

GCE
Chemistry
Summer 2009

Mark Schemes

Issued: October 2009

NORTHERN IRELAND GENERAL CERTIFICATE OF SECONDARY EDUCATION
(GCSE) AND NORTHERN IRELAND GENERAL CERTIFICATE OF EDUCATION

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
General Certificate of Education
2009

Chemistry

Assessment Unit AS 1

assessing

Module 1: General Chemistry

[ASC11]

WEDNESDAY 3 JUNE, MORNING

MARK SCHEME

Quality of Written Communication

- 2 marks The candidate expresses ideas clearly and fluently through well-linked sentences and paragraphs. Arguments are generally relevant and well-structured. There are 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 A
- 3 C
- 4 A
- 5 C
- 6 C
- 7 A
- 8 B
- 9 D
- 10 B

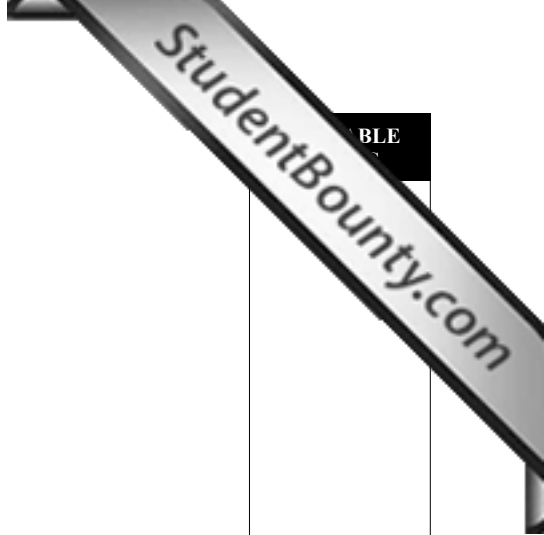
[2] for each correct answer

[20]

20

Section A

20



BLE

Section B

- | | | |
|---|---|----------|
| <p>11 arrow down
from level 2
to level 1</p> | <p>[1]
[1]
[1]</p> | |
| <p>12 $\delta^- \quad \delta^+$
O — H</p> <p>$\delta^- \quad \delta^+$
Cl — Br</p> <p>$\delta^+ \quad \delta^-$
N = O</p> | <p>[1]</p> <p>[1]</p> <p>[1]</p> | <p>3</p> |
| <p>13 relative molecular mass
$C_{11}H_{18}O_2 = 11 \times 12 + 18 \times 1 + 2 \times 16 = 132 + 18 + 32 = 182$</p> <p>182 g</p> <p>$182/6 \times 10^{23} = 30.3 \times 10^{23} = 3.02 \times 10^{22} \text{ g}$</p> <p>$60 \times 3.02 \times 10^{-22} \text{ g} = 181.2 \times 10^{-22} \text{ g} = 1.812 \times 10^{-20} \text{ g}$</p> | <p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p> | <p>4</p> |

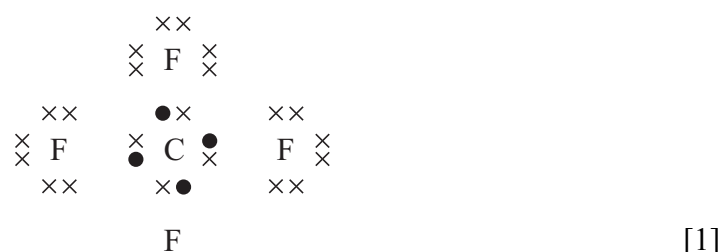
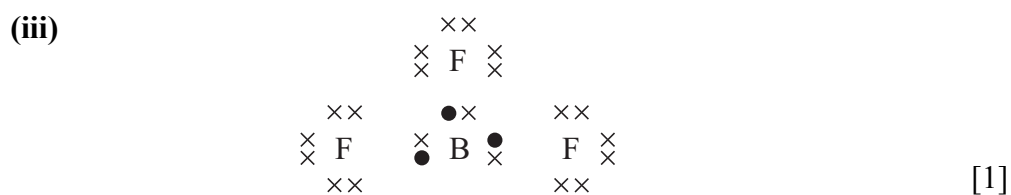
14 (a) (i) strong bonds [1]
(between carbon atoms) and giant structure [1] [2]

