PHYSICS ACADEMY
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SUBJECT – THERODYNAMICS & STATISTICAL

CLASS ROOM TEST–01

"CSIR-NET/JRF JUNE-2021"

For –

- ☞ **CSIR-NET/JRF**
- ☞ **GATE / JEST**
- ☞ **TIFR / BARC**
- ☞ **All Ph.D. Entrance Exams**

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1. An ideal gas expands by using an equation of process PV^{γ} = constant. For which value of γ gas will show heating effect?

(a) $-1 < \gamma < 0$ (b) $1 < \gamma < 2$

(c) $0 < \gamma < 1$ (d) $2 < \gamma < 3$

2. The average energy per particle for a Fermi gas at T = 0, in terms of Fermi energy ε_F, If density of states is proportional $\varepsilon^{-1/2}$ is given by.

(a) $\frac{3}{5}\varepsilon_F$ (b) $\frac{1}{2}\varepsilon_F$ (c) $\frac{3}{4}\varepsilon_F$ (d) $\frac{1}{3}\varepsilon_F$

3. The expression $-\frac{1}{V}\left(\frac{\partial^2 G}{\partial P^2}\right)_T$ represents which thermodynamic quantity?

(a) Isothermal susceptibility (b) Coefficient of volume expansion

(c) Isothermal compressibility and is also equal to $-\frac{1}{V}\left(\frac{\partial^2 G}{\partial P^2}\right)_T$

(d) Isothermal compressibility but not equal to $-\frac{1}{V}\left(\frac{\partial^2 G}{\partial P^2}\right)_T$

4. In the first –order phase transition which is/are continuous.

(a) Volume (b) Chemical Potential

(c) Entropy (d) All

5. The energy of one mole of a particular system, is given by.

$$U = AP^2V$$

where A is a positive constant of dimension $[P]^{-1}$. The equation of the adiabats in P-V is.

(a) $PV^{5/3}$ = constant (b) $PV^{4/3}$ = constant

(c) $(AP+1)V^{1/3}$ = constant (d) $(AP+1)V^{1/2}$ = constant

6. Consider a system of distinguishable particle with energy levels $0, \varepsilon, 2\varepsilon, 3\varepsilon, 4\varepsilon, \ldots\ldots$ for a system with 2 particles and energy 2ε, the entropy of the system is.

(a) kln3 (b) 2kln2 (c) 2kln3 (d) kln5

7. Consider a system of two particles A and B. Each particle can occupy one of three possible quantum states $|1\rangle$, $|2\rangle$ and $|3\rangle$. The ratio of the probability that the two particles are in the same to the probability that the two particles are in different states is calculated for bosons and classical (Mawell-Boltzman) particles. They are respectively.

(a) 1 and 0 (b) ½ and 1 (c) 1 and ½ (d) 0 and ½

8. Consider a system of N non-interacting and distinguishable particles with single particle of energies $\varepsilon_1, \varepsilon_2, \varepsilon_3 \ldots\ldots\ldots\ldots \varepsilon_j$ with corresponding degeneracies g_1, g_2,

g_3 ……g_j. The value of the single particle partition function in the limit $T \to \infty$ will be.

(a) 1 (b) g_1 (c) $\sum_j g_j$ (d) $(g_j)^N$

9. Consider that the density of states g(E) for super-relativistic gas is defined as.

$$g(E) = \begin{cases} 1, & 0 < E < E_D \\ 0, & E > E_D \end{cases}$$

The specific heat at constant volume C_V for gas of boson and fermions in very low temperature limit ($T \to 0$) varies as.

(a) $C_V \alpha\ T^3$ for bosons and $C_V \alpha\ T$ for fermions

(b) $C_V \alpha\ T$ for bosons and $C_V \alpha\ T^3$ for fermions

(c) $C_V \alpha\ T^2$ for bosons and $C_V \alpha\ T$ for fermions

(d) $C_V \alpha\ T$ for bosons and $C_V \alpha\ T$ for fermions

10. The excitations of a three-dimensional solid are bosonic in nature with their frequency ω and wave-number k are related by $\omega \propto k$. If the chemical potential is zero, the behavior of the specific heat of the solid at low temperature is proportional to.

