**Thermodynamics**
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**Lecture 50**
**Tutorial Problem Part-3**

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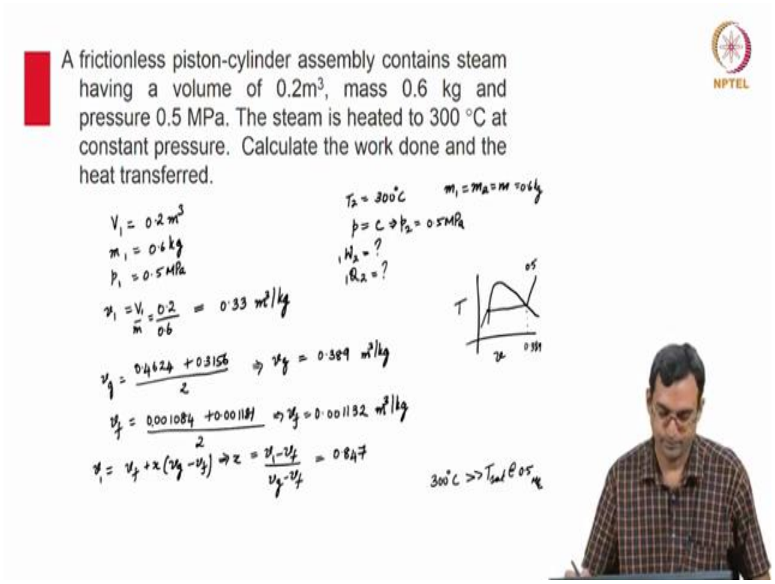
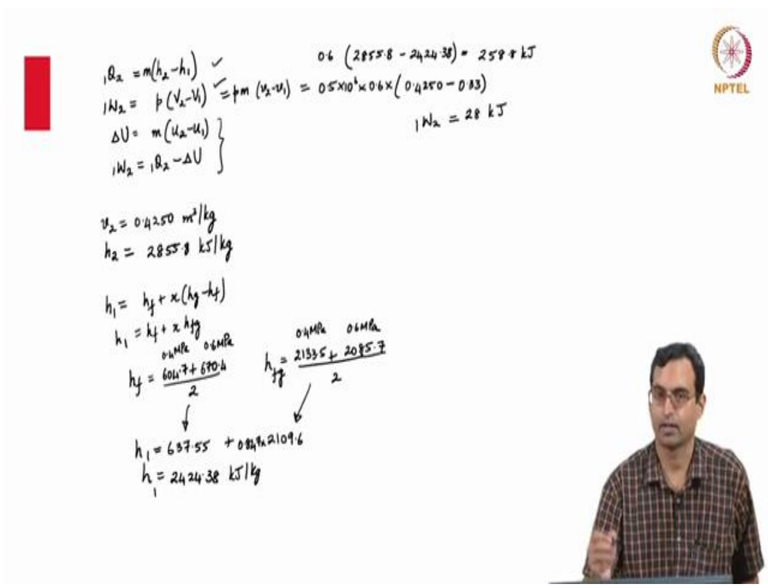
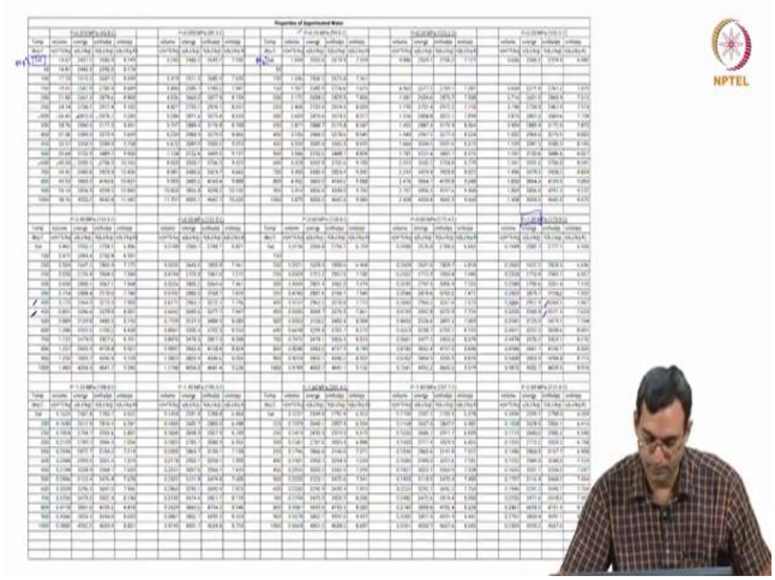
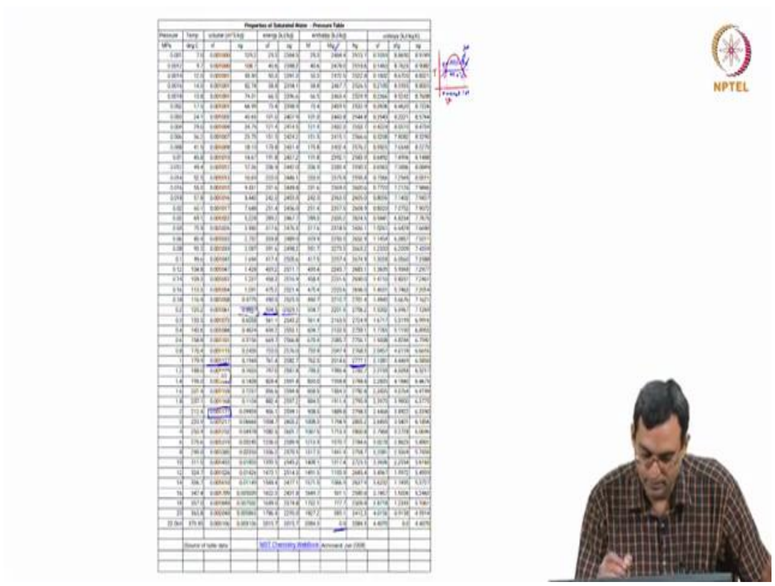



