Mark scheme – Type of Chemical Reactions (F)

Question			Answer/Indicative content	Marks	Guidance
1			A	1 (AO1.1)	
			Total	**1**	
2			A	1 (AO2.1)	
			Total	**1**	
3			B	1 (AO 2.1)	**Examiner's Comments** A was a popular incorrect response.
			Total	**1**	
4			(acid + alkali →) **salt** ✓ + **water** ✓	2 (AO1.2)	**ALLOW** answers in either order
			Total	**2**	
5		i	Any value <7 ✓	1 (AO2.1)	
		ii	**Any one from:** Acid rain ✓ erosion of stonework ✓ corrosion of metals ✓ kills trees or kills living things in rivers / lakes ✓ breathing difficulties ✓	1 (AO1.1)	
			Total	**2**	
6	a		*Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** Correctly names the acid and the base used in the neutralisation reaction. **AND** Method can be followed to make a pure, dry sample of potassium chloride. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.*	6 (AO1.1 ×2 2.2 ×2 3.3a ×2)	**AO1.1 Demonstrates knowledge and understanding of neutralisation reactions** • base neutralises the acid • acid + base → salt + water • potassium chloride is a salt • potassium chloride is neutral **AO2.1 Application of knowledge and understanding related to making a salt by neutralisation** • acid used is hydrochloric acid

			Level 2 (3–4 marks) Correctly names the acid and the base used in the neutralisation reaction. **OR** Method can be followed to make a salt sample. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Method includes adding acid to base. **OR** Correctly names either the acid or the base used in the neutralisation reaction. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*		• base used is potassium hydroxide / potassium oxide / potassium carbonate • pH paper / pH probe is used to show solution made is neutral **AO3.3 Analyse of information and ideas to develop experimental procedures** • pH probe will not contaminate the solution • evaporate some of the water to form crystals • leave the crystals to dry / dry crystals in an oven
	b	i	Hydrogen ion / H^+	1 (AO1.1)	
		ii	$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ Reactant ✓ Product ✓	2 (AO2.2 ×2)	
	c	i	pH meter ✓	1 (AO1 1.2)	**ALLOW** pH probe
		ii	Wash the probe with water ✓ Put the probe into the solution ✓	2 (AO1.2)	**ALLLOW** calibrate the meter / probe
			Total	**12**	
7	a	i	7.6✓	1 (AO3.2b)	
		ii	error taking the temperature (at start or at end) ✓	1 (AO3.2a)	**ALLOW** used more/less metal / used more/less acid **ALLOW** reaction did not finish **IGNORE** faulty thermometer **Examiner's Comments** Most candidates explained what an

					anomalous result is rather than explain what might have caused the anomalous result.
		iii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 10.3 (°C) award 2 marks** (10.3 + 10.5 + 10.2) ÷ 3 = 10.3333…. (°C) ✓ = 10.3 (°C) (1 decimal place) ✓	2 (AO2.2)	**Examiner's Comments** Most candidates calculated the mean correctly but some truncated their answer rather than rounding it.
	b	i	**Improvement** **Any one from:** Put a lid on the polystyrene cup / Put insulating material around the polystyrene cup / Use a digital thermometer ✓ Use a data logger ✓ **AND** **Reason** **Any one from:** Stops/reduces heat loss (through evaporation) / Prevents/reduces heat loss (from the polystyrene cup) / (Digital thermometer) is easier to read / (Digital thermometer) gives more accurate/precise readings ✓ (data logger) gives continuous data so can get max T	2 (AO3.3b) (AO2.2)	Reason must be linked to the Improvement to be awarded the second mark **ALLOW** add same amount of metal / acid/measure mass metal / measure volume acid ..... so can compare results **ALLOW** more metal / acid ..... gives larger T change / errors are less significant **Examiner's Comments** Candidates found this very difficult. Repetition was the most common improvement with accuracy for the reason. Some thought glass to be a better insulator than polystyrene. Most able candidates discussed either heat loss or digital devices.
		ii	**Any two from:** Use different types of acids ✓ Use a wider range of metals ✓ Change the mass of metal used ✓ Change the volume of acid used ✓	2 (AO3.3a)	**ALLOW** more reactive/less reactive metals **IGNORE** concentration **Examiner's Comments** Candidates found this difficult with a significant number omitting the question. Those that answered the question usually only gave one further test. Using a wider range of metals was the most common response.
			Total	**8**	
8		i	(iron oxide + carbon →) **iron + carbon dioxide** ✓	1(AO 2.1)	**ALLOW** carbon monoxide / carbon oxide **ALLOW** symbols iof correct **Examiner's Comments** The word equation was well known. Even