(ii) layers [1] (of carbon atoms) can slide over each other/
weak van der Waals [1] [2]

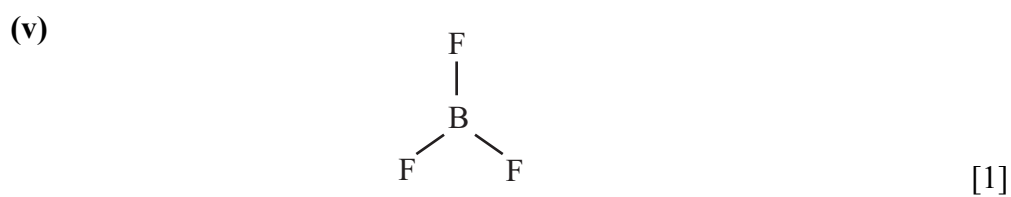
(iii) e.g. high melting point/boiling point [1] [1]

(b) (i) $2B + 3F_2 \rightarrow 2BF_3$ [2]

(ii) $CH_4 + 4F_2 \rightarrow CF_4 + 4HF$ [2]



(iv) octet rule: eight [1] outer [1] electrons (around a central atom) [2]
boron has 6 [1]
carbon has 8 [1]



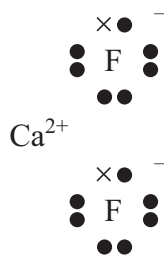
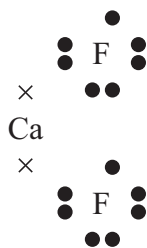
bonding electron (pairs) repel [1] [1]

as far apart as possible [1] [1]

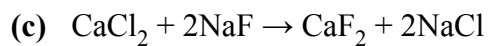
15 (a) white

[1]

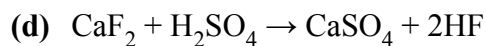
(b)



[4]



[1]



[2]

(e) (i) $\text{CaF}_2 = 40 + 2 \times 19 = 78$

[1]

(ii) $0.0025/78 = 3.2 \times 10^{-5}$

[1]

(iii) $2 \times 3.2 \times 10^{-5} = 6.4 \times 10^{-5}$

[1]

(iv) 6.4×10^{-5}

[1]

(v) $10 \times 6.4 \times 10^{-5} = 6.4 \times 10^{-4}$

[1]

(f) (i) helps to prevent tooth decay

[1]

(ii) takes away freedom of choice

[1]

15

- 16 (a) (i) 11 electrons 11 protons 12 neutrons [2]
- (ii) They have the same number of protons [1]
different number of neutrons [1]
- (b) $2 \times 24 = 48$
 $98 \times 23 = 2254$
total = 2302
- relative atomic mass = 23.02 [2]
- (c) (i) $c = v\lambda \quad 3 \times 10^8 = v \times 589 \times 10^{-9}$
 $v = 5.093 \times 10^{14}$
- $E = hv = 6.63 \times 10^{-34} \times 5.093 \times 10^{14} = 3.38 \times 10^{-19} \text{ J}$ [3]
- (ii) nichrome wire cleaned with concentrated hydrochloric acid [1]
placed in blue Bunsen flame [1]
yellow [1]
dissolve in water [1]
add silver nitrate solution [1] to produce a white precipitate [1]
to a maximum of [4]
 $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{NaNO}_3 + \text{AgCl}$ [1] [5]
- (d) (i) $\text{Na(g)} \rightarrow \text{Na}^+(\text{g}) + \text{e}^-$ [2]
- (ii) (more energy is needed to) remove an electron from a full shell [1]
the electron(s) are nearer to the nucleus [1]
from a positive ion [1]
Any 2 from 3 [2]
- (e) sodium metal has delocalised electrons [1]
which move and thus a current flows [1]
sodium chloride consists of ions [1]
in fixed positions which cannot move [1]
can move in solution or when molten [1]
- Quality of written communication [2]

