

Triple - Chemistry - Key Stage 4

Quantitative Chemistry

# Volumes of gases

Mrs. Begum



# Periodic Table of Elements

Key:

relative atomic mass →

Name →

Atomic symbol

Atomic (proton number)

1 <b>H</b> hydrogen 1																	4 <b>He</b> helium 2
7 <b>Li</b> lithium 3	9 <b>Be</b> beryllium 4											11 <b>B</b> boron 5	12 <b>C</b> carbon 6	14 <b>N</b> nitrogen 7	16 <b>O</b> oxygen 8	19 <b>F</b> fluorine 9	20 <b>Ne</b> neon 10
23 <b>Na</b> sodium 11	24 <b>Mg</b> magnesium 12											27 <b>Al</b> aluminium 13	28 <b>Si</b> silicon 14	31 <b>P</b> phosphorus 15	32 <b>S</b> sulfur 16	35.5 <b>Cl</b> chlorine 17	40 <b>Ar</b> argon 18
39 <b>K</b> potassium 19	40 <b>Ca</b> calcium 20	45 <b>Sc</b> scandium 21	48 <b>Ti</b> titanium 22	51 <b>V</b> vanadium 23	52 <b>Cr</b> chromium 24	55 <b>Mn</b> manganese 25	56 <b>Fe</b> iron 26	59 <b>Co</b> cobalt 27	59 <b>Ni</b> nickel 28	63.5 <b>Cu</b> copper 29	65 <b>Zn</b> zinc 30	70 <b>Ga</b> gallium 31	73 <b>Ge</b> germanium 32	75 <b>As</b> arsenic 33	79 <b>Se</b> selenium 34	80 <b>Br</b> bromine 35	84 <b>Kr</b> krypton 36
85 <b>Rb</b> rubidium 37	88 <b>Sr</b> strontium 38	89 <b>Y</b> yttrium 39	91 <b>Zr</b> zirconium 40	93 <b>Nb</b> niobium 41	96 <b>Mo</b> molybdenum 42	[97] <b>Tc</b> technetium 43	101 <b>Ru</b> ruthenium 44	103 <b>Rh</b> rhodium 45	106 <b>Pd</b> palladium 46	108 <b>Ag</b> silver 47	112 <b>Cd</b> cadmium 48	115 <b>In</b> indium 49	119 <b>Sn</b> tin 50	122 <b>Sb</b> antimony 51	128 <b>Te</b> tellurium 52	127 <b>I</b> iodine 53	131 <b>Xe</b> xenon 54
133 <b>Cs</b> caesium 55	137 <b>Ba</b> barium 56	139 <b>La*</b> lanthanum 57	178 <b>Hf</b> hafnium 72	181 <b>Ta</b> tantalum 73	184 <b>W</b> tungsten 74	186 <b>Re</b> rhenium 75	190 <b>Os</b> osmium 76	192 <b>Ir</b> iridium 77	195 <b>Pt</b> platinum 78	197 <b>Au</b> gold 79	201 <b>Hg</b> mercury 80	204 <b>Tl</b> thallium 81	207 <b>Pb</b> lead 82	209 <b>Bi</b> bismuth 83	[209] <b>Po</b> polonium 84	[210] <b>At</b> astatine 85	[222] <b>Rn</b> radon 86
[223] <b>Fr</b> francium 87	[226] <b>Ra</b> radium 88	[227] <b>Ac*</b> actinium 89	[267] <b>Rf</b> rutherfordium 104	[270] <b>Db</b> dubnium 105	[269] <b>Sg</b> seaborgium 106	[270] <b>Bh</b> bohrium 107	[270] <b>Hs</b> hassium 108	[278] <b>Mt</b> meitnerium 109	[281] <b>Ds</b> darmstadtium 110	[281] <b>Rg</b> roentgenium 87	[285] <b>Cn</b> copernicium 112	[286] <b>Nh</b> nihonium 113	[289] <b>Fl</b> flerovium 114	[289] <b>Mc</b> moscovium 115	[293] <b>Lv</b> livermorium 116	[293] <b>Ts</b> tennessine 117	[294] <b>Og</b> oganesson 118

\* The lanthanides (atomic numbers 58 - 71) and the Actinides (atomic numbers 90 - 103) have been omitted.

Relative atomic masses for **Cu** and **Cl** have not been rounded to the nearest whole number.



