Mark Scheme (Final)

Summer 2008

GCE

GCE Chemistry (6246/01A)

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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.

Using the mark scheme

1. / means that the responses are alternatives and either answer should receive full credit.
2. ( ) 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.
3. [ ] words inside square brackets are instructions or guidance for examiners.
4. Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
5. 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.

In general, an inference should follow an observation.

Apparatus and Materials

Apparatus

Each candidate will require:

1. 50.0 cm^3 burette, stand and clamp, with small funnel for filling, white tile and a small beaker for draining burette;
2. two 250 cm^3 conical flasks;
3. 25.0 cm^3 pipette and safety filler;
4. six test tubes and one boiling tube in a test tube rack;
5. one 10 cm^3 and two 25 cm^3 measuring cylinders;
6. a supply of dropping pipettes;
7. a 250 cm^3 beaker of hot water at about 70 °C to be used as a water bath.

Materials

Each candidate will require:

(a)* 200 cm^3 of aqueous sodium thiosulphate of concentration 0.110 mol dm^{-3} labelled **Solution A**. The concentration of this solution is **not** to be disclosed to candidates;

(b)* 200 cm^3 of aqueous potassium manganate(VII) of concentration 0.020 mol dm^{-3} labelled **Solution B**;

(c)* 10 cm^3 of approximately 0.25 mol dm^{-3} aqueous zinc sulphate labelled **Solution of C**. The identity of this solution is **not** to be disclosed to candidates;

(d)* 5 cm^3 of approximately 0.10 mol dm^{-3} aqueous potassium chromium(III) sulphate, labelled **Solution of D**. The identity of this solution is **not** to be disclosed to candidates;

(e)* 5 cm^3 of propanone labelled **E**. The identity of this compound is **not** to be disclosed to candidates;

(f) 100 cm^3 of dilute sulphuric acid of concentration approximately 1.0 mol dm^{-3}, labelled **Dilute sulphuric acid**;

(g) 100 cm^3 of aqueous potassium iodide of concentration approximately 0.50 mol dm^{-3} labelled **Aqueous potassium iodide**;

(h) 15 cm^3 of dilute sodium hydroxide; concentration approximately 1.0 mol dm^{-3};

(i) 15 cm^3 of dilute aqueous ammonia; concentration approximately 2.0 mol dm^{-3};

(j) 5 cm^3 of dilute hydrochloric acid; concentration approximately 2.0 mol dm^{-3};

(k) 5 cm^3 of aqueous barium chloride; concentration approximately 0.2 mol dm^{-3};

(l) 10 cm^3 of freshly-prepared aqueous hydrogen peroxide; concentration approximately 10 vol;

(m) 5 cm^3 of 2,4-dinitrophenylhydrazine solution. This may be made by adding 0.1 g of the solid reagent to 45 cm^3 of water and 5 cm^3 of concentrated hydrochloric acid, stirring and filtering if necessary. Alternatively centres may prepare this reagent using their own procedure providing the reagent gives a positive test with propanone;

(n) 5 cm^3 dilute sulphuric acid; concentration approximately 1.0 mol dm^{-3} (for Question 3);

(o) 5 cm^3 of aqueous potassium dichromate(VI); concentration approximately 0.20 mol dm^{-3};

(p) 10 cm^3 of aqueous sodium hydroxide; concentration approximately 0.50 mol dm^{-3}. Label this solution **0.50 mol dm^{-3} sodium hydroxide for Q3(c)**;

(q) 10 cm^3 of iodine/potassium iodide solution made by adding 2 g iodine to 6 g potassium iodide dissolved in 100 cm^3 water and labelled **aqueous iodine**;

(r) 20 cm^3 of freshly prepared aqueous starch; concentration approximately 1% labelled **starch**;

(s) a supply of distilled water.

For **home** centres (ONLY), the chemicals identified with an asterisk (*) will be sent by a firm of manufacturing chemists.

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(a)	**Table 1** Check subtractions and averaging arithmetic, correcting if necessary. All volumes recorded to 0.05 cm^3 **(1)** *ALLOW one slip but withhold this mark if any readings are in the wrong boxes.* *ALLOW* 0 as initial volume *NOT* 50 as initial volume All subtractions correct **(1)** *[✓✓top RHS of Table 1]* **Mean titre** For correct averaging of chosen values / choosing identical values and for recording the average correct to 2 or 3 dps or to nearest 0.05 cm^3 **(1)** **Do not penalise missing 2/3rd dp if already penalised in Table 1.** *[✓by the mean in space <u>or</u> near the dotted line in paragraph below]* **Accuracy** If the candidate has made an arithmetical error in the Table 1 volumes used in the mean or in averaging the examiner must calculate a new average. • For an averaging error simply calculate a new value using the candidate's chosen titres. • If a wrongly subtracted titre has been used in the mean then choose any two identical titres or take an average of the closest two titres. Calculate the difference(d) between the candidate's mean titre and that of the examiner or supervisor. Examiner's titre = 22.70 cm^3 (to be confirmed at standardisation) Award marks for accuracy as follows. <table><tr><td>Difference (d) =</td><td>±0.20</td><td>±0.30</td><td>±0.40</td><td>±0.50</td></tr><tr><td>Mark</td><td>4</td><td>3</td><td>2</td><td>1</td></tr></table>			10

