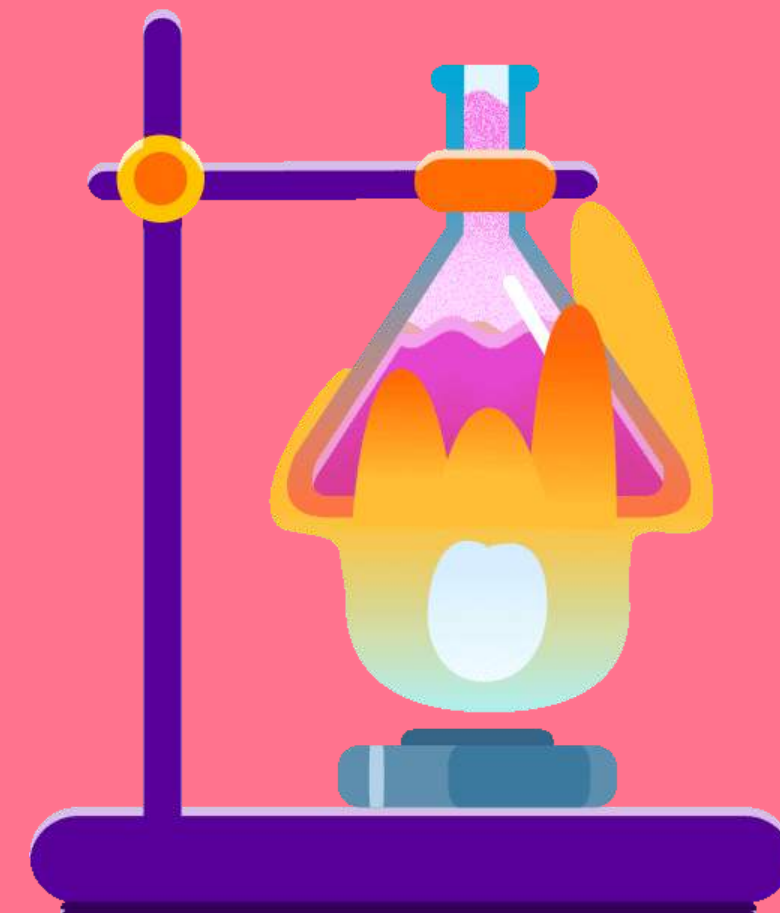
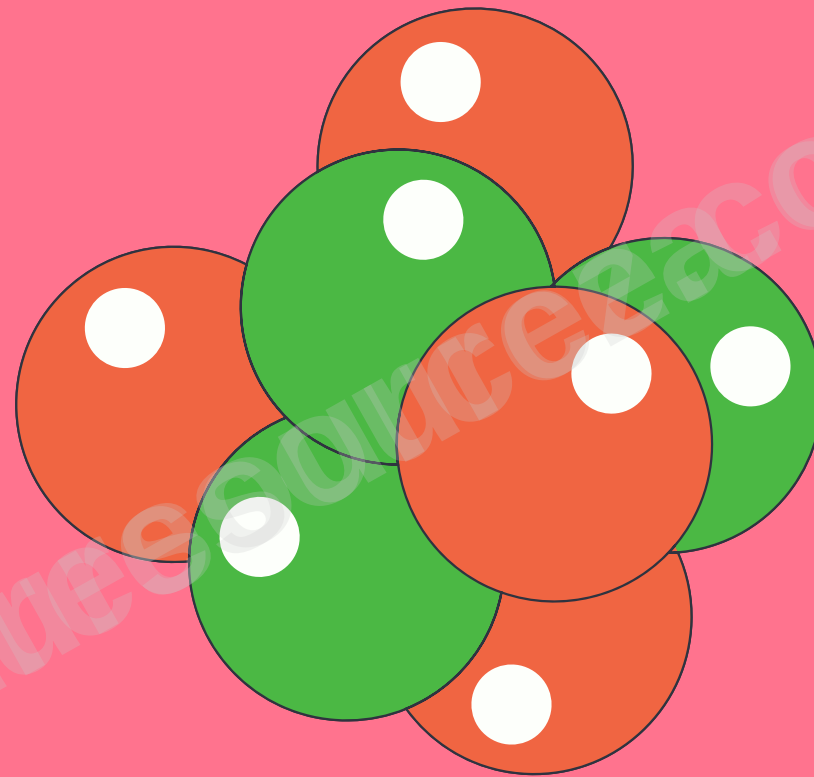




0654 The Mole



IGCSE
SCIENCES CO-ORDINATED



The Mole?



