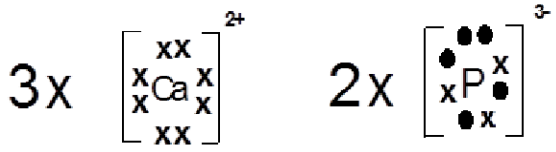
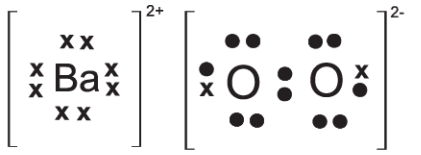
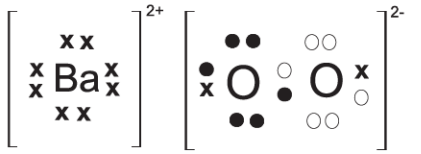
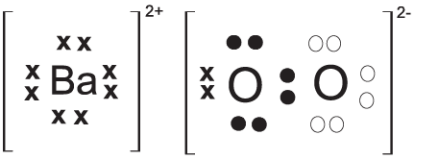
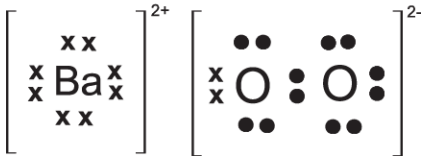
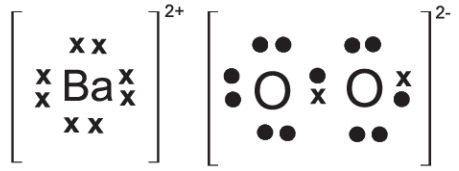
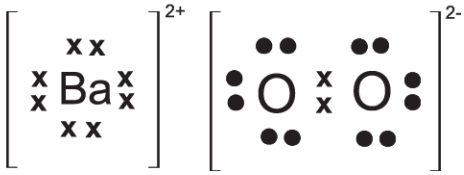
Mark scheme – Compounds, Formulae and Equations

Question			Answer/Indicative content	Marks	Guidance
1	a	i	Effervescence **OR** fizzing **OR** bubbling **OR** gas produced **AND** The solid **OR** zinc carbonate would dissolve **OR** disappear ✓	1	**ALLOW** 'carbon dioxide produced' **DO NOT ALLOW** incorrectly named gas eg H_2 **Examiner's Comments** Most candidates realised that effervescence and dissolving would be seen.
		ii	$ZnCO_3 + 2HCl \lozenge ZnCl_2 + CO_2 + H_2O$ ✓	1	**ALLOW** multiples **IGNORE** state symbols **Examiner's Comments** Nearly all candidates were able to write the equation successfully – including those who had omitted effervescence in (i).
	b	i	$Ca(OH)_2$ **OR** Calcium hydroxide **OR** CaO **OR** Calcium oxide ✓ 1	1	**ALLOW** Calcium carbonate **OR** $CaCO_3$ **Examiner's Comments** The unusual equation involving P4 molecules was answered well. Weaker candidates assumed that phosphorus was monatomic and consequentially lost credit.
		ii	$6Ca + P_4 \lozenge 2Ca_3P_2$ ✓	1	**ALLOW** multiples **IGNORE** state symbols **Examiner's Comments** This potentially difficult dot-and-cross diagram of the ions present was done well by candidates.
		iii	 Ca with 8 (or no) electrons AND phosphide ion with dot-and-cross outermost octet ✓ Three Ca ions **AND** two phosphide ions with correct charges ✓	2	For first mark: If 8 electrons are shown on the cation then the extra electron in the anion must match the symbol chosen for the electrons in the cation. **IGNORE** inner shells **IGNORE** circles **ALLOW** one mark if both electron arrangements and charges are correct but only one of each ion is drawn.

