
CHEMISTRY

9701/51

Paper 5 Planning, Analysis and Evaluation

October/November 2017

MARK SCHEME

Maximum Mark: 30

Published

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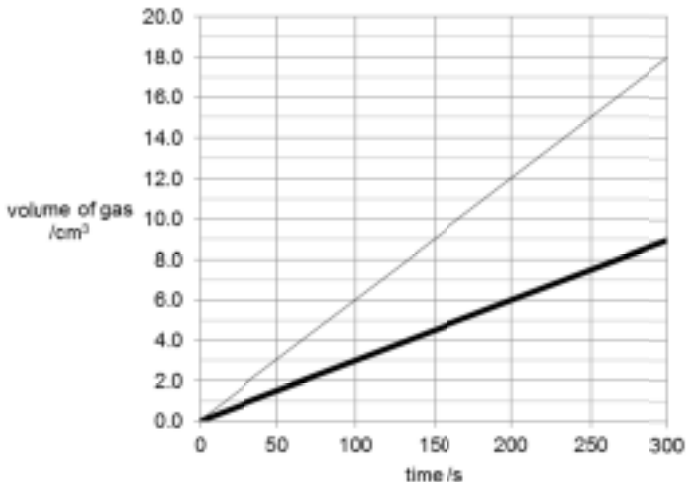
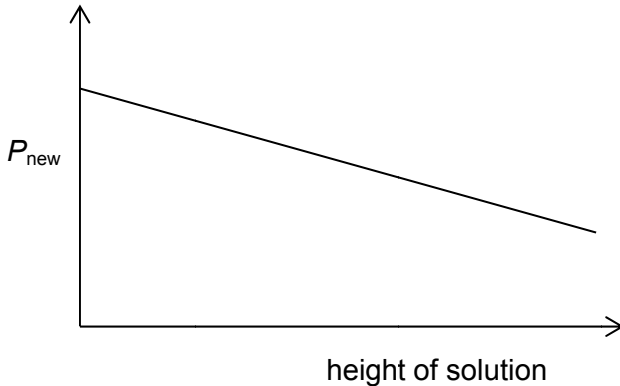
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Question	Answer	Marks
1(a)(i)	mass = $228.2 \times 1.00 \times (250/1000)$ = 57.1 g	1
1(a)(ii)	Distilled/deionised water must be mentioned somewhere for 2 marks to be given. Dissolve (all) the solid in a (suitable container) with (distilled) water	1
	Transfer / add to a <u>250 cm³</u> volumetric flask AND make to mark with (distilled) water	1
1(a)(iii)	(starch) gives a sharp 'end-point' / turns blue sharply / goes blue with volume of I ₂ invisible to naked eye	1
1(b)	volumes of (NH ₄) ₂ S ₂ O ₈ (aq) constant	1
	volumes of I ⁻ varying with range	1
	total volume constant, made up by water	1
1(c)(i)	mol I ₂ (aq) = $V(\text{S}_2\text{O}_3^{2-}) \times [\text{S}_2\text{O}_3^{2-}] / 2$ = $\left(\frac{0.005 \times 0.0050}{2} \right)$ = 1.25×10^{-5}	1
	$[\text{I}_2(\text{aq})] = \frac{\text{moles of I}_2(\text{aq})}{V_{\text{total}}} = \frac{1.25 \times 10^{-5}}{0.021} = 5.95 \times 10^{-4}$	1
	rate = $[\text{I}_2(\text{aq})] / \text{time}$ = $\frac{5.95 \times 10^{-4}}{134}$ = 4.44×10^{-6}	1
1(c)(ii)	repeat the experiment (and take average)	1
1(c)(iii)	% error = $\frac{2 \times 0.05}{5.0} \times 100\% = 2(.0) \%$	1

Question	Answer	Marks
1(d)	No thiosulfate had been added	1
1(e)	Ammonium persulfate must be stated along with its hazard and linked to the precaution. Ammonium persulfate is a skin irritant so wear gloves OR Ammonium persulfate is an irritant to the respiratory system; do the experiment in fume cupboard/face mask OR Ammonium persulfate is harmful if swallowed so avoid mouth contact/wear face mask OR Ammonium persulfate is oxidising so avoid contact with flammable/combustible materials. OR Ammonium persulfate is harmful/hazardous to the environment so do not dispose of down the drain/use (large quantities) of water to dilute before disposal	1

