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CHEMISTRY

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Paper 3 Advanced Practical Skills 2

May/June 2017

MARK SCHEME

Maximum Mark: 40

Published

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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 °C 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 °C 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 = $\frac{\text{mass Mg from (a)}}{24.3}$	1
	Correct use of $\Delta H = \frac{\text{(i)}}{n(\text{Mg}) \times 1000}$ 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 $\frac{\Delta T \text{ longer piece}}{\Delta T \text{ shorter piece}}$ to 2 dp Award 2 marks if 1.80 to 2.20 Award 1 mark if 1.70 to 2.30	2

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Question	Answer	Marks
1(e)	<ul style="list-style-type: none"> • correct (larger) ΔT from thermometer readings and correct (larger) mass (from balance readings) • correct expression of $25 \times 4.2 \times \Delta T$ • 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 $\Delta H = - 25 \times 4.2 \times \Delta T \times 24.3 \div [m(\text{Mg}) \times 1000]$ 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 $\Delta H / \Delta T$	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 (<i>owtte</i>) so less heat lost	1

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Question	Answer	Marks
1(g)(i)	$\text{Mg(s)} + 2\text{H}^+(\text{aq}) \rightarrow \text{Mg}^{2+}(\text{aq}) + \text{H}_2(\text{g})$ 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 <ul style="list-style-type: none"> • a stronger acid or correct identification provides a greater concentration of H^+ / more hydrogen ions (<i>ora</i>) • (some) energy required to break O–H bond (allow OH bond) • –I effect/increased electronegativity of Cl increases strength of (trichloroethanoic) acid / makes it easier to release H^+ (compared to ethanoic acid) 	2
	Total:	25

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Question	Answer	Marks
FB 5 is HCl; FB 6 is H₂SO₄; FB 7 is HNO₃; FB 8 is KI(aq)+Na₂CO₃(aq)		
2(a)(i)	AgNO ₃ observations correct	1
	Ba(NO ₃) ₂ observations correct	1
	Na ₂ CO 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
		<i>(not 'no observation' or '-')</i>	
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 ₂ CO ₃	Effervescence / fizz / bubbles	Effervescence / fizz / bubbles	Effervescence / fizz / bubbles
	Positive limewater test – see above		

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Question	Answer	Marks
2(a)(ii)	H ⁺ / hydrogen ion	1
2(a)(iii)	Adds named reactive metal (or symbol) (Mg or Zn, <i>allow Al, Fe</i>) / 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

<i>Test</i>	<i>Observation</i>
HCl	Fizz / etc. or gas / CO ₂ turns limewater milky / etc. and
H ₂ O ₂	Brown / yellow (darker yellow if yellow with HCl) / 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
HCl	Brown colour [1]
Na ₂ S ₂ O ₃	White / cream / off-white / pale grey and solid / residue / ppt [1]