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Mark Scheme (Results)
Summer 2014

IAL Chemistry (WCH03/01)
Chemistry Laboratory Skills I

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.
( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication
Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Acceptable Answer	Reject	Mark
1 (a)	(Flame colour is) yellow-red / brick-red / orange-red / red-yellow ALLOW Red	Crimson, orange, yellow	**1**

Question Number	Acceptable Answer	Reject	Mark
1(b)	Yellow solid / crystals / precipitate (both words required) **(1)** (Precipitate) does not dissolve / does not change / is insoluble / remains **(1)** ALLOW Goes lighter / paler yellow "Nothing happens / no reaction" ONLY IF there is reference to precipitate in first part	Cream precipitate	**2**

Question Number	Acceptable Answers	Reject,	Mark
1(c)	(Dark) Brown / yellow / yellow-brown / red-brown / (pale) straw coloured **(1)** ALLOW combinations of colours or reverse of colour orders in pairs Iodine / tri-iodide ion / I_2 / I_3^- **(1)**	Red, orange, purple, violet, (dark) grey, black Iodide, I^-, I^{-3}	**2**

Question Number	Acceptable Answers	Reject	Mark
1(d)	Blue-black ALLOW Just "blue" / just "black" / dark blue	Purple Blue-black to colourless	**1**

Question Number	Acceptable Answer	Reject	Mark
1(e)	(The precipitate is) calcium carbonate / $CaCO_3$ **(1)** (The gas is) carbon dioxide / CO_2 **(1)** Mark independently		**2**

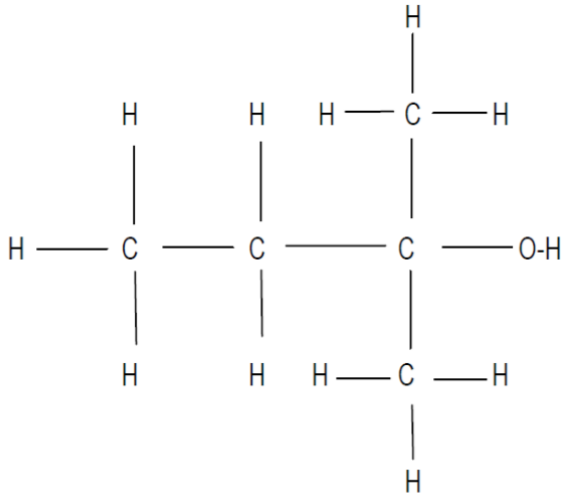
Question Number	Acceptable Answers	Reject	Mark
1(f)(i)	Iodine / I_2 **(1)** (Shiny) black solid / grey solid / purple fumes State AND colour needed ALLOW Vapour or gas for fumes Violet for purple (Dark) brown solution Purple in organic solvent **(1)** No TE for a test on an incorrect product, or if no product is given	 Brown solid Just "purple"	**2**

Question Number	Acceptable Answers	Reject	Mark
1(f)(ii)	Hydrogen sulphide / H_2S **(1)** (Colourless gas with) bad egg smell / turns lead ethanoate (paper) black / turns lead nitrate (paper) black **(1)** OR Sulfur / S **(1)** Yellow solid ALLOW Yellow precipitate **(1)** ALLOW Sulfur dioxide / SO_2 **(1)** (Colourless gas with) choking smell / pungent smell / acrid smell / Turns... (potassium / sodium) dichromate((VI)) (paper) green blue litmus (paper) red Universal Indicator (paper) red potassium manganate((VII)) colourless potassium permanganate colourless ALLOW Correct formulae **(1)** IGNORE Bubbles / effervescence / misty fumes / steamy fumes No TE for a test on an incorrect product, or if no product is given		**2**

Total for Question 1 = 12 marks

Question Number	Acceptable Answer	Reject	Mark
2(a)(i)	From maximum value of *m/e* OR From maximum value of *m/z* OR From maximum mass / charge ratio OR From (position of) peak furthest to right of spectrum (excluding small peaks due to isotopes) ALLOW Value furthest to the right hand side from (position of) last peak "line" for peak IGNORE Molecular ion	Just "highest value" Biggest peak Highest peak	**1**