17 (a) ammonia = 17 oxygen = 32 nitrogen = 28	[1]	
ammonia is lighter	[1]	
(b) $\text{NH}_4\text{Cl} = 14 + 4 + 35.5 = 53.5$ $1.07/53.5 = 0.02 \text{ mol}$ $\text{volume} = 0.02 \times 24 \text{ dm}^3 = 0.48 \text{ dm}^3$	[3]	
(c) (i) blue/violet	[1]	
(ii) $\text{NH}_3 + \text{HCl} \rightarrow \text{NH}_4\text{Cl}$ White smoke/fumes	[1] [1]	
(d) reactants: Cu = +2 N = -3 products: Cu = 0 N = 0 copper has been reduced and nitrogen has been oxidised	[1] [1] [1]	11
Section B		80
Total		100



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2009

Chemistry

Assessment Unit AS 2

assessing

Module 2: Organic, Physical and Inorganic Chemistry

[ASC21]

THURSDAY 11 JUNE, AFTERNOON

MARK SCHEME

Quality of written communication:

- 2 marks The candidate expresses ideas clearly and fluently through well-linked sentences and paragraphs. Arguments are generally relevant and well-structured. There are 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

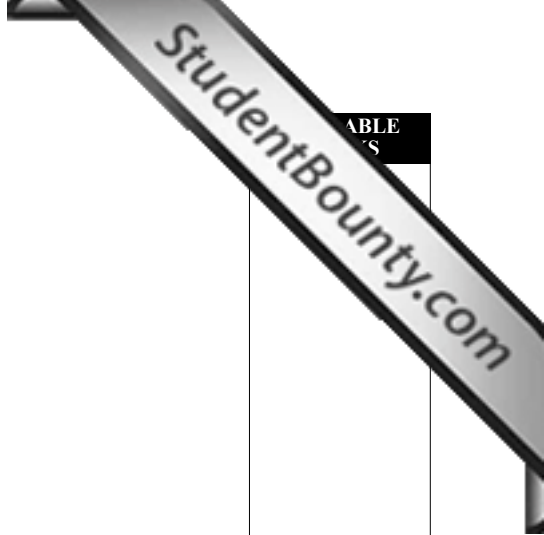
- 1 A
- 2 D
- 3 B
- 4 D
- 5 B
- 6 A
- 7 A
- 8 C
- 9 C
- 10 B

[2] for each correct answer

[20]

20

20



ABLE
S

Section B

11	(a) (i) methanol	[1]	4
	(ii) water	[1]	
	(iii) hydrogen bond	[1]	
	(b) solubility/melting point/boiling point	[1]	
12	(a) e.g. gasoline (petrol)/diesel/naphtha/lubricating oil/kerosine/bitumen/refinery gas	[3]	7
	(b) oil boiled and fraction evaporates and is condensed fractions obtained at a specific temperature/range of temperature	[1] [1]	
	(c) carbon hydrogen	[1] [1]	
13	(a) the outside shell contains s electrons	[1]	11
	(b) (i) the ionic radius increases down the group the number of shells of electrons increases	[1] [1]	
		(ii) the ionisation energy decreases down the group the outer electron is further from the nucleus/more shielding	
	(c) combustion		
	magnesium gives a white/bright light/calcium red light	[1]	
	white solids are formed	[1]	
	reaction with water		
	magnesium slow/no gas given off; calcium fizzes/bubbles	[1]	
	magnesium gives no heat; calcium is exothermic	[1]	
	magnesium stays shiny, dull, grey; calcium gives a white solid/ppt	[1]	
	to a maximum of [2]		
	reaction with hydrochloric acid		
	both magnesium and calcium fizz/bubbles	[1]	
both magnesium and calcium dissolve/disappear	[1]		
both reactions are exothermic	[1]		
to a maximum of [2]			

