2020

PHYSICS (Honours)

Paper : PHYH - DC-6T

[CBCS]

Full Marks : 25 Time : Two Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers
in their own words as far as practicable.

1. Answer any *five* questions : 2×5=10

(a) What do you mean by 'heat' and 'work' in thermodynamics ?

(b) Prove that for a system undergoing isothermal isochoric transformation the Helmholtz free energy remains constant.

(c) How would you justify that the work done (dW) by a thermodynamic system is an imperfect differential ?

(d) A substance of unit mass with latent heats L_1 and L_2 at the melting and boiling points T_1 and T_2 respectively, has specific heat C given by $C = A + BT + DT^2$. Where A, B and D are constants. Find the change in entropy of the system when it is converted to the vapour state at T_2 from the solid state at T_1.

(e) Write down Kelvin-Planck and Clausius statement of the second law of thermodynamics.

(f) The efficiency of a Carnot engine is 40%. The sink temperature is 15°C. Find out the corresponding source temperature.

(g) Explain why the specific heat of a gas at constant pressure is greater than that at constant volume.

(h) Using the proper thermodynamic function, deduce the Maxwell's relation

$$\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$$

2. Answer any *three* questions : 5×3=15

(a) Prove that the Clausius statement and the Kelvin-Planck statement of the second law of thermodynamics are equivalent. 5

(b) The efficiency of a Carnot engine can be increased either by increasing the source temperature or by lowering the sink temperature. Show analytically which one is the more effective way. 5

(c) M gm of water at a temperature T_1K is isobarically and adiabatically mixed with an equal mass of water at T_2K. Show that the entropy change of the universe is

$$2MC_p \ln \frac{(T_1 + T_2)/2}{\sqrt{T_1 T_2}}$$

where C_p is specific heat at constant pressure. 5

(d) Deduce the relation $\mu = \frac{1}{C_p}\left[T\left(\frac{\partial V}{\partial T}\right)_p - V\right]$

where μ denotes the *J-T* co-efficient and the other symbols are usual. 5

(e) From the first law of thermodynamics, show that

$$C_p - C_v = \left[P + \left(\frac{\partial U}{\partial V}\right)_T\right]\left(\frac{\partial V}{\partial T}\right)_P$$

where the symbols are usual. 5