Question	Marking Guidance		Mark	Comments
1(a)	Method 1	Method 2		
	Mass of H_2O = 4.38-2.46 (= 1.92 g)	Percentage of H_2O = 44%	1	If there is an AE in M1 then can score M2 and M3 If M_r incorrect can only score M1
	$ZnSO_4$ $\quad$ H_2O $\frac{2.46}{161.5}$ $\quad$ $\frac{1.92}{18}$ (0.0152 $\quad$ 0.107) (1 : 7)	ZnSO4 $\quad$ H2O $\frac{56}{161.5}$ $\quad$ $\frac{44}{18}$ (0.347 $\quad$ 2.444) (1 : 7)	1	
	x = 7	x = 7	1	If x = 7 with working then award 3 marks. Allow alternative methods. If M1 incorrect due to AE, M3 must be an integer.
1(b)	Moles HCl = <u>0.12(0)</u>		1	
	mol $ZnCl_2$ <u>= 0.06(0)</u> ***OR*** <u>0.12 / 2</u>		1	If M2 incorrect then CE and cannot score M2, M3 and M4.
	mass $ZnCl_2$ = 0.06 × 136.4		1	Allow 65.4 + (2 × 35.5) for 136.4
	= <u>8.18(4)</u> (g) ***OR*** <u>8.2</u> (g)		1	Must be to 2 significant figures or more. Ignore units.

1(c)	Moles $ZnCl_2 = \frac{10.7}{136.4}$ (= 0.0784) ***OR*** moles Zn = 0.0784 Mass Zn reacting = 0.0784 × 65.4 = (5.13 g) % purity of Zn = $\frac{5.13}{5.68} \times 100$ = <u>90.2</u>% ***OR*** <u>90.3</u>%	1 1 1 1	 M2 is for their M1 × 65.4 M3 is M2 × 100 / 5.68 provided M2 is < 5.68 Allow alternative methods. M1 = Moles $ZnCl_2 = \frac{10.7}{136.4}$ (= 0.0784) M2 = Theoretical moles Zn = $\frac{5.68}{65.4}$ (= 0.0869) M3 = M1 × 100 / M2 = (0.0784 × 100 / 0.0869) M4 = <u>90.2%</u> ***OR*** <u>90.3</u>%
1(d)	Ionic <u>Strong</u> (electrostatic) <u>attraction</u> (between ions) between oppositely charged ions / + and – ions / F^- and Zn^{2+} ions	1 1 1	If not ionic CE = 0/3 If IMF, molecules, metallic bonding implied CE = 0/3

Question	Marking Guidelines	Mark	Additional Guidance
2(a)	‘Initial mass’ must be the *y*-axis	1	If axis unlabelled, use data to decide that ‘Initial mass’ is on the *y*-axis.
	Sensible scale	1	Do not award this mark if **plotted points** do not cover at least half of the grid. Do not award this mark if any plotted point is outside the grid.
	All points plotted correctly	1	Allow ± one small square.
	Point at (0,0) is ringed	1	
2(b)	Best-fit straight line that goes through the origin ± ½ small square	1	Mark consequentially to plotted points but the line must still go through the origin ± ½ small square. Lose this mark if the line is doubled or kinked. If the points are plotted correctly, lose this mark if the line deviates towards the anomalies.
2(c)	Students 3 and 5	1	Allow masses of 1.15 and 1.53 or 2.82 and 3.58 Mark consequentially to plot.
2(d)	Samples 3 or 5 have not lost all their water	1	Allow reaction / decomposition incomplete.
	Sample not heated for enough time / larger masses will take a longer time to dehydrate / decompose	1	

Question	Marking Guidelines	Mark	Additional Guidance
3(a)	Percentage of oxygen is 42.5% **(M1)**	1	Allow if shown clearly in the calculation.
	Co 13.0/58.9 = 0.221, N 18.6/14 = 1.329, K 25.9/39.1 = 0.662, O 42.5/16 = 2.656 **(M2)**	1	Allow alternative method if chemically correct. If A_r has been divided by the percentage, chemical error, lose **M2** and **M3**.
	$CoN_6K_3O_{12}$ **(M3)**	1	Allow in any order. Correct answer without working scores this mark only.
3(b)	$Co(NO_2)_6^{3-}$	1	Allow a correct diagram bonding through N or O Do not allow $CoN_6O_{12}^{3-}$ Must have correct overall charge. Allow consequential answer from Q6(a) if the charge on the anion is correct.

4.(a) (i) The power of an <u>atom</u> or <u>nucleus</u> to withdraw or attract electrons ***OR*** electron density ***OR*** a pair of electrons (towards itself)

Ignore retain

1

In a <u>covalent</u> bond

1

(ii) More protons / bigger nuclear charge

1

Same or similar shielding / electrons in the same shell or principal energy level / atoms get smaller

Not same sub–shell
Ignore more electrons

1

(b) Ionic

If not ionic then CE = 0 / 3
If blank lose M1 and mark on

1

Strong or many or lots of (electrostatic) <u>attractions</u> (between ions)

If molecules / IMF / metallic / atoms lose M2 + M3, penalise incorrect ions by 1 mark

1

Between + and − ions / between Li^+ and F^- ions / oppositely charged ions

Allow strong (ionic) bonds for max 1 out of M2 and M3

1

(c) Small electronegativity difference / difference = 0.5

Must be comparative
Allow 2 non-metals

1

(d) (i) (simple) <u>molecular</u>

Ignore simple covalent

1

(ii) $OF_2 + H_2O \longrightarrow O_2 + 2HF$

Ignore state symbols
Allow multiples
Allow OF_2 written as F_2O

1

(iii) 45.7% O

1

$$\begin{pmatrix} O & F \\ \frac{45.7}{16} & \frac{54.3}{19} \end{pmatrix}$$

If students get M2 upside down lose M2 + M3
Check that students who get correct answer divide by 16 and 19 (not 8 and 9). If dividing by 8 and 9 lose M2 and M3 but could allocate M4 ie max 2

1

(2.85 2.85)
(1 1)

EF = <u>OF or FO</u>

Calculation of OF by other correct method = 3 marks
Penalise Fl by 1 mark

1

MF (= 70.0 / 35) = O_2F_2 or F_2O_2

1

[14]