PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

CSIR NET Physics - June 2025 - Full Paper

Complete question paper with answer key

75 questions . Answer key included

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Q1. [June 2025] . 2.0 marks

General Aptitude > Reasoning

CSIR NET	2025 June	2M

Consider the following statements:

Statement I: All Booklets are Manuals.

Statement II: All Manuals are Catalogues.

If Statements I and II are True, which one of the following conclusions can be conclusively drawn?

1. All Manuals are Booklets.
2. All Catalogues are Booklets.
3. All Booklets are Catalogues.
4. All Catalogues are Manuals.

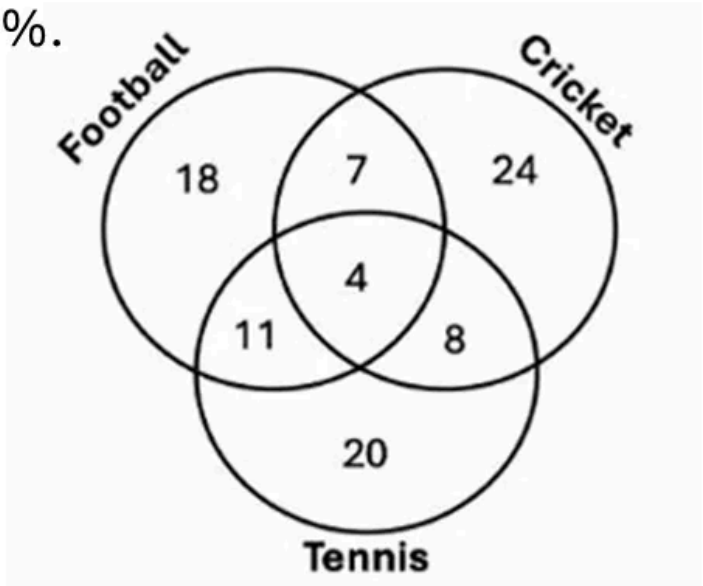
Q2. [June 2025] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2025 June	2M

The given Venn diagram shows numbers of players playing one or more than one sport.

The percentage of players who play exactly two sports is closest to ___ %.



1. 5
2. 14
3. 28
4. 32

Q3. [June 2025] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2025 June	2M

The value of a company is measured as the total value of its shares owned by different investors. Rakesh owns $2/15$ of the shares of a company. He sells $1/3$ of his shares for Rs. 75,000/-. What is the total value of the company at that time?

1. Rs. 15,75,800
2. Rs. 16,87,500
3. Rs. 17,75,800
4. Rs. 18,27,500

Q4. [June 2025] . 2.0 marks

General Aptitude > Basic Physics

CSIR NET	2025 June	2M

A car has wheels of diameter 36 cm . If it runs at a speed of 60 km/h, then the rotation per minute (RPM) will be closest to ___ .

1. 884
2. 898
3. 906
4. 986

Q5. [June 2025] . 2.0 marks

General Aptitude > Basic Physics

CSIR NET	2025 June	2M

A cylindrical container of radius 20 cm was filled with water up to 25 cm height. A solid spherical ball of radius 7 cm was then immersed in the water. What would be the approximate increase in water level in the container after the ball was fully immersed?

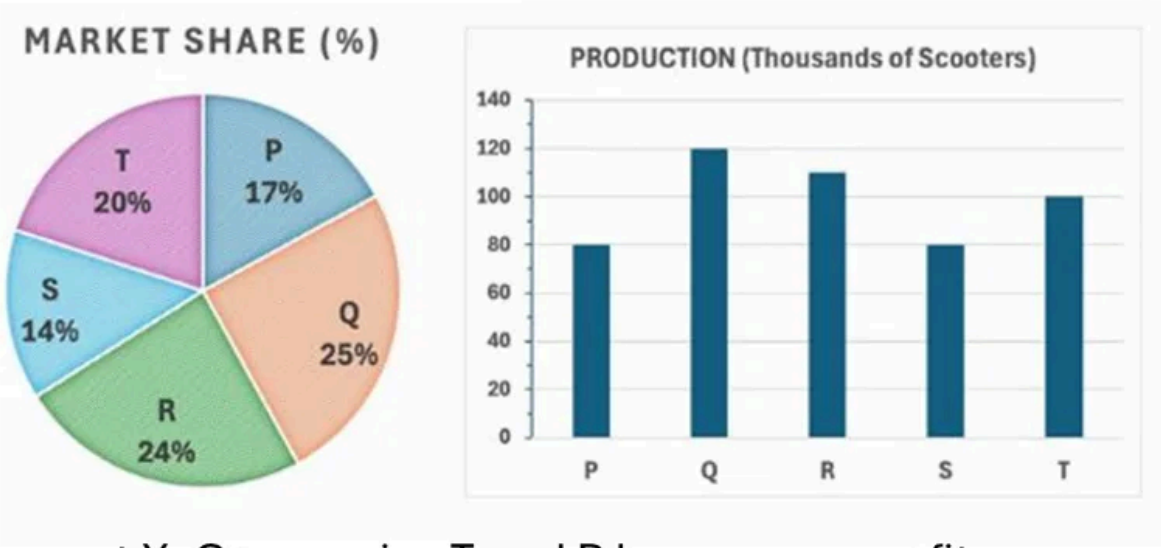
1. 1.14 cm
2. 2.28 cm
3. 5.50 cm
4. 7.00 cm

Q6. [June 2025] . 2.0 marks

General Aptitude > Data Analysis

CSIR NET	2025 June	2M

The market share (%) and annual production of scooters from five automobile companies P, Q, R, S, and T are shown in graphs. If the profit of a company is directly proportional to the ratio of market share to production, then which of the following statements is/are CORRECT?



Statement X: Companies T and P have same profit

Statement Y: Company R has the maximum profit

Statement Z: Company S has the minimum profit

1. X and Y
2. X and Z
3. Y and Z
4. Only Z

Q7. [June 2025] . 2.0 marks

General Aptitude > Basic Physics

CSIR NET	2025 June	2M

Rahul and his father started jogging on a circular track of radius 'r' ($r > 2$). Rahul completed one round and stopped. His father got tired half way into the first round and returned to his starting point along a straight line. What is the ratio of the distances covered by Rahul and his father?

1. $\pi r/(\pi + 2)$
2. $2\pi/(\pi + 2)$
3. 1
4. 2

Q8. [June 2025] . 2.0 marks

General Aptitude > Basic Physics

CSIR NET	2025 June	2M

Kavita starts from her house and walks 200 m northward, then turns 45° right and walks 70 m . After that, she turns 90° right and walks 70 m . Which of the following is the closest value of the shortest distance between Kavita's current location and her house?

