

Mid-West University
Examinations Management Office

Final Examinations-2080

Bachelor level/ B. Sc. /2nd Semester

Time: 3 hours

Full Marks: 60

Pass Marks:30

Subject: Thermal Physics (PHY421/321)

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

Group – A

Attempt all long answer questions. [4x6 = 24]

1. What considerations led Van der waals to modify gas equation of state? Deduce van der waals gas equation $\left(P + \frac{a}{V^2}\right)(V - b) = RT$. What are the dimension of a and b ?
2. Discuss Brownian motion. Describe how the experimental study of this motion yielded the value of Avogadro number?
3. Define entropy and show that change in entropy of a system is zero for reversible process and it is always increase in irreversible process.

OR

Explain theory of Joules Thomson expansion. Show that Joules Thomson coefficient is zero for perfect gas but non zero for real gas.

4. Define Photon gas? Derive Planck's radiation formula for photons using Bose-Einsteins statistics. Also signify the result.

Group – B

Attempt all numerical questions. [6x4= 24]

5. A quantity of air ($\gamma = 1.4$) at 27⁰C is compressed (a) slowly and (b) suddenly to two third of its volume. Find the change in tempure in each case.
6. Calculate the critical temperature of CO₂ for which the Vander Waals constant are given to be, $a=0.0072$ and $b=0.002$. The unit of pressure is atmosphere and unit of volume is that of a *gm.mol* of gas at N.T.P.
7. A black body with initial temperature of 3000⁰C is allowed to cool inside an evacuated enclosure surrounded by melting ice at the rate of 0.35⁰C per sec. If the mass, specific heat and surface area of the body are 32 gm , 0.10 cal/gm and 8 cm² respectively. Calculate Stefan's constant.
8. There are 2.54×10^{22} free electrons per cm³ in sodium. Calculate its Fermi energy, Fermi velocity and Fermi temperature. ($h=6.62 \times 10^{-34}$ joule-sec, $m=9.1 \times 10^{-31}$ kg, $k=1.38 \times 10^{-23}$ joule/K, $1\text{eV}=1.6 \times 10^{-19}$ joule).

OR

The Fermi energy for lithium is 4.72 eV at absolute zero. Calculate the number of conduction electrons per unit volume in lithium. ($h=6.63 \times 10^{-34}$ J-s, $m=9.1 \times 10^{-31}$ kg)

9. Calculate the change in vapour pressure of water as the boiling temperature changes from 100⁰C to 103⁰C. Given, latent heat of steam = 540 cal/gm and specific volume of steam= 1670 cc/gm.

10. Calculate the increase in entropy when 1 gram of ice at -10°C is converted in to steam at 150°C . Given, specific heat of ice = $0.5 \text{ cal/gm}^{\circ}\text{C}$, latent heat of ice = 80 cal/gram , latent heat of steam = 540 cal/gram .

Group-C

Answer in brief any Six questions. [6x2= 12]

11. Explain how first law of thermodynamics leads to concept of internal energy?
12. Write importance of results of Andrews experiment.
13. Discuss the effect of temperature and pressure on mean free path?
14. A red piece of glass glows with a green light when it is heated, why?
15. Explain second law of thermodynamics?
16. Explain P-T diagram of water.
17. Differentiate isobaric and isochoric process?
18. Write the postulates of classical statistical mechanics?

The End