Question	Answer				Marks
2(a)	time /s	burette reading /cm ³	volume (of hydrogen) /cm ³	charge /C	2
	0	46.20	0.00	0	
	50	41.20	5.00	40	
	100	36.20	10.00	80	
	150	31.45	14.75	120	
	200	25.80	20.40	160	
	250	20.80	25.40	200	
	300	16.40	29.80	240	
	350	11.45	34.75	280	
	400	6.80	39.40	320	
	450	1.50	44.70	360	
	volumes of hydrogen correct to 2 d.p. charge correct				
2(b)	All ten points plotted correctly				1
	Best-fit straight line drawn				1
2(c)	Yes, (the data is reliable because) most of the points are on the line OR only a few points are not on the line.				1
2(d)(i)	co-ordinates read and recorded correctly				1
	gradient determined				1
2(d)(ii)	= (i) ÷ 24000				1
2(d)(iii)	= 1 ÷ (2 × (ii))				1

Question	Answer	Marks
2(e)(i)	 straight line from origin to (300, 9.0)	1
2(e)(ii)	Oxygen is (slightly) soluble in water	1
2(f)(i)	 straight line with negative gradient	1
2(f)(ii)	Faraday constant will be <u>lower</u> (than calculated) because the volume / V_m larger	1

Question	Answer	Marks
2(g)	No effect at cathode	1
	Less gas produced at anode	1
	Copper anode will dissolve/is (an) active (anode) OR copper has lower/more negative $E^\ominus$	1

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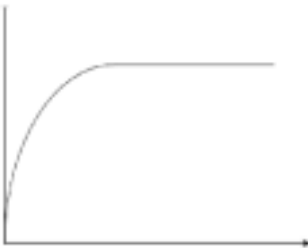
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Question	Answer	Marks
1(a)(i)	CuCO_3 and Cu(OH)_2 both react (with HCl) or both form copper(II) chloride	1
1(a)(ii)	(Transfer) $12.5(0) \text{ cm}^3$ of $(10.0 \text{ mol dm}^{-3}) \text{ HCl}$ using a (graduated) pipette or a burette	1
	add to a 250 cm^3 volumetric flask AND make to mark with distilled water	1
1(a)(iii)	Measure a volume of gas from the carbonate reaction or measure the (loss of) mass from the carbonate reaction	1
1(a)(iv)	Suitable apparatus for production of CO_2	1
	Suitable means of measuring CO_2 evolved	1
1(a)(v)	Correct labels on axes y-axis: volume (of gas) or mass loss or mass of 'limewater' and x-axis: time or t	1
	curved line (from origin) to reach a plateau, e.g. 	1

Question	Answer	Marks
1(a)(vi)	Any sensible attempt seen to make the experiment accurate If mass loss Reduce risk of mass loss through spraying Insert cotton wool plug If gas collection Any method to reduce risk of gas loss Check apparatus is sealed Insert bung quickly Any attempt to measure temperature Check apparatus is at room temperature Apparatus accuracy Use an accurate or 2dp (or more) balance / gas syringe / measuring cylinder	1
1(a)(vii)	mol of $\text{CuCO}_3 = 0.5 \div 123.5 = 4.05 \times 10^{-3} \text{ mol}$	1
	moles of $\text{HCl} = 2 \times 4.05 \times 10^{-3} = 8.10 \times 10^{-3} \text{ mol}$ and volume of $\text{HCl} = 8.10 \times 10^{-3} \div 0.500 = 0.0162 \text{ dm}^3$ $= 16.2 \text{ cm}^3$	1

