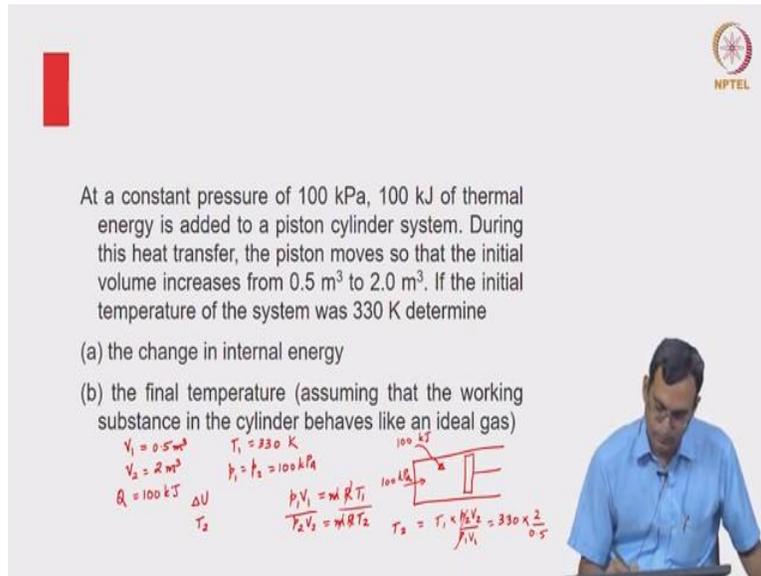**Thermodynamics**
Professor Anand T N C
Department of Mechanical Engineering
Indian Institute of Technology, Madras
Lecture - 31
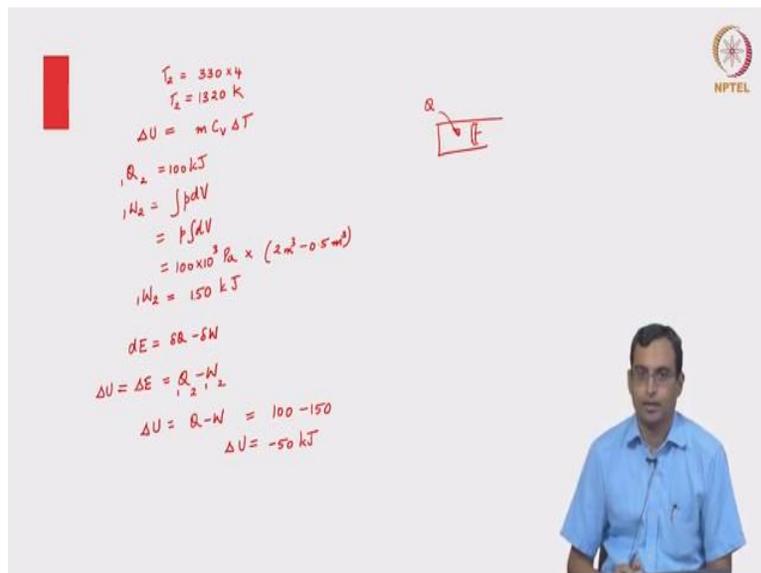**Tutorial Problem - Part 5**

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Figure 1.

Solution of the problem given in Fig. 1:

$$V_1 = 0.5\ m^3, V_2 = 2\ m^3, Q = 100\ kJ, T_1 = 330\ K, p_1 = p_2 = 100\ kPa$$

Assumption: working substance in the cylinder is an ideal gas.

We write the ideal gas equation for two states of the system and take their ratio to calculate T_2, the final temperature.

$$\frac{p_1 V_1}{p_2 V_2} = \frac{mRT_1}{mRT_2}$$

Hence, $T_2 = T_1 \frac{V_2}{V_1} = 330 \times \frac{2}{0.5} = 1320\ K$

Heat is transferred into the system. The volume of the system is increasing. Hence, work is done by the system. It is a constant pressure process.

$$W = \int p dV = p \int dV = 100 \times 10^3 \times (2 - 0.5) = 150\ kJ$$

The first law in the integrated form is,

$\Delta U = Q - W$ (There are no changes in kinetic and potential energy. Hence, $\Delta E = \Delta U$.)

$\Delta U = 100 - 150 = -50\ kJ$

Hence, the final internal energy of the system is lower than its initial internal energy. The system is losing energy during the process.