EV20001

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ASSIGNMENT – II

Q1)

(a) We have,

$$4C_3H_5 + 17O_2 \rightarrow 12CO_2 + 10H_2O$$

Global energy = 300×10^{15} kJ

Amount of C_3H_5 used

$$= \frac{300 \times 10^{15}}{40000}$$

$$= 7.5 \times 10^{12} \text{ kg}$$

∴ Amount of CO_2 = $7.5 \times 10^{12} \times \frac{12}{4} \times \frac{44}{41}$

$$= 24.146 \times 10^{12} \text{ kg}$$

∴ Amount of CO_2 released

$$= \underline{\underline{24.146 \times 10^{12} \text{ kg}}}$$

(b) Weight of air $= 5 \times 10^{18}$ kg

Molecular weight of air $= 29$ kg/kg mol

$$CO_2 \text{ concentration (in ppm) by weight} = \frac{\text{Amount of } CO_2}{\text{weight of air}} \times 10^6$$

$$= \frac{24.146 \times 10^{12} \times 10^6}{5 \times 10^{18}}$$

$$= 4.83 \text{ ppm by weight}$$

$$CO_2 \text{ concentration} = 4.83 \times \frac{\text{mol. wt of air}}{\text{mol. wt of } CO_2}$$

$$= 4.83 \times \frac{29}{44}$$

$$\cong 3.18 \text{ ppm by volume}$$

Q2)

(i) We have,

$\Delta T = 2K$

$\Delta F - \lambda \Delta T = k \Delta T$

PTO

$$\Delta F - \lambda(\Delta T) = k(\Delta T)$$

$$\Rightarrow 5.35 \ln\left(\frac{c}{280}\right) - 1.4 \times 2 = 0.6 \times 2$$

$$\Rightarrow \ln\left(\frac{c}{280}\right) = \frac{4}{5.35}$$

$$\Rightarrow c = 280 \times e^{0.747}$$

$$\simeq 591$$

$\therefore$ Concentration of CO_2 (in ppm) = 591

(ii) Change in concentration of CO_2

$= 591 - 280 = 311$ ppm

Gt c corresponding to 1 ppm

$= 2.1$ Gt c $\times 2$

Gt c corresponding to 311 pm

$= 2.1 \times 2 \times 511$ Gt c

$= 1306.2$ Gt c

(iii) Given 540 Gt c,

the increase in emissions

$$= \frac{1}{2.1 \times 2} \times 540$$

$$\cong 128.57 \text{ ppm}$$

$$\Delta T_{overall} = 2k$$

$$\Delta T_{by \text{ non-}CO_2 \text{ forcings}} = 0.5\ K$$

$$\therefore \Delta T_{by\ CO_2 \text{ forcings}} = 1.5\ K$$

Now,

we know,

$$5.35 \ln\left(\frac{c}{280}\right) = (k+\lambda)\,\Delta T = 2 \times 1.5$$

$$\Rightarrow \ln\left(\frac{c}{280}\right) = \frac{3}{5.35}$$

$$\Rightarrow c = 280 \times e^{0.56} = 490.555 \text{ ppm}$$

We have,

total emissions that already exists

$= 280 + 128.57$ ppm

$= 408.57$ ppm

Remaining emission $= 490.555 - 408.57$

$\simeq 82$ ppm

$\therefore$ Remaining carbon budget

$= 4.2 \times 82$ Gt c

$= 344.4$ Gt c

(iv) Current Global Emissions

$k + \lambda = 1.8 \; w/m^2K$

$\Delta T = 1.5 \; K$

So,

$$5.35 \times \ln\left(\frac{c}{280}\right) = 1.8 \times 1.5$$

$$\Rightarrow \ln\left(\frac{c}{280}\right) = \frac{2.7}{5.35}$$

$\Rightarrow \quad C = 280 \times e^{0.5}$

$\quad \cong 463.8$ ppm

$\Rightarrow \Delta C = 183.8$ ppm

$\therefore$ Gtc corresponding to 183.8 ppm

$= 183.8 \times 4.2$

$= 772$ Gt c

$\therefore$ New budget $= 772 -$ Already existing

$= 772 - 540$

$= 232$ Gt c

Hence,
years on continuing with current emissions

$$= \frac{232 \text{ Gt c}}{10 \text{ Gtc /yr}} = \boxed{23.2 \text{ yrs}}$$