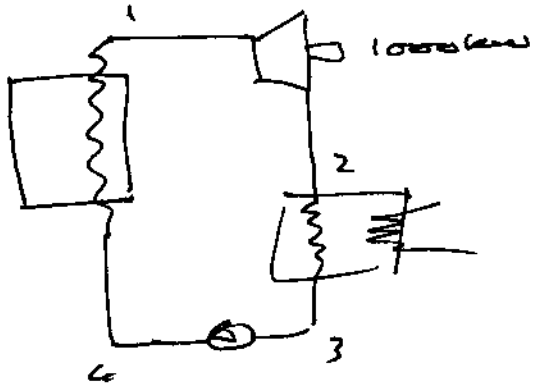
Q6 2001



$h_1 = h_g @ 27°C = 412.23 + \frac{2}{5}(414.74\frac{3}{5} - 412.23) = 413.23$

$p_1 = p_s @ 27°C = 6.525 + \frac{2}{5}(7.7 - 6.6525) = \underline{7.076}$

$p_3 = p_s @ 8°C = 3.4966 + \frac{3}{5}(4.459 - 3.4966) = \underline{3.8866}$ bar

$h_3 = h_f @ 8°C = 206.75 + \frac{3}{5}(213.57 - 206.75) = \underline{210.84}$ kJ/kg

$s_1 = s_g @ 27°C = 1.7158 + \frac{2}{5}(1.7142 - 1.7158) = \underline{1.715}$ kJ/kgK

ISENTROPIC EXPANSION

$s_2 = s_1 = 1.7152 = s_f + x s_{fg} @ 8°C$

$s_f = 1.0243 + 3/5(1.0243 - 1.0484) = \underline{1.038}$ kJ/kgK

$s_g = 1.7238 + 3/5(1.7215 - 1.7238) = \underline{1.7224}$ kJ/kgK

$s_{fg} = 1.7224 - 1.038 = \underline{0.6837}$ kJ/kgK

$1.7152 = 1.038 + x \times .6837 \quad x = \underline{0.989}$

$h_f = 206.75 + 3/5(213.57 - 206.75) = \underline{210.84}$ kJ/kg

$h_g = 401.33 + 3/5(404.16 - 401.33) = \underline{403.03}$ kJ/kg

$h_{fg} = 403.03 - 210.84 = \underline{192.19}$ kJ/kg

$h_2' = 210.84 + .989 \times 192.19 = \underline{400.91}$ kJ/kg

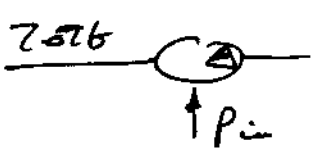
$h_2 = 413.23 + .9(413.23 - 400.91) = \underline{402.1}$ kJ/kg

Q6 2001

$P_{out} = 1000\ kw = M_r (h_1 - h_2)$

$10000 = M_r (413.23 - 402.1)$ $\quad M_r = \underline{89.85\ kg/s}$

Pump



$P_{in} = \dfrac{\dot{m}\, v\, \Delta p}{\eta_s} = \dfrac{89.85 \times .0075\,(7.07 - 3.886) \times 10^5}{0.85}$

$P_{in} = \underline{252.2\ kw}$

$h_4 = h_3 + \dfrac{252.2}{89.85} = 210.84 + 2.81 = \underline{213.6\ kJ/kg}$

$P_{nett} = 10000 - 252.2 = \underline{747.8\ kw}$

$\dot{Q}_{in} = M_r (h_1 - h_4) = 89.85 (413.23 - 213.6)$

$\dot{Q}_{in} = 17\,937\ kw$

$\eta_{th} = P_{nett} / \dot{Q}_{in} = 5.57\ \%$

$\dot{Q}_{cond} = M_r (h_2 - h_3) = 89.85 (402.1 - 210.84)$

$\dot{Q}_{out} = 17185\ kw$

$\dot{Q}_{nett} = 17\,937 - 17185 = 752\ kw$

WATER

BOILER $\quad 17\,937 = M_w \times 4.2 \times (28 - 26)$

$M_w = \underline{2135\ kg/s}$

COND $\quad 17185 = M_w \times 4.2 \times (9 - 5)$

$M_w = \underline{1023\ kg/s}$