels come together	[1]	
	(c)	**(i)** $H(g) \rightarrow H^+(g) + e^-$ (–1 for each mistake)	[2]	
		(ii) $3 \times 10^8 = 91.1 \times 10^{-9} \times$ frequency 3.29×10^{15}	[1]	
		(iii) $E = hf = (6.63 \times 10^{-34}) \times (3.29 \times 10^{15}) = 2.18 \times 10^{-18}$ [1] $(2.18 \times 10^{-18}) \times (6.02 \times 10^{23}) = 1314\,kJ\,mol^{-1}$ [1]	[2]	8
			Section B	**80**
			Total	**100**

Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2009

Chemistry

Assessment Unit AS 2

assessing

Module 2: Further Physical and Inorganic Chemistry and Introduction to Organic Chemistry

[AC121]

THURSDAY 11 JUNE, AFTERNOON

MARK SCHEME

Quality of written communication:

2 marks The candidate expresses ideas clearly and fluently through well-linked s and paragraphs. Arguments are generally relevant and well-structured. The few errors of grammar, punctuation and spelling.

1 mark The candidate expresses ideas clearly, if not always fluently. Arguments may sometimes stray from the point. There may be some errors of grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.

0 marks The candidate expresses ideas satisfactorily, but without precision. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling are sufficiently intrusive to disrupt the understanding of the passage.

Section A

1 A

2 C

3 D

4 D

5 C

6 B

7 B

8 C

9 B

10 B

[2] for each correct answer [20] 20

Section A **20**

Section B

11 copper sulphate [1]
sulphuric acid [1]
sodium chromate [1]
potassium sulphate [1] [4] 4

12 **(a)** reaction is endothermic + mention of high temperature [1]
reaction moves to RHS to absorb heat [2]
increased temperature speeds up reaction [1]
To a maximum of [3] [3]

(b) Comment/statement on formula for % atom economy [2]

$CH_4(g) + 2H_2O(g) \rightarrow CO_2(g) + 4H_2(g)$
16 36 44 8

$$\frac{8}{52} \times 100 = 15.4\% \quad [2]$$

atom economy very low [1]
(no problem with disposal of carbon dioxide [1])
except that it causes global warming [1]
need to find a use for the carbon dioxide [1]
large amount of waste produced [1]
To a maximum of [4] [4]

(c) energy needed to break bonds in reactants
4C—H = 4 × 413 = 1652
4O—H = 4 × 464 = 1856 total = 3508

energy needed to break bonds in products
2C═O = 2 × 805 = 1610
4H—H = 4 × 436 = 1744 total = 3354

+3508 – 3354 = (+)154 kJ [3]

(d) high pressure (is expensive to maintain/thicker pipes needed) [1]
high temperature/endothermic (needs fuel which is expensive) [1] [2]

(e) **(i)** carbon monoxide is poisonous [1]

(ii) use an excess of water/steam [1]

(iii) $1CH_4 \rightarrow 3H_2$
16 g → 3 × 24 dm^3
16 tonnes → $10^6 \times 3 \times 24\ dm^3$
4 tonnes → $10^6 \times 3 \times 6\ dm^3$
= $1.8 \times 10^7\ dm^3$ [3] 17

13 **(a)** **(i)** conc. ammonia [1]
white smoke [1] [2]

(ii) $CH_3OH + HCl \rightarrow CH_3Cl + H_2O$ [1]

(iii) the gas would escape from the reaction flask/needs to be condensed/difficult to collect [1]

(b) **(i)** $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$ [1]

(ii) $1s^2 2s^2 2p^6 3s^2 3p^5$ [1]

(iii) provides the energy [1]
to break the Cl—Cl bond [1] [2]

(iv) $^{\cdot}CH_3 + {}^{\cdot}CH_3 \rightarrow C_2H_6$ [1]

(c) $CH_3NH_2/CH_3NH_3^+ Cl^-$ [1]
CH_3OH [1] [2] 11

14 **(a)** **(i)** number of molecules [1]

(ii) no molecules hence no energy [1]

(iii) there are always some molecules with (a higher/some) energy [1]

(iv) the number of particles [1]
with (energy greater than) the activation energy [1] [2]

(b) **(i)** peak moves to the RHS [1]
and is lower [1] [2]

(ii) more particles have (energy greater than) the activation energy [1]

(c) the activation energy is less [1]
the number of particles with the required activation energy is greater [1] [2] 10

15 **(a)** the outer shells contain s electrons [1]

(b) the solubility of the sulphates decreases down the group [1]