1. 296 m
2. 240 m
3. 200 m
4. 223 m

Q9. [June 2025] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2025 June	2M

The initial monthly salaries of employees John, Riya, and Sunil were in the proportion 4:3:5. After an increase of Rs 10000 monthly to all, the new proportion becomes 6: 5: 7. What was the initial salary of Sunil?

1. Rs 20000
2. Rs 25000
3. Rs 30000
4. Rs 35000

Q10. [June 2025] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2025 June	2M

Numbers of Rose, Lotus, and Marigold plants in a garden are in the proportion 8:5:7. Later, 75%, 40% and 50% more plants of their respective categories were added. What will be the new proportion of plants, in the same order?

1. 5: 3: 4
2. 4:2:3
3. 5:4:3
4. 7:4:5

Q11. [June 2025] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2025 June	2M

What will be the digit at the unit's place of $1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 + 8^3 + 9^3$?

1. 0
2. 5
3. 7
4. 9

Q12. [June 2025] . 2.0 marks

General Aptitude > Reasoning

CSIR NET	2025 June	2M

Suresh asked Ramesh to identify the person in a photo that the latter is holding. Ramesh responds, "I have no brothers or sisters. However, that man's father is my father's son." Who is the person in the photo?

1. Suresh
2. Ramesh
3. Ramesh's son
4. Ramesh's cousin

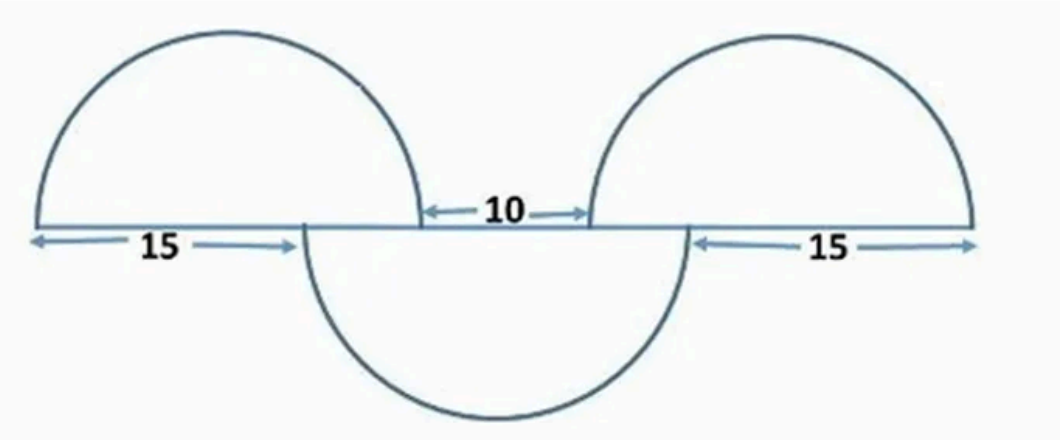
Q13. [June 2025] . 2.0 marks

General Aptitude > Geometry

CSIR NET	2025 June	2M

Three identical semi-circles are arranged as shown. What is the diameter of the semi-circles?

1. 5π
2. 20
3. $15\pi/2$
4. 25



Q14. [June 2025] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2025 June	2M

A number is mistakenly divided by 2 instead of being multiplied by 2 . What is the change in the result caused by this mistake?

1. 25%
2. 50%
3. 75%
4. 100%

Q15. [June 2025] . 2.0 marks

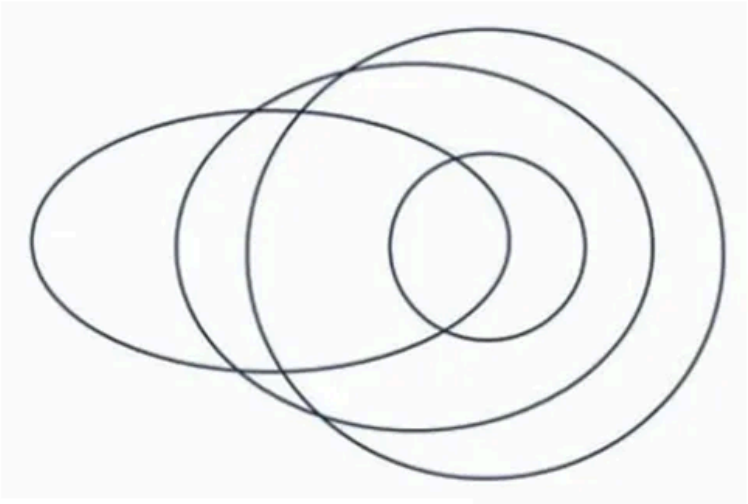
General Aptitude > Reasoning

CSIR NET	2025 June	2M

The following diagram represents the relationship between four categories.

The categories could be

1. Rivers, water bodies, oceans, sources of evaporation
2. Parliamentarians, celebrities, elected persons, professional politicians
3. Monkeys, four-legged animals, pet animals, land animals
4. Furniture, chairs, seats, wooden objects



Q16. [June 2025] . 2.0 marks

General Aptitude > Reasoning

CSIR NET	2025 June	2M

In a code, the word DELTOID is written as 3152893 . Then LOTION could be written as

1. 582986
2. 582981
3. 198396
4. 198392

Q17. [June 2025] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2025 June	2M

Sum of the digits of a two-digit number 'ab' is subtracted from the number and the result is divided by 9 . Then the result of this will be

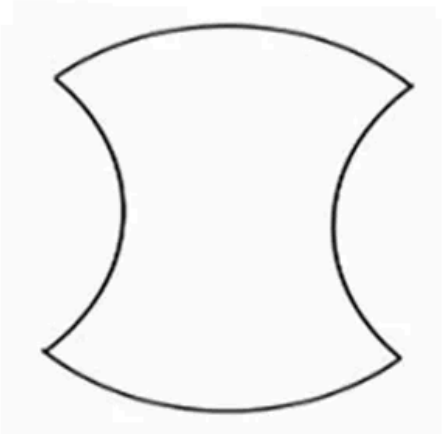
1. always a
2. always b
3. neither a nor b
4. either a or b depending on a+b

Q18. [June 2025] . 2.0 marks

General Aptitude > Geometry

CSIR NET	2025 June	2M

A circle of radius 1 unit is divided into four quarters and rejoined as shown below. What is the area of this shape?



1. π
2. 1
3. 2
4. 4

Q19. [June 2025] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2025 June	2M

A stock market trader has lost two thirds of her investment on a day. Next day she recovered one third of the previous day's loss. What fraction of her initial investment is she left with?