14 (a) (i) catalyst	[1]	
(ii) molecules adsorbed on the surface/weak temporary bonds with surface	[1]	
activation energy lowered	[1]	
bonds weakened/broken	[1]	
interaction with d-orbitals of metal	[1]	
orientation of molecules on the surface	[1]	
to a maximum of [3]		
(iii) more molecules on the left hand side	[1]	
increased yield at high pressure/moves to RHS }	[1]	
(iv) reaction must be endothermic	[1]	
increased yield at high temperature/moves to RHS }	[1]	
(b) $\text{CH}_2\text{OCH}_2 = 24 + 4 + 16 = 44$		
$\text{CH}_2\text{OHCH}_2\text{OH} = 24 + 6 + 32 = 62$		
44 tonnes of ethylene oxide produce 62 tonnes of ethylene glycol		
1 tonne of ethylene oxide produce 1.41 tonnes of ethylene glycol		
2 tonnes of ethylene oxide produce 2.82 tonnes of ethylene glycol	[3]	11
15 (a) C_5H_8	[1]	
(b) (i) monomers/short chain molecules	[1]	
join together	[1]	
or long chain structure with repeating pattern [2]		
(ii) double bond	[1]	
(c) (i)		
$ \begin{array}{c} \text{CH}_3 \quad \text{H} \\ \quad \\ \text{CH}_3 - \text{C} - \text{C} - \text{CH}_3 \\ \quad \\ \text{H} \quad \text{H} \end{array} $	[1]	
(ii) 2-methylbutane	[2]	
(iii) nickel	[1]	
(d) (i) $\text{C}_5\text{H}_8 + 7\text{O}_2 \rightarrow 5\text{CO}_2 + 4\text{H}_2\text{O}$	[2]	
(ii) carbon/carbon monoxide	[1]	
(e) (i) smoke produced because of carbon	[1]	
carbon dioxide causes greenhouse effect	[1]	
carbon monoxide poisonous } to a maximum of [2]		
(ii) landfill/recycling.	[1]	14

- 16 (a) (i) $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ [1]
- (ii) cation size/charge density [1]
lattice enthalpy [1]
- (b) (i) reacts with an acid (to produce a salt)/neutralised by acids/
proton acceptor [1]
- (ii) $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$ [1]
- (iii) $\text{Ca(OH)}_2 = 40 + 2 + 32 = 74$
 $0.021 \text{ mol} = 0.021 \times 74 = 1.554 \text{ g}$
 $1.554 \text{ g dissolved in } 1 \text{ dm}^3/1000 \text{ cm}^3$
 $0.3885/0.39 \text{ g dissolved in } 250 \text{ cm}^3$ [3]
- (c) (i) $\text{Ca(OH)}_2 + 2\text{HCl} \rightarrow \text{CaCl}_2 + 2\text{H}_2\text{O}$ [2]
- (ii) red/brick red [1] 11
-
- 17 (a) (i)
- $$\begin{array}{c} \text{H} \quad \text{H} \\ | \quad | \\ \text{H}-\text{C}-\text{C}-\text{Cl} \\ | \quad | \\ \text{H} \quad \text{H} \end{array}$$
- [2]
- (ii) hydrogen bonding forces greater than van der Waals/dipole-dipole [2]
- (b) (i) represents the number of molecules [1]
with (an energy greater than) the activation energy [1]
- (ii) peak moved to the right [1]
peak lower than the previous peak [1]
- (iii) more molecules have energy greater than the activation energy [2]
- (c) (i) $\begin{array}{c} \delta+ \delta- \\ \text{C}-\text{Cl} \end{array}$ [1]
- (ii) chlorine is more electronegative than carbon [1]
the electrons in the bond are closer to chlorine [1]
- (d) ammonia has a lone pair [1]
in the ammonium ion the lone pair forms a dative bond [1]

- (e) chlorobutane gives a white precipitate
 bromobutane gives a cream precipitate
 iodobutane gives a yellow precipitate
 iodobutane forms precipitate first/chlorobutane last
 the C—I bond is the weakest

Quality of written communication

	MARKS
[1]	
[1]	
[1]	
[1]	
[1]	
[2]	22
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

[ASC31]

MONDAY 11 MAY, AFTERNOON

MARK SCHEME

1 Observation/deduction

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

Answer parts (a) and (b) of question 1.