(a) $T^{1/2}$ (b) $T^{3/2}$ (c) T^3 (d) T

11. A system consists of N very weakly interacting particles at a temperature sufficiently high such that classical statistics are applicable. Each particle has mass m and oscillates in one direction about its equilibrium position. If restoring force is proportional to x^3, the heat capacity at temperature T is.

(a) $\frac{3}{2}Nk$ (b) $\frac{5}{4}Nk$ (c) $\frac{3}{4}Nk$ (d) $\frac{5}{2}Nk$

12. Suppose that in some sample the density of states of the electrons $D(\epsilon)$ is a constant D_0 for energy $\epsilon < \mu_0$ and $D(\epsilon) = 0$ for $\epsilon > \mu_0$ the total number of electrons is equal to N. The volume occupied by sample is V. (consider spin and T = 0). The chemical potential is.

(a) 0 (b) $\frac{N}{2VD_0}$ (c) $\frac{N}{4VD_0}$ (d) $\frac{N}{VD_0}$

13. Consider a system of N non-interacting localized spin-$\frac{1}{2}$ particles embedded in an external magnetic field $\vec{B}$. The number of particles in the state for which spin along magnetic field is (μ_B is Bohr magnetron).

(a) $\frac{e^{-\frac{\mu_B B}{kT}}}{2\cos h\left(\frac{\mu_B B}{kT}\right)}$ (b) $\frac{e^{-\frac{\mu_B B}{kT}} - e^{-\frac{\mu_B B}{kT}}}{2\cos h\left(\frac{\mu_B B}{kT}\right)}$

(c) $\frac{Ne^{-\frac{\mu_B B}{kT}}}{2\cos h\left(\frac{\mu_B B}{kT}\right)}$ (d) $\frac{Ne^{-\frac{\mu_B B}{kT}}}{e^{+\frac{\mu_B B}{kT}}}$

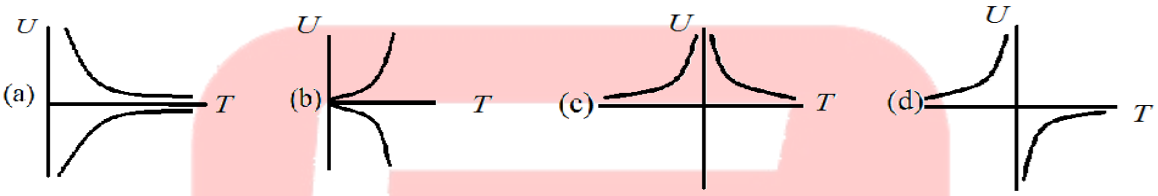
14. The equation of state of one mole of gas is given by $\left(P + \frac{a}{TV^2}\right)(V - b) = RT$, Where a, b are positive constant of appropriate dimensions and R is universal gas constant, the value of critical temperature of the gas is.

(a) $\sqrt{\left(\frac{8a}{27bR}\right)}$ (b) $\frac{8a}{27bR}$ (c) $\frac{3a}{27bR}$ (d) $\sqrt{\left(\frac{a}{27bR}\right)}$

15. The entropy S of an ideal paramagnet in a magnetic field is given approximated by.

$$S = S_0 - CU^2$$

Where, U is the energy of the spin system and C is a constant. For the variation of internal energy with absolute temperature T. which of the following plots is correct?



16. The entropy S of a system of N particles at temperature T is given by S = a $(NVU)^{1/3}$, where U and V are internal energy and volume of the system respectively and a is constant. If temperature changes to 4T then specific heat of the system at constant volume becomes.

(a) Four times (b) Two times (c) Eight Times (d) Half

ANS-KEY

1.	**C**	**2.**	**D**	**3.**	**D**	**4.**	**B**	**5.**	**D**
6.	**A**	**7.**	**C**	**8.**	**C**	**9.**	**D**	**10.**	**C**
11.	**C**	**12.**	**B**	**13.**	**C**	**14.**	**A**	**15.**	**D**
16.	**B**								