1. $\frac{1}{3}$
2. $\frac{2}{3}$
3. $\frac{2}{9}$
4. $\frac{5}{9}$

Q20. [June 2025] . 2.0 marks

General Aptitude > Reasoning

[image unavailable]

Q21. [June 2025] . 3.5 marks

Mathematical Physics > Ordinary Differential Equations

CSIR NET	2025 June	3.5M	MMP

The solutions of the differential equation

$$\frac{dy}{dx} = -\frac{x}{y+1}$$

are a family of

1. ellipses with different eccentricities
2. circles with different centres
3. circles with different radii
4. ellipses with different foci

Q22. [June 2025] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2025 June	3.5M	MMP

For the function $f(z) = \exp\left[z - 1 + \frac{1}{z-1}\right]$

1. $z = 1$ is a pole of order one.
2. $z = 1$ is an essential singularity.
3. $z = 1$ is a pole of order two.
4. $z = 1$ is a removable singular point.

Q23. [June 2025] . 3.5 marks

Mathematical Physics > Matrices and Linear Algebra

CSIR NET	2025 June	3.5M	MMP

For the matrix $A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 3 & 1 \\ 0 & 1 & 0 \end{bmatrix}$, which of the following is true?

1. $A^3 = 5A^2 - 4A - 2$
2. $A^3 = 4A^2 - 6A + 3$
3. $A^3 = 5A^2 - 5A - 1$
4. $A^3 = 8A^2 + 3A - 4$

Q24. [June 2025] . 3.5 marks

Mathematical Physics > Dirac Delta Function

CSIR NET	2025 June	3.5M	MMP

The value of the integral

$$\int_1^e dy \int_0^5 dx \delta(x^2 - y^2) \ln(xy)$$

is

1. $\frac{1}{2}$
2. $\frac{1}{3}$
3. $\frac{1}{e}$
4. $\frac{e}{5}$

Q25. [June 2025] . 3.5 marks

Classical Mechanics > Basic Mechanics

[image unavailable]

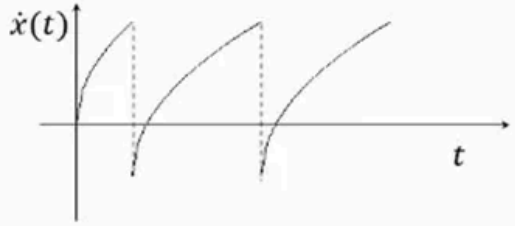
Q26. [June 2025] . 3.5 marks

Classical Mechanics > Basic Mechanics

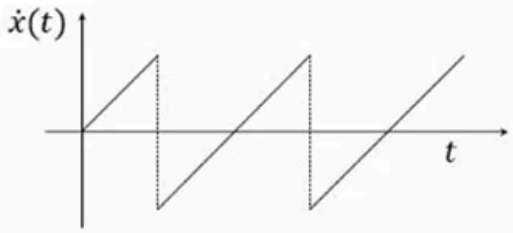
CSIR NET	2025 June	3.5M	CM

A particle of mass m is subjected to a potential $V(x) = V_0\Theta(x) - kx$, where V_0 and k are positive constants and V_0 is much larger than the energy of the particle. The function $\Theta(x) = 1$ for $x \geq 0$ and equals 0 otherwise. The particle starts from rest at $t = 0$ and $x = -5$. In the limit $V_0 \to \infty$, the graph for $\dot{x}(t)$ is best represented by

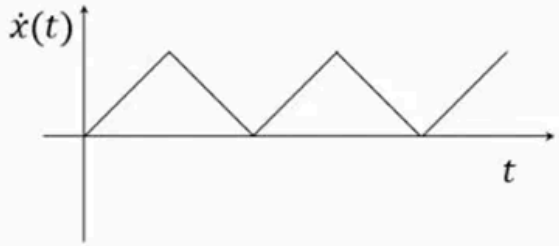
1.



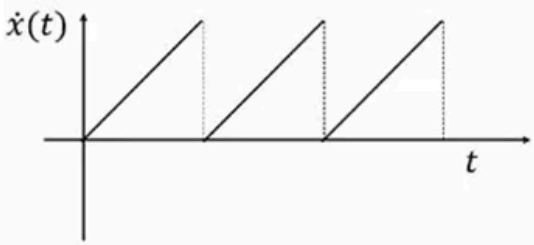
2.



3.



4.



Q27. [June 2025] . 3.5 marks

Classical Mechanics > Lagrangian and Hamiltonian

CSIR NET	2025 June	3.5M	CM

The Hamiltonian of a system is given by $H(x,p) = -\left[p^2 + V^2(x)\right]^{1/2}$, where x and p are generalized co-ordinate and momentum respectively and $V(x) \geq 0$. The corresponding Lagrangian is

1. $-V(x)\sqrt{1-\dot{x}^2}$
2. $-V(x)/\sqrt{1-\dot{x}^2}$
3. $V(x)\sqrt{1-\dot{x}^2}$
4. $V(x)/\sqrt{1-\dot{x}^2}$

Q28. [June 2025] . 3.5 marks

Classical Mechanics > Rotation Motion

CSIR NET	2025 June	3.5M	CM

Consider the earth to be a free rigid body symmetric about its north-south (z) axis. If the principal moments of inertia satisfy $I_z = 1.003I_x$, then its angular velocity (in the body fixed frame) would precess about the z-axis with a period of nearly

1. 167 days
2. 333 days
3. 556 days
4. 667 days

Q29. [June 2025] . 3.5 marks

Quantum Mechanics > Quantum Harmonic Oscillator

CSIR NET	2025 June	3.5M	QM

The energy eigenstates of a one-dimensional harmonic oscillator are denoted by $|i\rangle$, where $i = 0,1,2,3$ .... . If the momentum operator $\hat{p}$ satisfies $\frac{\langle n+1|\hat{p}|n\rangle}{\langle 2|\hat{p}|1\rangle} = \sqrt{2}$, then the value of n is

1. 0
2. 1
3. 2
4. 3

Q30. [June 2025] . 3.5 marks

Quantum Mechanics > Two particle System

CSIR NET	2025 June	3.5M	QM

A system consists of two non-interacting identical spin-$\frac{1}{2}$ particles. The spatial wave functions for the individual particles are given by $\varphi_1(x)$ and $\varphi_2(x)$. Let x_1 and x_2 denote the positions of the particles respectively. The total wave function of the system (not necessarily normalized) can be

1. $[\varphi_1(x_1)\varphi_2(x_2) - \varphi_2(x_1)\varphi_1(x_2)][|\uparrow\rangle_1|\downarrow\rangle_2 + |\downarrow\rangle_1|\uparrow\rangle_2]$
2. $[\varphi_1(x_1)\varphi_1(x_2) + \varphi_2(x_1)\varphi_2(x_2)]|\uparrow\rangle_1|\uparrow\rangle_2$
3. $\varphi_1(x_1)\varphi_2(x_2)|\uparrow\rangle_1|\uparrow\rangle_2$
4. $[\varphi_1(x_1)\varphi_2(x_2) - \varphi_2(x_1)\varphi_1(x_2)][|\uparrow\rangle_1|\downarrow\rangle_2 - |\downarrow\rangle_1|\uparrow\rangle_2]$

Q31. [June 2025] . 3.5 marks

Quantum Mechanics > Spin Angular momentum

CSIR NET	2025 June	3.5M	QM

A spin-$\frac{1}{2}$ system is prepared in the initial state $|\varphi\rangle = \frac{\sqrt{3}}{2}|\uparrow\rangle + \frac{1}{2}|\downarrow\rangle$ where $|\uparrow\rangle$ & $|\downarrow\rangle$ are eigenstates of $\hat{S}_z$ with eigenvalues $+\frac{\hbar}{2}$ & $-\frac{\hbar}{2}$ respectively. A measurement of $\hat{S}_z$ is followed by a measurement of $\hat{S}_x$ on the system. What is the probability that the measurement of $\hat{S}_x$ yields a value $+\frac{\hbar}{2}$?

