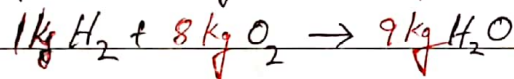
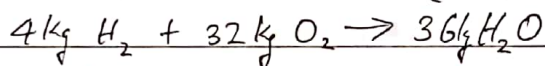
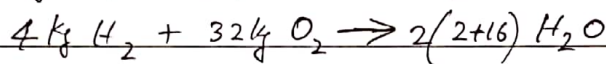


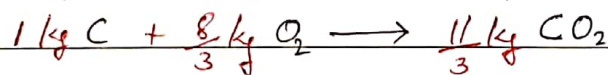
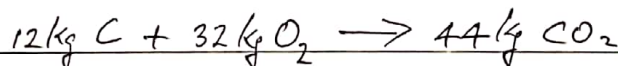
Combustion of Fuels.

		Molecular weight
Carbon	C	12
Oxygen	O ₂	32
Hydrogen	H ₂	2
Nitrogen	N ₂	28
Sulphur	S	32

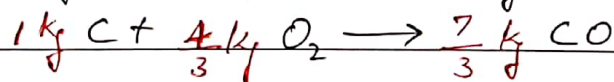
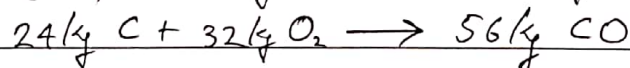
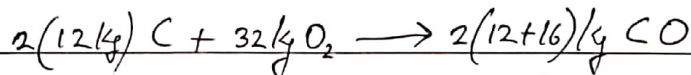
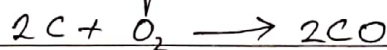
1) Combustion of Hydrogen



2) Complete Combustion of Carbon



3) Partial/Incomplete Combustion of Carbon



Constituents of Air

$$\frac{23}{100} \text{ kg } O_2 + \frac{77}{100} \text{ kg } N_2 = 1 \text{ kg air}$$

By weight $N_2 = 77\%$
 $O_2 = 23\%$

$$\frac{100}{23} \left(\frac{23}{100} \text{ kg } O_2 + \frac{77}{100} \text{ kg } N_2 \right) = \frac{100}{23} \text{ kg air}$$

$$1 \text{ kg } O_2 + \frac{77}{23} \text{ kg } N_2 = \frac{100}{23} \text{ kg air}$$

$\therefore 1 \text{ kg } O_2$ is accompanied by $\frac{77}{23} \text{ kg } N_2$

Stoichiometric quantity of air is that quantity which is required for complete combustion of 1 kg of fuel without any oxygen appearing in the products of combustion

Excess air \rightarrow common practice to use 25% - 50% excess air.

Weight of air required for given requirement of O_2

for $x \text{ kg } O_2 \rightarrow y \text{ kg air}$

$1 \text{ kg } O_2 \rightarrow \frac{100}{23} \text{ kg air}$

$$\text{air required} = x \times \frac{100}{23} \text{ kg}$$

Example:

The percentage composition of sample of liquid fuel by weight is C = 84.8% and $H_2 = 15.2\%$. Calculate i) Weight of air needed for complete combustion of 1 kg fuel. ii) The volumetric composition of products of combustion if 15% excess air is supplied

Element	Weight (kg)	O_2 required	Products
C	84.8% 0.848	$0.848 \times \frac{8}{3} = 2.261$	$CO_2 \rightarrow 0.848 \times \frac{11}{3} = 3.109 \text{ kg}$
H_2	15.2% 0.152	$0.152 \times 8 = 1.216$	$H_2O \rightarrow 0.152 \times 9 = 1.368 \text{ kg} \uparrow$
Total O_2 required = 3.477			

i) Weight of air required for combustion = $3.477 \times \frac{100}{23} = 15.11 \text{ kg}$

Excess air supplied = 15%

$$= \frac{15.11 \times 15}{100} = 2.266 \text{ kg excess air}$$

$$\text{Weight of } O_2 \text{ in excess air} = 2.266 \times \frac{23}{100} = 0.521 \text{ kg}$$

$$\begin{aligned} \text{Total air supplied for combustion} &= \text{Minimum air required} + \text{Excess air} \\ &= 15.11 + 2.266 = 17.376 \text{ kg} \end{aligned}$$

$$\text{Weight of Nitrogen } N_2 \text{ in flue gases} = 17.376 \times \frac{77}{100} = 13.38 \text{ kg}$$

ii)	Weight	Molecular weight	Proportional Vol = $\frac{WF}{Mol wt}$	Percentage vol = $\frac{\text{Proportional}}{\text{total vol}}$
CO_2	3.109	44	0.07	12.43%
O_2	0.521	32	0.016	2.84%
N_2	13.38	28	0.477	84.72%
H_2O				
			$\Sigma \text{ vol} = 0.563$	

Normally volumetric analysis is done on dry basis, yielding the volume percentage of all products except water vapour. This allows a simple method of determining the actual air-fuel ratio and excess air used in a combustion process.