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

Experiment	Observations	Deductions
(i) Describe the appearance of X.	White solid [1]	Not a transition metal ion/ possibly Gp I or II or NH_4^+ ion/compound. Possibly contains an s-block ion/element/metal. [1]
(ii) Add half a spatula-measure of X to a test tube a quarter full of water. Stir or shake the solid with the water. Add an equal volume of dilute hydrochloric acid. Add 1 cm ³ of barium chloride solution.	Dissolves [1]	Soluble [1]
	No effervescence [1]	Not a $\text{CO}_3^{2-}/\text{HCO}_3^-/\text{SO}_3^{2-}$ [1]
	White ppt [1]	SO_4^{2-} /sulphate [1]
(iii) Place a half spatula-measure of X on a watch-glass and add 3 drops of concentrated hydrochloric acid. Use a clean loop of nichrome wire to place a small amount of this acidified sample of X in a blue Bunsen flame.	Yellow flame colour [1]	Contains Na^+ ion or sodium compound [1]
(iv) Place a spatula-measure of X in a test tube, add 2 cm ³ of dilute sodium hydroxide solution and warm gently. Test any gas evolved with damp Universal Indicator paper.	Dissolves [1]	Soluble
	UI turns blue/purple [1]	Alkaline/pH>7 [1]
	Pungent smell [1]	Ammonia/ NH_4^+ ion [1] (conditional on smell)

Name the **two** salts in X _____ Sodium sulphate [1]
 _____ Ammonium sulphate [1]

AVAILABLE
MARKS

(b) You are supplied with three halobutanes labelled A, B and C. Carry out the experiment and complete the table below. Identify A, B and C.

Experiment	Observations	Deductions
Place 1 cm ³ of A, B and C separately in three test tubes. Label the test tubes with their contents. Add 1 cm ³ of ethanol and 1 cm ³ of silver nitrate solution to each test tube. Place the three test tubes in a beaker of water heated to just below boiling point. Leave for 5 minutes.	A Yellow ppt [1]	A (1-) Iodobutane/Iodine [1]
	B White ppt/no ppt [1]	B (1-) Chlorobutane/Chlorine [1]
	C Cream ppt [1]	C (1-) Bromobutane/Bromine [1]

A is (1-) Iodobutane
 B is (1-) Chlorobutane
 C is (1-) Bromobutane } [2]

AVAILABLE MARKS

25

2 (a) Titration

Consistency:

Decimal places: this does not apply to the averaging of titres.

All to one decimal place, except 0.05 or 0.00, two or more decimal places penalised [-1] each time.

The use of 0 is penalised [-1] if used more than once. [2]

Titration consistency:

This is the difference between the first and second accurate readings.

Difference	Mark
------------	------

±0.1	[5]
±0.2	[4]
±0.3	[3]
±0.4	[2]
±0.5	[1]

Titration agreement with supervisor:

Difference	Mark
------------	------

±0.2	[6]
±0.3	[5]
±0.4	[4]
±0.5	[3]
±0.6	[2]
±0.7	[1]

Average value:

The average can be two decimal places, e.g. 0.33.

The use of the rough value is [-1].