1. $\frac{1}{2}$
2. $\frac{2+\sqrt{3}}{4}$
3. $\frac{2-\sqrt{3}}{4}$
4. $\frac{3}{8}$

Q32. [June 2025] . 3.5 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2025 June	3.5M	QM

A particle of mass m is in the third energy eigenstate of an infinite potential well of width a. The time interval in which the phase of this wave function changes by 2π is

1. $\frac{4ma^2}{3\pi\hbar}$
2. $\frac{4ma^2}{9\pi\hbar}$
3. $\frac{8ma^2}{3\pi\hbar}$
4. $\frac{8ma^2}{9\pi\hbar}$

Q33. [June 2025] . 3.5 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2025 June	3.5M	QM

The Hamiltonian of the 1-dimensional quantum harmonic oscillator is given by $H = \frac{p^2}{2m} + \frac{1}{2}m\omega^2 x^2$. The expectation value of $[D, H]$ in the ground state, where $D = \frac{1}{2\hbar}(xp + px)$, is (in units of $\hbar\omega$)

1. i
2. $\frac{1}{2}$
3. 3. $\frac{-3i}{2}$
4. 0

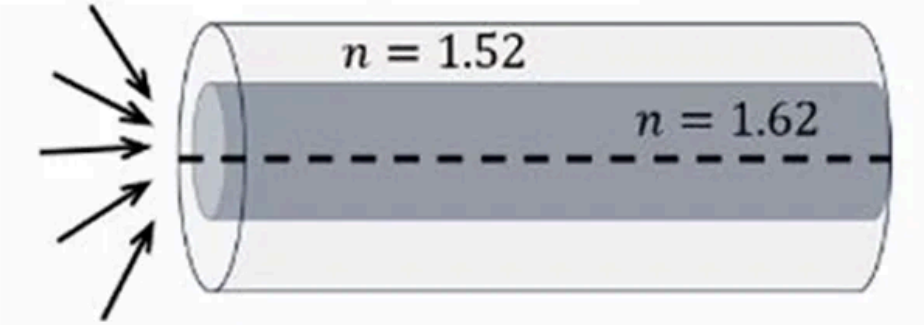
Q34. [June 2025] . 3.5 marks

Optics > Ray Optics

CSIR NET	2025 June	3.5M	EMT

A 1 km long optical fiber of core and clad refractive indices 1.62 and 1.52 , respectively, is laid in a straight line. Several identical light pulses are launched simultaneously from air on the entrance of this fiber from different angles about its axis, as shown below. The diameter of the fiber is small compared to its length. The maximum time difference between the pulses emerging at the other end of the fiber would be closest to

1. $355ns$
2. $317ns$
3. $5.40\mu s$
4. $5.75\mu s$



Q35. [June 2025] . 3.5 marks

Electromagnetism > EM Waves

CSIR NET	2025 June	3.5M	EMT

A plane electromagnetic wave $\overrightarrow{E_I}\cos(k_z z + \omega t)$ is incident normally on a perfectly reflecting mirror in vacuum. If the permittivity of free space is ε_0, the force exerted on an area A of the mirror would be

1. $A\varepsilon_0\left|\overrightarrow{E_I}\right|^2\hat{z}$
2. $-\frac{A\varepsilon_0}{2}\left|\overrightarrow{E_I}\right|^2\hat{z}$
3. $\frac{A\varepsilon_0}{2}\left|\overrightarrow{E_l}\right|^2\hat{Z}$
4. $-A\varepsilon_0\left|\overrightarrow{E_I}\right|^2\hat{z}$

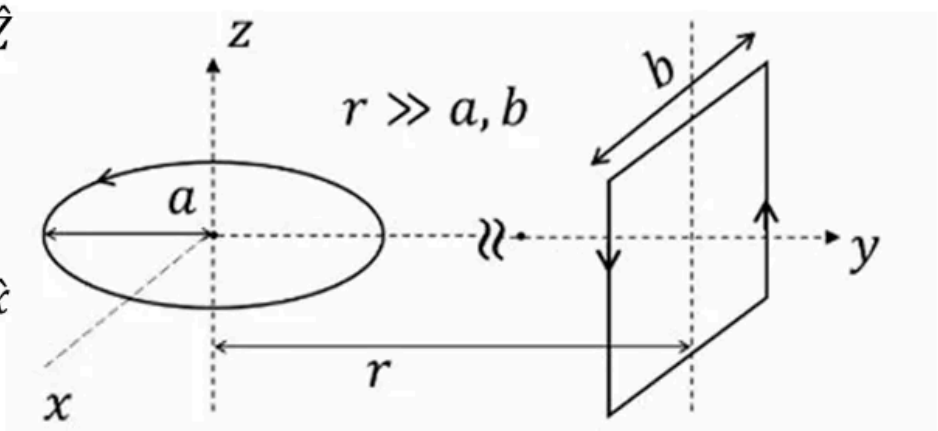
Q36. [June 2025] . 3.5 marks

Electromagnetism > Magetostatics

CSIR NET	2025 June	3.5M	EMT

A circular loop of radius a (in the $x-y$ plane) and a square loop of side b (in the x-z plane) are kept at a distance r. Both carry current I as shown in the figure. If $r \gg a, b$, the torque exerted on the square loop by the circular loop is

1. $-\frac{\mu_0}{4\pi}\frac{1}{r^3}\pi a^2 b^2 I^2 \hat{Z}$
2. 0
3. $\frac{\mu_0}{4\pi}\frac{1}{r^3}\pi a^2 b^2 I^2 \hat{x}$
4. $-\frac{\mu_0}{4\pi}\frac{1}{r^3}\pi a^2 b^2 I^2 \hat{x}$



Q37. [June 2025] . 3.5 marks

Electromagnetism > Relativistic electromagnetism

CSIR NET	2025 June	3.5M	EMT

In a particular inertial frame, electric field $\vec{E}$ and magnetic field $\vec{B}$ are

$$\vec{E} = E_0\hat{x}, \vec{B} = \frac{E_0}{2c}\hat{x}$$

Which of the following statements is true?