Figure 1.







**Solution of the problem in Fig. 1:**

$$V_1 = 0.2\ m^3, m_1 = 0.6\ kg, p_1 = 0.5\ MPa, T_2 = 300\ ℃, m_2 = m_1 = 0.6\ kg, p_2 = p_1 = 0.5\ MPa$$

$$v_1 = \frac{V_1}{m_1} = 0.33 \frac{m^3}{kg}$$

At 0.5 MPa, $v_g = 0.389 \frac{m^3}{kg}$ and $v_f = 0.001132 \frac{m^3}{kg}$ (These values are the average of those at 0.4 MPa and 0.6 MPa. In the tables provided, 0.5 MPa is not listed. Hence, we did linear interpolation.)

Now, $v_f < v_1 < v_g$. Hence, the state 1 (initial state) is inside the liquid-vapor dome.

Now, $x_1 = \frac{v_1 - v_f}{v_g - v_f} = 0.847$

This is a constant pressure process. At $p_2$ = 0.5 MPa, the temperature is 300 ℃. Now, 300 ℃ > saturation temperature at 0.5 MPa which is 151.8 ℃. Hence, the state 2 lies in the superheated zone. We are asked to calculate Q and W.

For a constant pressure process, we know that $Q = \Delta H = m\Delta h = m(h_2 - h_1)$……(1)

Also, the work done $W = p\Delta V = pm(v_2 - v_1)$……(2)

Now, at state 2, $v_2 = 0.5226 \frac{m^3}{kg}, h_2 = 3064.6 \frac{kJ}{kg}$ (from tables for superheated steam)

Now, $h_1 = h_f + x_1(h_{fg}) = 2424.38 \frac{kJ}{kg}$

Now, (1) implies $Q = 0.6(3064.6 - 2424.38) = 384.1\ kJ$

(2) implies $W = 0.5 \times 10^6 \times 0.6 \times (0.5226 - 0.33) = 57.8\ kJ$