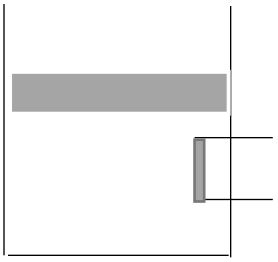
Q- 15 kg of air in a piston cylinder device is heated inside the cylinder from 25^0C to 75^0C by passing current through a resistance heater inside the cylinder. The pressure inside the cylinder is kept constant at 2 bar during the process and the heat loss of 50 kJ occurs. Determine the electrical energy supplied in kWh.



Air can be considered as an ideal gas and its mean molar mass is 29 gram/mol. Thus, the number of moles in 15 kg of air can be given by

$n = 15000\ g/29 = 517.24$

The process (expansion of air) is at constant presses means isobaric one.

The molar specific heat of a substance is the amount of heat energy needed to raise temperature of one mol of substance through one degree.

As air expands in isobaric way we have to take molar specific heat at constant pressure (C_P).

The molar specific heat of air at constant pressure is 29.19 J/mole/K

Hence the heat required to increase temperature will be

$Q_1 = n*C_p*\Delta T$

Or $Q_1 = 517.24*29.19*(75 - 25) =$ **754.91 KJ**

[The temperature **difference** is same in Kelvin and ^{0}C]

The heat lost during the process is

$Q_2 = 50$ KJ

Hence the total heat supplied by the heater will be

$Q = Q_1 + Q_2 = 754.91 + 50 = 804.91$ KJ

Or $Q = 804.91/3600 =$ **0.224 KWH**