Definition

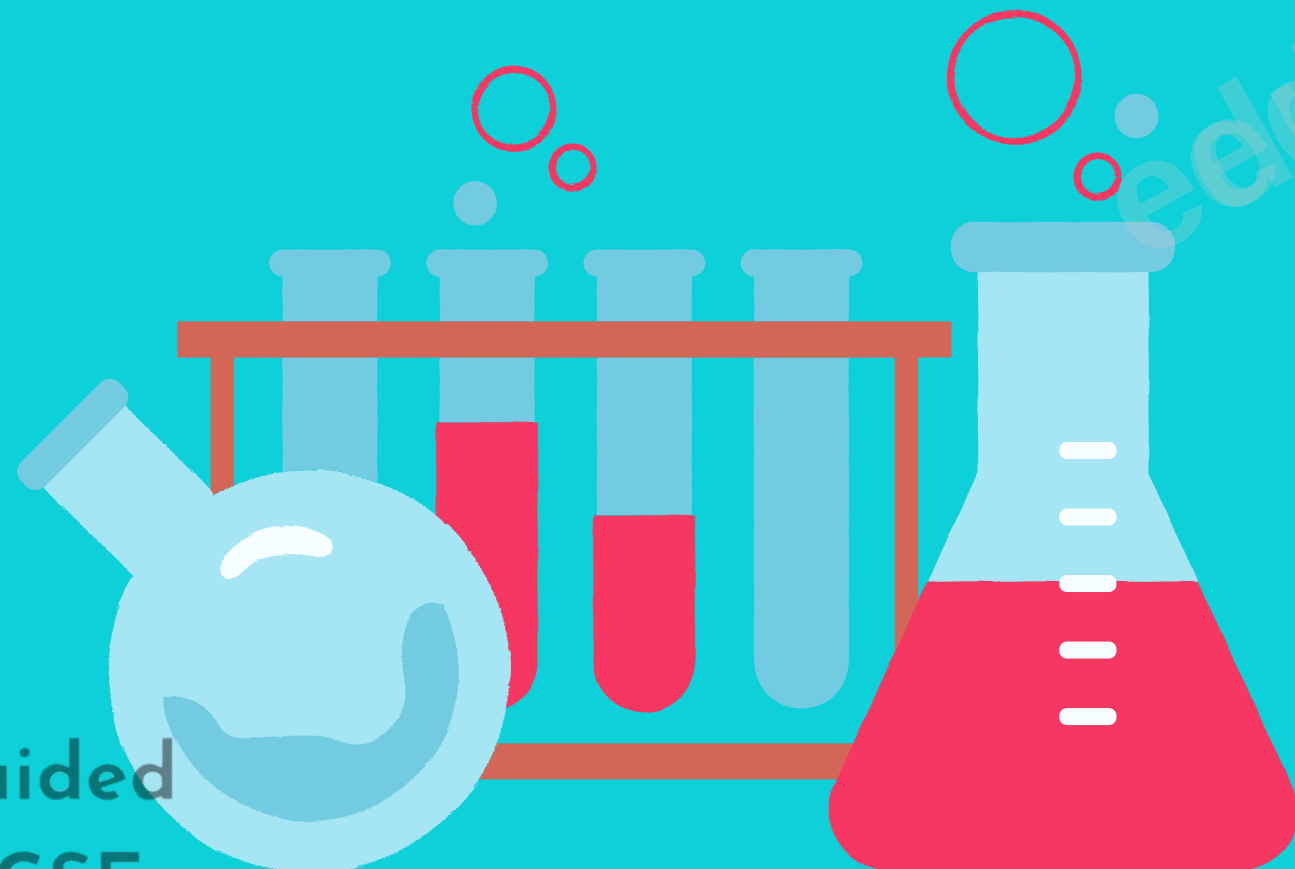
$$6.02 \cdot 10^{23}$$

The number of particles in one mole of a substance

units: mol^{-1}

A mole is the amount of a substance that contains the Avogadro number of particles

atoms, ions, molecules



Clarity

A mole: the mass of the substance that contains as many particles as there are in 12 grams of Carbon 12

Example:

24 grams of Mg contains as many particles as 12 grams of C 12



	III	IV	V	VI	VII
	5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19
	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5
	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79
	48 Cd cadmium	49 In indium	50 Sn tin	51 Sb antimony	52 Te tellurium
					53 I iodine

Connections

A mole: the mass of the substance that contains as many particles as there are in 12 grams of Carbon 12

1 mol of any substance has the Avogadro number of particles

Using formula:

$$\text{moles}(n) = \frac{\text{mass}(m)}{\text{molar mass}(M)}$$

$$\text{moles of Mg} = \frac{24\text{g}}{24\text{g mol}^{-1}}$$

$$\text{moles of C} = \frac{12\text{g}}{12\text{g mol}^{-1}}$$

Both equal to 1 mol.

