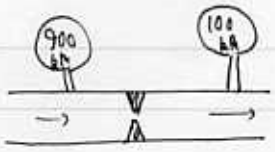
Qu. 4



From SFEE $\dot{Q} + \dot{W} = \dot{m}\,\Delta\left(\frac{V^2}{2} + gz + h\right)$ $\therefore h_1 = h_2$

(A) For steam at 900 kPa & $x = 0.97$ $(t_{sat} = 175.4°C)$

$h_1 = 742.6 + 0.97 \times 2029.5 = 2711.2$ kJ/kg K

& $s_1 = 2.094 + 0.97(6.619 - 2.094) = \underline{6.483}$ kJ/kg K

@ 100 kPa h_2 must also equal 2711.2 kJ/kg.

This is $> h_g$ @ 100 kPa $\therefore$ steam is superheated.

From superheat tables (p.16) @ 100°C $h = 2676$ kJ/kg

@ 125°C $h = 2726$ "

$\therefore$ by interpolation 2711.2 occurs @ $\underline{\underline{t_2 = 114.6°C}}$

s_2 (from Table 10) is $7.362 + \left(\frac{114.6 - 100}{25}\right) \times (7.492 - 7.362) = \underline{7.438}$ kJ/kg K

$\therefore \Delta S = 7.438 - 6.483 = \underline{\underline{0.955}}$ (an increase).

(B) For air if $h_1 = h_2$ $C_p T_1 = C_p T_2$

$\therefore \underline{\underline{T_2 = 28°C}}$

ΔS must be found from a reversible process connecting state 1 to state 2 — in this case an isothermal expansion from 900 kPa / 28°C to 100 kPa / 28°C

$Q + W = \Delta U$ but $\Delta U = \phi$

$\therefore dQ = -dW = p\,dV$ $(pV = mRT)$

$\therefore \frac{dQ}{T} = \frac{p\,dV}{T}$ or $mR\frac{dV}{V}$

$$\Delta S = \int_1^2 \frac{dQ}{T} = \int_1^2 mR\frac{dV}{V} = mR\ln\left(\frac{V_2}{V_1}\right) \text{ or } mR\ln\left(\frac{p_1}{p_2}\right)$$

$\therefore \Delta S = R\ln\left(\frac{p_1}{p_2}\right) = 0.287\ln\left(\frac{900}{100}\right) = \underline{\underline{0.631}}$ kg/kg K (an increase)