## MARK SCHEME for the May/June 2012 question paper

## for the guidance of teachers

## 9701 CHEMISTRY

9701/53

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.

• Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2012	9701	53

Question	Sections	Indicative material	Mark
1 (a)	PLAN Problem	<ul> <li>(i) &amp; (ii) States the moles of product increase (as the moles on ammonium nitrate (V)/reactant increases) and the x-axis is labelled moles ammonium nitrate (V)/reactant.</li> <li>Accept proportional or directly proportional for increase. In (ii) it has to be clearly stated that both products are increasing with the</li> </ul>	[1]
		increase in ammonium nitrate moles.	
		There are a 1:1 & 1:3 ratios correctly given either in text or in the graph. No curves or plateaus	[1]
		Two lines starting at the origin with moles on the <i>y</i> -axis are correctly labelled with temperature or gas identity and the higher temperature line has a slope greater than that of the other line. No curves or plateaus.	[1]
(b)	PLAN Problem	(i) moles of ammonium nitrate.	
		(ii) moles of nitrogen(I) oxide.	[2]
		Accept mass/weight of ammonium nitrate and volume of nitrogen(I) oxide together for one mark.	
(c)	PLAN Method	A diagram which shows a heated (closed but with an output tube) piece of apparatus. No water baths or hot plates	[1]
		Showing a condenser and collector for water (e.g. cooled (ice) U-tube) connected to the ammonium nitrate apparatus. If a gas collector is after this piece then the water collector must be gas tight. If no gas collection is attempted after the water condenser then it must be open to air. Allow a Liebig condenser provided it fulfils the same conditions as stated above.	[1]
		Showing a calibrated collecting device accept label syringe/ burette/measuring cylinder as equal to calibrated. To be labelled with size (minimum 10 cm <sup>3</sup> ). To be in train after the water condenser – if a condenser not present – then connected to the heating apparatus.	[1]

Page 3		Mark Scheme: Teachers' version	Syllabus	Paper	
		GCE AS/A LEVEL – May/June 2012	9701	53	
(d)	d) PLAN At least five experiments. May be in table (Five+ rows in the table counts as 5 experiments).		e table [1]		
		States intended gas volumes. The range to from x cm <sup>3</sup> to 3 times x cm <sup>3</sup> where $x > = 10$ volume does not exceed collector capacity	) cm <sup>3</sup> and maxin		
		A correct calculation for a mass of ammon produce one of the gas volumes above. Or stated mass. This calculation is not restrict the gas collector.	r a volume from	a	
		Stopping at a constant volume of gas (not solid disappeared/syringe plunger stops m <u>observation</u> not a deduction as – all decon gas.	oving. Must be a	an	
(e)	PLAN Method	Identification of ammonium nitrate as oxidi NH <sub>4</sub> NO <sub>3</sub> combustible) from the hazcard inf suitable precaution – keeping away from c wear (chemical) resistant gloves. Accept h resistant gloves/tongs.	ormation and giv ombustible mate	ving a erial /	
(f)	PLAN Method	Four columns are required. mass/weight (not amount) of ammonium n nitrogen(I) oxide (/cm <sup>3</sup> ) (/dm <sup>3</sup> ); number of n nitrate (no unit); number of moles of nitrog The full word for the unit can be used with	moles of ammon en(Ι) oxide (no ι	ium ınit).	
		Four fully correct, two marks; three correct zero.	, one mark; othe	erwise [2]	
	[Total:				

