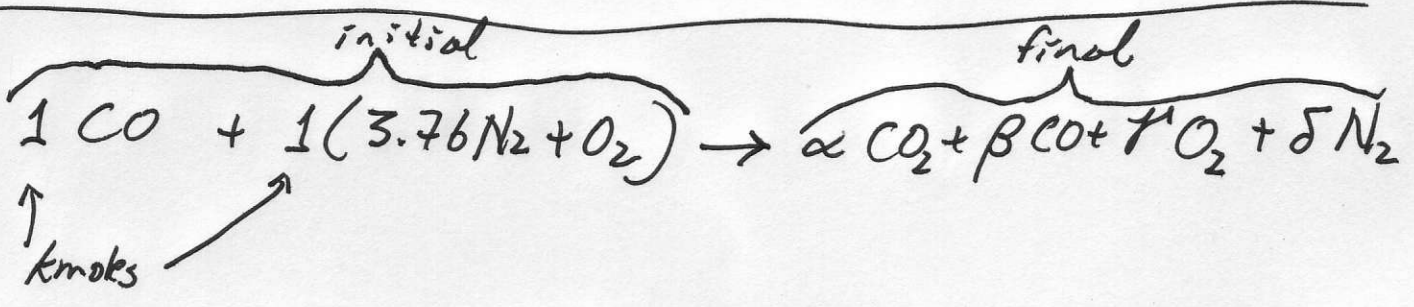


14.25

initial state: 1 kmole CO
4.76 kmole dry air

final state: unknown amounts of CO₂, CO, O₂, N₂

(equilibrium) T = 3000K, p = 1 atm

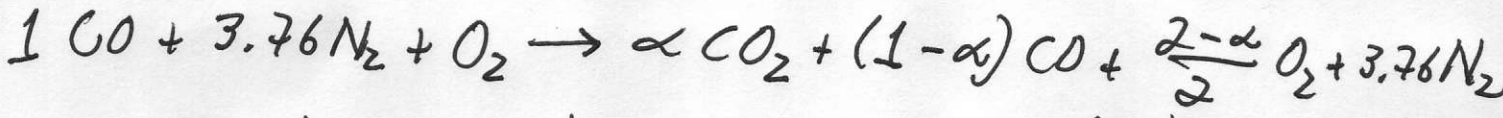


atomic mass balance requires

C: 1 = α + β → β = 1 - α

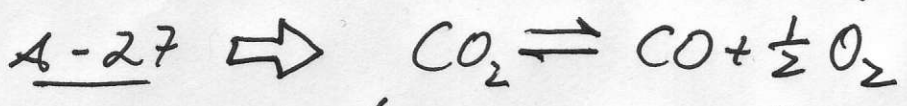
O: 1 + 2 = 2α + β + 2γ ⇒ 3 = 2α + 1 - α + 2γ ⇒ γ = (2 - α) / 2

N: δ = 3.76



N₂ plays no chemical role (although it plays a role in determining mole fractions).

The Reaction involves CO, O₂, CO₂



log₁₀ K(3000K) = -0.485 → K = 0.327

K = (y_{CO} y_{O₂^{1/2}) / y_{CO₂} (1/1)^{1 + 1/2 - 1}}

n_{TOT} = α + 1 - α + (2 - α) / 2 + 3.76 = 5.76 - α / 2

y_{CO} = (1 - α) / (5.76 - α / 2)

y_{CO₂} = α / (5.76 - α / 2)

y_{O₂} = ((2 - α) / 2) / (5.76 - α / 2)



$$.327 = \left(\frac{1-\alpha}{5.76 - \frac{\alpha}{2}} \right) \left(\frac{\frac{2-\alpha}{2}}{5.76 - \frac{\alpha}{2}} \right)^{1/2} = \left(\frac{1-\alpha}{\alpha} \right) \sqrt{\frac{2-\alpha}{11.52-\alpha}}$$

$$.327 = \frac{1-\alpha}{\alpha} \sqrt{\frac{2-\alpha}{11.52-\alpha}}$$

solve iteratively $\Rightarrow \alpha = 0.528$

Hence final composition is

CO_2 : 0.528 kmoles

CO : 0.472 kmoles

O_2 : 0.736 kmoles

N_2 : 3.76 kmoles

14.25 continued