UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2009 question paper for the guidance of teachers

9701 CHEMISTRY

9701/32 Paper 32 (Advanced Practical Skills), maximum raw mark 40

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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UNIVERSITY of CAMBRIDGE
International Examinations

Question	Sections	Indicative material	Mark	
1 (a)	PDO Recording	Appropriate headings and units Balance readings <u>consistent</u> to 1 dp, to 2 dp or to 3 dp according to precision of balance used Examiner to check subtraction – do not penalise any error here – see section **I(d)**	1 1	[2]
(b)				
(c)	MMO Collection PDO Recording MMO Quality	**(i)** Total volume and temperature recorded for at least 2 different concentrations **(ii)** Total volume increased by 2.00 cm^3 ($\pm$0.10 cm^3) for at least 3 different concentrations of solution Volumes must be recorded to 2 dp. **(iii)** Appropriate headings and units **(iv)** All temperatures recorded to 0.5 ^oC. Check mass of **FB 1** on Supervisor and candidate scripts, particularly if Supervisor and candidate temperatures differ greatly. Round temperatures to nearest 0.5^oC if necessary. Where there are repeated temperature readings, take the average correct to 1 decimal place (do not round). **(v) & (vi)** . Compare temperature at 14.00 cm^3 with temperature recorded by the Supervisor. Award **(v) & (vi)** if within 2.5 ^oC Award **(vi) only** if temperature difference is $>$ 2.5 ^oC and $\leq$ 5 ^oC **(vii) & (viii)** Compare temperature at 16.00 cm^3 with temperature recorded by the Supervisor. Award **(vii) & (viii)** if within 2.5 ^oC Award **(viii) only** if temperature difference is $>$ 2.5 ^oC and $\leq$ 5 ^oC	1 1 1 1 2 2	[8]

Acceptable form of units – illustrated for mass.

1. using the solidus. / g
2. using brackets. (g)
3. fully in words. mass of ……. in grams
4. composite. mass of ……. in g

Where the unit is not incorporated into the heading it must appear after <u>every</u> data entry.

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Question	Sections	Indicative material	Mark	
(d)	ACE Interpretation	Examiner to check solubility calculated for each volume of water. Use candidate's mass of **FB 1** from **(a)**. Correct rounding required for sig fig displayed. Give 2 marks if **all four** solubilities are correct. Give 1 of these 2 marks if **three** only are correct. *Deduct 1 mark from those to be awarded if* 1. *there is an error in subtraction in* **(a).** **OR** 2. the mass recorded in **(a)** is less than 10 g or more than 30 g. No negative marks.	2	
Allow these marks if candidate tabulates solubility and, volume of water instead of temperature.	PDO Display	3 or 4 significant figures given in **each** answer given by the candidate	1	[3]
(e)	PDO Layout	Plots solubility on *y*-axis and temperature on *x*-axis. Axes labelled (ignore incorrect or absent units) and points plotted over ½ of each axis - (count large squares containing the points). *Consider* 1. Spread of the *4 experimental points alone* ***or*** 2. Spread of the *4 experimental points and 42.5°C even if it is not possible to plot the point at 42.5 °C on the y-axis*	1	
If candidate plots solubility against volume of water the following marks only may be awarded: L5 L6 L3 The maximum for the section is 3 marks.		Scales used are easy for examiner to use and enable all points to be plotted 4 °C/large square is acceptable. Penalise non-linear scales here.	1	
		Correctly plots all solubility/temperature points. *Plotting to within ¼ small square – in the correct square.*	1	
		Attempts to draw a straight line or curve through plotted points (minimum of 3 points)	1	
		Plots appropriate curve through a minimum of 4 points. This is a mark for the quality of the line drawn and should be a close match to the plotted points. Look for: (i) good spread of points; (ii) even distribution of points either side of the line (3 on line, 1 off, OK); (iii) smooth curve or regular straight line	1	
	ACE Interpretation	The solubility of **FB 1** at 42.5 °C (± ¼ square) read from the graph. *Correct solubility recorded or correct solubility rounded to nearest gram recorded*	1	[6]
(f)	ACE Conclusions	Give 1 mark for stating there is a higher solubility at higher temperature	1	[1]

