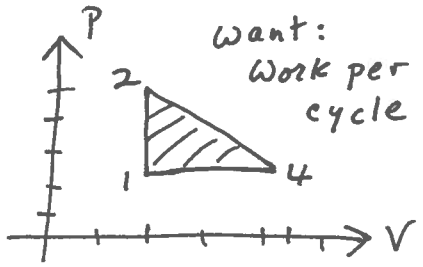
15 - heatEngine

① 

want: Work per cycle

Given: $P_1 = 1.4E3$ $V_1 = 2.8\ m^3$

$P_2 = 2.8E3$ $V_4 = 5.1\ m^3$

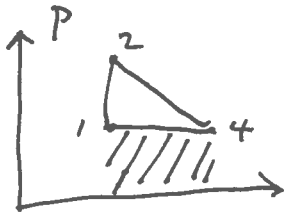
Work per cycle is area:

$W = \frac{1}{2}$ base · height

base = 5.1 − 2.8

heigh = $(2.8 - 1.4) \cdot 10^3$

Work = 1.61E3 J

② 

$P_1 = 3E3$

$P_2 = 5.9E3$

$V_1 = 2.5$

$V_4 = 3.6$

SI units

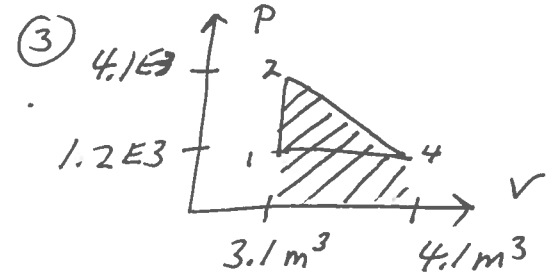
want Work from 1-4

W = base · height

base = $V_4 - V_1 = 3.6 - 2.5$

height = $P_4 = P_1 = 3E3$

Work = $3(3.6 - 2.5)E3 =$ **3.3E3 J**

③ 

Want: "4"

$Work = \int_{"2"} P\,dV$

= Area under curve.

Area = Rectangle + Triangle

$= P_1(V_4 - V_1) + \frac{1}{2}(P_2 - P_1)(V_4 - V_1)$

$= \left\{P_1 + \frac{1}{2}P_2 - \frac{1}{2}P_1\right\}\{V_4 - V_1\}$

$= \frac{1}{2}(P_1 + P_2)(V_4 - V_1)$

$= \frac{1}{2}(1.2 + 4.1)(E3)(4.1 - 3.1) =$ **3.18E3 J**

④ $PV = nRT \rightarrow T = \frac{PV}{nR}$

R = gas constant = 8.314 SI units (with mols)

n = 1.4 mol

P = 2.2E3 Pascals (SI unit)

$V = 3.3\ m^3$

$T = \text{Temperature} = \frac{(2.2)(3.3E3)}{(1.4)(8.314)}$

T = 624 Kelvins