					ALLOW (brackets not required) $3[Ca^{2+}]$ $3[Ca]^{2+}$ $[Ca^{2+}]_3$ $2[P^{3-}]$ $2[P]^{3-}$ $[P^{3-}]_2$ **DO NOT ALLOW** $[Ca_3]^{2+}$ $[3Ca]^{2+}$ $[Ca]^{32+}$ $[P_2]^{3-}$ $[2P]^{3-}$ $[P]_2$
			Total	**6**	
2			Ga^{3+} ✓	1	**Examiner's Comments** The formula, Ga^{3+}, was almost universally known.
			Total	**1**	
3			$2Al + 3F_2 \rightarrow 2AlF_3$ ✓	1	**ALLOW** multiples **IGNORE** state symbols **Examiner's Comments** Although the formula of AlF_3 was not given, this question was well answered. When the mark was not awarded it was rarely because of errors in the formula for AlF_3, but more in the ratio of the reactants or in fluorine not being given as diatomic. Occasionally, the symbol for fluorine was given as Fl.
			Total	**1**	
4			$C_{12}H_{25}$ ✓	1	**IGNORE** $C_{24}H_{50}$ **Examiner's Comments** The majority of candidates were able to deduce the correct empirical formula of the alkane.
			Total	**1**	
5			NH_4+ ✓ NO_3^- ✓	2	Mark incorrect ions first **Examiner's Comments** This question proved more difficult than intended. The specification indicates the polyatomic ions which the candidates are expected to know the formulae of and it was little surprising that many candidates could not make the leap from the empirical formula given to the possible ions present. Weak answers came from candidates who took their lead from the

					empirical formula $H_4N_2O_3$ to suggest that the ions were H^+ and N_2O^-. Among stronger candidates it was more common to identify NO_3^- than NH_4^+, although it remained rare to see both correct ions given.
			Total	**2**	
6		i	**Reaction 1:** $Ba + 2H_2O \rightarrow Ba(OH)_2 + H_2$ ✓ **Reaction 2:** $Ba_3N_2 + 6H_2O \rightarrow 3Ba(OH)_2 + 2NH_3$ Correct products ✓ Balancing ✓	3	Ignore state symbols **Examiner's Comments** Both equations were relatively challenging. Reaction 1 was a direct question about reactions of Group 2 elements. Reaction 2 demanded a higher level of application based upon information given. Many identified the alkaline gas as NH3, but then incorrectly assumed that the alkaline solution was BaO instead of $Ba(OH)_2$. Weaker candidates suggested equations with hypothetical species that could not have born any relation to formulae that they might have encountered before.
		ii	Giant ionic (lattice) ✓	1	**ALLOW** 'Giant lattice with ionic bonds' **ALLOW** 'Giant ionic bonds' **DO NOT ALLOW** 'atoms or molecules or dipoles' **Examiner's Comments** This question was relatively well answered, although some candidates did negate the mark by referring to molecules of Ba_3N_2 either directly or by indirect reference to intermolecular forces.
		iii		1	Ba must have a 2+ charge Ba can be with or without octet. **IGNORE** lack of charge on O_2^{2-} ion

			 **OR**  **OR**  **OR** 		O_2^{2-} ion to have 12 electrons belonging to O atoms + 2 other electrons of another symbol. The 2 other electrons must match Ba if Ba has an octet. If O electrons are shown as 6 of one symbol and 6 of another, each O must have six electrons of the same symbol **ALLOW**  **OR**  **Examiner's Comments** This question was designed to be difficult, but many candidates rose to the challenge. Weaker candidates simply drew a *'dot-and-cross'* diagram for BaO_2 in which they treated each oxygen species as an oxide ion each having a single negative charge. Many stronger candidates did realise from the structure given in the question that there was only a single bond between the two oxygen atoms, as was clear from their suggested diagram. Only the stronger candidates managed to incorporate correctly the electrons from barium, to arrive at a correct version of the bonding of BaO_2.
			Total	**5**	
7			$AlBr_3$	1	
			Total	**1**	