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Question	Sections	Indicative material	Mark	
(g)	ACE Conclusions	States that process is endothermic. Uses knowledge of equilibria to explain why it is endothermic. e.g. Refers to absorption of heat energy to dissolve potassium nitrate **or** States that a rise in temperature shifts equilibrium to the right. (*or words to that effect).* *Beware answers that simply repeat information given in* **(f)**.	1 1	[2]
(h)	ACE Interpretation	Give 1 mark for each acceptable source of inaccuracy. *Evaporation of water;* *Supercooling;* *Thermal time lag in thermometer;* *Difficulty in seeing crystals form;* *Time delay in seeing crystals and reading thermometer;* *Some solid forms on side of tube – not initial* **FB 1***;* *Precision of thermometer;* ***not human error***	2	[2]
(i)	ACE Improvement PDO Display	Outlines steps necessary to determine solubility, *(weigh solution, evaporate, weigh residue)* Shows working for calculating the solubility. $\frac{\text{mass of solid}}{(\text{mass of solution} - \text{mass of solid})} \times 100$ or $\frac{\text{mass of solid}}{\text{mass of water}} \times 100$	1 1	[2]
Qn 1	**Total**			**[26]**

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Question	Sections	Indicative material	Mark	
FB 2 is $Fe_2(SO_4)_3$(s); **FB 3** is ZnO(s)/Na_2SO_3(s); **FB 4** is $CaSO_3$(s) [Na_2SO_3]				
2 (a)	MMO Collection	Observes: colourless solution with **FB 4**, yellow, orange or brown solution with **FB 2**. Describes **<u>one</u>** of the following **<u>gas tests</u>**:	1 1	
	MMO Decisions	**(i)** Potassium dichromate(VI) used in testing for SO_2 with **FB 3** or **FB 4**. (orange to green in colour); **(ii)** Blue litmus turning red on warming with hydrochloric acid; **(iii)** Limewater used to test gas – no change in the limewater.		[2]
(b)	PDO Recording	**(i)** All observations in a single table. *There must be no repetition of "headings".*	1	
	MMO Collection	**(ii)** Reports addition of reagents to excess whenever a precipitate is formed on first addition of the reagent. **(iii)** and **(iv)** Give 2 marks for correct observations for all 3 cations with both reagents *Give 1 of these 2 marks for 2 of the three observations correct*. **FB 2** – red brown or brown ppt (insol in excess **not** required but <u>con</u> if either ppt is soluble in excess) with both reagents **FB 3** – white ppt soluble in excess with both reagents **FB 4** – no ppt with either reagent.	1 2	
	ACE Conclusions	**(v)** Give **one mark** for conclusions that match observations. <u>minimium observation required</u> **FB 2** – Fe^{3+}; red-brown/brown colour of each precipitate **FB 3** – Zn^{2+}; white ppt with each reagent and ppt with NH_3 soluble in excess of aqueous ammonia **FB 4** – **<u>two of</u>** Ba^{2+} or Ca^{2+} or NH_4^+ from no ppt with either reagent If conclusions fit observations for more than one pair of ions – allow this mark.	1	[5]
(c)	MMO Decisions	Selects appropriate reagent to distinguish between **<u>any</u>** pair of cations identified in **(b)**. For Ba^{2+}/Ca^{2+} – accept H_2SO_4 or chromate/dichromate; For Ba^{2+}/NH_4^+ – accept H_2SO_4 or chromate/dichromate **or** gas turns red litmus blue with NaOH (warming not required); For Ca^{2+}/NH_4^+ – accept gas turns red litmus blue with NaOH (warming not required)	1	[1]

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Question	Sections	Indicative material	Mark	
(d)	MMO Collection	Observes white ppt with $BaCl_2$, soluble in HCl with **FB 3** and **FB 4**.	1	
		Observes white; off-white or cream (but not yellow) ppt with $BaCl_2$, and **FB 2** **and** ppt insoluble on adding acid (ignore any colour change in the precipitate)	1	
	ACE Conclusion	Conclusion matching observations. Expected ions - sulfate in **FB 2**, sulfite in **FB 3** and **FB 4**. Formulae must be correct.	1	[3]
(e)	ACE Conclusion	Explains that $BaCl_2$ must be added first to form the precipitate (whose solubility is then tested with acid) **or** Addition of $BaCl_2$ to acidified solution will give no ppt even if sulfite present. *Allow wtte*.	1	[1]
(f)	MMO Collection	Observes **one** of the following when aqueous potassium iodide is added to the solution of **FB 2.** A darker solution than in **(a)** if there is no reference to colour change; *Acceptable solution colours are in the range: yellow, orange, red-brown, brown (but not red).* accept red-brown or brown solution formed; accept grey or black precipitate **AND** blue, blue-black, black, purple colour (solution or solid) when starch is added.	1	
	ACE Conclusion	Identifies **FB 2** as an oxidant/oxidising agent or iodide as a reductant/reducing agent or converse.. **or** states that it is a redox reaction. *This mark can be given from either observation.*	1	[2]
Qn 2	**Total**			**[14]**

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