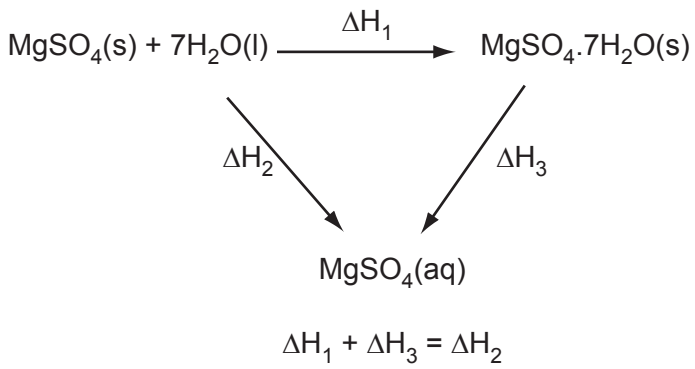
(c) **(i)** $CaSO_4.2H_2O = 40 + 32 + 64 + 2 \times 18 = 172$
$CaSO_4 = 40 + 32 + 64 = 136$
172 g of gypsum gives 136 g of anhydrous calcium sulphate
34.4 g of gypsum gives $136/172 \times 34.4$ g of anhydrous calcium sulphate = 27.2 g
percentage yield = $26.0/27.2 \times 100 = 95.588 = 95.6\%$ [3]

(ii) $CaSO_4 \rightarrow CaO + SO_3$ [1]

(iii) the size of the cation increases down the group [1]
the polarising power of the cation is decreased [1]
charge density less [1]
anion is "deformed" [1]
Any three from four [3]

(d) **(i)** the enthalpy change in a reaction is independent of the route taken [2]

(ii)



$\Delta H_1 + \Delta H_3 = \Delta H_2$

$\Delta H_2 = 10 \times 100 \times 4.2 \times 9 = 37.8 \times 10^3$ J = –37.8 kJ (exothermic)
$\Delta H_3 = 10 \times 100 \times 4.2 \times 3 = 12.6 \times 10^3$ J = +12.6. kJ (endothermic)

$\Delta H_1 + 12.6 = -37.8 \quad \Delta H_1 = -50.4$ kJ [4]

(iii) Any **three** from **four**:
- insulated container/plastic cup [1]
- add solid to water [1] with stirring [1]
- measure temperature before and after with thermometer [1]

major error is heat loss [1]
increase insulation/use lid/stop draughts [1]
(Maximum [5]) [5]

Quality of written communication [2] 22

16 **(a)** **(i)** $C_3H_6 + NH_3 + 1.5O_2 \rightarrow CH_2{=}CHCN + 3H_2O$ [2]

(ii) catalyst [1]

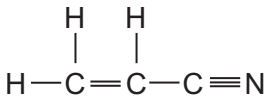
(iii) the IR spectra are unique for a compound they will differ [1]
because of the different position of the C=C absorption [1]/
fingerprint regions of each don't match
or
superimpose the spectra of each compound
they will be different [2]

(b) $CH_2{=}CHCl + NaCN \rightarrow CH_2{=}CHCN + NaCl$ [2]

(c) **(i)** C_3H_3N [1]

(ii) C_3H_3N [1]

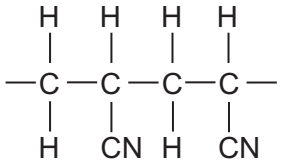
(iii)



[2]

(iv) no [1]
propenonitrile contains CH_2 group/explain by drawing structures [1] [2]

(d) **(i)**



[2]

(ii) addition polymerisation [1] 16

Section B **80**

Total **100**

Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2009

Chemistry

Assessment Unit AS 3

assessing

Module 3: Practical Examination 1

[AC131]

MONDAY 11 MAY, AFTERNOON

MARK SCHEME

Section A

1 Titration exercise

(a) **(i)** Rinse out a pipette with one of the solutions and (using a pipette filler) transfer/pipette a known volume of the solution into a conical flask [1]
(ii) Add 2 or 3 drops of phenolphthalein [1]
(iii) Rinse out the burette with the other solution and fill the burette [1]
(iv) Add the solution from the burette until the end point is reached [1]
(v) Repeat (for accuracy) [1]

To a maximum of [4]

(b) Table [1]
Significant figures [2]
Calculation of average titre [2]
Titration consistency [3]
Agreement with supervisor's titre [4] [12]

NOTES:

Table:
Table should include initial burette reading, final burette reading, and volume delivered for rough and accurate titrations. [1]

Significant figures:
All burette readings should be to at least one decimal place – each mistake is penalised by [1].
(However, initial burette readings of 0 are penalised once only)
If used, the second decimal position should be 0 or 5 only – other values are penalised by [1]. [2]

Average titre:
The average titre should be calculated and units should be included.
Accurate titrations only should be used.
The use of the rough value is [–1].
The average value can be two or three decimal places, e.g. 25.375/25.38
An incorrect calculation is 0. [2]

Titration consistency:
This is the difference between the first and second accurate readings.