1. There exists an inertial frame where $\vec{E} = 0, \vec{B} \neq 0$
2. There exists no inertial frame where either $\vec{E} = 0$ or $\vec{B} = 0$
3. There exists an inertial frame where $\vec{B} = 0, \vec{E} \neq 0$
4. There exists an inertial frame where both $\vec{E} = 0$ and $\vec{B} = 0$

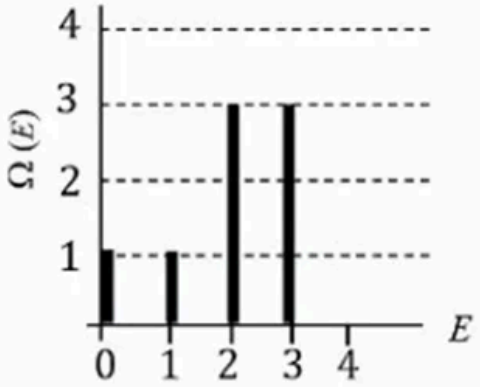
Q38. [June 2025] . 3.5 marks

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.



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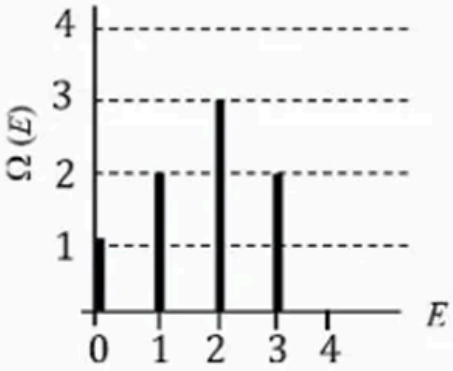

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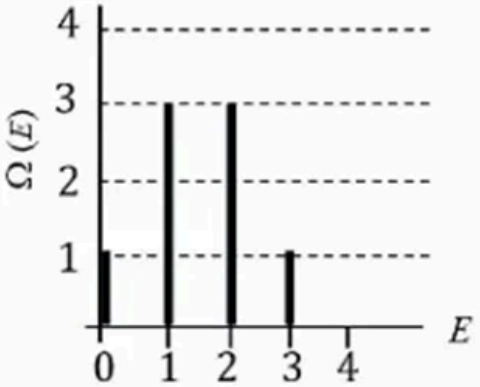

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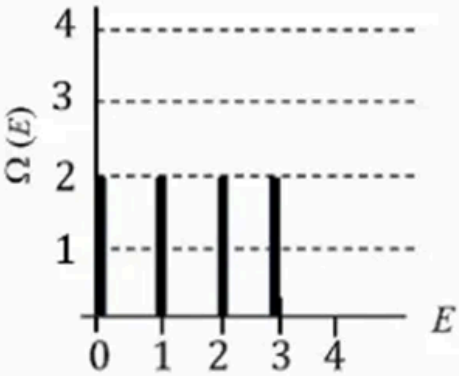


Q39. [June 2025] . 3.5 marks

Statistical Mechanics > Microcanonical Ensemble

CSIR NET	2025 June	3.5M	Stat. Mech.

The internal energy of a system is given by $U = g(N)V^{-\frac{2}{3}}\exp\left[\frac{2S}{3NR}\right]$, where V is the volume, S is the entropy, N is the number of molecules and R is a constant. The function $g(N)$ is proportional to

1. $N^{5/3}$
2. $N^{1/3}$
3. $N^{2/3}$
4. N

Q40. [June 2025] . 3.5 marks

Thermodynamics > Kinetic theory of Gases

CSIR NET	2025 June	3.5M	Thermal

Consider one mole of an ideal diatomic gas molecule at temperature T such that $k_B T \gg hv$, where v is the frequency of its vibrational mode. If C_p and C_v are specific heats of this gas at constant pressure and volume respectively, then the ratio $\gamma = \frac{c_p}{c_v}$, is

1. 2
2. $\frac{7}{5}$
3. $\frac{5}{3}$
4. $\frac{9}{7}$

Q41. [June 2025] . 3.5 marks

Thermodynamics > Carnot Cycle

CSIR NET	2025 June	3.5M	Thermal

A refrigerator can be thought to be a reversible engine operating between $T_2 = 20^{\circ}\text{C}$ and $T_1 = -10^{\circ}\text{C}$. The work needed to run this is supplied by another engine, that takes in energy at the rate of 500 W and runs with 50% efficiency. If the refrigerator freezes 5kg of water at 0^0C (latent heat $Q_L = 334\ \text{kJ/kg}$ for ice) in n hours, then n is closest to

1. 0.4
2. 0.3
3. 0.1
4. 0.2

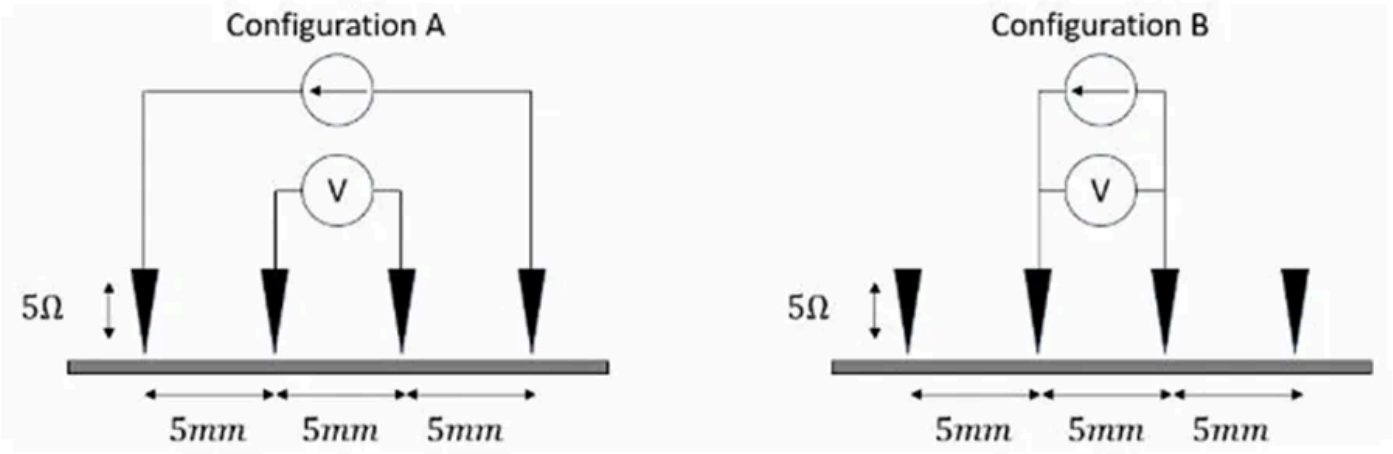
Q42. [June 2025] . 3.5 marks

Electronics > Instruments

CSIR NET	2025 June	3.5M	Electronics

Let R_A and R_B be the resistances of a channel determined (by taking the ratio of the voltage measured and current flowing) using configurations A and B respectively, as shown in the figure. In both configurations, each lead resistance is 5Ω and each contact resistance is 10Ω. The channel has a resistivity of $20\Omega/\text{mm}$. Considering the voltmeter and the current source as ideal devices, the ratio R_B/R_A is:

