

Question	Part	Sub Part	Marking Guidance	Mark	Comments
2	(a)	(i)	$M_r = 132.1$	1	132
			0.0238	1	Allow 0.024 Allow 0.0237 Penalise less than 2 sig fig once in (a)
2	(a)	(ii)	0.0476	1	0.0474-0.0476 Allow (a) (i) x 2
2	(a)	(iii)	1.21	1	Allow consequential from (a) (ii) ie allow (a) (ii) x 1000 / 39.30 Ignore units even if wrong
2	(b)		$\frac{34 \times 100}{212.1}$	1	Allow mass or M_r of desired product times one hundred divided by total mass or M_r of reactants/products If 34/212.1 seen correctly award M1
			= 16.0(3)%	1	Allow 16% 16 scores 2 marks
2	(c)		100(%)	1	Ignore all working
2	(d)		$PV = nRT$ or $n = \frac{PV}{RT}$	1	If rearranged incorrectly lose M1 and M3
			$n = \frac{100000 \times 1.53 \times 10^{-2}}{8.31 \times 310}$	1	M2 for mark for converting P and T into correct units in any expression
			= 0.59(4)	1	Allow 0.593 M3 consequential on transcription error only not on incorrect P and T

2	(e)	(Na ₂ SO ₄) (44.1%)	H ₂ O 55.9%	1	M1 is for 55.9
		44.1/142.1 0.310 =1	55.9/18 3.11 =10	1	Alternative method gives 180 for water part = 2 marks
		x = 10		1	X = 10 = 3 marks 10.02 = 2 marks

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2(a)(i)	<u>0.0212</u>	1	Need 3 sig figs Allow correct answer to 3 sig figs eg 2.12×10^{-2}
2(a)(ii)	0.0106	1	Mark is for 2(a)(i) divided by 2 leading to correct answer ≥ 2 sig figs
2(a)(iii)	M _r = <u>100.1</u> 1.06 g	1 1	Allow 100.1 as 'string' Need 3 sig figs or more Consequential on 2(a)(ii) x 100(.1)
2(a)(iv)	Neutralisation or acid / base reaction	1	Allow acid / alkali reaction Apply list principle
2(b)(i)	T = 304(K) and P = 100 000 (Pa) $\frac{100\,000 \times 3.50 \times 10^{-3}}{8.31 \times 304}$ OR $n = \frac{PV}{RT}$ 0.139 (mol)	1 1 1	Only T and P correctly converted Allow <u>0.138 – 0.139</u>
2(b)(ii)	0.0276 – 0.0278(mol)	1	Allow answer to 2(b)(i) divided by 5 leading to a correct answer Allow 0.028

2(c)	4.20 g $\text{Ca}(\text{NO}_3)_2$	1	
	$\begin{array}{r} \text{Ca}(\text{NO}_3)_2 \quad \text{H}_2\text{O} \\ \hline 4.20 \quad \quad 1.84 \\ 164(.1) \quad \quad 18 \end{array}$	1	Mark is for dividing by the correct M_r values M2 and M3 dependent on correct M1
	0.0256 0.102		M2 can be awarded here instead
	1 : 3.98		
	x = 4	1	If $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ seen with working then award 3 marks Credit alternative method which gives x = 4

Question	Marking Guidance	Mark	Comments
6(a)	$\text{Mol Pb} = 8.14 / 207(.2) (= 0.0393 \text{ mol})$ $\text{Mol HNO}_3 = 0.0393 \times 8 / 3 = 0.105 \text{ mol}$ $\text{Vol HNO}_3 = 0.105 / 2 = 0.0524 \text{ (dm}^3\text{)}$	1 1 1	M1 and M2 are process marks Allow mark for $\text{M1} \times 8/3$ or $\text{M1} \times 2.67$ Accept range 0.0520 to 0.0530 No consequential marking for M3 Answer to 3 sig figs required
6(b)	$101000 \text{ (Pa) and } 638 \times 10^{-6} \text{ (m}^3\text{)}$ $n = pV/RT \quad (= \frac{101000 \times 638 \times 10^{-6}}{8.31 \times 298})$ $0.026(0) \text{ (mol)}$	1 1 1	Can score M2 with incorrect conversion of p and V If T incorrect lose M1 and M3 If answer correct then award 3 marks Allow answers to 2 sig figs or more $26.02 = 1$ If transcription error lose M3 only
6(c)(i)	$2\text{Pb}(\text{NO}_3)_2(\text{s}) \rightarrow 2\text{PbO}(\text{s}) + 4\text{NO}_2(\text{g}) + (1)\text{O}_2(\text{g})$	1	Allow multiples Allow fractions
6(c)(ii)	Decomposition not complete / side reactions / by-products / some NO_2 escapes / not all reacts / impure $\text{Pb}(\text{NO}_3)_2$	1	Ignore reversible / not heated enough / slow
6(c)(iii)	Hard to separate O_2 from NO_2 / hard to separate the 2 gases	1	Allow mixture of gases Not 'all products are gases'