Difference less than or equal to	Mark
0.1	3
0.2	2
0.3	1
0.4	0

[3]

Titration agreement with supervisor:
This is the difference between the candidate's calculated average titre and the supervisor's value.

Difference less than or equal to	Mark
±0.1	[4]
±0.2	[3]
±0.3	[2]
±0.4	[1]
±0.5	[0]

[4]

(c) Colourless to pink/red (or vice-versa depending on titration) [1]

(d) $CH_3COOH(aq) + NaOH(aq) \rightarrow CH_3COONa(aq) + H_2O(l)$
[1] for equation, [1] for state symbols [2]

(e) **(i)** Correct calculation using volume in dm^3 [2]

$$\text{Number of moles} = \text{concentration (mol dm}^{-3}) \times \frac{\text{volume (cm}^3)}{1000}$$

(ii) Uses 1 : 1 ratio from equation
If equation incorrectly balanced in **(d)** the candidate's ratio should be used (i.e. carry error through (c.e.t.)) [1]

(iii) Correct calculation using volume in dm^3
Divide by volume (in dm^3) of ethanoic acid used in titration [2]

(iv) Correct calculation
Multiply by RMM of ethanoic acid [1] [6] 25

2 Observation/deduction

Safety goggles must be worn at all times and care should be exercised during this practical examination.

(a) You are provided with a mixture of two salts, labelled A, which have a common cation. Carry out the following experiments on the mixture. Record your observations and deductions in the spaces below and identify the two salts.

Experiment	Observations	Deductions	
1 Describe the appearance of A.	*White solid* [1]	*Does not contain a Transition metal ion. Group I or II/Ammonium compound/s-block ion present* [1]	[2]
2 Dip a wire loop in concentrated hydrochloric acid; touch sample A with the wire, then hold it in a blue Bunsen flame.	*Yellow/orange/golden* [1]	*Na^+/Sodium ion/compound (present)* [1]	[2]
In a fume cupboard: **3** Add about 1 cm^3 of concentrated sulphuric acid to a half spatula-measure of A in a test tube. Test the gas given off using a glass rod which has been dipped into concentrated ammonia solution.	*Bubbling/fizz/gas given off/ effervescence/frothing* [1] *Misty/Steamy fumes* [1] *White smoke/cloudy/ solid/fumes* [1]	*Hydrogen chloride/HCl (g) or chloride/Cl^-* [1]	[4]
4 Make up a solution of A by dissolving a half spatula-measure of A in a test tube half-full of dilute nitric acid. Put 1 cm^3 of the solution into each of two separate test tubes.	*No effervescence* [1] *Colourless solution* [1]	*Not carbonate or hydrogencarbonate or sulphite* [1]	
(a) (i) Add a few drops of silver nitrate solution into the first test tube.	*White solid/ precipitate* [1]		
(ii) Add about 1 cm^3 of concentrated ammonia into the first test tube.	*White precipitate dissolves/ disappears* [1]	*Chloride* [1]	
(b) Add a few drops of barium chloride solution into the second test tube.	*White solid/ precipitate* [1]	*Sulphate* [1]	

[8]

Name the two salts present in A:

Sodium chloride [1]

Sodium sulphate [1]

AVAILABLE MARKS

(b) You are provided with an aqueous solution containing an organic substance X. Ca
following experiments. Record your observations and deductions in the spaces below

Experiment	Observations	Deductions	
1 Describe the solution and add a few drops on to Universal Indicator paper.	*Colourless (solution)* [1] *Shades of green* [1]	*Not a carboxylic acid/ Neutral* [1]	[3]
In a fume cupboard: **2** Shake a small volume of the solution with bromine water.	*Yellow/orange colour* [1] *remains* [1]	*Saturated or no C═C* [1] *Not an alkene/not unsaturated*	[3]
3 Heat about 2 cm^3 of the solution with 2 cm^3 of acidified potassium dichromate solution.	*Orange* [1] *to green* [1] *Change in smell* [1]	*Primary or secondary alcohol/not a tertiary alcohol/aldehyde* [1] *can be oxidised/aldehyde or ketone formed* *is a reducing agent* [1]	[5]