1. 1.1 2. 1.2 3. 1.3 4. 1.5



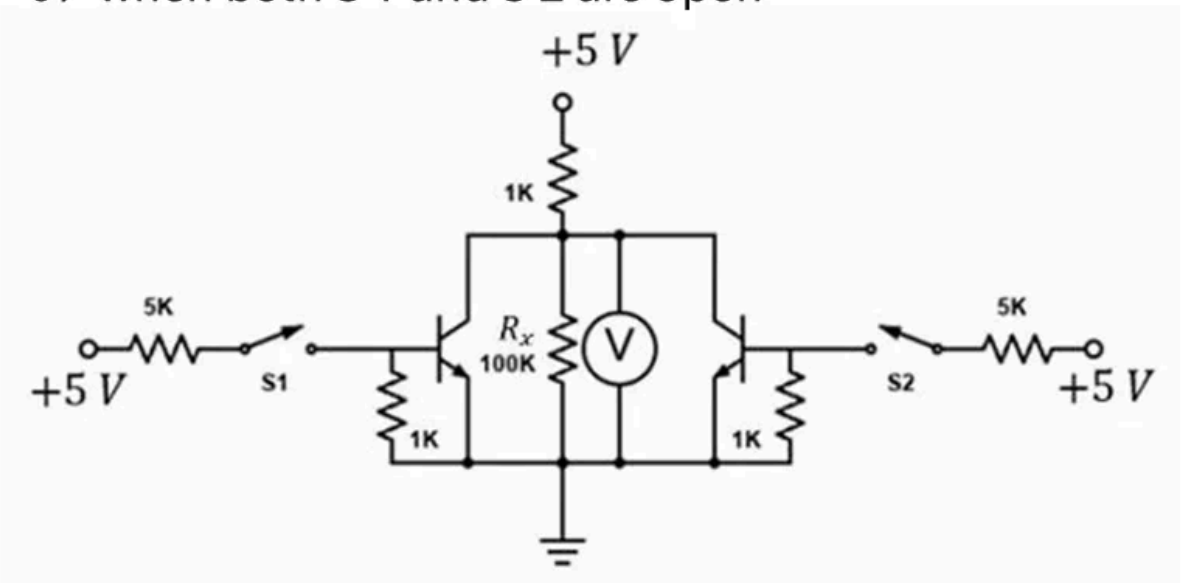
Q43. [June 2025] . 3.5 marks

Electronics > Transistors

CSIR NET	2025 June	3.5M	Electronics

The circuit, composed of npn transistors of high β, resistors and switches, is shown in the figure. The biasing is sufficient to turn on the transistors when respective switches S1 and S2 are closed. The voltage across the resistor $R_x = 100\text{k}\Omega$ is

1. $\sim 5V$ when both S 1 and S 2 are closed
2. $\sim 5V$ when either S 1 or S 2 are closed
3. $\sim 5V$ when both S 1 and S 2 are open
4. $\sim 0V$ when both S 1 and S 2 are open



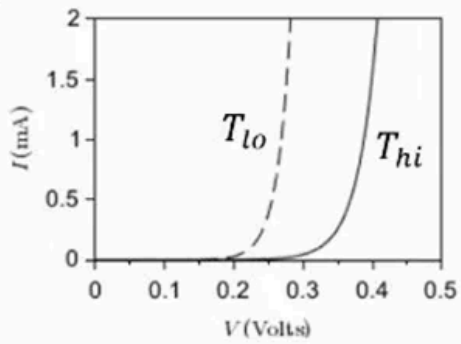
Q44. [June 2025] . 3.5 marks

Electronics > Diodes

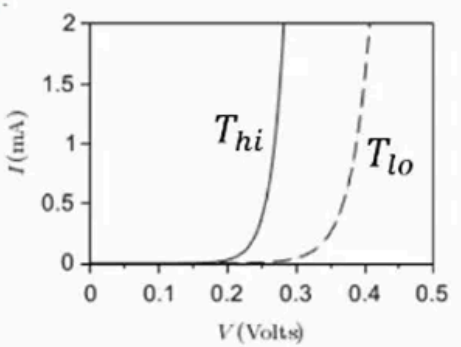
CSIR NET	2025 June	3.5M	Electronics

A Silicon p-n junction diode is operated under forward bias at two temperatures $T_{hi} \approx 300$ K, (shown by solid line) and $T_{lo} \approx 200$ K, (shown by dotted line). Which of the following plots best represents the I-V characteristics of the diode?

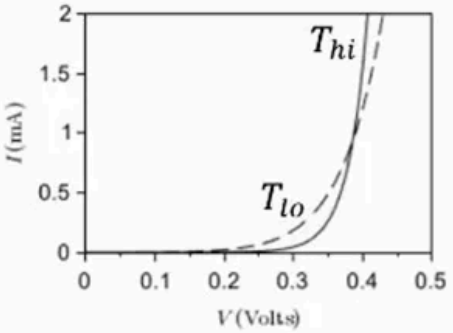
1.



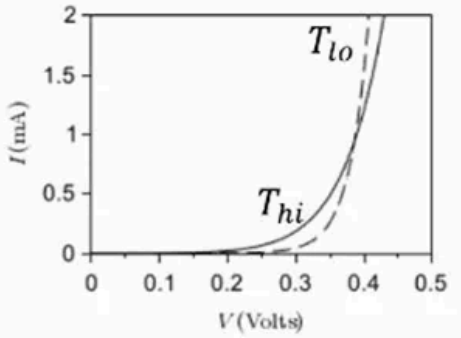
2.



3.



4.