Question Number	Acceptable Answers	Reject	Mark
2a(ii)	x = 5 y = 11		**1**

Question Number	Acceptable Answers	Reject	Mark
2(b)	 TE on (a)(ii) for a correct tertiary alcohol with the number of C atoms given in (a) (ii) ALLOW Partial display eg –OH, -CH_3, -C_2H_5 ALLOW CH_3 | CH_3-C-OH | C_2H_5	Structure shown as fully structural (no bonds shown) skeletal formula -HO Bonds should not go from C to H of OH	**1**

Question Number	Acceptable Answer	Reject	Mark
2(c)(i)	Hydrogen chloride / hydrochloric acid / HCl / HCl(aq)		**1**

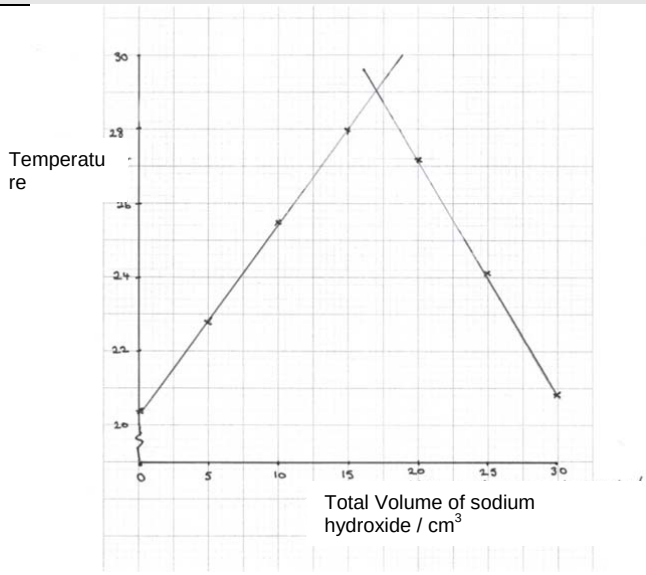
Question	Acceptable Answers	Reject	Mark

Number			
2(c)(ii)	$NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$ Correct formulae ALLOW $NH_4^+ Cl^-$ / $NH_4^+ + Cl^-$ Multiples **(1)** State symbols **(1)** Second mark depends on equation showing **only** correct species even if unbalanced. ALLOW HCl(aq)		**2**

Question Number	Acceptable Answer	Reject	Mark
2(d)	Alcohol has a peak for O-H bond OR ether has no peak for O-H bond ALLOW Alcohol has a peak for C-OH / C-O-H / -OH OR **Identification from C-O if stated that** C-O in ether absorbs at a different wavenumber from C-O in alcohol / ether has C-O-C OR Look at fingerprint region **and** compare with a compound of known identity ALLOW Use of " absorption / stretch / vibration / wave number / reading / drop / trough" instead of peak R-O for C-O IGNORE "ester" if apparently written by mistake for "ether" Broad and sharp (peaks)	Just 'alcohol has an OH bond / group' Just identification from C-O without detail C-O peak higher in ether range / spectrum instead of peak	**1**

Total for Question 2 = 7 marks

Question Number	Acceptable Answers	Reject	Mark
3(a)	In acid: colourless **(1)** In alkali: (pale) pink ALLOW Purple / red / magenta in alkali or combinations of colours eg purple-red **(1)** Correct colours wrong way round scores **(1)**	Clear or white for colourless Violet	**2**

Question Number	Acceptable Answers	Reject	Mark
3(b)	 Points correctly plotted **(1)** 2 best-fit straight lines through the points intersecting **(1)** Maximum temperature 29.1 ± 0.2 °C TE on linear extrapolation **(1)** Volume of NaOH 17.25 ± 0.5 cm^3 ALLOW 17 cm^3 TE on volume corresponding to maximum temperature after linear extrapolation **(1)** IGNORE sf except for one sf		**4**

Question Number	Acceptable Answer	Reject	Mark
3(c)(i)	35.5 x 4.18 x 10.2 = (1513.578) = 1514 (J) ALLOW 1.514 kJ IGNORE sf except 2 sf or less	1500 J 1513 J 1.5 kJ / 1.513 kJ	**1**