This means that 1 mol of Mg and 1 mol of C contain 6.02×10^{23} particles (atoms)

Formulas

Molar mass is the relative atomic mass or the relative molecular mass, expressed in grams.

$$\text{moles}(n) = \frac{\text{mass}(m)}{\text{molar mass}(M)}$$

$$\text{moles}(n) = \frac{\text{volume}(v)(dm^3)}{\text{volume at rtp}(v_r)(24dm^3)}$$

$$\text{moles}(n) = \text{volume}(dm^3) \cdot \text{concentration}(mol\ dm^{-3})$$

Practice

eduresourceza.com

Fig. 1.2 shows a small piece of sodium reacting with ethanol to form hydrogen gas at 25 °C.

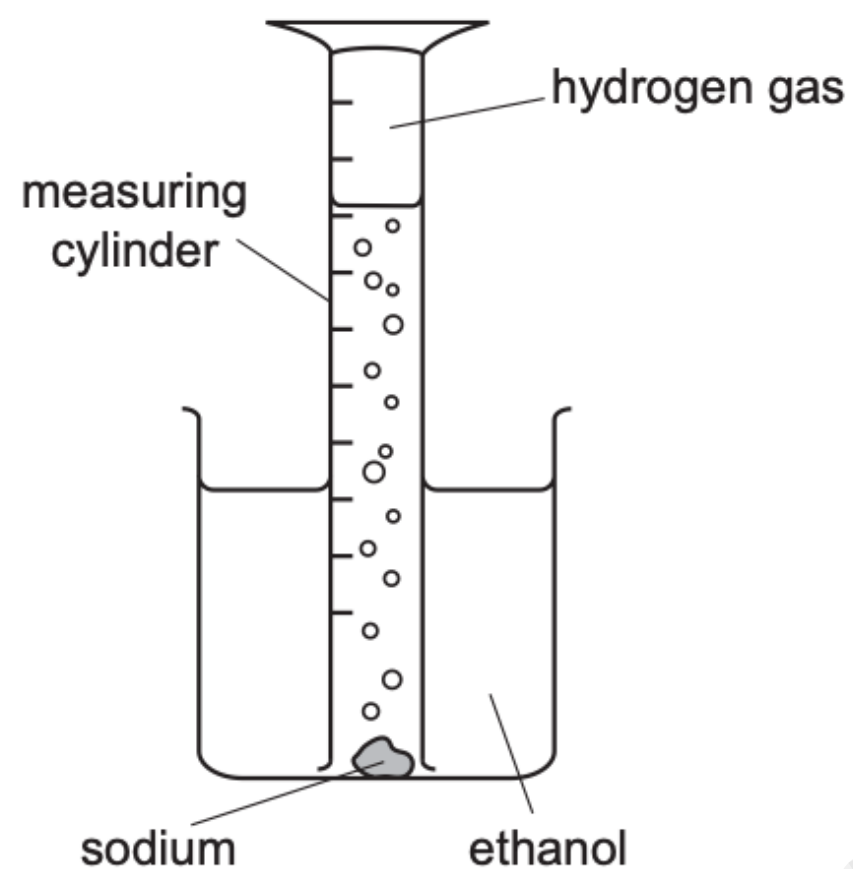


Fig. 1.2

- (i) The total volume of hydrogen gas produced by the reaction is 8.4 cm^3 .

Calculate the number of moles of hydrogen gas in 8.4 cm^3 .

The molar gas volume at 25 °C is 24 dm^3 .

Show your working.

Specimen 2019 Paper 4

Fig. 1.2 shows a small piece of sodium reacting with ethanol to form hydrogen gas at 25 °C.