Question	Answer	Marks
1(b)	Any suitable precaution relating to stated hazard of given chemical For HCl Precaution (lab) gloves Explanation (10 mol dm⁻³) HCl is corrosive For CuCO₃ Precaution (lab) gloves / wash hands (after use) / face or mouth mask Explanation Harmful if swallowed	1
1(c)(i)	$\text{moles of H}_2\text{SO}_4 = 0.40 \times \frac{24.15}{1000} = 9.66 \times 10^{-3} \text{ mol}$	1
	$\text{mass of Cu}_3(\text{CO}_3)_2(\text{OH})_2 = 344.5 \times 9.66 \times 10^{-3} \div 3 = 1.11 \text{ g}$	1
	$\% \text{ by mass} = \frac{1.11}{1.50} \times 100\% = 74.0\%$	1

Question	Answer	Marks
1(c)(ii)	Problem 1 titres are not concordant / are too far apart / are 0.5(0) cm^3 apart / difference is too large Improvement Repeat until (two) concordant titres have been achieved / two readings within 0.1(0) cm^3 Problem 2 colour change (of indicator) will be masked Improvement 2 Use an alternative indicator / named indicator [1] for each problem, [1] for an improvement	3

Question	Answer				Marks
2(a)(i)	Difference in conc. D	$\frac{D}{m}$	$\log(\frac{D}{m})$	$\log[X]$	3
	24.04	120.20	2.08	−0.02	
	24.31	97.24	1.99	−0.16	
	24.40	81.33	1.91	−0.22	
	24.59	70.26	1.85	−0.39	
	24.67	61.68	1.79	−0.48	
	24.73	54.96	1.74	−0.57	
	24.77	49.54	1.69	−0.64	
	24.80	45.09	1.65	−0.70	
	24.83	41.38	1.62	−0.77	
	D data correct [1] $\log[X]$ data correct [1] All data to 2 dp [1]				
2(a)(ii)	greater adsorption				1
	greater surface area available				1
2(b)	all nine points plotted correctly				1
	best-fit straight line drawn				1
2(c)	Correct point (at −0.22, 1.91) identified				1
	Statement explaining lack of adsorption, e.g. not enough stirring, mass of activated charcoal too low, surface area not high enough / too low / coagulation of charcoal / bulkier particles used not left long enough				1

Question	Answer	Marks
2(d)(i)	co-ordinates read and recorded correctly	1
	gradient determined and same value for b	1
2(d)(ii)	intercept on y -axis read and recorded correctly	1

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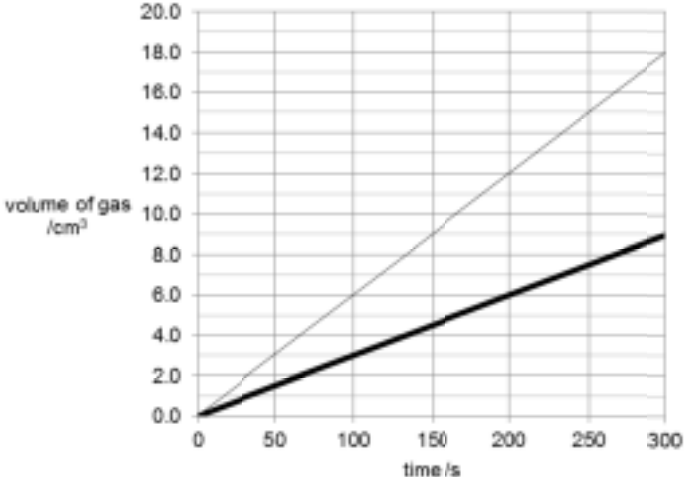
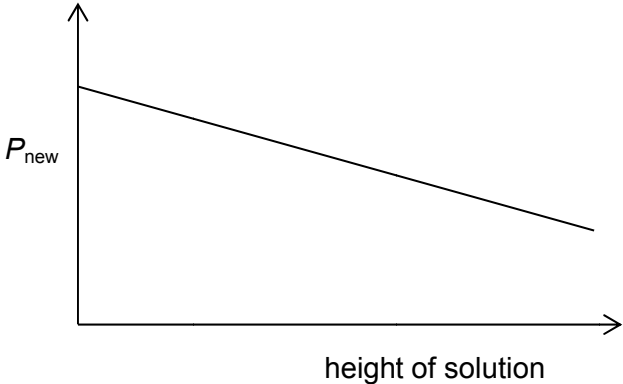
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