<b>Q1.</b> A s	amp	le of 2.18 g of ox	xygen gas has a volume of 1870 cm³ at a pressure of 101 kF	'a.
		is the temperatuas constant is F	ure of the gas? R = 8.31 J K <sup>-1</sup> mol <sup>-1</sup> .	
Δ	<b>A</b>	167 K	0	
Е	3	334 K	0	
c		668 K	0	
D	)	334 000 K	0	(Total 1 mark
			ntify a Group 2 metal (X), 0.102 g of X reacts with an excess c acid according to the following equation.	of
			$X + 2HCI \longrightarrow XCI_2 + H_2$	
			gen gas given off is 65 cm³ at 99 kPa pressure and 303 K. R = 8.31 J K-¹ mol-¹.	
V	Vhich	n is X?		
Δ	Ą	Barium	0	
В	3	Calcium	0	
C		Magnesium	0	
D	)	Strontium	0	(Total 1 mark
		eated, iron(III) n xygen.	nitrate ( $M_r$ = 241.8) is converted into iron(III) oxide, nitrogen d	ioxide
		4Fe(NO <sub>3</sub> ) <sub>3</sub>	$_3(s) \longrightarrow 2Fe_2O_3(s) + 12NO_2(g) + 3O_2(g)$	
Д	A 2.16	6 g sample of iro	on(III) nitrate was completely converted into the products sho	own.

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Calculate the amount, in moles, of iron(III) nitrate in the 2.16 g sample.

(a)

(i)

	Give your answer to 3 significant figures.	
		(1)
(ii)	Calculate the amount, in moles, of oxygen gas produced in this reaction.	
		(1)
(iii)	Calculate the volume, in m³, of <b>nitrogen dioxide</b> gas at 293 °C and 100 kPa	
	produced from 2.16 g of iron(III) nitrate. The gas constant is $R = 8.31 \text{ JK}^{-1} \text{ mol}^{-1}$ .	
	(If you have been unable to obtain an answer to part (i), you may assume the number of moles of iron(III) nitrate is 0.00642. This is <b>not</b> the correct answer.)	
		(4)
Sug	gest a name for this type of reaction that iron(III) nitrate undergoes.	
		(1)

(b)

4.The metal lead reacts with warm dilute nitric acid to produce lead(II) nitrate, nitrogen monoxide and water according to the following equation.  3Pb(s) + 8HNO₃(aq) → 3Pb(NO₃)₂(aq) + 2NO(g) + 4H₂O(I)  (a) In an experiment, an 8.14 g sample of lead reacted completely with a 2.00 mol dm³ solution of nitric acid.  Calculate the volume, in dm³, of nitric acid required for complete reaction. Give your answer to 3 significant figures	(c)	Assume a complete reaction.	
monoxide and water according to the following equation.  3Pb(s) + 8HNO <sub>3</sub> (aq)		(Total	(1 8 marks
monoxide and water according to the following equation.  3Pb(s) + 8HNO <sub>3</sub> (aq)	.The me	netal lead reacts with warm dilute nitric acid to produce lead(II) nitrate. nitrogen	
(a) In an experiment, an 8.14 g sample of lead reacted completely with a 2.00 mol dm³ solution of nitric acid.  Calculate the volume, in dm³, of nitric acid required for complete reaction. Give your answer to 3 significant figures  (Extra space)			
solution of nitric acid.  Calculate the volume, in dm³, of nitric acid required for complete reaction.  Give your answer to 3 significant figures		$3Pb(s) + 8HNO_3(aq) \longrightarrow 3Pb(NO_3)_2(aq) + 2NO(g) + 4H$	I₂O(I)
Give your answer to 3 significant figures	(a)		<b>n</b> -3
(Extra space)			
(Extra space)			
(Extra space)			
		(Extra space)	
			(3
			(0)
(b) In a second experiment, the nitrogen monoxide gas produced in the reaction			

(b) In a second experiment, the nitrogen monoxide gas produced in the reaction occupied 638 cm³ at 101 kPa and 298 K. Calculate the amount, in moles, of NO gas produced. (The gas constant R = 8.31 J K⁻¹ mol⁻¹)

(Exti	ra space)	
	en lead(II) nitrate is heated it decomposes to form lead(II) oxide, nitrogen oxygen.	dioxide
(i)	Balance the following equation that shows this thermal decomposition.	
	Pb(NO <sub>3</sub> ) <sub>2</sub> (s)	O <sub>2</sub> (g)
(ii)	Suggest <b>one</b> reason why the yield of nitrogen dioxide formed during this reaction is often less than expected.	
(iii)	Suggest <b>one</b> reason why it is difficult to obtain a pure sample of nitroge dioxide from this reaction.	n
	<b>,</b>	otal 9 ma

