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Reg. No. :

Code No. : 30745 E Sub. Code : EMPH 21

B.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2024

Second Semester

Physics — Core

HEAT, THERMODYNAMICS AND STATISTICAL
PHYSICS

(For those who joined in July 2023 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer.

1. The molecules of an ideal gas have
- (a) only kinetic energy
 - (b) only potential energy
 - (c) both kinetic and potential energies
 - (d) zero energy

2. In Joule-Thomson effect, temperature of the gas

- (a) increases
- (b) decreases
- (c) sometimes increases
- (d) none of the above

3. The efficiency of Carnot's engine between 127°C and 27°C is

- (a) 25% (b) 50%
- (c) 75% (d) 100%

4. An engine works between the temperatures 300 K and 30 K. What is its efficiency?

- (a) 50% (b) 47%
- (c) 9% (d) 10%

5. According to Clausius theorem,

- (a) $\oint \frac{dQ}{T} > 0$ (b) $\oint \frac{dQ}{T} < 0$
- (c) $\oint \frac{dQ}{T} = \text{constant}$ (d) $\oint \frac{dQ}{T} = 0$

6. The second law of thermodynamics is

- (a) $\int \frac{d'Q}{T} \geq 0$ (b) $\oint \frac{d'Q}{T} > 0$
 (c) $\int \frac{d'Q}{T} < 0$ (d) $\frac{d'Q}{T} = 0$

7. The speed of heat radiations is

- (a) 300 ms^{-1} (b) $3 \times 10^8 \text{ cm.s}^{-1}$
 (c) $3 \times 10^8 \text{ m.s}^{-1}$ (d) $3 \times 10^{10} \text{ m.s}^{-1}$

8. Stefan's-Boltzmann's law is

- (a) $E = \sigma T^5$ (b) $\lambda_m \cdot T = \text{Constant}$
 (c) $E = \sigma(T^4 - T_0^4)$ (d) $E = \sigma T^4$

9. The particles obeying Maxwell-Boltzmann Statistics are

- (a) Identical
 (b) Identical and indistinguishable
 (c) Distinguishable
 (d) Photons

10. From Fermi-Dirac Statistics, $n_i = ?$

- (a) $\frac{g_i}{e^{\alpha + \beta E_i}} + 1$ (b) $\frac{2g_i}{e^{\alpha + \beta E_i}} + 1$
 (c) $\frac{2g_i}{e^{\alpha + \beta E_i}} - 1$ (d) $\frac{g_i}{e^{\alpha + \beta E_i}} - 1$

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PART B — (5 × 5 = 25 marks)

Answer ALL questions choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Explain the behaviour of real gases above and below the Boyle's temperature.

Or

- (b) Write a short notes on :

- (i) Mayer's relation
 (ii) Joule-Kelvin effect.

12. (a) State the zeroth law of Thermodynamics and explain it.

Or

- (b) Write a short notes on : Heat engine.

13. (a) Explain the Second law of thermodynamics and explain its significance.

Or

- (b) Calculate the efficiency of a heat engine working between 127°C and 27°C .

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[P.T.O.]

14. (a) Write a short notes on :

(i) Stefan's law

(ii) Wien's law.

Or

(b) State and explain Rayleigh-Jean's law.

15. (a) Define : Microstate and Macrostate. Explain with suitable examples.

Or

(b) Explain the term phase space.

PART C — ($5 \times 8 = 40$ marks)

Answer ALL questions choosing either (a) or (b).
Each answer should not exceed 600 words.

16. (a) Describe the Joly's method for determination of C_v .

Or

(b) Discuss the liquefaction of gases by Linde's process.

17. (a) Discuss the concept of first law of thermodynamics. State its significance.

Or

(b) Explain the working of Carnot's engine.

18. (a) State and prove Clausius-Clapeyron's equation.

Or

(b) State and explain the third law of thermodynamics.

19. (a) Define : Wien's law. Discuss the Wien's law of distribution for short wavelength.

Or

(b) Describe the Lee's disc method to find the thermal conductivity of a bad conductor.

20. (a) Discuss Maxwell-Boltzmann Statistics.

Or

(b) Compare the basic postulates of M-B, B-E and F-D statistics.