Question Number	Acceptable Answers	Reject	Mark

3(c)(ii)	(1513.578/3.00 x 10^{-2} = 50452.6 J)
	
	ΔH = -50.5 (kJ mol^{-1})
	Value
	
	ALLOW
	If (c)(i) is 1510, ΔH = -50.3 (kJ mol^{-1})
	
	TE from (c)(i)
	e.g.
	If (c)(i) is 1500, ΔH = -50.0 (kJ mol^{-1})
	If (c)(i) is 1513, ΔH = -50.4 (kJ mol^{-1})
	
	If (c)(i) = 20 x 4.18 x 10.2 = 852.72J
	Then ΔH = -28.4 (kJ mol^{-1}) **(1)**
	
	Sign **and** 3 sf if a value has been calculated **(1)**
			2

Question Number	Acceptable Answers	Reject	Mark
3(c)(iii)	Temperature is taken before heat loss occurs / before mixture cools ALLOW Because heat will be lost To reduce errors due to heat loss Temperature falls / drops quickly	 To prevent heat loss Temperature rises / changes quickly	**1**

Question Number	Acceptable Answer	Reject	Mark
3(c)(iv)	**One** mark each for any TWO of the following Temperatures are monitored continuously Equivalent to having more / many readings More points give a more accurate line / plot Magnetic stirrer more efficient than manual stirring / stirring is more uniform / makes temperature more uniform / makes concentration more uniform Heat loss is reduced because reaction is completed more quickly / because there is no time delay in readings IGNORE Comments on insulation of beaker, rate of reaction as opposed to time for experiment to be completed, parallax error Prevents human error	 Monitored frequently Prevents errors when drawing graphs Just "Heat loss is reduced"	**2**

Question Number	Acceptable Answers	Reject	Mark
3(d)(i)	Correct answer without working scores **(2)** (Moles of HCl) = 20.0 x 1.50/1000 = 3.00×10^{-2} = (Moles of NaOH) ALLOW Moles of HCl / NaOH = 3.00×10^{-2} **(1)** Concentration $= \left(\frac{3.00 \times 10^{-2}}{15.50} \times 10^{3} =\right)$ 1.93548 / 1.94 /1.9 (mol dm^{-3}) **(1)** IGNORE sf except 1 sf TE from first to second mark	Just '3.00×10^{-2} / 0.03' 1.93 and other incorrect roundings	**2**

Question Number	Acceptable Answers	Reject	Mark
3(d)(ii)	$\frac{2 \times 0.05}{5.00} \times 100\%$ = (±)2%	Two answers eg 0.02 and 2	**1**

Question Number	Acceptable Answers	Reject	Mark
3(e)(i)	To make temperature (change) bigger / (more) obvious / (more) significant OR To make more exothermic / to produce more heat energy / so more heat is given out OR To reduce percentage error in **temperature** (change) IGNORE Additional comments on rate increasing if rest of answer is correct Reference to volumes Easier to measure temperature change	To allow reaction to go to completion To increase enthalpy change Just 'to increase the heat'	**1**

Question Number	Acceptable Answer	Reject	Mark
3(e)(ii)	It is corrosive / burns skin / damages eyes / caustic ALLOW Damages skin IGNORE More irritant or harmful or dangerous NaOH is an alkali	Toxic Just "damaging" Flammable	**1**

Total for Question 3 = 17 marks

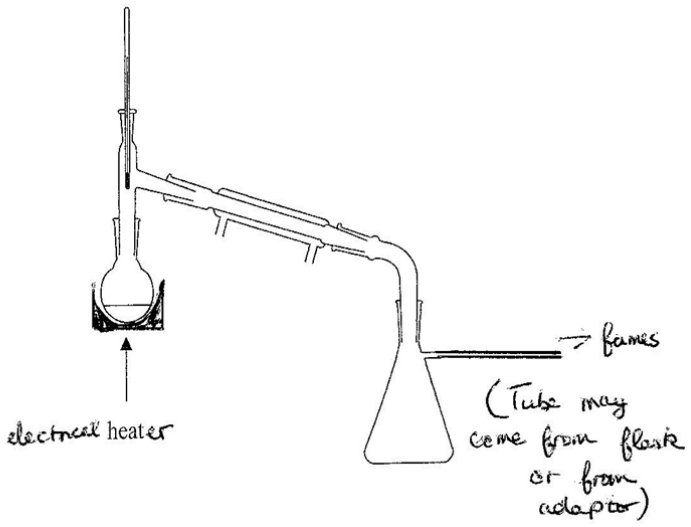
Question Number	Acceptable Answers	Reject	Mark
4(a)	Orange to green / blue / brown ALLOW Orange to blue-green Orange to dark green		**1**

