1. Mass of 15kg of air in a piston cylinder device is heated from 25°C to 90°C by passing current through resistant heater inside the cylinder. The pressure inside the cylinder is held constant at 300kpa during the process and heat loss of 60 KJ occurs. Determine the electric energy supplied in kilowatt hour. and change in internal energy.

Given Data:

$m = 15\,kg$

$T_1 = 25°C + 273 = 298\,K$

$T_2 = 90°C + 273 = 363\,K$

constant pressure

$P_1 = P_2 = 300\,kPa$ $\quad \therefore 1kPa = 1\,kN/m^2$

$= 300\,kN/m^2$

$Q = -60\,KJ$

To find :-

Work in kilowatt hour.

change in internal Engergy (ΔU)

Solution:

work done in kilowatt hour. $\quad \therefore 1J = 1W$

$1KJ = 1KW$

$= \frac{\text{work done}}{(W)} \times 3600$

work done : $mR(T_2 - T_1)$

$R = 0.287\,KJ/kg.K$

$= 15 \times 0.287\,(363 - 298)$

$= 15 \times 0.287 (65)$

$= 15 \times 18.655$

$W = 279.81$ KJ

$= 279.81 \times 3600$

Work done in KW.Hr $= 1.007 \times 10^6$ KW.Hr

To Find change in internal Energy $(\Delta u) = mC_v(T_2 - T_1)$

(or)

$\Delta u = Q - W$

$\therefore Q = W + \Delta u$

$\Delta u = -60 - 279.81$

$= -339$ KJ

Formula:

$\gamma = 1.4$

$\gamma = \frac{cp}{cv}$

$= \frac{cp}{cv}$

$= \frac{1.005}{0.718}$

$\gamma = 1.4$

$pV = mRT$

↓

ideal gas equation.

$R = cp - cv$

$= 1.005 - 0.718$

$R = 0.287$ KJ/kg.