# Task 1

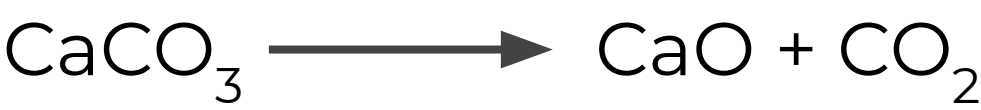
Calculate the volume of gas in:

1. 4 g of  $\text{H}_2$
2. 8 g of  $\text{CH}_4$
3. 3.55 g of  $\text{Cl}_2$
4. 0.002 g of He
5. 8.8 g of  $\text{CO}_2$
6. 2 g of Ar
7. 1 g of  $\text{N}_2$
8. 16 g of  $\text{O}_2$



# Task 2

1. What volume of carbon dioxide is produced when 125 g of calcium carbonate is thermally decomposed?

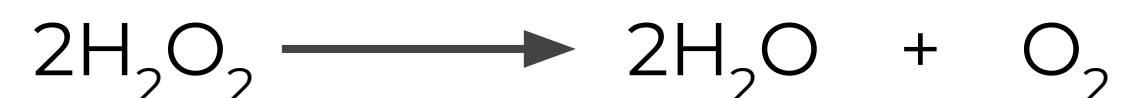


Balance symbol equation	
Calculate $M_r$ of $\text{CaCO}_3$	
Moles of $\text{CaCO}_3$	
Work out the ratio	
Calculate the volume of carbon dioxide	



# Task 3

1. What volume of oxygen is produced when 0.34 g hydrogen peroxide is left to decompose?



2. What volume of nitrogen is needed to produce 6.8 g of ammonia?



3. What volume of chlorine is needed to produce 4.68 g sodium chloride?



4. What volume of oxygen is required to produce 2 g sodium oxide? Answer in  $\text{cm}^3$ .



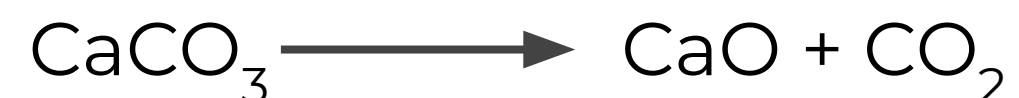
# Task 1 answers

1. 4 g of  $\text{H}_2$ . **moles =  $4/2 = 2$ . Volume =  $2 \times 24 = 48 \text{ dm}^3$**
2. 8 g of  $\text{CH}_4$ . **moles =  $8/16 = 0.5$ . Volume =  $0.5 \times 24 = 12 \text{ dm}^3$**
3. 3.55 g of  $\text{Cl}_2$ . **moles =  $3.55/71 = 0.05$ . Volume =  $0.05 \times 24 = 1.2 \text{ dm}^3$**
4. 0.002 g of He. **moles =  $0.002/2 = 0.001$ . Volume =  $0.001 \times 24 = 0.024 \text{ dm}^3$**
5. 8.8 g of  $\text{CO}_2$ . **moles =  $8.8/44 = 0.2$  Volume =  $0.2 \times 24 = 4.8 \text{ dm}^3$**
6. 2 g of Ar. **moles =  $2/40 = 0.05$  Volume =  $0.05 \times 24 = 1.2 \text{ dm}^3$**
7. 1 g of  $\text{N}_2$ . **moles =  $1/28 = 0.036$ . Volume =  $0.036 \times 24 = 0.86 \text{ dm}^3$**
8. 16g of  $\text{O}_2$ . **moles =  $16/32 = 0.5$  Volume =  $0.5 \times 24 = 12 \text{ dm}^3$**



## Task 2 answers

1. What volume of carbon dioxide is produced when 125 g of calcium carbonate is thermally decomposed?

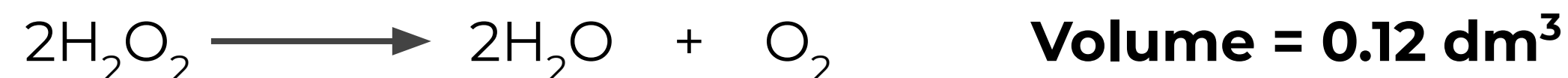


Balance symbol equation	<b><math>\text{CaCO}_3 \longrightarrow \text{CaO} + \text{CO}_2</math></b>
Calculate $M_r$ of $\text{CaCO}_3$	<b><math>\text{CaCO}_3 = 100</math></b>
Moles of $\text{CaCO}_3$	<b><math>125 / 100 = 1.25</math></b>
Work out the ratio	<b>Ratio 1 : 1      Moles of <math>\text{CO}_2 = 1.25</math></b>
Calculate the volume of carbon dioxide	<b>Volume = <math>1.25 \times 24 = 30 \text{ dm}^3</math></b>

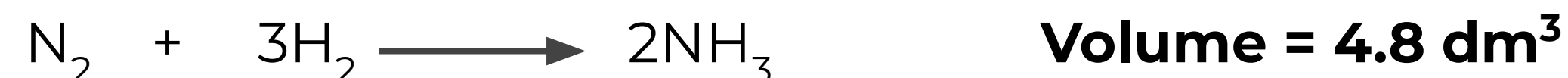


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