Page 4		Mark Scheme: Teachers' version	Syllabus	Paper
	G	CE AS/A LEVEL – May/June 2012	9701	53
2 (a)	ACE Data	The required two column headings PV and then 1/V and (1/B) and /cm <sup>-3</sup> are fully correct the unit can be used with or without / or (). column headings are required. Can accept unit only e.g. 3.05 data as /10 <sup>3</sup> kPacm <sup>3</sup> or ( data in standard form.	ect. The full word All 3 features of t standard form i	for the n the
		Both columns are fully completed to the co significant figures and all the calculations i correct, (allow two errors).		[1]
(b)	ACE Data	Check for a slightly downward sloping con straight/horizontal lines. Ignore the line bet after the last point.		
(c)	ACE Data	Label the <i>x</i> -axis pressure and the <i>y</i> -axis 1/ column headings or unambiguous descript unit in the correct form (/ or ()). The axes n the plotted points must cover at least half t directions and all points must be on the giv required on both scales.	tions with the cor nust be scaled so the grid in both ven grid. A true c	rrect o that rrigin is
		This mark not available for other plots. marks for inverted plots.	·	
		First check any outlying points then check 5, 7, 9 & 10. All 10 points present.	the plotting of po	oints 1, [1]*
		Line/curve starting at the origin, accept be origin to point 5 (170 kPa) then curving to i points. Due to differences in plotting, the s further and remain correct provided it term provided it is the line of best fit.	nclude the rema traight line may e	ining 4
(d)	ACE Evaluation	These marks not available for other plo	ts.	
		All the anomalous points are circled on the unambiguously stated in the text. (Selection this mark.) (max 5 anomolies)		egate [1]
		An appropriate explanation gains one mar low). Volume measured at a lower tempera- low 1/V, accept higher temperature.	<b>`</b>	• • •

	Page 5		Mark Scheme: Teachers' version	Syllabus	Рар	
			GCE AS/A LEVEL – May/June 2012	9701	53	
2	<b>2 (e)</b> ACE Two pairs of construction lines on the graph drawn from the line in the initial straight section to the axes and correctly deduces values of these two intercepts. If the true origin has been used calculating the slope then only one pair of lines and one intercepts is necessary.		ces the ised in	[1]*		
			These construction lines must be in the init the plot into the origin and would normally x. If the actual plotting and straight line of t this point a construction that is in the straig correct. No construction lines into curved s the initial straight line is produced onwards more than 170 kPa is correct.	not exceed 170 he candidate ex ht line section is sections can be u	kPa on ceeds s used. If	
			Allow data from points on the plotted line to there is some indication on the plot that the in slope calculation. If the candidate has durather than a curve then the construction in the line provided the line is drawn into the gradients on tangents to a curve unless the or at $x = 0$ or $y = 0$ .	e point has been rawn a straight li nay be anywhere origin. Do not all	used ne e along low	[1]*
			A correctly calculated value of the slope us figures. Check the candidate's calculation. The mark is for the magnitude (ignore units used the true origin in the slope calculation not needed in the calculation. Value of slop $10^{-4}$ .	and correct rour s). If the candida then two zeros	iding. ite are	
			If the slope expression is inverted, then the lost but the intercept value mark can be ga		rk is	
	(f)	ACE Conclusior	These marks not available for other plot the initial shape of their plot.	<b>ts.</b> This must rel	ate to	
			(i) The 'law' is justified.			
			AND			
			(ii) In the (initial section of the plot/at lower produce a straight line from the origin.	pressure) the d	ata	[1]
			(iii) The graph is a curve or not a straight li variable gradient.	ne. Or the graph	i has a	[1]
			The best way to verify a relationship is by plot (not a curve).	way of a straight	line	[1]

Page	e 6	Mark Scheme: Teachers' version	Syllabus	Paper
		GCE AS/A LEVEL – May/June 2012	9701	53
(a)		These marks not evailable for other n		

(g)	ACE Evaluation	These marks not available for other plots. Treat these points as the same question	
		(i) This is the area of linearity/straight line/constant gradient. Accept (at low pressures) the gas behaves ideally or (an area) where Boyle's law is obeyed.	[1]
		(ii) It is the 1/proportionality constant. It's the value of 1/k.	[1]
		(* is mark available for other plots)	
		[Το	tal: 15]