Homework: 5   Submission Date: 05/03/2024

The hand written solutions must be submitted at the start of the tutorial.

1. Calculate (i) the change in internal energy (ii) change in entropy and (iii) the quantity of heat absorbed when 1 mole of an idea monoatomic gas expands along the polytrope $pV^3 = $ Constant from $V_1 = 11$ litre at a pressure $p_1 = 20$ atmos. The temperature during the process is such that the molar specific heat $C_V = 3R/2$.

2. In the $S - P$ diagram consider a rectangle. A engine is operating in this cycle where an ideal gas is the working substance. It is called Brayton cycle. Show that efficiency of this engine is $\eta = 1 - (P_A/P_B)^{1-1/\gamma}$.

3. It is found experimentally that the product of pressure and the volume of a gas is a function of temperature only. Also, internal energy is a function of temperature only. Find out the equation of state of the gas.

4. The equation of a state of thermodynamic system is given by $p = AT^3/V$. The internal energy of the system is

$$U = BT^n ln(V/V_0) + f(T) \tag{1}$$

where $vvvvB, n, V_0$ are all constants and $f(T)$ depends on temperature only. Find the values of B and n.

5. Prove that the entropy S increases with volume V of a system whose equation of state is given by $p = f(V)T$.

6. Total internal energy of radiation in volume V is given by $U = AT^4V$, and pressure is $(1/3)AT^4$. Find the entropy of the system.