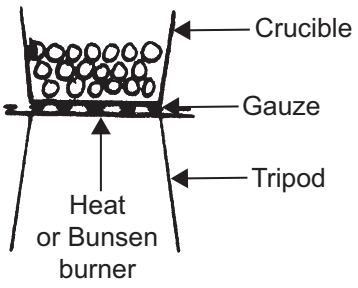
	AVAILABLE MARKS
Based on the above tests, suggest	
A functional group(s) which may be present in X:	
OH [1]	
A functional group(s) which the tests used above show is absent in X:	
C═C or —COOH [1]	
To a maximum of [29]	29
Section A	**54**

Section B

3 Planning

(a) (i) contains water of crystallisation [1]

(ii)



Heat/Bunsen burner – correctly labelled [1]
Tripod and gauze – correctly labelled [1]
Crucible – correctly labelled [1] [4]
(–1 for each omission)

(b) (i) Mass of container, e.g. crucible [1]
Mass of crucible + (hydrated) sodium carbonate [1]

(ii) Heat and weigh [1]
Repeat [1]
Until there is no further decrease in mass/to constant mass [1]

(iii) Allow apparatus (crucible) to cool/use gloves/use tongs [1] [6]

(c) (i) 11.44 – 4.24 = 7.20 g [1]

(ii) 7.2 ÷ 18 = 0.4 moles [1]

(iii) 4.24 ÷ 106 = 0.04 moles [1]

(iv)

Na_2CO_3	H_2O
0.04	0.4
1	10

[1]
x = 10 [1] [5]

(d) (i) 2.65 ÷ 106 = 0.025 mole [1]

(ii) $q = m \times c \times \Delta T$
$50.0 \times 4.2 \times 4.8 = 1008$ J [2]
(units not required)

(iii) 1008 ÷ 1000 = 1.008 kJ [1]
1.008 ÷ 0.025 = –40.3 kJ mol^{-1}
(units not required) (minus sign required) [1] [5] 20

4 **(a)** mass = density × volume = 0.81 × 13.7 = 11.10 g [1]

(b) 11.10 ÷ 74 = 0.150 moles [1]

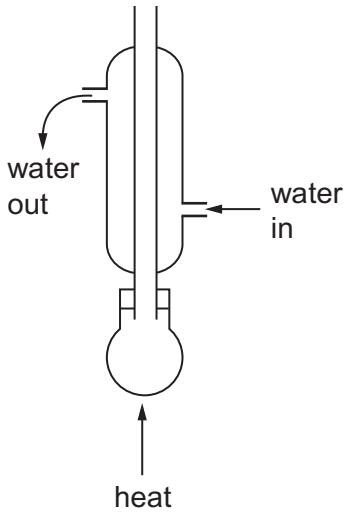
(c) 1:1 ratio 0.150 moles [1]

(d) Actual yield = 10.28 ÷ 137 = 0.075 moles [1]

(e) (Actual yield ÷ Theoretical yield) × 100 = % yield [1]

(f) Percentage yield = (0.075 ÷ 0.150) × 100 = 50% [1] 6

5 **(a)**



Condenser should have water in and water out as shown [3]
no heat source [–1]
no double jacket on condenser [–1]
condenser sealed at top [–1]
top of flask must not be open [–1]
no labels [–1]

(b) To ensure smooth boiling [1] 4

6	**(a)**	Sodium hydroxide or NaOH	[1]	
	(b)	Potassium thiocyanate or KCNS	[1]	
	(c)	Blood red solution forms (If candidate gives the result of a positive test for part **(a)** this can be credited i.e. $Fe^{2+} \rightarrow$ green precipitate; $Fe^{3+} \rightarrow$ red/brown precipitate	[1]	3
7	**(a)**	Add water The layer which increases in volume is the aqueous layer Qualitative explanation using densities [2]	[1] [1]	
	(b)	Acts as a drying agent	[1]	3
			Section B	**36**
			Total	**90**

Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2009

Chemistry

Assessment Unit AS 3

assessing

Module 3: Practical Examination 2

[AC132]

FRIDAY 15 MAY, MORNING

MARK SCHEME

Section A

1 Titration exercise

(a) **(i)** Rinse out a pipette with one of the solutions and (using a pipette filler) transfer/pipette a known volume of the solution into a conical flask [1]
(ii) Add 2 or 3 drops of phenolphthalein [1]
(iii) Rinse out the burette with the other solution and fill the burette [1]
(iv) Add the solution from the burette until the end point is reached [1]
(v) Repeat (for accuracy) [1]

