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Mark Scheme (Results)

January 2015

Pearson Edexcel International Advanced level in Chemistry (WCH06) Paper 01

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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 Answers	Reject	Mark
1(a)(i)	Use of nichrome/platinum wire/rod ALLOW Nickel chromium wire **(1)** Dip wire into (concentrated) hydrochloric acid and then the solid ALLOW Mixing hydrochloric acid with salt then dipping in wire IGNORE References to cleaning wire **(1)** Place in/on (hot/roaring/blue cone of) Bunsen flame (and observe flame colour) This mark is consequential on first and second mark unless **wire / salt** placed in/on (hot/roaring/blue cone of) Bunsen flame (and observe flame colour) **(1)**	Nichrome / platinum alone Nickel / chromium wire Deflagrating / combustion spoon Sulfuric acid **Any** reference to **burn / burning / burned** Use of yellow Bunsen flame Under Bunsen flame In/on Bunsen burner	3

Question Number	Acceptable Answers	Reject	Mark
1(a)(ii)	Na^+ (ions)	Na alone Sodium (ion) $Na^{2+}/Fe^{2+}/Cr^{3+}$	1

Question Number	Acceptable Answers	Reject	Mark
1(b)(i)	**B** sulfur/S/S_8 **(1)** **C** sulfur dioxide/SO_2/sulfur(IV) oxide **(1)**	 Hydrogen sulfide / H_2S	2

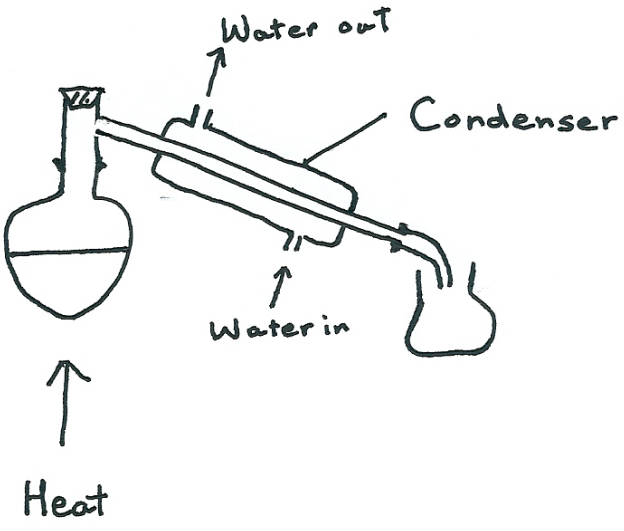
Question Number	Acceptable Answers	Reject	Mark
1(b)(ii)	(Pale/light) yellow/straw ALLOW (light/pale) brown/red-brown	Orange/Red Correct colour 'to colourless' Also colourless to correct colour	1

Question Number	Acceptable Answers	Reject	Mark
1(b)(iii)	Thiosulfate	$S_2O_3^{2-}$	1

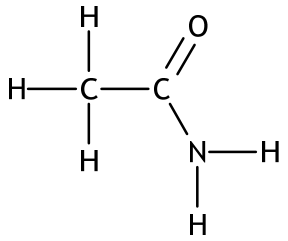
Question Number	Acceptable Answers	Reject	Mark
1(b)(iv)	$Na_2S_2O_3$ ALLOW Na_2SO_3 if sulfite/sulfite(IV)/ sulfate(IV) given in (b)(iii) Any number of H_2O's in the formula COMMENT Any Group 1 or Group 2 metal ion with correct formula	Any additional salt formulae even if with correct answer.	1

Total for Question 1 = 9 marks

Question Number	Acceptable Answers	Reject	Mark
2(a)	Test 1 (Damp/moist red) litmus (paper) / universal indicator / UI / pH (paper) turns blue **(1)** Accept any correctly named acid base indicator (paper) with alkaline colour. Test 2 (Rod/stopper dipped in concentrated/dilute) hydrochloric acid/hydrogen chloride (gas)/HCl ((g)) **(1)** Gives (dense) **white** smoke/ **white** fumes **(1)** ALLOW Other suitable tests e.g. with copper(II) sulfate solution forming blue solution **(2)**	Turns purple Reaction with chlorine or other halogen Steamy/misty fumes White precipitate/solid Smell	3