Question	Marking Guidance	Mark	Comments
5(a)	P = 100 000 Pa and T = 298 K	1	Wrong conversion of V or incorrect conversion of P/T lose M1 + M3
	$n = \frac{PV}{RT}$ or $\frac{100\,000 \times 4.31}{8.31 \times 298}$	1	If not rearranged correctly then cannot score M2 and M3
	n(total) = 174(.044)	1	
	n(NO) = <u>69.6</u>	1	Allow student's M3 x 4/10 but must be to 3 significant figures
5(b)(i)	$\frac{3000}{17}$	1	Allow answer to 2 significant figures or more
	176.5	1	Allow 176–177 But if answer = 0.176 – 0.18 (from 3/17) then allow 1 mark

5(b)(ii)	176.47 x 46 = 8117.62	1	M1 is for the answer to (b)(i) x 46. But lose this mark if 46 ÷ 2 at any stage However if 92 ÷ 2 allow M1
	$8117.62 \times \frac{80}{100}$ (= 6494 g)	1	M2 is for M1 x 80/100
	$\frac{6494}{1000} = 6.5$	1	M3 is for the answer to M2 ÷ 1000 to min 2 significant figures (kg)
	OR If 163 mol used: 163 x 46 = 7498 (1) $7498 \times \frac{80}{100} = 5998.4$ g (1) 6.00 kg (1)		

5(c)	$0.543 \times \frac{2}{3} (= 0.362)$	1	If not $\times \frac{2}{3}$ CE = 0/2
	$0.362 \times \frac{1000}{250} = 1.45 \text{ (mol dm}^{-3}\text{)}$	1	Allow 1.447-1.5 (mol dm ⁻³) for 2 marks
5(d)	NO ₂ contributes to acid rain / is an acid gas / forms HNO ₃ / NO ₂ is toxic / photochemical smog	1	Ignore references to water, breathing problems and ozone layer. Not greenhouse gas
5(e)	Ensure the ammonia is used up / ensure complete reaction or combustion OR Maximise the yield of nitric acid or products	1	
5(f)	Neutralisation	1	Allow acid vs alkali or acid base reaction

Question	Marking Guidance	Mark	Comments
6(a)	Correct conversion of temperature and pressure (773 and 101 x 10 ³)	1	correct answer with or without working scores 4 marks
	No moles P = (220 / 4 x 31.0) = 1.77	1	Max 2 (M1 and M3) if 31.0 used (=0.451 m ³ or if 220/31 rounded to 2 sf ie 7.1 then 0.452)
	V = nRT/P (correct rearrangement or insert of values V = 1.77 x 8.31 x 773 / 101 x 10 ³ = 0.1128 m ³)	1	Max 2 (M1 and M3) if 284 (P ₄ O ₁₀) used then 0.0493
	V = <u>0.113</u> (m ³)	1	Must be 3 sig figs
6(b)	No moles H ₃ PO ₄ = 3 x 10 ³ (dm ³) x 5 = 15,000 (mols)	1	correct answer with or without working scores 3 marks If M1 incorrect then can only score M2
	No moles phosphorus(V) oxide = $\frac{15\,000}{4}$ (= 3,750 mols)	1	M2 = $\frac{M1}{4}$ (process) If M2 incorrect can only score M1
	1.1 x 10 ⁶ or 1.07 x 10 ⁶ or 1.065 x 10 ⁶ (g) or 1,100 or 1,070 or 1065 kg or 1.1 or 1.07 or 1.065 tonne	1	= (3.75 x 10 ³ x 284.0) Min 2 sig fig

