

MARK SCHEME for the October/November 2015 series

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.

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Page 2	Mark Scheme	Syllabus	Paper
	Cambridge International A Level – October/November 2015	9701	51

Question	Expected Answer	Mark
1 (a)	$PV = nRT$	[1]
	M_r = mass/amount in mol OR $M_r = m/n$ OR g/n OR any of these formulae correctly re-arranged	[1]
(b) (i)	volume (measured/recorded at 60 °C) is higher OR volume is lower at 50 °C/at lower temperature (calculated) M_r is lower	[3]
(ii)	The volume would be reduced OR as P increases M_r increases AND answer closer to the true value/yes	[1]
(c)	Place water/oil/sand within the outer VM tube AND heat the outer tube	[1]
	Shows appropriate connections to collect the air over water/in syringe (any size) using the side tube	[1]
(d)	Hexane: • is (in)flammable/burns readily • causes irritation to the skin • causes breathing difficulties • forms explosive mixture (with air) OR is combustible Any one from the list above	[1]
(e) (i)	The air expands (And) goes into the collection apparatus	[1] [1]
	(ii) (Wait until) no more bubbles (of air are produced) in the water/syringe no longer moves	[1]
(f)	The mass of tube + hexane and mass of empty tube	[1]
	Temperature and pressure	[1]
	Syringe reading before hexane is added + the syringe reading after hexane is added	[1]
Qn1		[Total: 15]

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International A Level – October/November 2015	9701	51

Question	Expected Answer		Mark
2 (a)	Temperature rise/°C	barium hydroxide added / mol	
	1.2	0.00292	
	2.4	0.00585	
	3.7	0.00877	
	4.7	0.0117	
	7.3	0.0175	
	9.7	0.0234	
	10.4	0.0292	
	10.4	0.0351	
	10.4	0.0468	
	Values in temperature column correct and to 1 decimal place Values in barium hydroxide column are correct and to 3 sig figs		[1] [1]
(b) (i)	All points plotted correctly	[1]	
(ii)	Two best-fit straight lines drawn and then levelling to a horizontal line	[1]	
	The value on the x-axis is read correctly	[1]	
(c)	The concentration of the acid is calculated as: $(2 \times \text{mol of Ba(OH)}_2) \times 1000 / 60$	[2]	
(d)	Exothermic reaction	[1]	
	After hydrochloric acid is neutralised / fully reacted OR barium hydroxide is in excess the temperature (rise) is constant	[1]	
(e) (i)	Loss of heat (to the surroundings)	[1]	
	Greater temperature gradient OR the reaction is slower OR (rate of) heat loss is greater	[1]	
(ii)	Give polystyrene cup a lid or cover / use a finer powder	[1]	

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Question	Expected Answer	Mark
(f)	Line rises less steeply and intersects second line at a lower temperature rise	[1]
	Maximum is reached at the same mol of barium hydroxide as the experiment with hydrochloric acid	[1]
	Some of the heat that would have been released is used to ionise the ethanoic acid	[1]
Qn2		[Total: 15]

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1 (a) (i)	chlorobutane, bromobutane, iodobutane	[1]
	decreasing electronegativity of chlorine, bromine and iodine	[1]
(ii)	iodobutane, bromobutane, chlorobutane	[1]
	decreasing size of atoms of iodine, bromine and chlorine/decreasing bond length of the C-Hal bond	[1]
(b) (i)	The halogenoalkane(s) AND the amount of precipitate	[1]
(ii)	Equal moles/amounts are not being used	[1]
	Use same number of moles/amounts of halogenoalkane	[1]
(iii)	• Use the same amount of sodium hydroxide each time	[1]
	• heat water/oil bath/heating mantle (to 50 °C)	[1]
	• mix reagents/mix halogenoalkane and hydroxide and immediately start timer	[1]
	• add nitric acid	[1]
	• allow precipitate to settle	[1]
(iv)	The precipitates should be filtered and dried	[1]
	The precipitates should be weighed	[1]
(c)	Avoid the use of flames/keep away from flames/use a fume cupboard/wear a face mask/well ventilated room	[1]
		[15]

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2 (a)	$K = \frac{[\text{NO}_2]^2}{[\text{N}_2\text{O}_4]}$	[1]										
(b)	<table border="1"><tr><td>$[\text{NO}_2(\text{g})]^2 / \text{mol}^2 \text{dm}^{-6}$</td></tr><tr><td>0.00531</td></tr><tr><td>0.00472</td></tr><tr><td>0.00413</td></tr><tr><td>0.00354</td></tr><tr><td>0.00300</td></tr><tr><td>0.00236</td></tr><tr><td>0.00152</td></tr><tr><td>0.00118</td></tr><tr><td>0.000590</td></tr></table> All sig figs correct All results for $[\text{NO}_2(\text{g})]^2$ are correct	$[\text{NO}_2(\text{g})]^2 / \text{mol}^2 \text{dm}^{-6}$	0.00531	0.00472	0.00413	0.00354	0.00300	0.00236	0.00152	0.00118	0.000590	[1] [1]
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(c) (i)	All points plotted correctly Appropriate straight line drawn through the origin	[1] [1]										
(ii)	Points read correctly from the graph Gradient calculated correctly K_c given to 3 sig figs with correct units: mol dm^{-3}	[1] [1] [1]										
(d)	Point at $[\text{N}_2\text{O}_4] = 0.3 \text{ mol dm}^{-3}$ chosen or other valid anomalous point Equilibrium has not been properly established / the temperature was lower than (25 °C) / temperature was too low	[1] [1]										

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(e) (i)	Straight line through the origin($\pm \frac{1}{2}$) with steeper gradient.	[1]
(ii)	Reaction is endothermic.	[1]
(i)	Value of K_c will be higher	[1]
(iv)	No change	[1]
(f)	$0.9 + (0.0729/2) = 0.9 + 0.03645$ $0.93645 \text{ mol dm}^{-3}$	[1]
		[15]