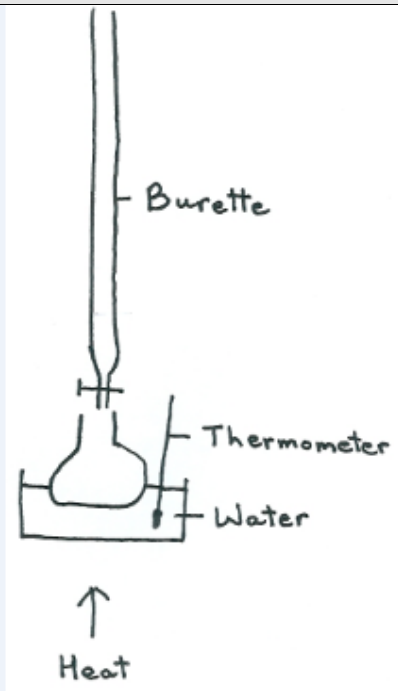
Question Number	Acceptable Answers	Reject	Mark
2(b)(i)	 **First Mark** Heat/arrow (may be directed to any part of the liquid in the flask)/**hot** water bath/**heating / electrical** mantle IGNORE Fractionating column **AND** round bottomed/pear shaped flask **AND** Downward delivery tube **(1)** **Second Mark** Condenser jacket/tube (labelled condenser) **and** water direction and collection Condenser must slope downwards Water in must be below and to the right of water out **(1)** ALLOW Correct unlabelled arrows or just water in/out. Ignore thermometer even if incorrectly placed Ignore air gaps at apparatus joints and accidental lines sealing apparatus.	Reflux apparatus **(0)** 'Reflux' instead of heat Sealed apparatus or open flask	2

Question Number	Acceptable Answers	Reject	Mark
2(b)(ii)	Ethanoic acid/CH_3CO_2H/ CH_3COOH OR displayed / skeletal formula Ignore carboxylic acid/ RCO_2H/ RCOOH		1

Question Number	Acceptable Answers	Reject	Mark
2(c)(i)	**D** is ethanamide ALLOW acetamide **(1)**  **(1)** ALLOW undisplayed CH_3 and or NH_2	Ethylamide Ethamide Ethyl ethanamide	2

Question Number	Acceptable Answers	Reject	Mark
2(c)(ii)	$CH_3COCl + 2NH_3 \rightarrow CH_3CONH_2 + NH_4Cl$ ALLOW $CH_3COCl + NH_3 \rightarrow CH_3CONH_2 + HCl$ Do check 2s and 3s in all formulae.		1

Total for Question 2 = 9 marks

Question Number	Acceptable Answers	Reject	Mark
3(a)(i)	 Burette and (conical) flask / beaker **and** **Either** Heated water bath / direct heat Can be shown by heat/arrow **(1)** Thermometer in flask / water **(1)** **OR** Heating mantle / hot plate **(1)** With thermostatic control **(1)** ALLOW 1 mark for heating separate from the titration		2

Question Number	Acceptable Answers	Reject	Mark
3(a)(ii)	(The excess / unreacted) **zinc** / **Zn((s))** (is removed) Allow Insoluble zinc Insoluble reactant Zinc Zinc solid / left over	Insoluble impurities Insoluble reactant alone	1

Question Number	Acceptable Answers	Reject	Mark
3(a)(iii)	To prevent it / **T** being oxidized by air / oxygen ALLOW To prevent oxidation OR The vanadium(II) is easily oxidized by air / oxygen OR (As a) large volume / volume greater than 50 cm^3 of potassium manganate(VII) is required		1

