

1.2 Reacting Masses & Volumes

Question Paper

Course	DP IB Chemistry
Section	1. Stoichiometric Relationships
Topic	1.2 Reacting Masses & Volumes
Difficulty	Easy

Time allowed: 50
Score: /38
Percentage: /100

Question 1a

a)

In a firework, solid potassium nitrate, KNO_3 , decomposes to form solid potassium nitrite, KNO_2 , and oxygen, O_2 .

(i)

Write a balanced symbol equation for this reaction.

(ii)

Use section 6 of the data booklet to calculate the amount, in g, of potassium nitrate, KNO_3 , required to make 1.5 g of oxygen. Give your answer to 2 significant figures.

[4 marks]

Question 1b

b)

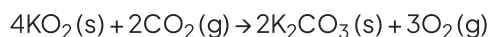
Use section 2 of the data booklet to calculate the volume of gas at STP, in dm^3 , that is produced in the reaction outlined in part (a). Give your answer to 2 significant figures.

[1 mark]

Question 1c

c)

Potassium can form a superoxide, $\text{KO}_2(\text{s})$, which will react with carbon dioxide, $\text{CO}_2(\text{g})$, to produce potassium carbonate, $\text{K}_2\text{CO}_3(\text{s})$ and oxygen, $\text{O}_2(\text{g})$, as shown in the equation below.



(i)

Calculate the amount, in moles, of 5.00 g of potassium superoxide. Give your answer to 3 significant figures

(ii)

Calculate the amount, in moles, and therefore volume, in dm^3 , of carbon dioxide which will react with the superoxide. Give your answer to 3 significant figures.

[3 marks]**Question 1d**

d)

A student calculated that 4.86 g of potassium carbonate, KCO_3 , should be produced during the reaction outlined in part (c), 2.61 g of potassium carbonate, KCO_3 , was produced when the experiment was carried out. Calculate the percentage yield for the production of potassium carbonate. Give your answer to 2 decimal places.

[1 mark]**Question 2a**

A student carried out a series of titration experiments. Their results from their experiments are shown in the table below.

Titration	Rough	1	2	3
Final reading / cm^3	25.45	21.95	43.65	22.10
Initial reading / cm^3	0.00	0.05	21.90	0.10
Titre / cm^3	25.45	21.90	21.75	22.00

a)

Calculate the mean titre using the concordant results. Give your answer to 2 decimal places.

[2 marks]

Question 2b

b)

The student added 0.10 mol dm^{-3} hydrochloric acid, $\text{HCl}(\text{aq})$, to the burette and performed the titration using a 25.00 cm^3 sample of an unknown carbonate solution. The equation for the neutralisation reaction is shown below.



(i)

Using your answer to part (a), calculate the amount, in moles, of hydrochloric acid used. Give your answer to 2 decimal places.

(ii)

Calculate the amount, in moles, of the aqueous carbonate solution. Give your answer to 2 decimal places.

[2 marks]

Question 2c

c)

Using your answer to part (b) (i) determine the concentration in mol dm^{-3} of the aqueous carbonate. Give your answer to 2 decimal places.

[1 mark]

Question 2d

d)

The student used 1.38 g of the unknown carbonate to make up a 250 cm^3 standard solution for the titration outlined in part (a). Using section 6 of the data booklet, prove that the unknown carbonate is potassium carbonate, K_2CO_3 .

Calculate the amount, in moles, of K_2CO_3

Calculate the concentration in, mol dm^{-3} , of K_2CO_3 solution

[4 marks]

Question 3a

a)

3.75 g of zinc oxide, $\text{ZnO}(\text{s})$, was added to 150 cm^3 of 1.00 mol dm^{-3} of sulfuric acid (aq) producing a salt. Write a balanced symbol equation for this reaction.

[1 mark]

Question 3b

b)

Using the equation in part (a) and section 6 of the data booklet, calculate the limiting reagent in the reaction. Give your answer to 2 significant figures.

[3 marks]

Question 3c

c)

Use your answer to part (b) and section 6 of the data booklet to calculate the amount, in grams, of the salt produced. Give your answer to 3 significant figures.

[1 mark]

Question 3d

d)

Calculate the amount, in moles, of the excess reactant left over at the end of the reaction. Give your answer to 2 decimal places.

[1 mark]

Question 4a

A sample of pure magnesium nitrate, $\text{Mg}(\text{NO}_3)_2$, was decomposed by heating as shown in the equation below



A 0.75 g sample of $\text{Mg}(\text{NO}_3)_2$ was completely decomposed by heating.

a)

Calculate the amount, in moles, of magnesium nitrate that was decomposed. Give your answer to 2 decimal places.

[2 marks]

Question 4b

b)

Calculate the total amount, in moles, of gas produced in the reaction. Give your answer to 2 decimal places.

[2 marks]

Question 4c

c)

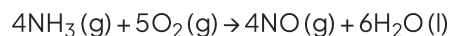
Calculate the total volume, in m^3 , of gas produced at 333 K and 100 kPa.

[2 marks]

Question 5a

a)

90 cm³ ammonia gas, NH₃(g), is combusted in oxygen, O₂(g), to produce nitrogen oxide and water, H₂O(l). What is the total volume of gases remaining when 90 cm³ of ammonia is combusted completely with 50 cm³ of oxygen according to the equation shown?



Deduce the limiting reagent for the combustion of ammonia, 90 cm³ ammonia gas, NH₃(g), is combusted in oxygen.

[1 mark]

Question 5b

b)

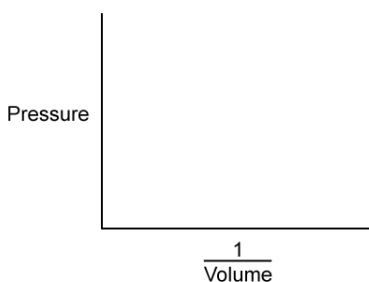
Calculate the total volume, in cm³, of gases remaining for the reaction in part (a).

[4 marks]

Question 5c

c)

Sketch a line on the graph below that shows the correct relationship between pressure and $\frac{1}{\text{volume}}$



[1 mark]

Question 5d

d)

At 25 °C and 100 kPa a gas occupies a volume of 35 dm³. Using the equation $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$, calculate the new temperature, in °C, of the gas if the volume is decreased to 15 dm³ at **constant** pressure.

[2 marks]