

Chemical reactions + calculations involving gases v1.2

Please note. A calculator is required

One mol of gas at STP occupies 22.4L

One mole of gas at NTP occupies 24.4L

For all other conditions use combined gas law



$$\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2}$$

Note use this without the n terms. P = pressure, t = temp V = volume

Q1. Hydrogen reacts with oxygen to produce water (steam).

- Write a balanced chemical equation.
- If 4 mol of oxygen reacts completely with excess hydrogen what number of mol of steam will form?
- What mass of steam is produced?
- What volume of steam should be produced if the product is kept in a gas state?
- What should happen to this volume as the gas mixture cools?

Q2. Oxygen forms when potassium chlorate is decomposed with heat. Potassium chloride is also produced during this decomposition.

- Write a balanced equation for this reaction
- If 245g of potassium chlorate is heated. How many mol of oxygen will form
- What volume of oxygen will form if it is cooled to zero degrees C (STP)

Q3. A student is asked to prepare 250mL of hydrogen gas at NTP. She has access to magnesium ribbon and 1M sulfuric acid solution. How many g of Mg, will be required to produce this amount of gas.

Step1. Write a balanced chemical equation.

Step 2 250mL of gas is equivalent to how many mol? Hint 1 mol = 24400mL of gas

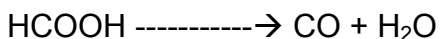
Step 3 Work back and find the mol of Mg required

Step 4 Find the mass of Mg

Q4 In a second experiment 96g of Mg is to be completely dissolved what volume of 1M sulphuric acid is needed.

Hints. Refer to a balanced equation. Find the mol of Mg present. How many mol of acid is required to dissolve? What volume of acid

Q5. Carbon monoxide (toxic) is made by dehydrating methanoic acid HCOOH. in the presence of concentrated sulphuric acid. The balanced equation is



23g of methanoic acid is dehydrated with sulphuric acid.

- What volume of CO is produced at NTP
- Use the combined gas law to find the volume of CO that will form if the temperature is increased to 80 degrees C. The pressure remains at 1 atm (atmosphere)

Hints remove n_1 n_2 $p_1 + p_2$ from the equation at the top of page. V_1 will be the volume of CO at NTP, T_1 will be 25C, T_2 will be 80C Rearrange the equation to find V_2 . V_2 will be greater than V_1

Q6. Sulphur dioxide forms when hydrochloric acid is added to sodium sulphite Na_2SO_3 . The other products are sodium chloride + water

- Write a balanced chemical equation
- What volume of sulphur dioxide forms if 4.5g of sulphite is completely reacted with hydrochloric acid at NTP Assume that none of the gas dissolves in water.
- Sulphur dioxide is toxic when it reaches 6 parts per million ppm

What is the minimum volume of SO_2 needed to make the air in a room (volume 75 cubic metres) toxic.....An interesting question.

Q7 When I was at school my chemistry teacher accidentally smashed a full bottle of Silicon tetrachloride SiCl_4 . This caused chaos as the whole lab filled with white hydrochloric acid fumes as the silicon tetrachloride reacted with water vapour in the air. Assuming that 500g of silicon tetrachloride reacted completely what volume of acid gas filled our science lab. (and NTP conditions)

PS One student Richard needed to be rushed to hospital with breathing difficulties. He was locked in the lab briefly by mistake. The SiCl_4 molecule is shown here

