

B.Sc. PHYSICS
THIRD SEMESTER
THERMAL PHYSICS
BSP – 302
(USE OMR FOR OBJECTIVE PART)

Duration: 3 hrs.

Full Marks: 70

Time: 30 min.

(Objective)

Marks: 20

Choose the correct answer from the following:

1 × 20 = 20

- In a diathermic boundary, which statement holds true?
 - Exchange of particles is allowed between the system and the surroundings.
 - Change of volume is allowed between the system and the surroundings.
 - Exchange of heat is allowed between the system and the surroundings.
 - Change of density is allowed between the system and the surroundings.
- In a reversible process, which statement is false?
 - The system should be quasi static.
 - The system is in equilibrium only in its final state.
 - The system should be free from dissipative forces.
 - Thermodynamic properties are defined at every step
- The change in entropy in an adiabatic process is ____?
 - 0
 - 1
 - < 1
 - > 1
- Which statement is false?

According to Kelvin-Planck statement of second law of thermodynamics,

 - No engine can have 100% efficiency.
 - The absolute zero temperature is non attainable.
 - Carnot's cycle rejects no heat to it is called the absolute zero on thermodynamics scale.
 - It is possible to construct an engine which, operating in a cycle, has the sole effect of extracting heat from a reservoir and performing an equivalent amount of work.
- When air rises and expands in the atmosphere, what happens to its temperature?
 - It remains constant
 - It increases
 - It decreases
 - It fluctuates
- In an isochoric process, what is constant?
 - Pressure
 - Volume
 - Temperature
 - Entropy
- Air compressor falls under what class of a system?
 - Closed
 - Open
 - Isolated
 - None of the above

8. Adiabatic demagnetization is a process primarily used to achieve
- Generation of electricity from magnet
 - Heating of magnetic materials
 - Cooling of magnetic materials
 - Reversal of magnetization in materials
9. Equation of state for an ideal gas is given by ?
- $f(P, V, T) = 0$
 - $PV = RT$
 - $f(P, V, T) = RT/2$
 - $f(P, V, N) = 0$
10. Increase in pressure of a substance isothermally results in
- Decrease in entropy
 - No change in entropy
 - Increase in entropy
 - Entropy equals zero
11. Increasing the pressure we observe that the boiling point
- Drops
 - Equals zero
 - Remains constant
 - Raises
12. According to law of equipartition of energy, energy associated with each degree of freedom is
- $k_B/2T$
 - $k_B T/2$
 - $k_B T$
 - $3k_B T/2$
13. Speed possessed by maximum fraction of total number of molecules of the gas
- Root-mean-square speed
 - Average speed
 - Most probable speed
 - none of the above
14. A substance which expands on heating is compressed. In the process
- Heat is consumed
 - Heat equals to zero
 - Heat remains constant
 - Heat is generated
15. Pick the correct pair-
- Isotherm: Gay-Lussac law
 - Isochore: Gay-Lussac law
 - Isochore: Charle's law
 - none of the above
16. Degree of freedom of a diatomic gas is
- 1
 - 3
 - 5
 - 7
17. The difference between C_p and C_v is given by
- R
 - nRT
 - 0
 - R
18. The real gas reduces to an ideal gas for
- Small number of molecules
 - Large number of molecules
 - Monoatomic gases
 - Diatomic gases
19. The ratio of Boyle's temperature T_B to Critical temperature T_C , is
- $27/8$
 - $8/27$
 - $9/2$
 - $2/9$
20. A gas allowed to undergo Joule Thomson expansion will cool down
- Above Temperature of inversion
 - Below Temperature of inversion
 - At Temperature of inversion
 - Never cools down

(Descriptive)

Time: 2 hrs. 30 min.

Marks: 50

[Answer question no.1 & any four (4) from the rest]

1. Derive the general expression for Maxwell's thermodynamic relation from the laws of thermodynamics and deduce the six Maxwell's relations. 4+6=10

2. State and derive the first law of thermodynamics. Derive the adiabatic gas equations applying the same. 5+5=10

3. a. What is Carnot's heat engine? Describe Carnot cycle and find out its efficiency. 2+3+5
=10
b. A Carnot's engine is operated between two reservoirs at temperatures of 450 K and 350 K. If the engine receives 1000 calories of heat from the source in each cycle, calculate the amount of heat rejected to the sink in each cycle. Calculate the efficiency of the engine and the work done by the engine in each cycle. (1 calorie= 4.2 joules)

4. What is entropy? Describe the change of entropy in a reversible cycle. Show that the entropy the universe increases. 1+4+5
=10

5. a. If pressure is increased by 2 atm, calculate the change in melting point of ice at 0°C. How much pressure is required to lower the melting point of ice by 1°C? 5+5=10
b. Determine the change in entropy during melting of 27.3 gm of ice at 0°C. (Given: L_{fusion} of ice= 330)

6. a. Mention and elaborate the assumptions made for deriving the Maxwell-Boltzmann Distribution law. 2+2+3+3
=10
b. Write down the expression for Maxwellian distribution of molecular speeds and draw a suitable plot for Maxwellian distribution function vs. molecular speeds of gases.
c. Explain what happens to the plot of distribution function for
i. increase in velocity ii. increase in temperature

8.

7. a. Explain how the Kronig-Bonn diagram can be used to define the relationships between thermodynamic potentials. Also, write the relations. 2+2+1+2
+3=10
- b. Write the Maxwell's first relation and elaborate with examples how it is used to study the first order phase transitions.
- c. Determine the change in entropy during phase transition from ice to water at $\sim 0^\circ\text{C}$. [Given $L_{\text{fusion}}(\text{ice}) = 330\text{Jgm}^{-1}$]
8. a. Describe briefly the assumptions made for correction of ideal gas equation made by van der Waal. Express the van der Waal's equation of state and discuss the correction terms. 5+5=10
- b. Describe briefly the porous plug experiment and explain how it proves existence of intermolecular attraction in gases.

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