To a maximum of [4]

(b) Table [1]
Significant figures [2]
Calculation of average titre [2]
Titration consistency [3]
Agreement with supervisor's titre [4] [12]

NOTES:

Table:
Table should include initial burette reading, final burette reading, and volume delivered for rough and accurate titrations. [1]

Significant figures:
All burette readings should be to at least one decimal place – each mistake is penalised by [1]
(However, initial burette readings of 0 are penalised once only)
If used, the second decimal position should be 0 or 5 only – other values are penalised by [1] [2]

Average titre:
The average titre should be calculated and units should be included.
Accurate titrations only should be used.
The use of the rough value is [–1]
The average value can be two or three decimal places, e.g. 25.375/25.38
An incorrect calculation is 0. [2]

Titration consistency:
This is the difference between the first and second accurate readings.

Difference less than or equal to	Mark
0.1	3
0.2	2
0.3	1
0.4	0

[3]

Titration agreement with supervisor:
This is the difference between the candidate's calculated average titre and the supervisor's value.

Difference	Mark
±0.1	[4]
±0.2	[3]
±0.3	[2]
±0.4	[1]
±0.5	[0]

[4]

(c) Colourless to pink/red (or vice-versa depending on titration) [1]

(d) $CH_3COOH(aq) + NaOH(aq) \rightarrow CH_3COONa(aq) + H_2O(l)$
[1] for equation, [1] for state symbols [2]

(e) **(i)** Correct calculation using volume in dm^3 [2]

$$\text{Number of moles} = \text{concentration (mol dm}^{-3}) \times \frac{\text{volume (cm}^3)}{1000}$$

(ii) Uses 1 : 1 ratio from equation
If equation incorrectly balanced in **(d)** the candidate's ratio should be used (i.e. carry error through (c.e.t.) [1]

(iii) Correct calculation using volume in dm^3
Divide by volume (in dm^3) of ethanoic acid used in titration [2]

(iv) Correct calculation
Multiply by RMM of ethanoic acid [1] [6]

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2 Observation/deduction

Safety goggles must be worn at all times and care should be exercised during this practical examination.

(a) You are provided with a mixture of two salts, labelled B, which have a common cation. Carry out the following experiments on the mixture. Record your observations and deductions in the spaces below and identify the two salts.

Experiment	Observations	Deductions	
1 Describe the appearance of B.	*White solid* [1]	*Does not contain a Transition metal ion. Group I or II/Ammonium compound/s-block ion present* [1]	[2]
2 Dip a wire loop in concentrated hydrochloric acid; touch sample B with the wire, then hold it in a blue Bunsen flame.	*Pink/Purple/Lilac* [1]	K^+*/Potassium ion/ compound (present)* [1]	[2]
In a fume cupboard: **3** Add about 1 cm^3 of concentrated sulphuric acid to a half spatula-measure of B in a test tube. Heat the test tube gently.	*Grey/black solid* [1] *Steamy fumes* [1] *Purple gas/clouds/fumes* [1]	*Iodine or iodide* I^- [1]	[4]
4 Make up a solution of B by dissolving a half spatula-measure of B in a test tube half-full of water. Put 1 cm^3 of the solution into each of two separate test tubes.	*Colourless solution* [1]		
(a) (i) Add a few drops of silver nitrate solution into the first test tube.	*Yellow solid/ precipitate* [1]		
(ii) Add about 2 cm^3 of concentrated ammonia into the first test tube.	*Yellow precipitate remains* [1]	*Iodide* [1]	
(b) Add a few drops of barium chloride solution to the second test-tube and then add 2 cm^3 of dilute nitric acid.	*White solid precipitate* [1] *No effervescence/does not dissolve* [1]	*Sulphite/Sulphate* [1] *Not carbonate or hydrogen carbonate/sulphite* [1]	[8]

Name the two salts present in B:

Potassium iodide [1]

Potassium sulphate [1]

AVAILABLE MARKS

(b) You are provided with an aqueous solution containing an organic substance Y. Carry out the following experiments. Record your observations and deductions in the spaces below.