An incorrect calculation is [-1]. [2] [15]

(b) (i) colourless to pink/red [1]

(ii) A titration figure of 25.0 cm³ is expected.

$$\frac{“25” \times 0.05}{1000} \text{ moles} = 0.00125 \text{ moles} \quad [2]$$

(iii) $\text{NaOH} + \text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O}$ [2]

(iv) 0.00125 [1]

(v) $0.00125 \times 40 = 0.05$ [2]

(vi) One mole of ethanoic acid is 60 g. Hence mass of acid is:
 $0.05 \times 60 = 3.0 \text{ g}$ [2]

25

- 3 (a) Tube, wool, oxide [1]
 Delivery tube and stopper [1]
 Trough and container to collect gas [1]
 Retort, clamp, boss [1] [4]
- (b) Mass of tube and wool [1]
 Mass of tube, wool and ethanol [1] [2]
- (c) (i) Inactive/no reaction [1]
 (ii) Need to form ethanol vapour [1]
- (d) First bubbles are air [1]
- (e) (i) Reduced pressure [1]
 (ii) Remove delivery tube/stopper [1]
- (f) (i) Removal of water [1]
 (ii) $C_2H_5OH \rightarrow C_2H_4 + H_2O$ [1]
 (iii) 8 moles of ethanol = $\frac{1.3}{46} = 0.0283$
 volume = $0.0283 \times 24 = 0.678 \text{ dm}^3$ [2]
 (iv) Not all ethanol reacted [1]
- (v) Bromine/bromine water [1]
 Yellow/orange [1]
 Colourless (not clear) [1] [3]
- (vi) Dissolves in water [1]

20

4 (a) (i) The answer can either be based on speed or accuracy.

quicker to measure volume than mass [1]

(ii) $6 \times 0.79 = 4.74 \text{ g}$ (units missing [-1]) [2]

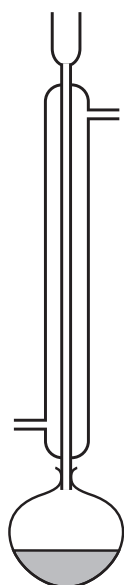
(b) The word slowly is mentioned twice in the text. Either just safety can be mentioned or a specific reason stated.

safety/heat produced in reaction [2]

(c) sodium dichromate is orange [1]
if not in excess it would be green [1] [2]

(d) The ethanal is distilled off as soon as it is formed, preventing further reaction. [1]

(e) (i) If the apparatus is sealed or there are gaps, [-1] in each case. If the condenser is in the distillation position both marks are lost. There is no need to indicate the direction of the water; hence, if the direction is wrong it is not penalised.



[2]

(ii) Vinegar is not accepted.

ethanoic acid/acetic acid [1]

(f) The boiling point of the ethanal is given in the text.

ethanal has low boiling point/volatile

[1]

(g) (i) $C_2H_6O = 24 + 6 + 16 = 46 \text{ g}$ (units needed)

[1]

(ii) $\frac{4.74}{46} = 0.103$

[1]

(iii) $\frac{0.1}{0.103} \times 100 = 97\%$

[2]

(h) Either a description can be given or the words fractional distillation gain the marks.

Any description should mention collecting fractions at different temperatures.

fractional distillation/description [1]

fraction collected between 20–22 °C [1]

[2]

(i) There are several possibilities based on dissolving and boiling. Other possibilities could be the liquids are miscible.

ethanol and ethanal boil [1]

comment on smell [1]

[2]

20

Total

90



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2009

Chemistry

Assessment Unit AS 3

assessing

Module 3: Practical Examination 2

[ASC32]

FRIDAY 15 MAY, AFTERNOON

MARK SCHEME

1 Observation/deduction

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

Answer parts (a) and (b) of question 1.

