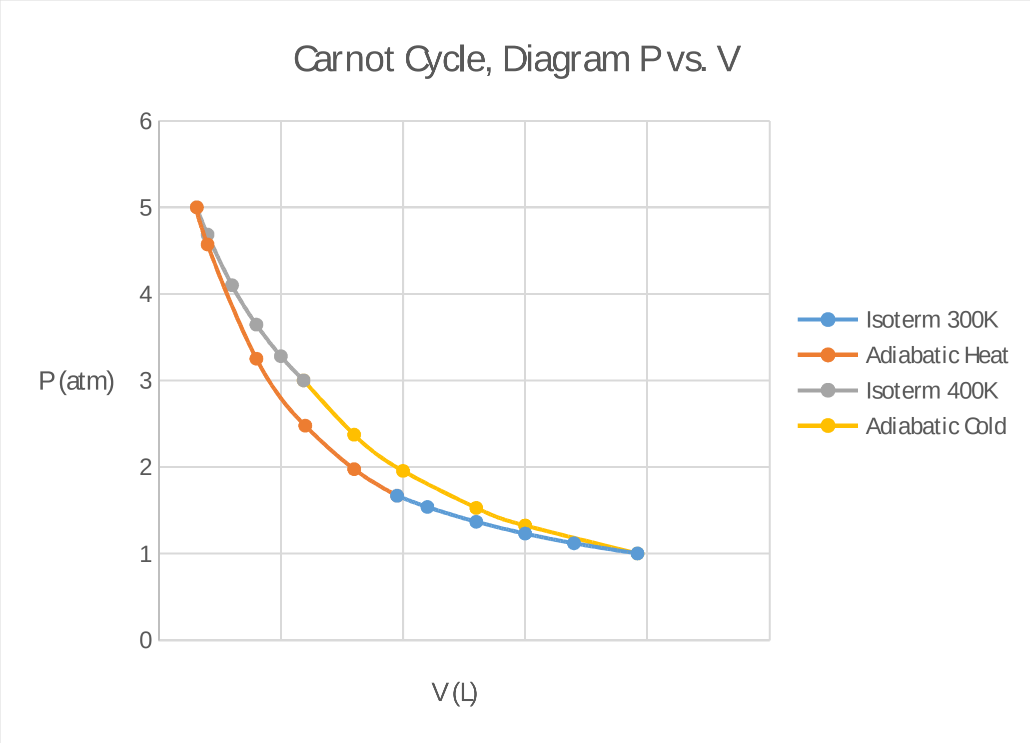
Problem 3 Carnot cycle

The graph in the problem can be transformed in:



3.1

In the isothermal compression:

ΔU = 0 W = - nRT.Ln(Vf/Vi) = - nRT.Ln(Pi/Pf) = - n.8.314.300.Ln(1/1.6667) = 1274.15n J

Q = - 1274.15n J

In the adiabatic compression:

Q = 0 ΔE = nCv.(Tf-Ti) = 100 n.Cv W = 100 n.Cv

In the isothermal expansion:

ΔU = 0 W = - nRT.Ln(Vf/Vi) = - nRT.Ln(Pi/Pf) = - n.8.314.400.Ln(5/3) = - 1698.8n J

Q = 1698.8 n J

In the adiabatic compression:

Q = 0 ΔE = n Cv.(Tf-Ti) = -100 n.Cv W = -100 n.Cv

Useful work in the cycle = - 424.65 n J. The work is not defined because the number of mol is missing.

3.2

The efficiency η is defined, η = (useful work)/(heat given) = (424.65n)/(1698.8n) = 0.25

Even the efficiency $\eta = 1 - (T_{cold}/T_{heat}) = 1-(300/400) = 0.25$

3.3

In the adiabatic compression:

P initial = 1.6667 V initial = nR(300)/1.6667

P final = 5 V final = nR(400)/5

The relation PV^{γ} = const is true.

Then:

$1.6667.(nR(300)/1.667)^{\gamma} = 5.(nR(400)/5)^{\gamma}$

$\{(300x5)/(400x1.6667)\}^{\gamma} = (5/1.6667)$

$2.25^{\gamma} = 3$

γ = 1.355 = 1 + R/Cv Cv = 5.634R/2

3.4

The Cv founded not correspond with Cv for monoatomic, diatomic or triatomic gas.

Solution proposed by

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