# PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

# Microstates and Macrostates - CSIR NET Physics PYQs

Statistical Mechanics . All PYQs (2015-2025) with answer key

**9 questions . Answer key included**

**www.physicsbyaaryan.com . www.csirnetphysics.com**
Contact: 9501976811

**Q1. [June 2018] . 3.5 marks**

Statistical Mechanics > Microstates and Macrostates

| CSIR NET | 2018 June | 3.5M |
|---|---|---|

The number of ways of distributing 11 indistinguishable bosons in 3 different energy levels is

1. $3^{11}$
2. $11^3$
3. $\frac{(13)!}{2!(11)!}$
4. $\frac{(11)!}{3!8!}$

**Q2. [Dec 2019] . 3.5 marks**

Statistical Mechanics > Microstates and Macrostates

| CSIR NET | 2019 Dec | 3.5M |
|---|---|---|

Two spin $\frac{1}{2}$ fermions of mass $m$ are confined to move in a one-dimensional infinite potential well of width $L$. If the particles are known to be in a spin triplet state, the ground state energy of the system (in units of $\frac{\hbar^2\pi^2}{2mL^2}$) is

1. 8
2. 2
3. 3
4. 5

**Q3. [June 2019] . 3.5 marks**

Statistical Mechanics > Microstates and Macrostates

| CSIR NET | 2019 June | 3.5M |
|---|---|---|

In a system comprising of approximately $10^{23}$ distinguishable particles, each particle may occupy any of 20 distinct states. The maximum value of the entropy per particle is nearest to

1. $20k_B$
2. $3k_B$
3. $10(\ln 2)k_B$
4. $20(\ln 2)k_B$

**Q4. [June 2020] . 5.0 marks**

Statistical Mechanics > Microstates and Macrostates

| CSIR NET | 2020 June | 5M |
|---|---|---|

Spin $\frac{1}{2}$ fermions of mass m and 4m are in a harmonic potential $V(x) = \frac{1}{2}kx^2$. Which configuration of 4 such particles has the lowest value of the ground state energy?

1. 4 particles of mass m
2. 4 particles of mass 4m
3. 1 particle of mass m and 3 particles of mass 4m
4. 2 particles of mass m and 2 particles of mass 4m

**Q5. [Dec 2023] . 3.5 marks**

Statistical Mechanics > Microstates and Macrostates

| CSIR NET | 2023 Dec | 3.5 M |
|---|---|---|

Each allowed energy level of a system of non-interacting fermions has a degeneracy M. If there are N fermions and R is the remainder upon dividing N by M , then the degeneracy of the ground state is

1. $R^M$
2. 1
3. $M$
4. ${}^{M}C_{R}$

**Q6. [Dec 2023] . 3.5 marks**

Statistical Mechanics > Microstates and Macrostates

| CSIR NET | 2023 Dec | 3.5 M |
|---|---|---|

Four distinguishable particle fill up energy levels $0, \in, 2 \in$. The number of available microstates for the total energy $4 \in$ is

1. 20
2. 24
3. 11
4. 19

**Q7. [June 2023] . 3.5 marks**

Statistical Mechanics > Microstates and Macrostates

| CSIR NET | 2023 June | 3.5M |
|---|---|---|

The single particle energies of a system of N non-interacting fermions of spin $s$ (at $\mathrm{T} = 0$ ) are $\mathrm{E_n} = \mathrm{n}^2\mathrm{E}_0$, $\mathrm{n} = 1,2,3\cdots$. The ratio $\epsilon_F\left(\frac{3}{2}\right)/\epsilon_F\left(\frac{1}{2}\right)$ of the Fermi energies for fermions of spin $3/2$ and spin $1/2$, is

1. 1/2
2. 1/4
3. 2
4. 1

**Q8. [June 2023] . 3.5 marks**

Statistical Mechanics > Microstates and Macrostates

| CSIR NET | 2023 June | 3.5M |
|---|---|---|

The energy levels available to each electron in a system of N non-interacting electrons are $E_n = nE_0$, $n = 0,1,2,\cdots$. A magnetic field, which does not affect the energy spectrum, but completely polarizes the electron spins, is applied to the system. The change in the ground state energy of the system is

