S. S. College. Jehanabad (Magadh University)

Department : Physics

Subject : Thermodynamics

Class : B.Sc(H) Physics Part I

Topic: Assignment (Application of Maxwell's Thermodynamical Relation)

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Exercise

1. Derive Maxwell's thermodynamical relations connecting the thermodynamic quantities.

2. Prove the relation

$$\left(\frac{\partial T}{\partial P}\right)_S = \frac{TV\alpha}{C_P}$$

Where symbols have their usual meaning

3. Prove the relations

$$\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$$

4. Prove the relations

(a) $T.dS = C_v dT + T\left(\dfrac{\partial P}{\partial T}\right)_V dV$

(b) $T.dS = C_P dT - T\left(\dfrac{\partial V}{\partial T}\right)_P dP$

Symbols have their usual meaning

5. Prove the following relation

$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$$

and also the value of $\left(\dfrac{\partial U}{\partial V}\right)_T$ for an ideal gas.

Also prove that

$$\frac{\partial C_V}{\partial V}\Bigg|_T = T\left(\frac{\partial^2 P}{\partial T^2}\right)$$

6. Deduce the general expression for the Joule-Thomson coefficient

$$\mu = \left(\frac{\partial T}{\partial P}\right)_H$$

$$= \frac{1}{C_P}\left[T\left(\frac{\partial V}{\partial T}\right)_P - V\right]$$

And by using Maxwell's relations show that for an ideal gas $\mu = 0$ and for a real gas

$$\mu = \frac{1}{C_P}\left(\frac{2a}{RT} - b\right)$$

OBJECTIVE QUESTIONS

1. Four thermodynamic potential are given by:

(a) Pressure, volume, temperature and internal energy function.
(b) Pressure, volume, internal energy and Helmholtz function.
(c) Internal energy function, Helmholtz function, enthalpy and Gibbs function
(d) none of these

2. Specific heat of saturated vapour pressure is
(a) zero
(b) positive
(c) negative
(d) sometimes positive sometimes negative

3. Rice takes longest time to cook
(a) in submarine 100 m below the surface of the sea.
(b) at the sea level
(c) at Simla
(d) at Mount-Everest

4. Paraffin wax contracts on solidification. The melting point of wax will

(a) increase with pressure

(b) decrease with pressure

(c) no change with pressure

(d) decrease linearly with pressure

5. Joule Kelvin Coefficient for a perfect gas is _____.