

Question number	Answer	Marks	Guidance																
1 (a) (i)	moles $\text{KNO}_3 = 1.00/101.1 = 9.89 \times 10^{-3} \text{ mol}$	1																	
1 (a) (ii)	$pV = nRT$ or $n = pV / RT$ moles $\text{O}_2 = n = pV / RT$ $= (100\,000 \times 1.22 \times 10^{-4}) / (8.31 \times 298)$ $= 4.93 \times 10^{-3} \text{ mol}$	1 1 1 1																	
1 (b) (i)	simplest ratio of atoms of each element in a compound	1	You must learn this definition exactly.																
1 (b) (ii)	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">K</td> <td style="text-align: center;">N</td> <td style="text-align: center;">O</td> <td></td> </tr> <tr> <td style="text-align: center;">45.9/39.1</td> <td style="text-align: center;">16.5/14</td> <td style="text-align: center;">37.6/16</td> <td></td> </tr> <tr> <td style="text-align: center;">1.17</td> <td style="text-align: center;">1.18</td> <td style="text-align: center;">2.35</td> <td></td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">2</td> <td style="text-align: center;"><math>\text{KNO}_2</math></td> </tr> </table>	K	N	O		45.9/39.1	16.5/14	37.6/16		1.17	1.18	2.35		1	1	2	$\text{KNO}_2$	3	If % of O is missing then you can only get one mark.
K	N	O																	
45.9/39.1	16.5/14	37.6/16																	
1.17	1.18	2.35																	
1	1	2	$\text{KNO}_2$																
1 (c)	$2\text{KNO}_3 \rightarrow 2\text{KNO}_2 + \text{O}_2$	1	You can put multiples of an equation.																
2 (a)	$P = 100\,000 \text{ Pa}$ and $T = 298 \text{ K}$  $n = PV/RT$ or $(100\,000 \times 4.31) / (8.31 \times 298)$  $n(\text{total}) = 174(.044)$  $n(\text{NO}) = 69.6$	1 1 1 1	Wrong conversion of $V$ or incorrect conversion of $P/T$ lose M1 + M3  If not rearranged correctly then cannot score M2 and M3  Allow student's M3 x 4/10 but must be to 3 significant figures																
2 (b)	3000 / 17  176.5  176.47 x 46 = 8117.62	1 1 1	Allow answer to 2 significant figures or more  Allow 176–177 But if answer = 0.176 – 0.18 (from 3/17) then allow 1 mark  M1 is for the answer to (b)(i) x 46. But lose this mark if $46 \div 2$ at any Stage However if $92 \div 2$ allow M1																

	$8117.62 \times 80 / 100 (= 6494 \text{ g})$ $6494 / 1000 = 6.5$ OR If 163 mol used: $163 \times 46 = 7498 (1)$ $7498 \times 80 / 100 = 5998.4 \text{ g} (1)$ $6.00 \text{ kg} (1)$	1  1	M2 is for $M1 \times 80/100$  M3 is for the answer to M2 $\div 1000$ to min 2 significant figures (kg)								
2 (c)	$0.543 \times 2 / 3 (= 0.362)$ $0.362 \times 1000 / 250 = 1.45 \text{ mol dm}^{-3}$	1  1	If not $\times 2 / 3$ CE = 0/2  Allow 1.447-1.5 ( $\text{mol dm}^{-3}$ ) for 2 marks								
2 (d)	$\text{NO}_2$ contributes to acid rain / is an acid gas / forms $\text{HNO}_3$ / $\text{NO}_2$ is toxic / photochemical smog	1	Ignore references to water, breathing problems and ozone layer. Not greenhouse gas								
2 (e)	Ensure the ammonia is used up / ensure complete reaction or combustion  OR  Maximise the yield of nitric acid or products	1									
2 (f)	Neutralisation	1	Allow acid vs alkali or acid base reaction								
3 (a)	Method 1  $\text{Mass of H}_2\text{O} = 4.38 - 2.46 = 1.92 \text{ g}$  <table style="width: 100%; border: none;"> <tr> <td style="text-align: center;"><math>\text{ZnSO}_4</math></td> <td style="text-align: center;"><math>\text{H}_2\text{O}</math></td> </tr> <tr> <td style="text-align: center;"><math>2.46 / 161.5</math></td> <td style="text-align: center;"><math>1.92 / 18</math></td> </tr> <tr> <td style="text-align: center;"><math>(0.0152</math></td> <td style="text-align: center;"><math>0.107)</math></td> </tr> <tr> <td style="text-align: center;"><math>(1</math></td> <td style="text-align: center;"><math>7)</math></td> </tr> </table> $x = 7$  Method 2  $\text{Percentage of H}_2\text{O} = 44\%$	$\text{ZnSO}_4$	$\text{H}_2\text{O}$	$2.46 / 161.5$	$1.92 / 18$	$(0.0152$	$0.107)$	$(1$	$7)$	1  1  1  A1	If there is an AE in M1 then can score M2 and M3 If $M_1$ incorrect can only score M1   If $x = 7$ with working then award 3 marks. Allow alternative methods. If M1 incorrect due to AE, M3 must be an integer.
$\text{ZnSO}_4$	$\text{H}_2\text{O}$										
$2.46 / 161.5$	$1.92 / 18$										
$(0.0152$	$0.107)$										
$(1$	$7)$										