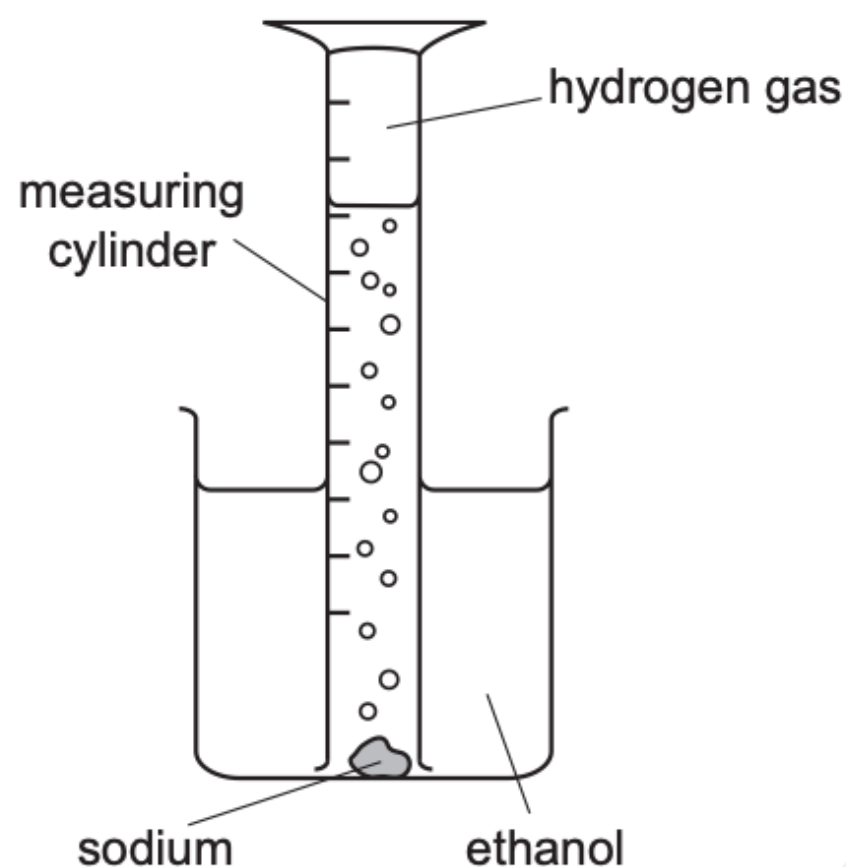


Fig. 1.2

- (i) The total volume of hydrogen gas produced by the reaction is 8.4 cm³.

Calculate the number of moles of hydrogen gas in 8.4 cm³.

The molar gas volume at 25 °C is 24 dm³.

Show your working.

conversion of cm³ to dm³

$$1 \text{ dm}^3 = 1000 \text{ cm}^3$$

$$x \text{ dm}^3 = 8.4 \text{ cm}^3$$

$$x = 8.4 \cdot 10^{-3} \text{ dm}^3$$

$$\text{by moles} = \frac{v}{v_r}; \text{ moles} = \frac{8.4 \cdot 10^{-3}}{24}$$

$$\text{moles of hydrogen gas} = 3.5 \cdot 10^{-4}$$

Specimen 2019 Paper 4

Fig. 5.2 shows a camping stove which uses ethanol as the fuel.

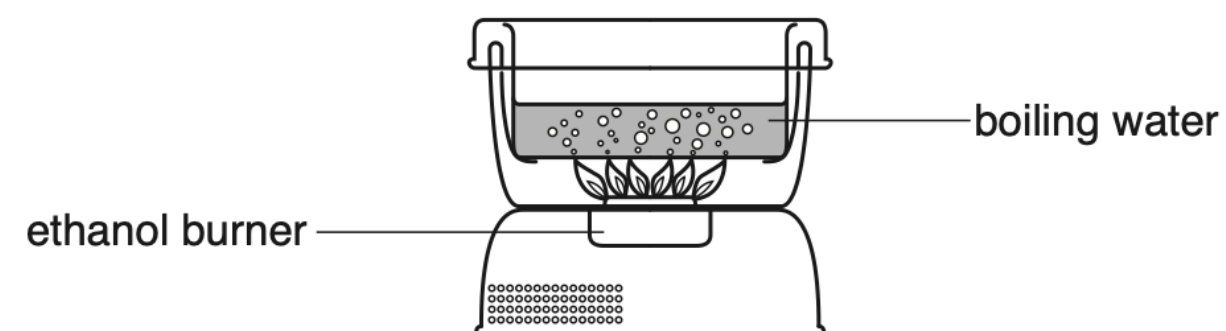
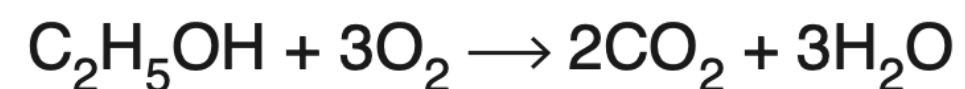


Fig. 5.2

Complete combustion of ethanol produces carbon dioxide and water.

