14.26 initial state: 1 kmole O_2, 2 kmole N_2, 1 kmole Ar

final state: some quantity of O_2, N_2, NO and Ar (equilibrium)

$T = 2727\,^\circ C = 3000K$

$p = 1$ atm

process

initial: $1\,O_2 + 2\,N_2 + 1\,Ar$ → final: $\alpha\,O_2 + \beta\,N_2 + \gamma\,NO + \delta\,Ar$

kmoles

$\delta = 1$

O: $2 = 2\alpha + \gamma$ $\quad \alpha = \frac{2-\gamma}{2}$

N: $4 = 2\beta + \gamma$ $\quad \beta = \frac{4-\gamma}{2}$

final state ⇒ $\frac{2-\gamma}{2}\,O_2,\ \frac{4-\gamma}{2}\,N_2,\ \gamma\,NO,\ 1\,Ar$

$n_{TOT} = \frac{2-\gamma}{2} + \frac{4-\gamma}{2} + \gamma + 1 = 1 - \frac{\gamma}{2} + 2 - \frac{\gamma}{2} + \gamma + 1$

$= \underline{4}$

Reaction involves O_2, N_2, NO

A-27 $\quad \frac{1}{2}O_2 + \frac{1}{2}N_2 \rightleftharpoons NO$

$\log_{10} K(3000K) = -0.913 \Rightarrow K = 0.122$

$$K = \frac{y_{NO}}{y_{O_2}^{1/2}\, y_{N_2}^{1/2}} \left(\frac{1}{1}\right)$$

$$0.122 = \frac{\gamma/4}{\left(\frac{2-\gamma}{2}\cdot\frac{1}{4}\right)^{1/2}\left(\frac{4-\alpha}{2}\frac{1}{4}\right)^{1/2}} = \frac{2\gamma}{\sqrt{(2-\gamma)(4-\alpha)}}$$

solving iteratively $\Rightarrow \gamma = 0.162$

∴

Final composition is:

- 1 kmole Ar
- 0.919 kmole O_2
- 1.919 kmole N_2
- 0.162 kmole NO

14.26 continued