$B_2O_3(s)$	+	3C(s)	+	3Cl <sub>2</sub> (g)	$\longrightarrow$	2BCl₃(g)	+	3CO(g)	
	The		s prod	duced oc	cupied a			ely with carbon and chlorine. 5000 cm³ at a pressure of 100	
	Give	e your ans	swer to	o 3 signif	icant fig				
	(1116	e gas con	stant i	K = 0.31	J K- MO	IT')			
			• • • • • • • • • • • • • • • • • • • •						
	(Ext	tra space)							
									(5)
									, ,
(b)	Bor	on trichlo	ride ca	an also b	e prepai	red from its	elem	ents.	
		e an equa lain why b				trigonal pla	nar sl	hape with equal bond angles.	
					De «	- C			

Boron trichloride (BCI<sub>3</sub>) can be prepared as shown by the following equation.

Q5.

(a)

	(Ext	ra space)	(3
(c)	(i)	Boron trichloride is easily hydrolysed to form two different acids as shown in the following equation.	
BCl₃(g)	+	3H <sub>2</sub> O(I) H <sub>3</sub> BO <sub>3</sub> (aq) + 3HCI(aq)	
		Calculate the concentration, in mol dm <sup>-3</sup> , of hydrochloric acid produced when 43.2 g of boron trichloride are added to water to form 500 cm <sup>3</sup> of solution. Give your answer to 3 significant figures.	
			(4
	(ii)	Boric acid $(H_3BO_3)$ can react with sodium hydroxide to form sodium borate and water. Write an equation for this reaction.	
			(*

(d)	Boron trichloride can be reduced by using hydrogen to form pure boron.	
	1	
	$BCI_{3}(g) + 1^{\frac{1}{2}}H_{2}(g) \longrightarrow B(s) + 3HCI(g)$	
	Calculate the percentage atom economy for the formation of boron in this reaction.	
	Apart from changing the reaction conditions, suggest <b>one</b> way a company producing pure boron could increase its profits from this reaction.	
	(Extra space)	
		(3)
(e)	A different compound of boron and chlorine has a relative molecular mass of 163.6	
	and contains 13.2% of boron by mass.	
	Calculate the molecular formula of this compound. Show your working.	
	(Futus angus)	
	(Extra space)	
	(Total 20 r	(4) narks)

	nia is used to make nitric acid (HNO₃) by the Ostwald Process. e reactions occur in this process.	
	Reaction 1 $4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(g)$	
	Reaction 22NO(g) + $O_2(g)$ $\longrightarrow$ 2NO <sub>2</sub> (g)	
	Reaction 3 3NO <sub>2</sub> (g) + H <sub>2</sub> O(I) $\longrightarrow$ 2HNO <sub>3</sub> (aq) + NO(g)	
(a)	In one production run, the gases formed in Reaction 1 occupied a total volume of 4.31 $\rm m^3$ at 25 $^{\circ}{\rm C}$ and 100 kPa.	
	Calculate the amount, in moles, of NO produced. Give your answer to 3 significant figures. (The gas constant $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$ )	
	(Extra space)	
		(4)
(b)	In another production run, 3.00 kg of ammonia gas were used in Reaction 1 and all of the NO gas produced was used to make NO <sub>2</sub> gas in Reaction 2.	
	(i) Calculate the amount, in moles, of ammonia in 3.00 kg.	

	(ii)	Calculate the mass of NO <sub>2</sub> formed from 3.00 kg of ammonia in Reaction <b>2</b> assuming an 80.0% yield.  Give your answer in kilograms.  (If you have been unable to calculate an answer for part (b)(i), you may assume a value of 163 mol. This is <b>not</b> the correct answer.)	
		(Extra space)	
(c)	Con	sider Reaction <b>3</b> in this process.	(3)
(0)	COIL	$3NO_2(g) + H_2O(I) \longrightarrow 2HNO_3(aq) + NO(g)$	
		ulate the concentration of nitric acid produced when 0.543 mol of NO <sub>2</sub> is reacted water and the solution is made up to 250 cm <sup>3</sup> .	
	•••••		
	(Exti	ra space)	

		(2)
(d)	Suggest why a leak of $NO_2$ gas from the Ostwald Process will cause atmospheric pollution.	
		(1)
(e)	Give <b>one</b> reason why excess air is used in the Ostwald Process.	
		(1)
( <b>f</b> )	Ammonia roacto with nitria acid as shown in this equation	
(f)	Ammonia reacts with nitric acid as shown in this equation.  NH <sub>3</sub> + HNO <sub>3</sub> > NH <sub>4</sub> NO <sub>3</sub>	
	Deduce the type of reaction occurring.	
	Boddoo the type of redeficin coodining.	
	(Total 14	(1) marks)