Q45. [June 2025] . 3.5 marks

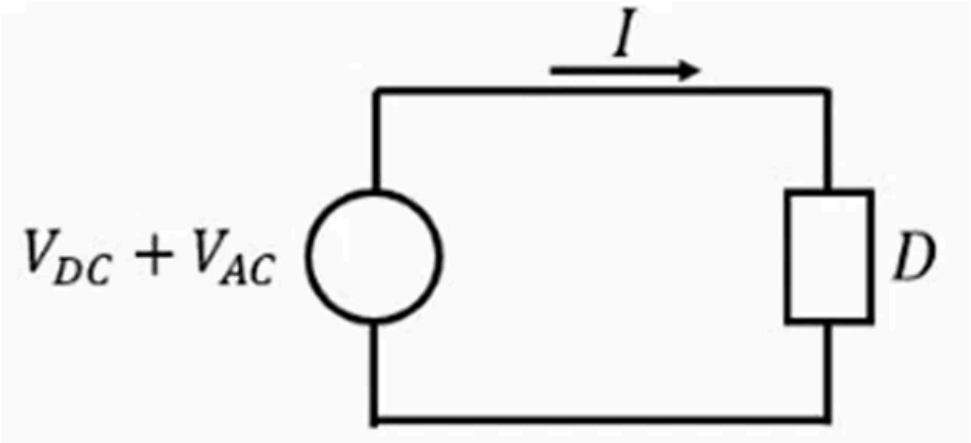
Electronics > Instruments

CSIR NET	2025 June	3.5M	Electronics

Consider the device D shown in the figure below. Its current-voltage characteristic is given by $I = aV + bV^2$, where I is the current, V is the input voltage, and a and b are constants. The device is used to mix a voltage signal $V = V_{DC} + V_{AC}$, where $V_{AC} = V_0 \cos\omega t$. V_{DC} and V_0 are constants.

The frequency components present in the current I are

1. 0 and ω
2. 0, ω and 2ω
3. 0 and 2ω
4. ω and 2ω



Q46. [June 2025] . 5.0 marks

Mathematical Physics > Special Functions

CSIR NET	2025 June	5M	MMP

Let $P_n(x)$ be a polynomial of degree n with real coefficients, where $n = 0,1,2,3,\cdots$. If $\int_2^4 P_n(x)P_m(x)dx = \delta_{mn}$, then

1. $P_1(x) = \pm\sqrt{\frac{3}{2}}(3-x)$
2. $P_1(x) = \pm\sqrt{\frac{3}{2}}(2-x)$
3. $P_1(x) = \pm\sqrt{\frac{3}{2}}(1-x)$
4. $P_1(x) = \pm\sqrt{3}(3+x)$

Q47. [June 2025] . 5.0 marks

Mathematical Physics > Complex analysis

CSIR NET	2025 June	5M	MMP

The value of the integral $\int_0^\infty \frac{\cos(\alpha x)}{1+x^2}dx$, where α is a positive real number, is

1. $\frac{\pi}{2}e^{-\alpha}$
2. $\pi e^{-\alpha}$
3. $\frac{\pi}{2}e^{-(\alpha/2)}$
4. $\pi e^{-(\alpha/2)}$

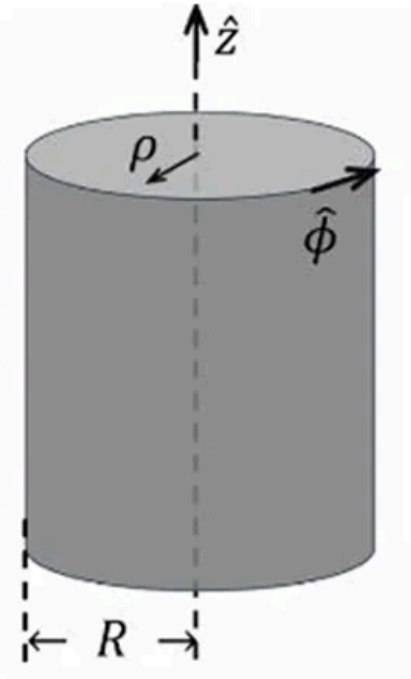
Q48. [June 2025] . 5.0 marks

Electromagnetism > Magnetism in matter

CSIR NET	2025 June	5M	EMT

A long cylinder of radius R carries a magnetization $\vec{M} = k\rho^2\hat{\phi}$, where k is a constant, ρ is the radial distance from the axis and $\hat{\phi}$ is the azimuthal unit vector (see in the figure). The magnetic field inside and outside the cylinder would be

1. $\vec{B}_{\text{inside}} = 0, \vec{B}_{\text{outside}} = \mu_0 k\rho^2\hat{\phi}$
2. $\vec{B}_{\text{inside}} = \mu_0 k\rho^2\hat{\phi}, \vec{B}_{\text{outside}} = 0$
3. $\vec{B}_{\text{inside}} = \vec{B}_{\text{outside}} = \mu_0 k\rho^2\hat{\phi}$
4. $\vec{B}_{\text{inside}} = \vec{B}_{\text{outside}} = 0$



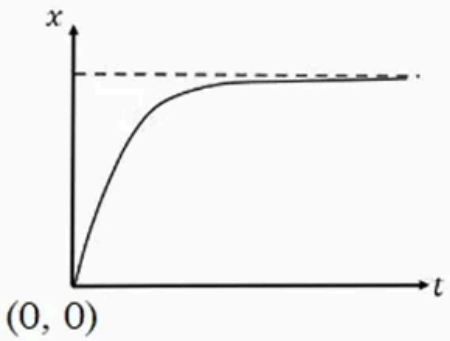
Q49. [June 2025] . 5.0 marks

Mathematical Physics > Ordinary Differential Equations

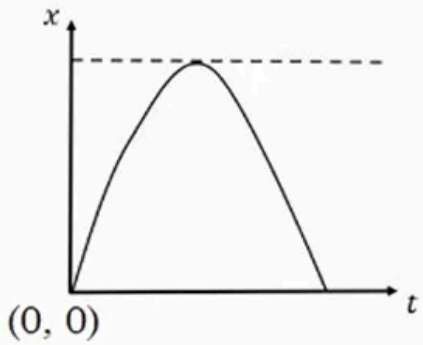
CSIR NET	2025 June	5M	MMP

Which one of the following curves best represents the solution of the differential equation $\frac{dx}{dt} + x = 1$, with the initial condition $x(0) = 0$?

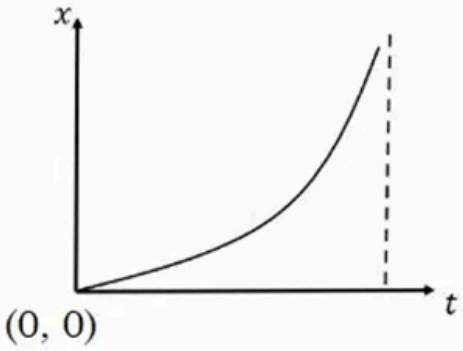
1.



