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 $M_r(N_2) = 28.0$.

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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.

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

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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.

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

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