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

Experiment	Observations	Deductions
(i) Describe the appearance of Y.	White solid	Not a transition metal ion/ possibly Gp I or II or NH_4^+ ion/compound. Possibly contains an s-block ion/element/metal.
	[1]	[1]
(ii) Make a solution of Y by dissolving a half spatula-measure of Y in a test tube half full of water. Place 1 cm ³ of this solution in a test tube with 1 cm ³ of dilute nitric acid and 1 cm ³ of silver nitrate solution. Add 2 cm ³ of dilute ammonia solution to the test tube.	No effervescence	Not a $\text{CO}_3^{2-}/\text{HCO}_3^-/\text{SO}_3^{2-}$
	White ppt	Cl^- /contains chlorine
	Dissolves	Confirms Cl^-
	[1]	[1]
	[1]	[1]
(iii) Place a half spatula-measure of Y on a watch-glass and add 3 drops of concentrated hydrochloric acid. Use a clean loop of nichrome wire to place a small amount of this acidified sample of Y in a blue Bunsen flame.	Yellow flame colour	Contains Na^+ ion
	[1]	[1]
(iv) Place a spatula-measure of Y in a test tube and add 2 cm ³ of dilute sodium hydroxide solution and warm gently. Test any gas evolved with damp Universal Indicator paper.	Dissolves	
	[1]	
	UI turns blue/purple	Alkaline/pH>7
	Pungent smell	Ammonia/ NH_4^+ ion (conditional on smell)
	[1]	[1]
	[1]	[1]

Name the **two** salts in Y _____ Sodium chloride [1]
 _____ Ammonium chloride [1]

AVAILABLE MARKS

- (b) You are supplied with three halobutanes labelled P, Q and R. Carry out the experiment and complete the table below. Identify P, Q and R.

Experiment	Observations	Deductions
Place 1 cm ³ of P, Q and R separately in three test tubes. Label the test tubes with their contents. Add 1 cm ³ of ethanol and 1 cm ³ of silver nitrate solution to each test tube. Place the three test tubes in a beaker of water heated to just below boiling point. Leave for 5 minutes.	P Cream ppt [1]	P (1-) Bromobutane/Bromine [1]
	Q White ppt/no ppt [1]	Q (1-) Chlorobutane/Chlorine [1]
	R Yellow ppt [1]	R (1-) Iodobutane/Iodine [1]

P is (1-) Bromobutane
 Q is (1-) Chlorobutane
 R is (1-) Iodobutane } [2]

AVAILABLE MARKS

25

2 (a) Titration

Consistency:

Decimal places: this does not apply to the averaging of titres.

All to one decimal place, except 0.05 or 0.00, two or more decimal places penalised [-1] each time.

The use of 0 is penalised [-1] if used more than once. [2]

Titration consistency:

This is the difference between the first and second accurate readings.

Difference	Mark
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±0.1	[5]
±0.2	[4]
±0.3	[3]
±0.4	[2]
±0.5	[1]

Titration agreement with supervisor:

Difference	Mark
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±0.2	[6]
±0.3	[5]
±0.4	[4]
±0.5	[3]
±0.6	[2]
±0.7	[1]

Average value:

The average can be two decimal places, e.g. 0.33.

The use of the rough value is [-1].

An incorrect calculation is [-1]. [2] [15]

(b) (i) colourless to pink/red [1]

(ii) A titration figure of 25.0 cm³ is expected.

$$\frac{25 \times 0.1}{1000} \text{ moles} = 0.0025 \text{ moles} \quad [2]$$

(iii) $\text{NaOH} + \text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O}$ [2]

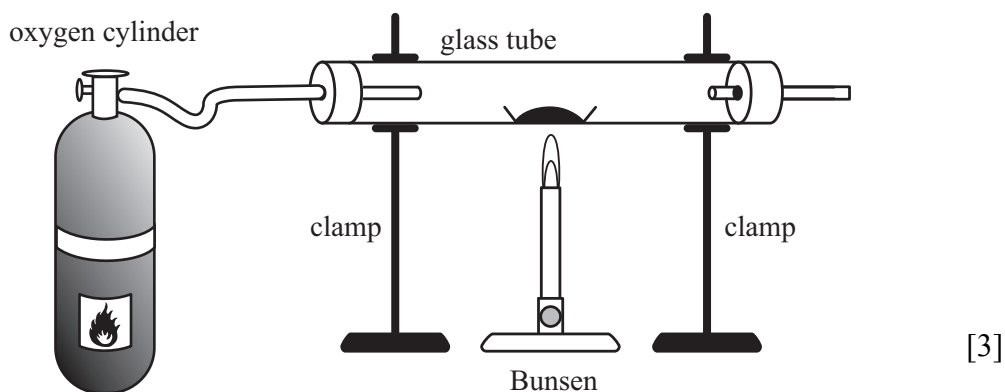
(iv) 0.0025 moles [1]

