Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1			**D**	1	**Examiner's Comments** The correct answer was D. Many candidates were able to identify the green precipitate as $Fe(OH)_2$ and the white precipitate as $BaSO_4$. A few candidates suggested C, identifying $BaCl_2$ as the white precipitate, or B, identifying $Cu(OH)_2$ as the green precipitate.
			Total	**1**	
2		i	$[Cu(NH_3)4(H_2O)_2]^{2+}$ ✓ **TAKE CARE** with correct brackets, numbers and 2+ charge	1 (AO 2.4)	**ALLOW** +2 for charge **IGNORE** $[Cu(NH_3)_4]^{2+}$ H_2O and NH3 can be in either order, i.e. $[Cu(H_2O)_2(NH_3)_4]^{2+}$ **Examiner's Comments** This reaction of copper(II) ions with aqueous ammonia and the formula of the complex ion formed are part of the specification. Within this novel context, the molar mass had been provided as a clue. Less than half the candidates correctly gave the correct formula and it was noticeable how well this part discriminated across abilities. This was another example of many candidates being unable to apply their knowledge and understanding to a novel context.
		ii	**Formula of precipitate** $Cu(OH)_2$ ✓ **IGNORE** name: copper(II) hydroxide --- **Formula of gas** $;NH_3$ ✓ **IGNORE** name: ammonia --- **Test for ammonia**	3 (AO 2.3 ×3)	ALLOW $Cu(OH)_2(H_2O)_4$ **ALLOW** charges on Cu **AND** OH e.g. $Cu^{2+}(OH^-)_2$ ✓ **DO NOT ALLOW** unbalanced charges. e.g. $Cu(OH^-)_2$ ✗ ---

			Available only from a reasonable attempt for identifying the gas as NH_3, e.g. NH_4, NH_4+, NH_2, ammonia, ammonium (Moist/damp) indicator/litmus (paper) turns blue ✓ Moist/damp **NOT** required. Initial colour of litmus **NOT** required but *blue* is **CON**		**DO NOT ALLOW** correct test for NH_3 based on incorrect ID of the gas **NO ECF** for a test on the wrong gas (has to be test for NH_3) **DO NOT ALLOW** bleaches indicator **CON** **Examiner's Comments** Addition of NaOH(aq) to the Tutton's salt results in two reactions: precipitation of copper(II) hydroxide and a reaction of an ammonium ion, used to show its presence as a qualitative test. As with Question 4 (c) (i), this part discriminated very well with many candidates able to be rewarded with some of the marks. The formula of copper(II) hydroxide, as $Cu(OH)_2$ or $Cu(OH)_2(H_2O)_2$ were both acceptable. This was correct more often than the responses related to the ammonium ion. The formula of the gas formed in the reaction of NaOH(aq) with the ammonium ion caused problems, with NH_3 and its subsequent test with moist indicator turning blue seen much less than the reaction of Cu^{2+}(aq) ions. Hydrogen (the 'squeaky pop test) and oxygen (relighting a glowing split) were common incorrect responses. This was another question in which referring back to the formula of the Tutton's salt would have revealed important clues.
		iii	**Reagent** $BaCl_2$ / barium chloride (solution) **OR** $Ba(NO_3)_2$ / barium nitrate (solution) **OR** Ba^{2+} (solution/aq) / barium ions ✓	2 (AO 2.3 ×2)	**ALLOW** $Ba(OH)_2$ or other **soluble** Ba^{2+} compounds --- **IGNORE** test for other anions provided they do **NOT** interfere with SO_4^{2-} test **e.g.** **IGNORE** addition of HCl/HNO_3/H^+ **BUT DO NOT ALLOW** H_2SO_4 *Interferes with SO_4^{2-} test*

			Observation **white** precipitate/ppt ✓ Only available from soluble Ba^{2+} reagent **ALLOW** minor slips in formula of Ba^{2+} reagent, e.g. BaCl, $BaNO_3$		**IGNORE** $Ag^{+}/AgNO_3$ **after** SO_4^{2-} test **DO NOT ALLOW before** SO_4^{2-} test **IGNORE** bubbling any gas through limewater **IGNORE** responses linked to CrO_4^{2-} *Not in Tutton's salt that student prepares* **Examiner's Comments** Th final part of Question 4 required candidates to identify the anion in the Tutton's salt as sulfate, and to recall that Ba^{2+} ions is used for the sulfate test to form a white precipitate. Any soluble barium compound was credited with barium chloride and nitrate being the commonest seen. As with earlier parts, this part discriminated very well. Most candidates who knew that barium ions were needed also collected the mark for the white precipitate observation. Over half the candidates did not score here, the most common errors being to repeat the test for the ammonium ion, or to use silver nitrate, clear confusion with the halide test.
			Total	**6**	