6(c)	No moles $\text{Ca}_3(\text{PO}_4)_2$ ($= 3.50\text{kg} = \frac{3.500\text{ g}}{310(.3)} = 11.28$	1	correct answer with or without working scores 4 marks
	Theoretical No. moles $\text{H}_3\text{PO}_4 = 11.28 \times 2 = 22.56$	1	If M1 incorrect can only score M2 and M3
	Theoretical mass $\text{H}_3\text{PO}_4 = 22.56 \times 98(.0) = 2211$ or Actual No. moles H_3PO_4 produced $= \frac{1090}{98} = 11.12$	1	If M2 incorrect can only score M1 and M3
	$49 - 49(.312) (\%)$	1	If M3 incorrect can only score M1 and M2
6(d)	Method 1 / (a) & (b) because only one product / no other products formed / atom economy = 100% (even though two steps)	1	(% yield (moles)) $= \left(\frac{11.12}{22.56} \times 100\right)$ or (% yield (mass)) $= \left(\frac{1090}{2211} \times 100\right)$ Allow calculations Do not allow if P_2O_5 is formed Allow converse explanation

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F321

Mark Scheme

June 2010

Question	Expected Answers	Marks	Additional Guidance
1 a i	^{118}Sn 50p 68n 50e Complete row ✓	1	
ii	$^{120}_{50}\text{Sn}$ has (two) more neutrons / 70 neutrons ✓ ora	1	ALLOW There is a different number of neutrons IGNORE correct reference to protons / electrons DO NOT ALLOW incorrect references to protons / electrons ALLOW ECF for stated number of neutrons from 1a(i)
b i	The (weighted) mean mass of an atom (of an element) OR The (weighted) average mass of an atom (of an element) ✓ compared with 1/12th (the mass) ✓ of (one atom of) carbon-12 ✓	3	ALLOW average atomic mass DO NOT ALLOW mean mass of an element ALLOW mean mass of isotopes OR average mass of isotopes DO NOT ALLOW the singular, 'isotope' For second and third marking points ALLOW compared with (the mass of) carbon-12 which is 12 ALLOW mass of one mole of atoms ✓ compared to 1/12th ✓ (mass of) one mole OR 12g of carbon-12 ✓ ALLOW $\frac{\text{mass of one mole of atoms}}{1/12\text{th mass of one mole OR } 12\text{g of carbon-12}}$
c	moles of Sn $= \frac{2080}{118.7} = 17.52$ ✓ $17.52 \times 6.02 \times 10^{23} = 1.05 \times 10^{25}$ atoms ✓	2	ALLOW 17.5 up to (correctly rounded) calculator value of 17.52316765 DO NOT ALLOW use of 118, which makes moles of Sn = 17.63 ALLOW 105×10^{23} atoms DO NOT ALLOW answers which are not to three sig figs for second marking point ALLOW two marks for answer only of 1.05×10^{25} ALLOW one mark for answer only if not 3 sig figs up to calculator value of $1.054894693 \times 10^{25}$ Eg 100×1 ALLOW ECF for any calculated moles of Sn (based on use of any A_r value) $\times 6.02 \times 10^{23}$ if shown to 3 sig figs DO NOT ALLOW mass of Sn $\times 6.02 \times 10^{23}$

Question		Expected Answers	Marks	Additional Guidance
1	d	$\frac{78.8}{118.7}$ and $\frac{21.2}{16.0}$ OR $= 0.66(4)$ and $= 1.3(25)$ ✓ $\frac{0.66(4)}{0.66(4)} = 1$ $\frac{1.325}{0.66(4)} = 2$ ans = SnO ₂ ✓	2	ALLOW SnO ₂ for one mark if no working shown ALLOW use of 118 for this part IGNORE incorrect rounding provided given to two sig figs IGNORE incorrect symbols e.g. T or Ti for Tin, as long as correct <i>A_r</i> of tin (118.7 or 118) used ALLOW Sn ₂ O for 1 mark ECF if both inverted mole calculations are shown ALLOW Sn ₃ O ₅ with evidence of use of both atomic numbers for one mark ALLOW 2 marks if candidate has adopted the following approach 78.8% of mass = 118.7 100% of mass = 118.7/0.788 = 150.6 (151) 150.6 – 118.7 = 31.9 (32) Both masses would get one mark 31.9/16 = 2
Total			9	