Exam - Thermodynamics

Time - 1 hour   Total - 20

(1) Given the Maxwellian distribution formula,

$$N(v)dv = 4\pi N \left(\frac{m}{2\pi k_B T}\right)^{\frac{3}{2}} v^2 e^{-\frac{mv^2}{2k_B T}} dv$$

Deduce the expression for

(a) Number of molecules in energy range E and $E+dE$ — 4

(b) Most probable energy — 2

(c) Mean energy — 4

$$\left[\begin{array}{l} \int_0^\infty x^{n-1} e^{-x} dx = \Gamma(n) \\ \Gamma(n+1) = n\,\Gamma(n) \\ \Gamma(\tfrac{1}{2}) = \sqrt{\pi} \end{array}\right]$$

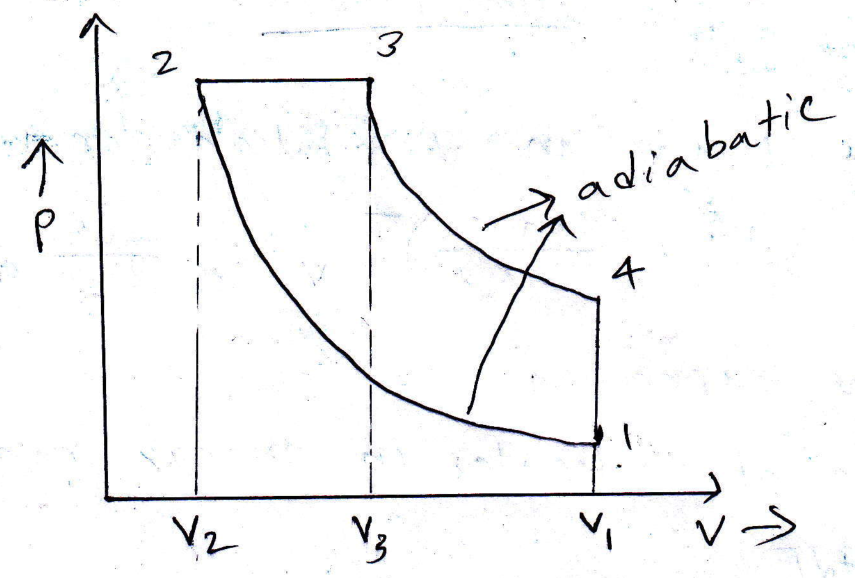
(2) Show that the heat transferred during an infinitesimal quasi-static process of an ideal gas can be written as,

$$dQ = \frac{C_V}{nR} V dp + \frac{C_P}{nR} p dV$$

4

P.T.O.

(3)



show that the efficiency of the engine is,

$$\eta = 1 - \frac{1}{\gamma} \frac{\left(\frac{1}{r_E}\right)^{\gamma} - \left(\frac{1}{r_c}\right)^{\gamma}}{\left(\frac{1}{r_E}\right) - \left(\frac{1}{r_c}\right)}$$

where, $r_c = \frac{V_1}{V_2}$, $r_E = \frac{V_1}{V_3}$

$\boxed{\text{Rest in Peace}}$