Cambridge International AS & A Level

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CHEMISTRY **9701/34**

Paper 3 Advanced Practical Skills 2 **May/June 2017**

MARK SCHEME

Maximum Mark: 40

Published

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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Question	Answer	Marks
1(a)	**I** Mass (of Mg) with correctly displayed unit and all temperatures recorded Initial T must be between 10–45 °C	**1**
	II All temperature readings to .5 ºC with at least one ending in .0 °C and at least one ending in .5 °C	**1**
	Round any thermometer readings to the nearest .5 °C Calculate ΔT from T at 2 minutes to T max from the table. Compare with supervisor ΔT. Award **III** if ΔT within 2 °C of supervisor Award **III** and **IV** if ΔT within 1 ºC of supervisor	**2**
1(b)	**I** Axes labelled (T on *y*-axis & t on *x*-axis). Scale chosen so that plotted points (and 10 °C extra on *y*-axis) occupy more than half the available space in both directions.	**1**
	II Points plotted to within half a small square. Points that should be on lines must be on the line and points that should not be on lines must not be on lines.	**1**
	III Two lines of best fit drawn – one up to 2 minutes and the other after the reaction has occurred.	**1**
	IV Both lines extrapolated to 2½ minutes and vertical line drawn at 2½ minutes	**1**
	V Examiner to calculate ΔT from candidate graph and award mark if within 0.5 °C of candidate's ΔT	**1**
1(c)(i)	Correctly calculates energy evolved = **25** × 4.2 × ΔT **and** answer to 2 – 4 sf.	**1**
1(c)(ii)	Correct use of moles of magnesium = $^{\text{mass Mg from (a)}}/_{24.3}$	**1**
	Correct use of $\Delta H = \frac{(\mathbf{i})}{\text{n(Mg)} \times 1000}$ **and** answer must be negative	**1**
1(d)	2 masses, 4 thermometer readings and 2 temperature rises with correct units and unambiguous headings shown	**1**
	Examiner to calculate $^{\Delta T \text{ longer piece}}/_{\Delta T \text{ shorter piece}}$ to 2 dp Award 2 marks if 1.80 to 2.20 Award 1 mark if 1.70 to 2.30	**2**

Question	Answer	Marks
1(e)	• correct (larger) ΔT from thermometer readings **and** correct (larger) mass (from balance readings) • correct expression of 25 × 4.2 × ΔT • correct expression for division by number of moles of Mg • answer with negative sign **and** evidence of division by 1000 **and** answer to 2 – 4 sf ΔH = – 25 × 4.2 × ΔT × 24.3 ÷ [m(Mg) × 1000] 3 points correct = 1 mark 4 points correct = 2 marks	**2**
1(f)(i)	**Either** yes **because** the reaction is faster so less heat is lost **or** no **because** a catalyst does not alter ΔH / ΔT	**1**
1(f)(ii)	No effect **because** the acid is in excess / magnesium is the limiting reagent / **all** the Mg reacts **or** ΔT would be larger because the reaction is **faster** as acid is **diprotic** (*owtte*) so **less heat lost**	**1**

Question	Answer	Marks
1(g)(i)	$Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$ Chemical symbols = 1 mark Correct balancing and state symbols = 1 mark	**2**
1(g)(ii)	Answer = + 1.9 = 2 marks Answer = – 1.9 / 1.9 / + 3.8 = 1 mark Some working must be shown to score both marks	**2**
1(h)(i) and 1(h)(ii)	**(i)** & **(ii)** together Allow any two correct statements • a stronger acid or correct identification provides a greater concentration of H^+ / more hydrogen ions (*ora*) • (some) energy required to break O–H bond (allow OH bond) • –I effect/increased electronegativity of C*l* increases strength of (trichloroethanoic) acid / makes it easier to release H^+ (compared to ethanoic acid)	**2**
	Total:	**25**

Question	Answer	Marks
	FB 5 is HC*l*; **FB 6** is H_2SO_4; **FB 7** is HNO_3; **FB 8** is KI(aq)+Na_2CO_3(aq)	
2(a)(i)	$AgNO_3$ observations correct	**1**
	$Ba(NO_3)_2$ observations correct	**1**
	Na_2CO_3 observations correct	**1**
	Gas / CO_2 / fizz turned limewater milky / chalky / cloudy white / formed white ppt with limewater in at least one box	**1**

Test	**FB 5**	**FB 6**	**FB 7**
$AgNO_3$	White ppt	No reaction / no change / no ppt	No reaction / no change / no ppt
NH_3	(ppt) soluble	No reaction / no change / no ppt	No reaction / no change / no ppt
		(*not 'no observation' or '–'*)	
$Ba(NO_3)_2$	No reaction / no change / no ppt	White ppt	No reaction / no change / no ppt
HNO_3	No reaction / no change / no ppt	(ppt) insoluble	No reaction / no change / no ppt
Na_2CO_3	Effervescence / fizz / bubbles	Effervescence / fizz / bubbles	Effervescence / fizz / bubbles
	Positive limewater test – see above		

Question	Answer	Marks
2(a)(ii)	H^+ / hydrogen **ion**	**1**
2(a)(iii)	Adds **named** reactive metal (or symbol) (Mg or Zn, *allow* A*l, Fe*) / named suitable acid-base indicator	**1**
	Effervescence / fizz / bubbles / gas / H_2 pops with lighted splint / correct final colour (chosen indicator must change colour in the pH range < 7)	**1**
2(a)(iv)	**FB 5** Cl^- **FB 6** SO_4^{2-} **FB 7** unknown Allow names of ions 3 correct scores 2 2 correct scores 1	**2**
2(a)(v)	Test: Name / correct formula of strong acid (and warm) **or** (acidified) potassium manganate(VII) / $KMnO_4$ No (brown) gas **or** not decolourised Conclusion: **FB 7** is NO_3^- / nitrate	**1**
2(b)	see expected observations table	**4**
	Ions present I^- **and** CO_3^{2-}	**1**
	Total:	**15**

Expected observations

Test	*Observation*
HC*l*	Fizz / etc. **or** gas / CO_2 turns limewater milky / etc. **and**
H_2O_2	Brown / yellow (darker yellow if yellow with HC*l*) / red-brown / orange-brown / yellow-brown (solution) **and**
Starch	Blue-black / black / **dark** blue (not purple) colour [1]
NaOH	No reaction / no ppt / solution remains colourless [1]
$CuSO_4$	Blue/green/brown range of coloured **ppt and**
HC*l*	Brown colour [1]
$Na_2S_2O_3$	White / cream / off-white / pale grey **and** solid / residue / ppt [1]