Question Number	Acceptable Answers	Reject	Mark
3(a)(iv)	**EITHER** Because the potassium manganate(VII) is self-indicating ALLOW Reaction is self-indicating ALLOW Potassium manganate (VII) changes colour during the reaction/ at the end point. **OR** at the end point a pink / purple solution forms (from a blue/yellow/green solution) ALLOW Modified pink e.g. yellow pink because of the yellow vanadate(V)	Just obvious / clear colour change without potassium manganate(VII)	1

Question Number	Acceptable Answers	Reject	Mark
3(b)(i)	$\frac{25 \times 0.10}{1000} = 2.5 \times 10^{-3}$/0.0025 (mol)		1

Question Number	Acceptable Answers	Reject	Mark
3(b)(ii)	Total volume of 0.02 mol dm^{-3} solution of potassium manganate(VII) = 25 + 50 = 75 cm^3 **(1)** $\frac{(75) \times 0.02}{1000}$ = 1.5×10^{-3}/0.0015 (mol) **(1)** ALLOW for 1 mark $\frac{25 \times 0.02}{1000}$ = 5×10^{-4}/0.0005 (mol) **OR** $\frac{50 \times 0.02}{1000}$ = 1×10^{-3}/0.001 (mol) ALLOW Internal TE for incorrect volume in first calculation for second mark.		2

Question Number	Acceptable Answers	Reject	Mark
3(b)(iii)	$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$		1

Question Number	Acceptable Answers	Reject	Mark
3(b)(iv)	**METHOD 1** 2.5×10^{-3} mol of vanadium ions lose $5 \times 1.5 \times 10^{-3} = 7.5 \times 10^{-3}$ mol electrons **(1)** Therefore 1 mol of vanadium ions lose 3 mol of electrons **(1)** As final oxidation state is +5 the oxidation state of vanadium in the purple solution is +2 **(1)** **METHOD 2** Ratio of Mn:V = 0.0015:0.0025 = 3:5 **(1)** Oxidation number of Mn changes by 5 so oxidation number of vanadium must change by 3 **(1)** As final oxidation state is +5 the oxidation state of vanadium in the purple solution is +2 **(1)** **METHOD 3** **First Mark** +2 (with no working) **Second Mark** Working backwards from this: Any mention of transfer of 3 electrons OR $V^{5+} + 3e^{(-)} \rightarrow V^{2+}$ OR $V^{2+} - 3e^{(-)} \rightarrow V^{5+}$ IGNORE $Mn(VII) + 3e^{(-)} \rightarrow Mn(II)$ **Third Mark** 7.5×10^{-3} mols of electrons / change in oxidation number removed from 2.5×10^{-3} V^{3+} OR 7.5×10^{-3} mols of manganate(VII) ion react with 2.5×10^{-3} mols V^{3+} ALLOW TE from (b)(ii) and (iii)		3

Question Number	Acceptable Answers	Reject	Mark
3(c)	$VO_3^- + 2H^+ \longrightarrow VO_2^+ + H_2O$		1

Question Number	Acceptable Answers	Reject	Mark
3(d)	**First Mark** V^{3+} / V(III) / (V)+3 **(1)** **Second Mark** Any of the following calculations : V(IV)/VO^{2+} to V(III)/ V^{3+} = +0.48 (V) OR V(III)/V^{3+} to V(II)/ V^{2+} =-0.12 (V) OR ALLOW V(V)/VO_2^+ to V(IV)/VO^{2+} =+0.66 (V) OR Sn^{2+}(aq)|Sn(s) has a more negative electrode potential than the last two vanadium potentials (so vanadium reduced to V^{3+}) Accept reverse argument OR By the anticlockwise rule if shown with appropriate arrows **(1)**		2

Total for Question 3 = 15 marks

Question Number	Acceptable Answers	Reject	Mark
4(a)	Syringe / (graduated) pipette / burette / micro-pipette / auto pipette / any pipette with a volume of $5cm^3$ or less ALLOW Calculate the mass and use a balance Recognisable spelling of pipette / burette but not biuret.	Measuring cylinder	1