1. $\frac{1}{2}N^2E_0$
2. $N^2E_0$
3. $\frac{1}{8}N^2E_0$
4. $\frac{1}{4}N^2E_0$

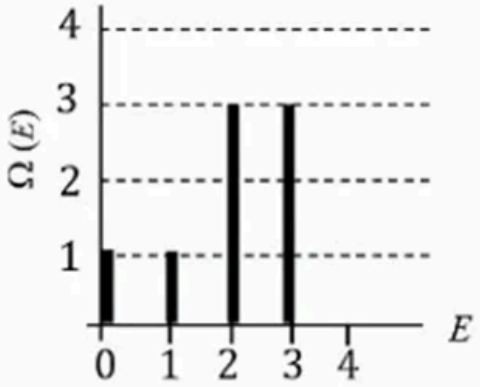
**Q9. [June 2025] . 3.5 marks**

Statistical Mechanics > Microstates and Macrostates

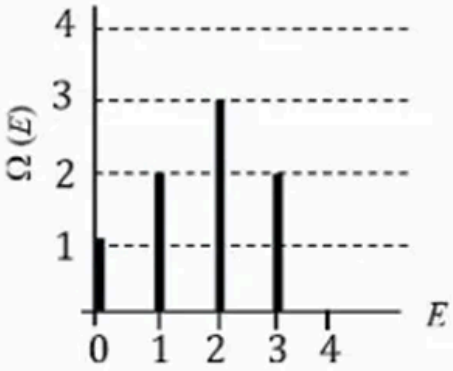
| CSIR NET | 2025 June | 3.5M | Stat. Mech. |
|---|---|---|---|

There are two boxes, one at the ground level, and the other at a fixed height $h$. There are three balls of different colours, each having mass $m$ and radius $r \ll h$. There is no restriction on the number of balls that can be simultaneously put in a given box. For a given value of the total energy $E$ (in units of $mgh$, $g$ being the acceleration due to gravity), the number of accessible microstates is $\Omega(E)$. The plot of $\Omega(E)$ vs $E$ is

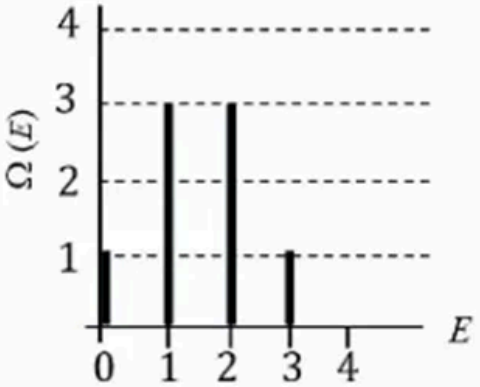
1.



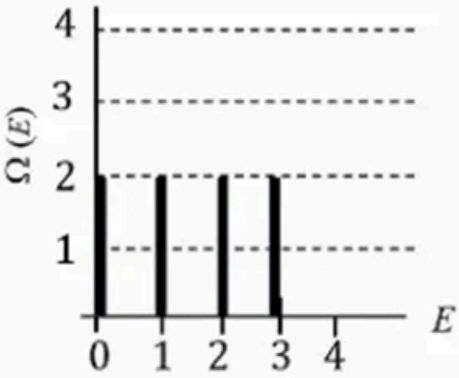

2.




3.




4.



# Answer Key

9 questions . Subject and topic for quick revision

| Q. No | Subject | Topic | Answer |
|---|---|---|---|
| Q1 | Statistical Mechanics | Microstates and Macrostates | **3** |
| Q2 | Statistical Mechanics | Microstates and Macrostates | **4** |
| Q3 | Statistical Mechanics | Microstates and Macrostates | **2** |
| Q4 | Statistical Mechanics | Microstates and Macrostates | **4** |
| Q5 | Statistical Mechanics | Microstates and Macrostates | **4** |
| Q6 | Statistical Mechanics | Microstates and Macrostates | **4** |
| Q7 | Statistical Mechanics | Microstates and Macrostates | **2** |
| Q8 | Statistical Mechanics | Microstates and Macrostates | **4** |
| Q9 | Statistical Mechanics | Microstates and Macrostates | **3** |

# Study with PhysicsByAaryan

Full CSIR NET / GATE / JEST / BARC Physics live batch by Aaryan Mehra Sir.
Concept-first teaching, complete PYQ coverage, daily doubt support.

**Use coupon CONSISTENCY for Rs. 500 off**

**Visit**
www.physicsbyaaryan.com
www.csirnetphysics.com

**Contact**
9501976811