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Mark Scheme (Results)

Summer 2013

GCE Chemistry 6CH07/01
Chemistry Laboratory Skills I
Alternative

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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)	Potassium (ions) / K^+	K /incorrect formula Name with incorrect formula e.g. "Potassium, K"	**1**

Question Number	Acceptable Answers	Reject	Mark
1(a)(ii)	No precipitate forms / no change / no reaction / colourless **solution** ALLOW clear for colourless	White precipitate dissolves just "dissolves"	**1**

Question Number	Acceptable Answers	Reject	Mark
1(a)(iii)	Silver nitrate (solution) / $AgNO_3$ Allow acidified silver nitrate **(1)** Yellow precipitate / solid ALLOW yellow suspension **(1)** Second mark depends on first mark (use of silver nitrate)	Pale yellow precipitate	**2**

Question Number	Acceptable Answers	Reject	Mark
1(a)(iv)	(precipitate) does not dissolve / (precipitate) is insoluble/ (precipitate) becomes paler in colour ALLOW "no change / no reaction" ALLOW mark for insoluble even if wrong reagent is used in (a)(iii) to form a **precipitate** regardless of colour Mark can only be given if there is a **precipitate** in (a)(iii)	Grey solid	**1**

Question Number	Acceptable Answers	Reject	Mark
1(a)(v)	KI Consequential on cation other than K^+ in (a)(i) ALLOW K^+I^-	Just potassium iodide Formula based on cation with incorrect charge or anion other than iodide	**1**

Question Number	Acceptable Answers	Reject	Mark
1(b)(i)	calcium (ions) / Ca^{2+} ALLOW +2 for 2+	Ca / incorrect formula Name with incorrect formula e.g. "Calcium, Ca"	**1**

Question Number	Acceptable Answers	Reject	Mark
1(b)(ii)	Dissolved / disappeared **(1)** Limewater /calcium hydroxide (solution) /$Ca(OH)_2$ ((aq)) **(1)**	Melted	**2**

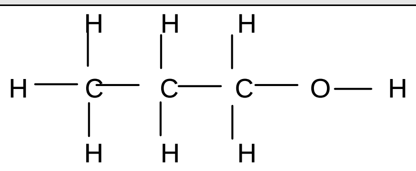
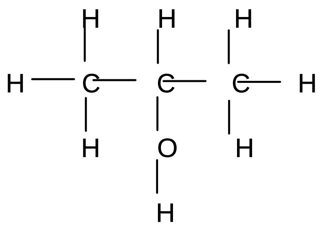
Question Number	Acceptable Answers	Reject	Mark
1(b)(iii)	$CaCO_3$ ALLOW $Ca(HCO_3)_2$ TE on incorrect metal ion in b(i) if correct formula given e.g $SrCO_3$, Na_2CO_3	Name Formula based on cation with incorrect charge e.g Ca_2CO_3 or anion other than carbonate or hydrogencarbonate	**1**

Question Number	Acceptable Answers	Reject	Mark
1(c)(i)	No double bonds between C atoms /C=C absent/not an alkene / **Z** is saturated / only single bonds between C atoms ALLOW not an alkene or alkyne	Just "no double bonds" Just "single bond(s)" alkane or any other functional group stated even if alcohol	**1**

Question Number	Acceptable Answers	Reject	Mark
1(c)(ii)	Alcohol / (−)OH / ROH / hydrox**yl** group present ALLOW (−)COH	OH^- / hydroxide for hydroxyl CHO carboxylic acid Phenol	**1**

Question Number	Acceptable Answers	Reject	Mark
1(c)(iii)	Primary / 1 ° alcohol **(1)** Secondary / 2 ° alcohol **(1)** ALLOW **Not** a tertiary alcohol for one mark ALLOW propan-1-ol **(1)** propan-2-ol **(1)**	Just “alcohol” Tertiary alcohols Other specific examples Alcohol and carboxylic acid	**2**

Question Number	Acceptable Answers	Reject	Mark
1(d)(i)	C 60.0 ÷ 12 = 5.0 → 3 H 13.3 ÷ 1 = 13.3 → 8 O 26.7 ÷ 16 = 1.67 → 1 Ratio 5.0 : 13.3 : 1.67 **(1)** C_3H_8O **(1)** Correct answer without working scores 2 Correct answer with incorrect working (eg mole calculations inverted) scores 1 No TE on incorrect ratios	C_3H_7OH	**2**

Question Number	Acceptable Answers	Reject	Mark
1(d)(ii)	 **(1)**  **(1)** ALLOW –OH for the hydroxyl group, but bond should go from C to O in propan-1-ol. IGNORE poorly placed OH in propan-2-ol. ALLOW skeletal formulae / structural formulae both correct – 1 mark ALLOW TE from 1(d)(i), e.g. if a different number of carbon atoms is given in 1di then allow 2 different isomers drawn displayed correctly	C-H-O C_3H_7OH	**2**