The balanced equation for this reaction is shown.



The stove uses 22 g of ethanol to boil 1 dm³ of water.

- (i) Complete steps 1 to 3 to calculate the maximum mass of carbon dioxide produced when boiling 1 dm³ of water.

Show your working.

[M_r: carbon dioxide, 44; ethanol, 46]

Step 1

Calculate the number of moles in 22 g of ethanol.

Fig. 5.2 shows a camping stove which uses ethanol as the fuel.

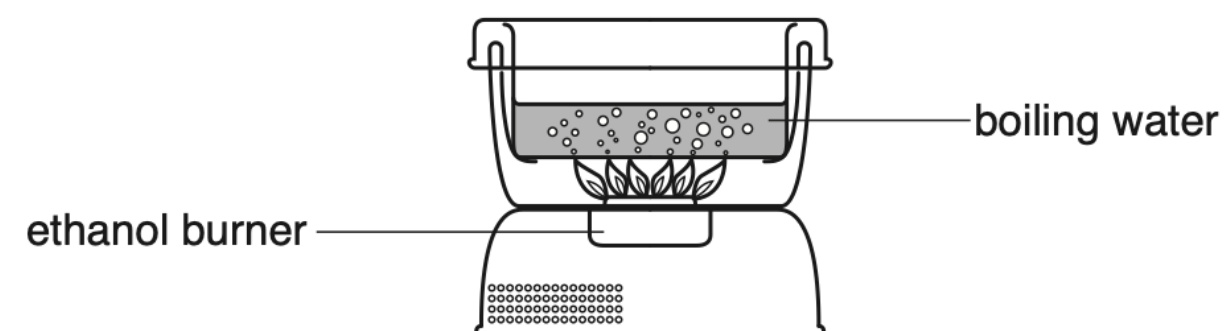
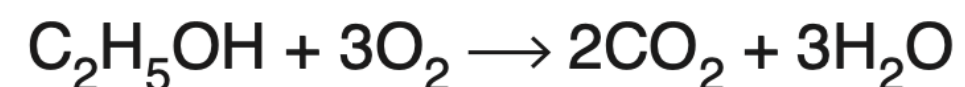


Fig. 5.2

Complete combustion of ethanol produces carbon dioxide and water.

The balanced equation for this reaction is shown.



The stove uses 22 g of ethanol to boil 1 dm³ of water.

- (i) Complete steps 1 to 3 to calculate the maximum mass of carbon dioxide produced when boiling 1 dm³ of water.

Show your working.

[M_r: carbon dioxide, 44; ethanol, 46]

Step 1

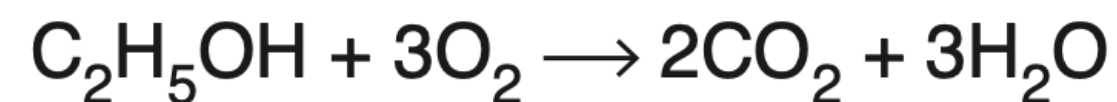
Calculate the number of moles in 22 g of ethanol.

by moles = $\frac{\text{mass}}{\text{molar mass}}$, moles of ethanol can be calculated:

$$\text{moles of ethanol} = \frac{22}{46}; \text{moles of ethanol} = 0.4782$$

Continued

Step 2



Calculate the number of moles of carbon dioxide produced when 22 g of ethanol burns.

ratio of ethanol to carbon dioxide is 1:2;

so moles of carbon dioxide is double the moles of ethanol;

2×0.478

number of moles = 0.956

Mole ratio is such that the mole of one particle is compared to that of another on the basis of the ratio of their molecule count in the balanced equation.

Use the mole ratio when the mass or volume of the substance, whose details need to be found, is not given.

Continued

Step 3

Calculate the mass of carbon dioxide produced when boiling 1 dm³ of water.

mass = ... g
[3]

eduresourceza.com

Step 3

Calculate the mass of carbon dioxide produced when boiling 1 dm³ of water.

mass = ... g
[3]

Rearranging the equation $\text{moles} = \frac{\text{mass}}{\text{molar mass}}$ to obtain $\text{mass} = \text{moles} \cdot \text{molar mass}$

Substituting moles and molar mass of CO₂ : $0.956 \cdot (12 + 2(16)) = 42.064$

mass = 42.1g

**Hope you learnt
the mole concept!**