Moles and gas volumes

AQA 8462 Separate Chemistry · Higher

Show your working and give units. RTP means room temperature and pressure.

Name _____ Date _____

1. Oxygen at RTP

A sample contains 0.350 mol of oxygen gas at RTP. Calculate its volume in dm^3. The molar gas volume at RTP is 24 dm^3 mol^{-1}.

2. A gas syringe reading

A syringe holds 180 cm^3 of hydrogen at RTP. Calculate the amount of hydrogen in moles. The molar gas volume at RTP is 24 dm^3 mol^{-1}.

3. Compare two gas samples

Cylinder A contains 16.0 g of oxygen, O_2. Cylinder B contains 14.0 g of nitrogen, N_2. Both gases are at the same temperature and pressure. Compare their volumes and explain your answer. $M_r(O_2) = 32.0$ and $M_r(N_2) = 28.0$.

Scan to try fresh questions online

Try a core or harder question. Use clues and worked answers.

gcse.chemistryhelp.co.uk/worksheets/aqa-molar-gas-volumes/

Moles and gas volumes

AQA 8462 Separate Chemistry · Higher

4. Aluminium and acid

2.70 g of aluminium reacts completely with excess hydrochloric acid. Calculate the volume of hydrogen formed at RTP in dm^3. $A_r(Al) = 27.0$. The molar gas volume at RTP is 24 $dm^3\ mol^{-1}$.

$2Al(s) + 6HCl(aq) \rightarrow 2AlCl_3(aq) + 3H_2(g)$

5. Find the mass of a metal

Pure zinc reacts completely with excess hydrochloric acid, producing 360 cm^3 of hydrogen at RTP. Calculate the mass of zinc used. $A_r(Zn) = 65.4$. Molar gas volume at RTP = 24 000 $cm^3\ mol^{-1}$.

$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$

6. Volumes in a gas mixture

36 cm^3 of CO burns completely in 25 cm^3 of O_2. All gas volumes are measured at the same temperature and pressure. Calculate the total gas volume after the reaction.

$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$

Scan to try fresh questions online

Try a core or harder question. Use clues and worked answers.

gcse.chemistryhelp.co.uk/worksheets/aqa-molar-gas-volumes/

Moles and gas volumes

AQA 8462 Separate Chemistry · Higher

7. The composition of limestone

3.50 g of limestone reacts with excess acid. Only $CaCO_3$ produces gas. All the CO_2 is collected and occupies 660 cm^3 at RTP. Calculate the percentage by mass of $CaCO_3$.

One mole of $CaCO_3$ produces one mole of CO_2. $M_r(CaCO_3) = 100$. Molar gas volume at RTP = 24 000 $cm^3\ mol^{-1}$.

8. Gases above room temperature

84 cm^3 of O_2 reacts completely with excess SO_2. All gas volumes are measured at 450 °C and the same pressure. Calculate the volume of SO_3 formed. Can you use 24 000 $cm^3\ mol^{-1}$ to calculate the amount of O_2? Explain.

$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

9. Extra challenge · Check a sample and its acid demand (Higher)

A limestone sample of mass 2.80 g gives 480 cm^3 CO_2 at RTP with excess HCl. The only gas source is $CaCO_3$. Calculate its percentage by mass, then find the minimum amount of HCl needed to react with that $CaCO_3$. $M_r(CaCO_3) = 100$. Use 24 000 $cm^3\ mol^{-1}$ at RTP.

$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$

Scan to try fresh questions online

Try a core or harder question. Use clues and worked answers.

gcse.chemistryhelp.co.uk/worksheets/aqa-molar-gas-volumes/

Worked answers

Moles and gas volumes · AQA 8462 Separate Chemistry · Higher

1. Oxygen at RTP

Volume = amount × molar volume = 0.350 × 24 = 8.40 dm^3.

2. A gas syringe reading

180 cm^3 = 0.180 dm^3. Amount = volume ÷ molar volume = 0.180 ÷ 24 = 0.00750 mol.

3. Compare two gas samples

A contains 16.0 ÷ 32.0 = 0.500 mol. B contains 14.0 ÷ 28.0 = 0.500 mol. Equal amounts of gas occupy the same volume at the same temperature and pressure, so the samples have equal volumes.

4. Aluminium and acid

Amount of Al = 2.70 ÷ 27.0 = 0.100 mol. The equation gives three moles of H_2 for every two moles of Al. Amount of H_2 = 0.100 × 3 ÷ 2 = 0.150 mol. Volume = 0.150 × 24 = 3.60 dm^3.

5. Find the mass of a metal

Amount of H_2 = 360 ÷ 24 000 = 0.0150 mol. The Zn to H_2 mole ratio is 1 to 1, so 0.0150 mol of Zn reacted. Mass = 0.0150 × 65.4 = 0.981 g.

Scan to try fresh questions online

Try a core or harder question. Use clues and worked answers.

gcse.chemistryhelp.co.uk/worksheets/aqa-molar-gas-volumes/

Worked answers

Moles and gas volumes · AQA 8462 Separate Chemistry · Higher

6. Volumes in a gas mixture

At the same temperature and pressure, the mole ratio also gives the volume ratio. The 36 cm^3 of CO requires 18 cm^3 of O_2 and produces 36 cm^3 of CO_2. This leaves 25 − 18 = 7 cm^3 of O_2. Total gas volume = 36 + 7 = 43 cm^3.

7. The composition of limestone

Amount of CO_2 = 660 ÷ 24 000 = 0.0275 mol. The same amount of $CaCO_3$ reacted, so its mass was 0.0275 × 100 = 2.75 g.

Percentage by mass = (2.75 ÷ 3.50) × 100 = 78.6% to three significant figures.

8. Gases above room temperature

The equation gives two volumes of SO_3 for each volume of O_2 at the same conditions. The volume of SO_3 is 2 × 84 = 168 cm^3.

The value 24 000 cm^3 mol^{-1} is for RTP. A gas's molar volume depends on its temperature and pressure. The ratio still works here because all gases are measured at the same conditions.

9. Extra challenge · Check a sample and its acid demand (Higher)

CO_2 amount = 480 ÷ 24 000 = 0.0200 mol, so the sample contains 0.0200 mol $CaCO_3$. Its mass is 2.00 g and its percentage is 2.00 ÷ 2.80 × 100 = 71.4%.

Two moles of HCl react with each mole of $CaCO_3$, so the minimum amount of HCl is 0.0400 mol.

Scan to try fresh questions online

Try a core or harder question. Use clues and worked answers.

gcse.chemistryhelp.co.uk/worksheets/aqa-molar-gas-volumes/