Experiment	Observations	Deductions	
1 Describe the solution and add a few drops on to Universal Indicator paper.	*Colourless (solution)* [1] *Shades of green* [1]	*Not a cartoxylic acid/Neutral* [1]	
In a fume cupboard: **2** Shake a small volume of the solution with bromine water.	*Yellow/orange colour* [1] *remains* [1]	*Saturated/no C═C* [1] *Not an alkene/not unsaturated*	[3]
3 Heat about 2 cm^3 of the solution with a few drops of acidified potassium dichromate solution.	*Orange* [1] *to green* [1] *Change in smell* [1]	*Primary or secondary alcohol/ not a tertiary alcohol/aldehyde* [1] *can be oxidised/aldehyde or ketone formed* *is a reducing agent* [1]	[3] [5]

Based on the above tests, suggest

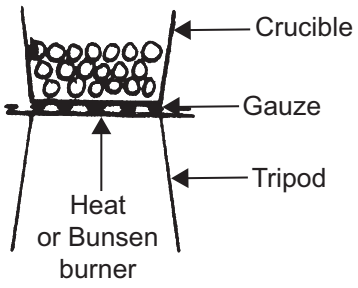
	AVAILABLE MARKS
A functional group(s) which may be present in Y:	
OH [1]	
A functional group(s) which is absent from Y:	
C═C or —COOH [1]	
To a maximum of [29]	29
Section A	**54**

Section B

3 Planning

(a) (i) contains water of crystallisation [1]

(ii)



Heat/Bunsen burner – correctly labelled [1]
Tripod and gauze – correctly labelled [1]
Crucible – correctly labelled [1] [4]
([–1] for each omission)

(b) (i) mass of container, e.g. crucible [1]
Mass of crucible + hydrated zinc sulphate [1]

(ii) Heat and weigh [1]
Repeat [1]
Until there is no further decrease in mass/to constant mass [1]

(iii) Allow apparatus (crucible) to cool/use gloves/use tongs [1] [6]

(c) (i) 8.63 – 4.85 = 3.78 g [1]

(ii) 3.78 ÷ 18 = 0.21 moles [1]

(iii) 4.85 ÷ 161 = 0.03 moles [1]

(iv)

$ZnSO_4$	H_2O
0.03	0.21
1	7

[1]
$x = 7$ [1] [5]

(d) (i) 0.5 × (50.0 ÷ 1000) = 0.025 mole [1]

(ii) $q = m \times c \times \Delta T$ [1]
$50 \times 4.2 \times 25.3 = 5313\,J$ [1]
(units not required)

(iii) 5313 ÷ 1000 = 5.313 kJ [1]
5.313 ÷ 0.025 = –212.5 kJ mol^{-1} [1] [5]
(units not required) (minus sign required)

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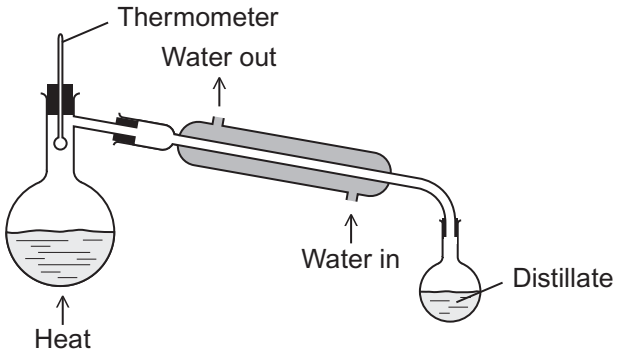
4	**(a)**	mass = density × volume = 1.05 × 11.4 = 11.97 g	[1]	
	(b)	11.97 ÷ 60 = 0.200 moles	[1]	
	(c)	0.200 moles	[1]	
	(d)	Actual yield = 5.28 ÷ 88 = 0.06 moles	[1]	
	(e)	(Actual yield ÷ Theoretical yield) × 100 = % yield	[1]	
	(f)	Percentage yield = (0.06 ÷ 0.200) × 100 = 30%	[1]	6
5	**(a)**		[2]	
		Condenser should have water in and water out as shown no heat source [–1] no double jacket on condenser [–1] distillation flask open at top [–1] thermometer missing [–1] no labels [–1]	[1]	
	(b)	To ensure smooth boiling	[1]	4
6	**(a)**	Ammonia solution/NH_3(aq)	[1]	
	(b)	(pale) blue precipitate/solid forms precipitate dissolves in excess to form a (deep) blue solution	[1] [1]	3
7	**(a)**	Add water the layer which does not increase in volume is the organic layer Qualitative explanation using densities [2]	[1] [1]	
	(b)	Acts as a drying agent	[1]	3
			Section B	**36**
			Total	**90**