

# B. N. BANDODKAR COLLEGE OF SCIENCE, THANE

## USPH 303

Duration: 2:30 Hrs.

Total Marks: 75

- N.B.:** 1) *All questions are compulsory.*  
2) *Figures on the right indicate full marks.*  
3) *Draw neat and clean diagrams where ever necessary.*  
4) *Non – programmable calculators are allowed.*

**Q.1) (A)** *Attempt any TWO.*

- 1) Explain the working of Carnot's heat engine with suitable diagram. (8)
- 2) State and prove Carnot's theorem. (8)
- 3) Describe the construction and working of steam engine. (8)
- 4) Derive Clausius-Clapeyron latent heat equation. (8)

**(B)** *Attempt any ONE.*

- 1) A Carnot engine working as refrigerator between 500 K and 300 K receives 400 calories of heat from the reservoir at the lower temperature. Calculate the amount of heat rejected to the reservoir at the higher temperature. Calculate also the amount of work done in each cycle to operate the refrigerator. (1 cal = 4.2J) (4)
- 2) In a double acting steam engine, the average pressure of steam is  $20^6$  newton/m<sup>2</sup>. The length of a stroke is 0.75 m and the area of the piston is 0.5 sq m. find the power of the engine if it makes 10 strokes per second. (4)

**Q.2) (A)** *Attempt any TWO.*

- 1) Show that the entropy remains constant in reversible process. (8)
- 2) Draw Carnot cycle in P-V and T-S coordinates. Explain the significance of T-S diagram. (8)
- 3) Explain Kelvin's thermodynamic scale of temperature. (8)
- 4) Derive an expression for entropy of an ideal gas in terms of its T and P. (8)

**(B)** *Attempt any ONE.*

- 1) Calculate the increase in entropy when 10 gm of ice at -15° C is converted into water at 0° C. (Given: Sp. heat of ice = 0.5 cal/gm/°C, latent heat of ice = 80 cal/gm) (4)

- 2) If 150 gm of water at 20° C is mixed with an equal amount of water at 80° C, (4)  
calculate the resultant increase in entropy. ( Given: Sp. heat of water =1  
cal/gm/°C )

**Q.3) (A) Attempt any TWO.**

- 1) Derive an expression for atomic packing factor for an SCC and BCC structure in (8)  
a cube of lattice constant 'a'.
- 2) What is the difference between an FCC structure and an hcp structures. Explain (8)  
very clearly by assuming atoms in layers. Enumerate the similarities also,  
between these two structures.
- 3) What is Bravais lattice? How many lattices are there in 3 dimensions and show (8)  
that there can be only 14 crystal structures.
- 4) What are Miller indices? What are the conditions to get Miller indices in a (8)  
plane?

**(B) Attempt any ONE.**

- 1) Find the interplanar distance of (200) and (111) plane of Ni crystal with radius = (4)  
1.245A (Ni has FCC structure)
- 2) Calculate the number of atoms per unit cell of a metal having lattice parameter, (4)  
2.29nm and density =7.87 Kg/m<sup>3</sup>, At Wt = 56 and  
 $N_A = 6.023 \times 10^{26} / \text{Kmol}$

**Q.4) Attempt any THREE.**

- 1) Define: Isochoric process, adiabatic process, Specific heat at constant volume, (5)  
and exhaust stroke of engine.
- 2) Explain the effect of pressure on melting point and boiling point of H<sub>2</sub>O. (5)
- 3) Explain the concept of increase in entropy. (5)
- 4) Show that negative temperature is not possible. (5)
- 5) Write short note on NaCl and ZnS Structure. (5)
- 6) Write down the four parameters of BCC structure: coordination number, APF, (5)  
relation between a and r and number of atoms per unit cell.

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