

Boost your performance and confidence with these topic-based exam questions

Practice questions created by actual examiners and assessment experts

Detailed mark scheme

Suitable for all boards

Designed to test your ability and thoroughly prepare you

## Time allowed 63 Minutes

2002

## CHEMISTRY

**Mark Scheme** 

## AQA AS & A LEVEL

Percentage

%

3.1 Physical chemistry

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Score

/53





P = 100 000 Pa and T = 298 K Wrong conversion of V or incorrect conversion of P / T lose M1 + M3

$$n = \frac{PV}{RT} \text{ or } \frac{100\ 000 \times 4.31}{8.31 \times 298}$$

If not rearranged correctly then cannot score M2 and M3

n(total) = 174(.044)

1

1

1

n (NO) = <u>69.6</u>



	ent's M3 × 4 / 10 but must be to 3 significant figures Allow stud	1
(i)	3000         17         Allow answer to 2 significant figures or more	1
	176.5 Allow 176 – 177 But if answer = 0.176 – 0.18 (from 3 / 17) then allow 1 mark	1
(ii)	176.47 × 46 = 8117.62 M1 is for the answer to (b)(i) × 46. But lose this mark if 46 ÷ 2 at any stage However if 92 ÷ 2 allow M1	1
	$8117.62 \times \frac{80}{100} (= 6494 \text{ g})$ $M2 \text{ is for } M1 \times 80 / 100$ $\frac{6494}{1000} = 6.5$ $M2 \text{ is for the ensure to } M2 + 1000 \text{ to min } 2 \text{ similar to the set}$	1
	M3 is for the answer to M2 ÷ 1000 to min 2 significant figures (kg)	

OR

(b)

If 163 mol used: 163 × 46 = 7498 (1)  $7498 \times \frac{80}{100} = 5998.4 g(1)$ 

6.00 kg (1)



(c) 
$$0.543 \times \frac{2}{3} (=0.362)$$
  
if not  $\times \frac{2}{3} CE = 0/2$ 

1

1

1

1

1

$$0.362 \times \frac{1000}{250} = 1.45 (\text{mol dm}^{-3})$$
  
Allow 1.447 - 1.5 (mol dm<sup>-3</sup>) for 2 marks

(d) NO<sub>2</sub> contributes to acid rain / is an acid gas / forms HNO<sub>3</sub> / NO<sub>2</sub> is toxic / photochemical smog

*Ignore references to water, breathing problems and ozone layer. Not greenhouse gas* 

(e) Ensure the ammonia is used up / ensure complete reaction or combustion

## OR

Maximise the yield of nitric acid or products

(f) Neutralisation

Allow acid vs alkali or acid base reaction

[14]





(a) P = 100 000 (Pa) and V = 5.00 x 10<sup>-3</sup> (m<sup>3</sup>)
 M1 is for correctly converting P and V in any expression or list Allow 100 (kPa) and 5 (dm<sup>3</sup>) for M1.

 $n = \frac{PV}{RT} = \frac{100\ 000 \times 5.00 \times 10^{-3}}{8.31 \times 298}$ 

*M2 is correct rearrangement of PV = nRT* 

= 0.202 moles (of gas produced) This would score M1 and M2.

Therefore  $\frac{0.202}{5}$  = 0.0404 moles B<sub>2</sub>O<sub>3</sub> M3 is for their answer divided by 5

Mass of  $B_2O_3 = 0.0404 \times 69.6$ M4 is for their answer to M3 x 69.6

=<u>2.81</u> (g)

M5 is for their answer to 3 sig figures. 2.81 (g) gets 5 marks.

1

1

1

1



(b)	B + 1	$1.5 \text{ Cl}_2 \rightarrow \text{BCl}_3$ Accept multiples.	1
	<u>3</u> bo	onds	1
	Pair	rs repel <u>equally</u> / by the <u>same amount</u> Do not allow any lone pairs if a diagram is shown.	1
(c)	(i)	43.2/117.3 (= 0.368 moles BCl₃)	1
		0.368 x 3 (= 1.105 moles HCI) Allow their BCl₃ moles x 3	1



	Conc = <u>2.2</u>	$\frac{1.105 \times 1000}{500}$ HCI = $\frac{1.105 \times 1000}{500}$ Allow moles of HCI × 1000 / 500 $\frac{0 \text{ to } 2.22}{0 \text{ mol dm}^{-3}}$ Allow 2.2 Allow 2 significant figures or more	1
	(ii) H₃BO	$H_3$ + 3NaOH $\rightarrow$ Na <sub>3</sub> BO <sub>3</sub> + 3H <sub>2</sub> O Allow alternative balanced equations to form acid salts. Allow H <sub>3</sub> BO <sub>3</sub> + NaOH $\rightarrow$ NaBO <sub>2</sub> + 2H <sub>2</sub> O	1
	10.8 (×10	0)	
(d)	120.3	Mark is for both <i>M</i> , values correctly as numerator and denominator.	1
	8.98(%)	Allow 9(%).	1
	Sell the HC		
(e)	Alternative	method	1
	CI = 86.8%	CI = 142 g	1