	$\text{ZnSO}_4$ 56 / 161.5  (0.347 ( 1 : 2.444 7 )  $x = 7$	A1     A1	
3 (b)	Moles HCl = 0.12(0)  mol $\text{ZnCl}_2$ = 0.06(0) <b>OR</b> 0.12 / 2  mass $\text{ZnCl}_2$ = 0.06 × 136.4  = 8.18(4) g <b>OR</b> 8.2 g	1  1  1  1	If M2 incorrect then CE and cannot score M2, M3 and M4.  Allow 65.4 + (2 × 35.5) for 136.4  Must be to 2 significant figures or more. Ignore units.
3 (c)	Moles $\text{ZnCl}_2$ = 10.7 / 136.4 (= 0.0784)  <b>OR</b> moles Zn = 0.0784  Mass Zn reacting = 0.0784 × 65.4 = 5.13 g  % purity of Zn = 5.13 / 5.68 × 100  = 90.2% <b>OR</b> 90.3%	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 $\text{ZnCl}_2$ = 10.7 / 136.4 (= 0.0784)  M2 = Theoretical moles Zn = 5.68 / 65.4 (= 0.0869)  M3 = M1 × 100 / M2 = (0.0784 × 100 / 0.0869)  M4 = 90.2% <b>OR</b> 90.3%
4 (a) (i)	$M_r \text{ MgO} = 40.3$  $0.741/40.3 = 0.0184$	1   1	If used 40 then penalise this mark but allow consequential M2 (0.0185)  0.018 with no $M_r$ shown = 0 Penalise if not 3 sig figs in this clip only
4 (a) (ii)	$0.0184 \times 5 / 2 = 0.0460$	1	Allow 0.0459 to 0.0463 Allow their 3(a)(i) × 5/2 ie allow

			process mark of $\times 5/2$ but insist on a correct answer being written down Ignore sig figs
4 (b)	$pV=nRT$ $(V= 0.402 \times 8.31 \times 333) / 100\,000$	1	If rearranged incorrectly then lose M1 If this expression correct then candidate has scored first mark
	0.0111	1	Ignore units
	11.1 dm <sup>3</sup>	1	3 marks for 11.1 dm <sup>3</sup> However if 11.1 m <sup>3</sup> or cm <sup>3</sup> allow 2 (ie penalise wrong units in final answer) Ignore sig figs- but must be 2 sig figs or greater
4 (c)	$0.0152 \times 2 = 0.0304$	1	Allow 0.03
	0.938 mol dm <sup>-3</sup>	1	Allow range 0.92 – 0.94 Minimum 2 sig figs Allow consequential marking from 3(c)(i) Ignore units even if wrong