					candidates who were confused still suggested answers such as 'iron and water' or 'iron and oxygen'.
		ii	Oxygen is removed (from iron oxide) ✓	1(AO 2.1)	The mark is for the process of reduction, not the products. 'It' refers to iron oxide **ALLOW** iron separates from the oxygen **BOD** **ALLOW** oxide is removed **IGNORE** oxygen is formed, iron is formed **ALLOW** iron **gains** electrons **IGNORE** electrons are gained **Examiner's Comments** All candidates found it difficult to explain how they could tell that the iron oxide had been reduced.
			Total	**2**	
9			**A** is exothermic as the temperature increases (1) **B** is neither exothermic nor endothermic as the temperature stays the same (1) **C** is endothermic as the temperature drops (1) **D** is exothermic as the temperature increases (1)	4	**ALLOW** no energy change
			Total	**8**	
10	a		C_4H_{10} / $H_{10}C_4$ (1)	1	**DO NOT ALLOW** C^4H^{10} / $H^{10}C^4$ / C4H10 / H10C4
	b	i	both points correctly plotted (1) reasonable line of best fit (1)	2	
		ii	−4 to −10 °C dependent on line of best fit (1)	1	
		iii	as the number of carbon atoms increases the boiling point increases (1) idea that larger molecules have greater intermolecular forces (1)	2	
			Total	**7**	
11			add universal indicator solution / pH paper (1) identify colour produced (1) match to colour chart to determine pH (1)	3	
			Total	**1**	
12		i	$ZnO + 2HNO_3 \rightarrow Zn(NO_3)_2 + H_2O$ correct formulae in correct position (1) balancing (1)	2	balancing mark is conditional on correct formulae **ALLOW** any correct multiple, e.g.

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>$2ZnO + 4HNO_3 \rightarrow 2Zn(NO_3)_2 + 2H_2O$ (2)

ALLOW = or Δ or ⇌ for arrow
DO NOT ALLOW ‘and’ or & for +
ALLOW one mark for correct balanced equation with minor errors in case, subscript and superscript
e.g. $ZnO + 2HNO^3 \rightarrow Zn(NO_3)_2 + H_2$</td></tr>
<tr><td></td><td></td><td>ii</td><td>any four from:
idea that an excess of zinc oxide must be added (1)
so reaction is complete / all nitric acid is reacted (1)
filter off excess zinc oxide (1)
evaporate off some of the water (1)
allow to crystallise (1)</td><td>4</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>4</td><td></td></tr>
<tr><td>13</td><td></td><td></td><td>Neutralisation (1)</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>14</td><td>a</td><td></td><td>When one drop makes the litmus change colour (1)

Correct colour change blue to red (1)</td><td>2</td><td>ALLOW use a pH probe = 1 mark

ALLOW gives a pH value of 7 when neutral = 1 mark</td></tr>
<tr><td></td><td>b</td><td>i</td><td><table>
<tr><th>Titration number</th><th>1</th><th>2</th><th>3</th></tr>
<tr><td>final reading in cm^3</td><td>17.8</td><td>37.5</td><td>32.1</td></tr>
<tr><td>initial reading in cm^3</td><td>0.0</td><td>20.4</td><td>15.0</td></tr>
<tr><td>titre (volume of acid added) in cm^3</td><td>17.8</td><td>17.1</td><td>17.1</td></tr>
</table></td><td>2</td><td>Correct burette readings = 1 mark

Correct titre = 1 mark

DO NOT ALLOW 0</td></tr>
<tr><td></td><td></td><td>ii</td><td>Yes

Titration 1 is a rough estimate / titration 1 is an outlier / titrations 2 and 3 are identical (1)</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>5</td><td></td></tr>
<tr><td>15</td><td></td><td></td><td>Hydrogen, chloride and sulfate are present (1)

Hydrogen ions because pH is 3 (1)

Sulfate because white precipitate with barium chloride (1)</td><td>4</td><td>ALLOW H^+, Cl^- and SO_4^{2-}
ALLOW (1) for the three correct ions
ALLOW(1) for each correct explanation (must be linked to correct ion)</td></tr>
</table>

			Chloride because white precipitate with silver nitrate (1)		
			Total	**4**	