

**MARK SCHEME for the October/November 2010 question paper  
for the guidance of teachers**

**9701 CHEMISTRY**

**9701/51**

Paper 5 (Planning, Analysis and Evaluation),  
maximum raw mark 30

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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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
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Question	Sections	Indicative material	Mark
1 (a)	PLAN Problem	Predicts a direct proportionality. Accept statements such as 'no. of moles of the precipitate/ $\text{PbCl}_2$ will increase (as the number of moles of $\text{NaCl}$ increases)'. Equation shows a 1 to 2 molar ratio or wtte.	[1]
		(If a 'plateau' graph is described for the first mark allow a correctly explanation for the second mark i.e. all the lead nitrate has been used up)	[1]
(b)	PLAN Method & Problem & ACE	All the lead nitrate was used up; moles or concentration of lead nitrate; <b>total</b> volume of lead nitrate. <b>NOT</b> amount A diagonal straight-line going through the origin. The line will abruptly change to a horizontal line Possible alternatives: <ul style="list-style-type: none"> <li>• Diagonal line only, with +ve slope from the origin – 1 mark</li> <li>• Diagonal line not starting at the origin with a horizontal line – 1 mark</li> <li>• Curve from the origin with decreasing gradient and horizontal straight-line – 1 mark</li> <li>• Curve not from the origin with decreasing gradient and horizontal straight-line – 0 marks</li> <li>• Any lines showing an increase in gradient – 0 marks</li> </ul>	[1] [1] [1]
(c)	PLAN Problem	Independent variable – volume/mass/moles of $\text{NaCl}$ Dependent variable – moles/mass of $\text{PbCl}_2$ / ppt Other variables – temperature. <b>NOT</b> amount and <b>NOT</b> concentration of the $\text{NaCl}$ . Three points correct – 2 marks Two points correct – 1 mark Any incorrect suggestions cancel correct suggestions	[2]

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Question	Sections	Indicative material	Mark
(d) (i)	PLAN Method	Calculating an appropriate mass of lead nitrate; this should be 8.275(8.3)g	[1]
		Dissolving the solid in water (or stirring) in a beaker or other appropriate vessel ( <u>volumetric/graduated/dilution</u> flask) using less than 250 cm <sup>3</sup>	[1]
(ii)		Adding to the <u>volumetric/graduated/dilution</u> flask and adding water to the 250 cm <sup>3</sup> mark (if 250 cm <sup>3</sup> of water are added directly to a <u>volumetric/graduated/dilution</u> flask (containing the solid of course) allow 1 mark)	[1]
		Any dilution from a 'given' solution of lead nitrate gets 0 marks out of 3. Synthesis of the lead nitrate from lead and nitric acid scores zero. A student who uses 33.1 grams of lead nitrate to make up correctly 1 dm <sup>3</sup> of solution can gain the first two marks, but to gain the third mark a measured 250 cm <sup>3</sup> needs to be taken using an appropriate measuring vessel.	[1]
		Apparatus for volume measurement (burette/pipette/measuring cylinder)(not a syringe) used to measure 50 cm <sup>3</sup> or less of lead nitrate and 100 cm <sup>3</sup> or less of sodium chloride (mention of only one measuring vessel is enough for this mark) Method for drying the precipitate (adding propanone and allowing to evaporate/pressing with filter paper/warm oven/sun leaving out to dry. <b>NOT</b> heat or the use of a Bunsen or microwave.	[1]
(e)	PLAN Method	Table needs <ul style="list-style-type: none"> <li>volumes of lead nitrate, sodium chloride and mass/weight of lead chloride/ppt with appropriate data (volumes must total no more than 250 cm<sup>3</sup> in each case)</li> <li>moles of sodium chloride and lead chloride/ppt</li> <li>correct units throughout (/cm<sup>3</sup>, /cm<sup>3</sup> and /g [accept grams]; accept ( ) instead of / ) (these are for the items in bullet point one)</li> </ul> <p>Normally there will be 5 sets of volumes with the volume of lead nitrate being constant. (no figures are required for the mass of the ppt) (allow 4 sets if the volumes are different to those in (d)).</p> <p><b>Ignore;</b> volumes of water; units in the mole columns; items such as filter paper; numbers in the mole columns.</p> <p><b>Do not allow;</b> n for the number of moles; zero for the volume of lead nitrate or sodium chloride.</p>	[1] [1] [1]
(f)	PLAN Method	The drying process should be repeated to constant mass Allow heat/reheat to constant mass/weight.	[1]
	<b>Total</b>		<b>[16]</b>



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Question	Sections	Indicative material	Mark
(d)	ACE Data	One mark if the two anomalous points furthest from the line (one on each side) are circled. Allow only one anomaly if there is only one or all the anomalies are on the same side. In plotting the points, it is possible that some points will be a little way from the correctly drawn line. These in many cases are likely not to be 'ringed'. If 5 or more points are 'ringed' do not award this mark but allow any subsequent correct discussion.	[1]
		For each of the two different anomalies an appropriate explanation gains one mark. If the graph is plotted correctly point 3 will be above the line and point 7 below the line. <b>POINT 3</b> ; temperature measured after freezing was complete (i.e. late); too much glucose added; reduced amount of water. <b>POINT 7</b> ; temperature recorded before freezing was complete; not all glucose dissolved; too much water. If two correct suggestions are given but not 'tied' to a particular point award one mark. If the comments are assigned to the wrong points NO marks.	[2]
(e) (i)	ACE data	Appropriately drawn lines on the graph with correctly deduced intercepts.	[1]
		For a correct calculation from the candidates figures with correct units ( $^{\circ}\text{C kg mol}^{-1}$ ) Since the results produce a good linear graph, the procedure is OK.	[1]
(ii)		Accept 'constant gradient', and references such as 'most of the points are close to the drawn line' etc. 'Line passing through the origin' is irrelevant.	[1]
(f)	ACE Data	The NaCl produces twice the number of <b>particles</b> . Allow the statement that NaCl produces $\text{Na}^+$ and $\text{Cl}^-$ .	[1]
(g)	ACE Data	Between answers to (a) and (f).	[1]
	<b>Total</b>		<b>[14]</b>

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A	B	C	D	E	F
mass of water /g	mass of glucose /g	freezing point depression $\Delta T_f / ^\circ\text{C}$	moles of glucose $\frac{B}{180}$	molality $D \times 10$ mol/kg	
100	10.0	1.03	0.0556	0.556	
100	12.2	1.26	0.0678	0.678	
100	18.0	2.09	0.100	1.00	
100	23.3	2.40	0.129	1.29	
100	27.7	2.86	0.154	1.54	
100	30.9	3.22	0.172	1.72	
100	33.1	3.31	0.184	1.84	
100	38.6	3.98	0.214	2.14	
100	42.3	4.37	0.235	2.35	