	Range Award a mark on the range of titres used by the candidate to calculate the mean. The range(r) is the difference between the outermost titres used to calculate the mean. If the examiner has corrected titres because of incorrect subtraction then award the range mark on the corrected titres used by the examiner to re-calculate the mean			

Range(r) of titres/cm^3	±0.20	±0.30	±0.50
Mark	**3**	**2**	**1**

	Examiner to show the mark awarded for accuracy and range as d= value ✓ 4 max r = value ✓ 3 max Then the mark out of 10 written in margin. [Overseas scripts: examiner to write "SR = titre value" on each script]			

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(b)	Moles MnO_4^- in 25.0 cm^3 = $\frac{25 \times 0.020}{1000}$ (1) moles $S_2O_3^{2-}$ in mean titre = moles MnO_4^- x 5 (1) concentration $Na_2S_2O_3$ = $\frac{\text{moles } S_2O_3^{2-} \text{ in mean titre}}{\text{mean titre} \div 1000}$ to 3 sf (1) Ignore units. Do not penalise loss of trailing zeros.	Correct answer from any method for **(3)** Ignore sf except on final conc^n.	Final conc^n if not to 3 sf. ∴ max (2)	3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(c)	Yellow to colourless	Straw (colour) to colourless	Colourless alone Any purple/brown	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(a)	**Observations** White precipitate (1) Dissolves / disappears (in excess NaOH) / colourless solution (1) **Inference** Zinc / Zn^{2+}, aluminium / Al^{3+}, lead(II) / Pb^{2+} any two (1) Ignore Cd^{2+} / Sn^{2+} / Sn^{4+} / Sb^{3+}	Soluble in excess/ goes clear	Symbols Zn, Al, Pb.	3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(b)	**Observations** White precipitate (1) Dissolves / disappears (in excess NH_3) / colourless solution (1) **Inferences** Zinc (ions) / Zn^{2+} (1) $Zn(OH)_2$ / $[Zn(H_2O)_4(OH)_2]$ (1) $[Zn(NH_3)_4]^{2+}$ (1)	Soluble in excess/ goes clear Allow equivalent Cd species if Cd given in (a) $[Zn(NH_3)_4(H_2O)_2]^{2+}$		5

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(c)	Observation White precipitate (1) Inference Sulphate / SO_4^{2-} (1)	hydrogensulphate/ HSO_4^-	Barium sulphate	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(d)	$ZnSO_4$	$CdSO_4$		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(e)	**Observations** (any) green precipitate (1) Dissolves/ disappears (in excess) / green solution (1) Any yellow / any brown solution (1) **Inferences** $Cr(OH)_3$ / $[Cr(H_2O)_3(OH)_3]$ (1) $[Cr(OH)_6]^{3-}$ (1) CrO_4^{2-} (1)	Soluble in excess/ goes clear		6

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(f)	$Cr_2(SO_4)_3$			1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(a)	**Observation** Yellow / orange precipitate (1) **Inference** Carbonyl / C=O/>C=O/ both of aldehyde or ketone (1)	Yellow-orange		2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(b)	**Observation** Stays orange / no change (1) **Inferences** Ketone / not aldehyde if follows A or K in (a) (1) Not oxidised / no redox / does not reduce $Cr_2O_7^{2-}$ (1)	No reaction	Just “nothing” Tertiary alcohol Reject cq on wrong colour	3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(c)	**Observation** (pale) Yellow precipitate (1) **Inferences** Triiodomethane / Iodoform / CHI_3 (1) Methyl ketone / CH_3CO (1)	Cream ppte	CH_3I Methyl secondary alcohol / ethanol / ethanal	3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(d)(i)	*m/e* 58 (1) Structure $CH_3—C=O$ with CH_3 below C (1) Ignore positive charge		CH_3COCH_3 Species with negative charge	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(d)(ii)	CH_3CO^+		Formula with no positive charge $C_2H_30^+$	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.	**1** ✓ (Add NaCl to all five); the one that gives white ppte is $AgNO_3$ **2** ✓ Add $AgNO_3$ to new samples of remaining four. **3** ✓ Solution that gives yellow ppte is KI. **4** ✓ Solution that gives brown ppte or no ppte is NH_3. **5** ✓ Solution that give white ppts are KCl and $AlCl_3$. **6** ✓ Add NH_3 to remaining two unknown solutions. **7** ✓ Solution that gives white ppte is $AlCl_3$.	No white ppte with NH_3		7

OR

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.	**1** ✓ (Add NaCl to all five); the one that gives white ppte is $AgNO_3$ **2** ✓ Add four solutions to (AgCl) ppte. **3** ✓ Ppte dissolves in NH_3. **4** ✓ Add NH_3 to remaining three solutions. **5** ✓ White ppts $AlCl_3$. **6** ✓ Add $AgNO_3$ to remaining solutions. **7** ✓ Yellow ppte with KI and white ppte with KCl.			7

OR

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.	**1** ✓ (Add NaCl to all five); the one that gives white ppte is $AgNO_3$ **2** ✓ Add four solutions to (AgCl) ppte. **3** ✓ Ppte dissolves in NH_3 **4** ✓ Add $AgNO_3$ to remaining three solutions. **5** ✓ White ppts with $AlCl_3$ + KCl and yellow ppte with KI. **6** ✓ Add NH_3 to solutions of $AlCl_3$ + KCl **7** ✓ White ppte with $AlCl_3$.			7