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B 13.2 10.8	CI 86.8 35.5	
	В 21.6 10.8	<i>CI</i> 142 35.5

1.22 2.45 or ratio 1:2 or BCl<sub>2</sub> 2:4 ratio

1

1

1

 $\begin{array}{l} \mathsf{BCl}_2 \text{ has } \textit{M}_r \text{ of } \texttt{81.8 so} \\ \texttt{81.8 x 2} = \texttt{163.6} \\ \texttt{Formula} = \texttt{B}_2\texttt{Cl}_4 \\ \qquad \qquad \texttt{B}_2\texttt{Cl}_4 \\ \qquad \qquad \texttt{Allow 4 marks for correct answer with working shown.} \\ \qquad \qquad \texttt{Do not allow } (\texttt{BCl}_2)_2 \end{array}$ 

[20]





Mol Pb = 8.14 / 207(.2) (= 0.0393 mol) *M1 and M2 are process marks* 

Mol HNO<sub>3</sub> = 0.0393 × 8 / 3 = 0.105 mol Allow mark for M1 × 8/3 or M1 × 2.67

Vol HNO<sub>3</sub> = 0.105 / 2 = 0.0524 (dm<sup>3</sup>) Accept range 0.0520 to 0.0530 No consequential marking for M3 Answer to 3 sig figs required

(b) 101000 (Pa) and  $638 \times 10^{-6}$  (m<sup>3</sup>)

1

1

1



$$\begin{array}{ll} n = pV/RT & (= \underline{101000 \times 638 \times 10^{-s}}) & (& 8.31 \times 298 \\ & ) & Can \ score \ M2 \ with \ incorrect \ conversion \ of \ p \ and \ V \\ If \ T \ incorrect \ lose \ M1 \ and \ M3 \\ \hline \underline{0.026(0) \ (mol)} \\ & If \ answer \ correct \ then \ award \ 3 \ marks \\ & Allow \ answers \ to \ 2 \ sig \ figs \ or \ more \\ & 26.02 = 1 \\ & If \ transcription \ error \ lose \ M3 \ only \\ \hline (i) \ 2Pb(NO_3)_2(s) \rightarrow 2 \ PbO(s) + 4NO_2(g) + (1)O_2(g) \\ & Allow \ multiples \\ & Allow \ fractions \end{array}$$

- (ii) Decomposition not complete / side reactions / by-products / some (NO<sub>2</sub>) escapes / not all reacts / impure Pb(NO<sub>3</sub>)<sub>2</sub>
   Ignore reversible / not heated enough / slow
- (iii) Hard to separate O<sub>2</sub> from NO<sub>2</sub> / hard to separate the 2 gases Allow mixture of gases Not 'all products are gases'

(c)

[9]

1

1

1



1

1

1

1

1



(i)

2.16 ÷ 241.	8 = <u>0.00893</u> or 8.93 × 10⁻₃ (mol) Penalise if not 3 significant figures.
(ii)	n(O₂) = 0.00893 <u>× 0.75</u> (= 0.00670 mol) Allow part(i) <u>× 0.75</u> .
(iii)	M1 = T = 566 K and P = 100 000 Pa If M1 incorrect can only score M2 and M3.
	M2 = Moles NO <sub>2</sub> = 0.0268 (mol) If M2 incorrect can only score M1 and M3. Allow moles of NO <sub>2</sub> = student's answer to part (i) × 3. <b>OR</b> part (ii) × 4 and consequential M4.

Minimum of 2 significant figures.

M3 = V =  $p^{p}$  OR =  $\frac{0.0268 \times 8.31 \times 566}{100\ 000}$ 

If M3 incorrect can only score M1 and M2.



	M4 = $0.00126 \text{ (m}^3) \text{ or } 1.26 \times 10^{-3} \text{ (m}^3)$ Allow minimum of 2 significant figures. Allow no units but incorrect units loses M4. <b>If 0.00642 moles used:</b> M2 = Moles NO <sub>2</sub> = 0.0193 mol.	
	$M3 = V = \frac{p}{p} = \frac{0.0193 \times 8.31 \times 566}{100\ 000}$ M4 = 9.06 × 10 <sup>-4</sup> (m <sup>3</sup> ) allow 9.06 to 9.08 × 10 <sup>-4</sup> .	1
(b)	(Thermal) decomposition Do not allow catalytic decomposition.	1
(c)	Other products are gases / other products escape easily Allow no other solid (or liquid) product.	1 [8]
		[1]

[1]

5.B

6.B