Question Number	Acceptable Answers	Reject	Mark
4(b)	To prevent solvent boiling / vaporising / escaping (from mouth of flask) ALLOW **Solvent** may ignite / is flammable Reactant / product / butan-2-ol / butanone are prevented from boiling / vaporising / escaping (from mouth of flask) IGNORE Comments on sulfuric acid spray being corrosive Butan-2-ol / solvent / butanone is volatile or has a low boiling temperature		**1**

Question Number	Acceptable Answers	Reject	Mark
4(c)	(Purpose:) removes / neutralizes (excess) acid **(1)** (Method:) Put in a (stoppered) **separating funnel / tap funnel** with sodium hydrogencarbonate (and shake the mixture) **(1)** Open the tap at intervals / remove stopper at intervals / release pressure at intervals ALLOW Pressure builds up because carbon dioxide forms **(1)** Final mark can be awarded if washing is carried out in a **stoppered** flask IGNORE comments on separating organic product after washing	Removes impurities	**3**

Question Number	Acceptable Answers	Reject	Mark
4(d)	Drying agent / removes water / removes moisture ALLOW Absorbs water	Dehydrating agent Reacts with water Removes impurities	**1**

Question Number	Acceptable Answer	Reject	Mark
4(e)	**First mark**: Suitable flask (round bottom or pear shaped) fitted with stillhead, **and** with thermometer in correct position with bulb opposite opening to condenser ALLOW Flask with long neck and delivery tube in place of flask & stillhead IGNORE Fractionating column **(1)** **Second mark:** Condenser angled downwards with correctly drawn inner tube and (water cooled) outer tube IGNORE (Direction of) water flow in condenser **(1)** **Third mark**: Collecting flask with vent in flask or in connection to it ALLOW Open necked flask / beaker **(1)** **Fourth mark**: Electrical heater ALLOW Water bath heated by electrical heater / Bunsen / heat arrow If heat source is shown as "Heat" or with an arrow then ALLOW either of these precautions: Tube between condenser and collecting flask to lead fumes away to drain or fume cupboard OR Cool collecting flask in ice **(1)** Labels only needed for items which cannot be identified in diagram eg electric heater	Conical flask Still head open Air condenser (ie no water jacket) Sealed system Use of Bunsen but no water bath	**4**



Question Number	Acceptable Answers	Reject	Mark
4(f)(i)	(5.0 / 0.805) = 6.2112 / 6.211 / 6.21 / 6.2 (cm^3) ALLOW comma for decimal point	6 (cm^3)	**1**

Question Number	Acceptable Answers	Reject	Mark
4(f)(ii)	There are many possible correct methods for this calculation. Two of these methods are shown below: **Look at final answer:** **4.8(2) (g) scores 3 marks,** **1.97 (g) OR 3.08 (g) scores 2 marks** For other answers, look at working; do not penalise intermediate rounding. 0.042 moles butanone gives final answer of 4.9 (g) **First mark:** 3.0 g butanone = 0.041609 mol **(1)** **THEN Route 1:** **Second mark** Need to make $\frac{0.0416 \times 100}{64}$ = 0.065 mol **(1)** **Third mark** Mass butanol = (0.065 x 74.1) = 4.8175 / 4.8(2) (g) **(1)** **OR Route 2:** **Second mark** Mass of 0.041609 mol butanol = 0.041609 x 74.1 = 3.082 (g) (Use of 0.042 mol gives 3.11 (g)) **(1)** **Third mark** **M**ass butanol needed = (3.082 x 100/ 64) = 4.8175 / 4.8(2) (g) **(1)** IGNORE sf except 1 sf at all stages Rounding may be done at different stages of calculation and intermediate values may not be shown		**3**

Total for Question 4 = 14 marks

Total for Paper = 50 marks

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