Total for Question 1 = 18 Marks

Question Number	Acceptable Answers	Reject	Mark
2(a)(i)	$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$ First mark for correct species in a balanced equation ALLOW hexaqua ions providing the equation is balanced IGNORE reversible arrows **(1)** Second mark for states Consequential on a reasonable attempt at the equation, including for a full equation or unbalanced equation E.g. ALLOW as reasonable Zn with one+ instead of 2+ Sulfate ions shown correctly but not cancelled out **(1)**	Sulfate ions not cancelled out Reversed equation Zn and Cu metal both shown as ions	**2**

Question Number	Acceptable Answers	Reject	Mark
2(a)(ii)	q = 50.0 x 4.18 x 46.5 **(1)** = 9718.5 (J) /9.7185 **kJ** **(1)** Correct answer with no working scores (2) IGNORE s.f. except 1 (ie allow 9719 / 9720 / 9700 or 9.719 / 9.72 / 9.7 **kJ**) IGNORE sign of q if given If mass used 55.0g and q = 55.0 x 4.18 x 46.5 = 10690.35 (J) scores (1) If mass used is 5g and q = 5 x 4.18 x 46.5 = 971.85(J) scores (1)	9718	**2**

Question Number	Acceptable Answers	Reject	Mark
2(a)(iii)	$\frac{50.0 \times 1}{1000}$ = 0.05 (mol) Mark is for final answer		**1**

Question Number	Acceptable Answers	Reject	Mark
2(a)(iv)	ΔH = − 9718.5 ÷ (0.050 x 1000) = -194.370 (kJ mol^{-1}) = **− 194** (kJ mol^{-1}) ALLOW = − 194000 **J mol^{-1}** First mark Value, ignore sign and sf Only penalise units if value is in J (mol^{-1}) without stating this **(1)** TE (a)(ii) ÷ ((a)(iii) x 1000) Using 10690.5 gives -2138810J = **-214** kJ mol^{-1} Second mark Sign and 3 s.f. **(1)** **This mark depends on a correct calculation method**		**2**

Question Number	Acceptable Answers	Reject	Mark
2(b)(i)	47.5 (°C)		**1**

Question Number	Acceptable Answers	Reject	Mark
2(b)(ii)	(1.0 x 100) ÷ 46.5 = 2.1505376 = (±) **2.15 / 2.2 / 2** (%) IGNORE sf ALLOW answer with 47.5 in the denominator which gives 2.1052631 = (±) **2.11 / 2.1 / 2** (%) ALLOW TE on value (b)(i)	2.0 and 2.1 2.0 and 2.2	**1**

Question Number	Acceptable Answers	Reject	Mark
2(c)	**First mark** Measure the temperature (of copper(II) sulfate) every minute / at realistic time interval (15 s to 1 minute) for e.g. 2 – 4 minutes before adding zinc OR measure temperature (of copper(II) sulfate) before adding zinc **(1)** **Second mark** Measure temperature each minute / at realistic time intervals (after adding zinc) for several minutes **(1)** **Note** These readings may be started after the maximum temperature is reached / after reaction has stopped and taken until the mixture has cooled to room temperature. Intervals should be chosen to allow at least 4 readings on cooling section of curve. **Third mark** Plot a temperature - time graph / plot a graph using measurements (of temp and time) obtained **(1)** This mark can be awarded if first two marks are insufficient for credit **Fourth mark** **Extrapolate** to find ΔT / maximum temperature (at the time of mixing) **OR** Use properly described intersecting lines to find maximum temperature **(1)** Allow third and fourth marking points to be shown on annotated diagrams / graph **If zinc is added in small portions or over a period of time only first and third marks can be awarded** (Since measurements of cooling will be incorrect and there is no definite time when reaction starts)	Readings more often than every 15s	**4**

Total for Question 2 = 13 Marks

Question Number	Acceptable Answers	Reject	Mark
3(a)(i)	Any two from Misty /steamy fumes **(1)** Purple / violet fumes **(1)** ALLOW purple gas / vapour Brown or black solution/ liquid /solid OR grey / grey-black solid **(1)** Yellow solid / deposit ALLOW yellow precipitate **(1)** IGNORE effervescence, bubbles, colour change, coloured fumes, solid disappears, description of smells, identification of products even if incorrect, follow-on tests e.g. effect on potassium dichromate paper	 White fumes Steamy white Smoke Yellow fumes Yellow liquid	**2**