(v) $40 \times 0.0025 = 0.1$ [2]

(vi) One mole of ethanoic acid is 60 g. Hence mass of acid is:
 $0.1 \times 60 = 6.0 \text{ g}$ [2]

25

3 (a) The diagram is marked by default. If there is an absent connection, [-1]. If the apparatus is sealed, [-1]. Absence of labelling is [-1]. Misuse or absence of a piece of apparatus is [-1].



(b) The test for oxygen could be advanced, e.g. GLC. The marks are awarded independently.

glowing splint [1]
relights [1] [2]

(c) (i) The answer “no” needs to be qualified. A comparison with other iron or steel articles or the fact that the temperature of the Bunsen flame is not high enough.

iron does not melt in a Bunsen flame/Bunsen not hot enough [1]

(ii) Two reasons are initially expected.

advantage that the reaction is faster because of greater surface area [1]
to ensure all the Ti is oxidised and not just on surface [1] [2]

- (d) Mass of container [1]
 Mass of container + titanium [1] [2]
- (e) no change in mass (if reaction finished) [1]
- (f) (i) The answer “no” needs to be qualified. Titanium oxide is still produced and the hydrogen will be swept away.
 titanium oxide still formed and hydrogen is a gas/disappears [1]
- (ii) A drying agent needs to be named. Even though not feasible it could be placed in the cylinder. The word anhydrous needs to be used with copper sulphate but not the others.
 named drying agent placed between cylinder and titanium (anhydrous copper sulphate/calcium chloride etc.) [1]
- (g) To cool down for any suitable following purpose is the answer; but the reason has to be acceptable.
 cool down apparatus [1]
- (h) mass of oxygen = mass of titanium oxide – mass of titanium
 = 6.0 – 3.6 = 2.4 g
 moles of titanium = $\frac{3.6}{48} = 0.075$
 moles of oxygen = $\frac{2.4}{16} = 0.15$
 ratio of moles = 0.075 : 0.15 = 1 : 2
 empirical formula is TiO₂ [3]
- (i) Recourse to reactivity tables may be needed if obscure metals are given.
 (i) e.g. iron [1]
 (ii) e.g. gold [1]
 (iii) e.g. gold is too unreactive [1]

4	(a) (i)	Reaction with water [1] Breaking down/splitting of H ₂ O or reagent [1]	[2]	
	(ii)	PCl ₃ + 3H ₂ O → H ₃ PO ₃ + 3HCl	[2]	
	(iii)	Hydrogen chloride is harmful	[1]	
	(b) (i)	Anti-bump granules/porcelain chips	[1]	
	(ii)	Lower joint	[1]	
	(iii)	To prevent moisture entering the apparatus [1] and reacting with both PCl ₃ and ethanoyl chloride [1]	[2]	
	(c)	Ethanoic acid	[1]	
	(d)	Hydrogen bonding (between OH groups) [1] Comment on weaker intermolecular forces in ethanoyl chloride [1]	[2]	
	(e) (i)	10 × 1.05 = 10.5 g	[1]	
	(ii)	$\frac{10.5}{60} = 0.175$	[1]	
	(iii)	78.5	[1]	
	(iv)	78.5 × 0.175 = 13.74	[1]	
	(v)	13.74 × 0.84 = 11.54 g (units needed)	[2]	
	(f)	Ethanoyl chloride faster/no heat required/no catalyst needed [1] and higher yield/not reversible [1]	[2]	20

Total	90
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