Question Number	Acceptable Answers	Reject	Mark
4(b)	Toxic/poisonous **(1)** Ignore harmful Corrosive/causes burns **(1)** Ignore harmful	Corrosive/causes burns/irritant/dangerous Oxidising/toxic/poisonous /irritant	2

Question Number	Acceptable Answers	Reject	Mark
4(c)(i)	Penalise rounding errors once only in parts (i) and (ii) Number of moles of cholesterol $= \frac{1.0}{386.7} = 2.58598 \times 10^{-3} = 2.59 \times 10^{-3}$ **(1)** Note 2.58×10^{-3} loses this mark as a rounding error but 2.6×10^{-3} is fine Mass of benzoyl chloride = 0.4 x 1.21 = 0.484 (g) **(1)** Number of moles of benzoyl chloride $= \frac{0.484}{140.6} = 3.4424 \times 10^{-3}$ **AND** So benzoyl chloride is in excess / cholesterol is the limiting factor **(1)**		3

Question Number	Acceptable Answers	Reject	Mark
4(c)(ii)	Number of moles of cholesteryl benzoate $= \frac{0.65}{490.8}$ $= 1.3244 \times 10^{-3}$ **(1)** Yield = $\frac{1.32 \times 10^{-3}}{2.59 \times 10^{-3}} \times 100$ $= 51(.1)\%$ Or = 51(.2) ignore SF **(1)** **OR** Expected/maximum mass of cholesteryl benzoate = $2.59 \times 10^{-3} \times 490.8 = 1.27$ g **(1)** Yield = $\frac{0.65}{1.27}$ $= 51(.1)\%$ Or = 51(.2) ignore SF **(1)** Correct answer no working **(2)**	50.9%	2

Question Number	Acceptable Answers	Reject	Mark
4(d)	Place flask in running **cold** water OR (in an) ice bath / beaker of cold / cool water	Add ice / Put in the fridge Washing with / adding cold water / ice	1

Question Number	Acceptable Answers	Reject	Mark
4(e)	To react with / remove (any residual) benzoyl chloride	Acts as a solvent Removes impurities	1

Question Number	Acceptable Answers	Reject	Mark
4(f)	Dissolve / add / put crystals in **minimum** (volume / amount) **(1)** of hot ethyl ethanoate **(1)** Penalise incorrect solvent e.g. water once only. Filter (hot) **and** allow to cool **(1)** Filter **and** wash with small amount of / cold solvent. **Note** notice if 'solvent' used here and in second marking point, this mark can be given **(1)** **Note** If ethyl ethanoate mentioned here can score second mark above **and** The wrong solvent may be used here e.g. water with the correct initial solvent. This should be separately penalised here. Dry between filter papers / dry in a desiccator ALLOW Keep suction filtration going until crystals are dry Dry in warm oven or **below** 100 °C **(1)**	Wash… …to remove soluble impurities …cold **solution** …to remove insoluble impurities but only penalise soluble / insoluble once Dry in oven alone	5

Question Number	Acceptable Answers	Reject	Mark
4(g)	**Method 1** **First Mark** (The crystals from) step 6 / pure crystals have a sharp (at 150°C / 423 K) melting temperature / melt over 1-2°C OR (The crystals from) step 6 / pure crystals melt within 2°C of / close to the data book value / at 150°C / 423 K **(1)** **Second Mark** (The crystals from) step 5 would melt over a larger temperature range OR Would melt (significantly) more / more than 2°C **and** below the data book value / 150°C / 423 K **(1)** **Method 2** Comparative answers Can score both marks if it clear which step the crystals are prepared in. Two Examples Both melting points measured and the pure sample / step 6 has a sharp**er** melting temperature **(2)** Both melting points measured and the pure sample / step 6 has a melting temperature clos(er) to than data book value / 150°C / 423 K **(1)** The impure sample melts at a temperature below that of the pure sample **(1)** Allow reverse arguments for step 5		2

Total for Question 4 = 17 marks
Total for paper = 50 marks

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