Mark scheme – Monitoring Chemical Reactions (F)

Question			Answer/Indicative content	Marks	Guidance
1			**D** ✓	1 (AO2.2)	
			Total	**1**	
2			**B** ✓	1(AO 1.1)	**Examiner's Comments** By contrast, atom economy was much less well understood. Candidates clearly realised that it is a measure of the desired products and so almost no-one chose option A with its heavy emphasis on the waste products. However, the choices between options B, C and D were fairly evenly spread at all ability ranges.
			Total	**1**	
3		i	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 120 (tonnes) award 3 marks** M_r of NH_3 = 17 **AND** M_r of NH_4NO_3 = 80 ✓ Mass of ammonium nitrate = $\frac{80}{17}$ x 25.5 / 1.5 x 80 ✓ = 120 (tonnes) ✓	3 (AO2.1)	**ALLOW** ECF from incorrect RMMs
		ii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 10(g) award 2 marks** Actual mass $= \frac{80 \times 12.5}{100}$ ✓ = 10 (g) ✓	2 (AO1.2) (AO2.2)	**ALLOW** % yield = (am ÷ pm) x 100 **OR** 80 = (am ÷ 12.5) x 100 for 1 mark if no other mark awarded
			Total	**5**	
4	a		(acid + alkali →) **salt** ✓ + **water** ✓	2 (AO1.2)	**ALLOW** answers in either order
	b		**Any one from:** Use a single indicator / named single indicator eg methyl orange / phenolphthalein (instead of universal indicator)✓ Idea that universal does not give a sudden colour change / universal indicator gives a continuous colour change / ORA ✓ **OR**	2 (AO3.3b)	**Explanation must be linked to reason** **ALLOW** idea of using a pH probe or pH meter

			Fill the burette exactly to the 0.0 cm^3 line ✓ Idea that this will give accurate volume of acid ✓ **OR** Idea of adding acid to the alkali **slowly or dropwise** near the end point ✓ As indicator should change colour on addition of one drop (of acid) ✓ **OR** Idea of swirling the alkali while adding the acid ✓ To ensure mixing of acid and alkali ✓ **OR** Use a white tile under the conical flask ✓ To see the colour change easily / clearly ✓		
	c		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 23.65 (cm^3) award 2 marks** Use of volume of acid from only titrations 2 & 3 / Use of only 23.60 & 23.70 ✓ Accurate volume of acid = 23.65 (cm^3) ✓	2 (AO2.2)	**ALLOW** 1 mark for average calculated using all results, ie 24.35 (cm^3)
			Total	**6**	
5			17 (g) of ammonia makes 66 (g) of ammonium sulfate So 51 g makes 198 g of ammonium sulfate (1)	1	
			Total	**1**	
6			Percentage yield = (actual yield ÷ predicted yield) × 100 or (2.2 ÷ 4.0) × 100 (1) 55 (1)	2	**ALLOW** full marks for answer with no working out
			Total	**2**	
7	a		Use a pipette filler (1) Potassium hydroxide is caustic / potassium hydroxide can burn skin (1)	2	
	b		When one drop makes the litmus change colour (1) Correct colour change blue to red (1)	2	**ALLOW** use a pH probe = 1 mark **ALLOW** gives a pH value of 7 when neutral = 1 mark

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<tr>
<td></td><td>c</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>
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<td>2</td>
<td>Correct burette readings = 1 mark

Correct titre = 1 mark

DO NOT ALLOW 0</td>
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<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>
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<td></td><td>d</td><td></td>
<td>Atom economy = (M_r of desired products / sum of M_r of all products) × 100

= (101 ÷ 119) × 100 (1)

= 84.9 (%) (1)</td>
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<td></td><td></td><td></td><td>Total</td><td>9</td><td></td>
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<tr>
<td>8</td><td></td><td></td><td>D</td><td>1</td><td></td>
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<td></td><td></td><td></td><td>Total</td><td>1</td><td></td>
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