Question Number	Acceptable Answers	Reject	Mark
3(a)(ii)	There is little / no HI formed (which is the reagent needed) **(1)** Because HI is **oxidized** (to iodine)/ because iodide ions are **oxidized** (to iodine)/sulfuric acid is oxidizing / HI **reduces** sulfuric acid / iodide ions **reduce** sulfuric acid **(1)** Must mention oxidation or reduction correctly for second mark IGNORE "an elimination reaction would occur" ALLOW "HI is oxidized to iodine" for both marks	 Iodide **ions** react with sulfuric acid sulfuric acid oxidizes **iodine** HI is **reduced** to iodine	**2**

Question Number	Acceptable Answers	Reject	Mark
3(b)	$2P + 3I_2 \rightarrow 2PI_3$ OR $P + 3/2\ I_2 \rightarrow PI_3$ OR $P_4 + 6I_2 \rightarrow 4PI_3$ ALLOW reversible sign IGNORE state symbols even if incorrect	Equations with ions I for I_2	**1**

Question Number	Acceptable Answers	Reject	Mark
3(c)(i)	Exothermic ALLOW fast / vigorous / violent	Dangerous Reactive (In)flammable Volatile	**1**

Question Number	Acceptable Answers	Reject	Mark
3(c)(ii)	(very) pale purple / yellow / straw coloured OR colourless mixture / is decolourised OR no purple colour	clear for colourless no (grey) solid remains add starch	**1**

Question Number	Acceptable Answers	Reject	Mark
3(c)(iii)	Diagram to show: Distillation flask and still-head and heat **(1)** (no need for a thermometer) ALLOW appropriate tubing as alternative to still head ALLOW heating with electrical, water bath, Bunsen or just arrow IGNORE thermometer and position, tap funnel in still head, absence of reagents in flask Condenser sloping downwards **(1)** With water entering at the bottom and suitable receiver (e.g. flask or beaker) **(1)**	 Conical flask	**3**

Question Number	Acceptable Answers	Reject	Mark
3(c)(iv)	This removes / reacts with (any residual) iodine OR Removes excess iodine / I_3^-	Removes acid Removes impurities Removes iodide Removes ions (other than I_3^-) Just reduces iodine to iodide	**1**

Question Number	Acceptable Answers	Reject	Mark
3(c)(v)	Anhydrous calcium chloride / it is drying agent OR anhydrous salt needed to remove water/hydrated salt will not remove water Allow moisture for water and absorb for remove	Just "calcium chloride is a drying agent"	**1**

Question Number	Acceptable Answers	Reject	Mark
3(c)(vi)	Distillation / re-distillation (over a narrow range of temperature) (either side of the boiling temperature of 1-iodobutane) ALLOW fractional distillation IGNORE filtering before distillation and any temperatures given	Recrystallization Just "purification"	**1**

Question Number	Acceptable Answers	Reject	Mark
3(d)(i)	(95.0 ÷ 74.0) x 92.5 g **(1)** = 118.75 / 118.8/ 119 g **(1)** ALLOW 118.77 (from use of 1.284) 3, 4 or 5 sf in final answer Correct final answer scores 2 marks OR Rounding errors by dividing 95.0 ÷ 74.0 as a first step e.g. (95.0 ÷ 74.0)=1.28, followed by 1.28 x 92.5 = 118.4 /118 **(1)** e.g. (95.0 ÷ 74.0)=1.3 followed by 1.3 x 92.5 =120.25 /120.3/120 **(1)**		**2**

Question Number	Acceptable Answers	Reject	Mark
3d(ii)	95.3 ÷ 3(d)(i) (95.3 ÷ 118.75) x 100 = 80.2563 = **80.25 / 80.3** % Many candidates give the answer to 3 d(i) to 3sf e.g. 119 but keep the full answer in their calculator resulting in a answer of 80.25 which is correct and should be allowed TE from 3(d)(i)	 80.2	**1**

Question Number	Acceptable Answers	Reject	Mark
3d(iii)	**One** of: Handling / transfer losses competing reactions / (unwanted) side reaction / byproducts form incomplete reaction	Just "losses"/spillage Impure reagents Loss by evaporation Other products form Not enough PCl_5 to react	**1**

Question Number	Acceptable Answers	Reject	Mark
3d(iv)	**Two** of: • low atom economy Ignore "low percentage / 80% yield" • phosphorus(V) chloride expensive • disposal of unwanted materials expensive or difficult • no (large scale) use for $POCl_3$ • difficult/expensive to separate required product No credit for Slow / time consuming Exothermic Not efficient High energy use Competing reactions Non renewable reactants HCl toxic / acidic Unwanted product**s**	Just "Atom economy not 100%" Just "It" would be expensive Anything to do with environmental friendliness or the ozone layer or the end of life on Earth!	**2**

Total for Question 3 = 19 Marks

Total for paper = 50 Marks

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