

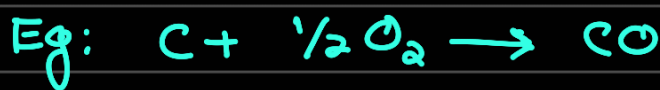
Day - 2

- If state not mentioned in quesⁿ, assume gaseous state.
- Stoichiometric air-fuel mixture:

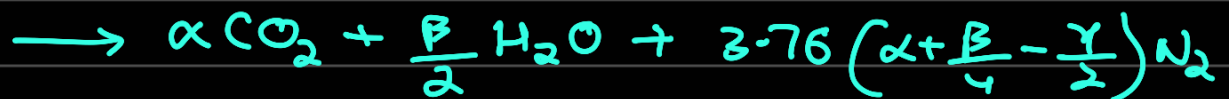
Fuel and oxidiser are in proportion, such that after complete combustion, all fuel and oxidiser are consumed and ??

↓

$\text{CO}_2, \text{H}_2\text{O} \leftarrow$ { the products should have highest -ve $\Delta H_{\text{formation}}$ and no other products in addition to these should be formed



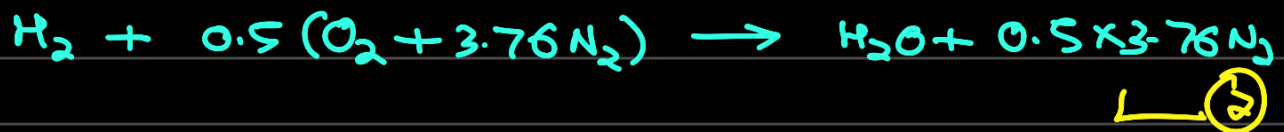
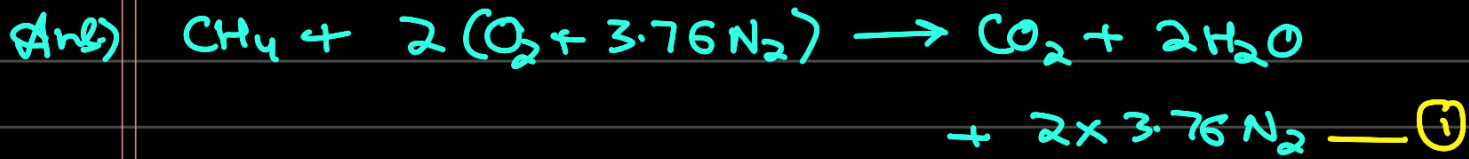
} Not stoichiometric



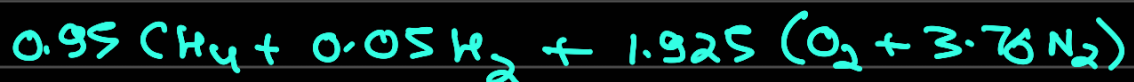
$$\text{so } a = \alpha + \frac{\beta}{4} - \frac{\gamma}{2}$$

→ Air-fuel ratio (A/F)

$$\frac{A}{F} = \frac{m_{\text{air}}}{m_{\text{fuel}}} = \frac{4.76 \times M_{\text{air}} \times a}{1 \times M_{\text{fuel}}}$$



$0.95 \times \text{(1)} + 0.05 \times \text{(2)}$ gives

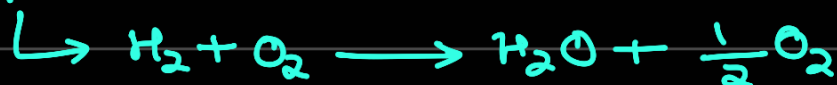


• Equivalence ratio (ϕ)

$$= \frac{(\text{Fuel-air ratio})_{\text{actual}}}{(\text{Fuel-air ratio})_{\text{stoich}}} \quad \text{Inverse of air-fuel ratio}$$

$\phi = 1 \rightarrow$ stoichiometric mixture

$\phi < 1 \rightarrow$ lean-mixture (excess air)



$\phi > 1 \rightarrow$ Rich - mixture



• Excess air ratio (λ)

$$\lambda = \frac{1}{\phi} = \frac{(A/F)_{\text{actual}}}{(A/F)_{\text{stoich}}}$$

→ iso-octane + air in stoich. ratio

(a) x_{fuel} (b) F/A (c) x_{water} in products

(d) Temp. of prod. below which H_2O vap. condenses at 1 atm pressure.

Ans) a) $a = \alpha + \frac{\beta}{4} - \frac{\gamma}{2} = 8 + \frac{18}{4} = 12.5$
(C_8H_{18})

$$x_{\text{fuel}} = \frac{1}{1 + 12.5 \times 4.76} = 0.0165$$

b) $F/A = \frac{1 \times 114}{12.5 \times 4.76 \times 29} = 0.066$

c) $x_{\text{water}} = \frac{9}{8 + 9 + 12.5 \times 3.76}$
 $= 0.141$

d) $p_{\text{water}} = 101.325 \times 0.14$
 $= 14.287 \text{ kPa}$
 $= 0.14287 \text{ bar}$

so $T \sim 53^\circ\text{C}$

(Book: S.R. Turns → Intro to Combustion)