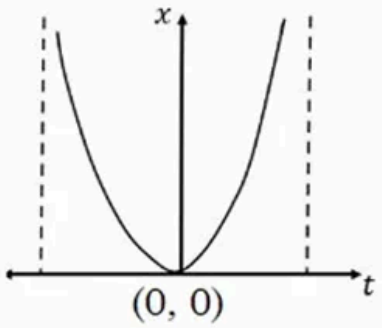
3.



2.



4.



Q50. [June 2025] . 5.0 marks

Mathematical Physics > Probability

CSIR NET	2025 June	5M	MMP

From a straight-line segment of unit length, three points are chosen at random, one after another. The probability that they are in increasing order is

1. $\frac{1}{3}$
2. $\frac{1}{8}$
3. $\frac{1}{9}$
4. $\frac{1}{6}$

Q51. [June 2025] . 5.0 marks

Classical Mechanics > Poisson brackets

CSIR NET	2025 June	5M	CM

For a free particle of mass m, consider the following time dependent quantity in phase space

$$Q = \frac{qp}{m} - \frac{p^2 t}{m^2},$$

where q and p are the canonically conjugate position and momentum coordinates respectively. Then $\frac{dQ}{dt}$ is given by

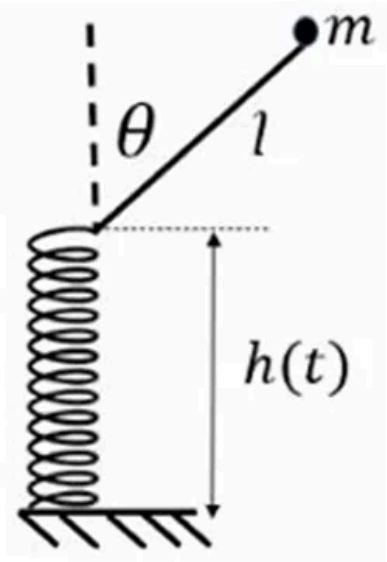
1. 0
2. $\frac{p^2}{m^2}$
3. $-\frac{p^2}{m^2}$
4. $\frac{qp}{mt}$

Q52. [June 2025] . 5.0 marks

Classical Mechanics > Lagrangian and Hamiltonian

CSIR NET	2025 June	5M	CM

A massless rod of length l is hinged at the extreme end of a vertical spring whose other end is fixed to the ground. A point mass m is fixed at end of the rod, as shown in the figure. Assume harmonic motion of the spring given by $h(t) = h_0(2 + \cos\omega t)$, where $h_0 > l$. The equation of motion of the mass (confined to the plane of the figure) is given by



1. $l\ddot{\theta} + \omega^2 h_0 \sin\theta \sin\omega t - g\sin\theta = 0$
2. $l\ddot{\theta} + \omega^2 h_0 \sin\theta \cos\omega t - g\sin\theta = 0$
3. $l\ddot{\theta} + \omega^2 h_0 \sin\theta \cos\omega t + g\sin\theta = 0$
4. $l\ddot{\theta} - \omega^2 h_0 \sin\theta \sin\omega t + g\sin\theta = 0$

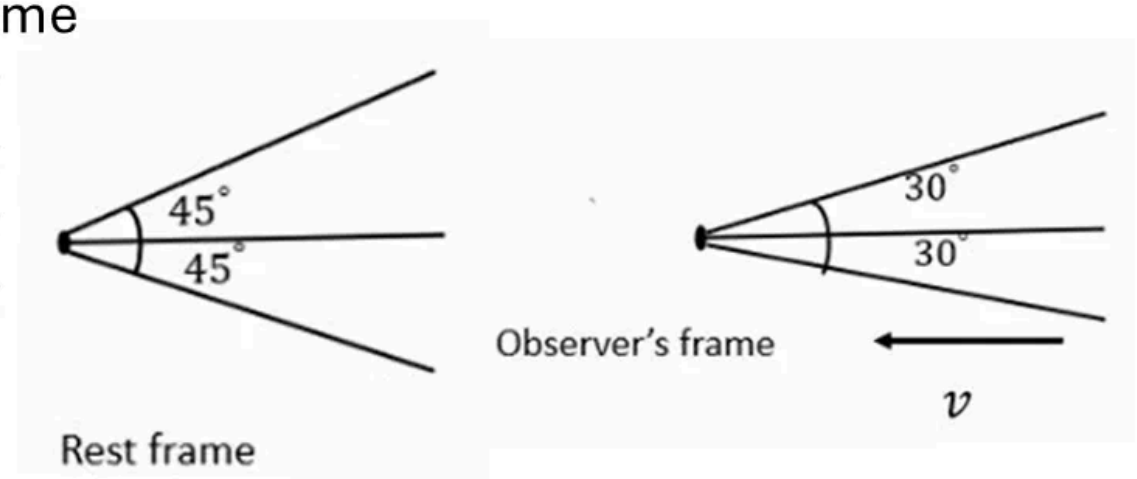
Q53. [June 2025] . 5.0 marks

Classical Mechanics > Special theory of relativity

CSIR NET	2025 June	5M	CM

In its rest frame, a source emits light in a conical beam of width -45° to 45°. An observer is moving towards the source with a speed v. For the observer, the beam width appears to be -30° to 30°. The speed of the observer is closest to

1. $0.62c$
2. $0.50c$
3. $0.82c$
4. $0.41c$



Q54. [June 2025] . 5.0 marks

Quantum Mechanics > Quantum Harmonic Oscillator

CSIR NET	2025 June	5M	QM

$|n\rangle$ denotes the eigenvector of the number operator for a particle of mass m in a one-dimensional potential $V = \frac{1}{2}m\omega^2x^2 (n = 0,1,2,\cdots)$. For the state vector $|\varphi(x,t=0)\rangle = \frac{1}{\sqrt{3}}|1\rangle + \sqrt{\frac{2}{3}}|2\rangle, \langle\hat{x}(t)\rangle$ is

1. $\frac{2\sqrt{2}}{3}\sqrt{\frac{\hbar}{2m\omega}}\cos\omega t$
2. $\frac{4}{3}\sqrt{\frac{\hbar}{2m\omega}}\cos\omega t$
3. $\frac{2\sqrt{2}}{3}\sqrt{\frac{\hbar}{2m\omega}}\cos 2\omega t$
4. $\frac{4}{3}\sqrt{\frac{\hbar}{2m\omega}}\cos 2\omega t$

Q55. [June 2025] . 5.0 marks

Quantum Mechanics > Pertubation theory

CSIR NET	2025 June	5M	QM

The ground state wavefunction for the hydrogen atom is $\psi_0 = \sqrt{\frac{1}{\pi a_0^3}}\, e^{-\frac{r}{a_0}}$, where a_0 is the Bohr radius. Considering an additional potential H' as a perturbation to the hydrogen atom Hamiltonian, given by

$$H' = \begin{cases} \frac{e^2}{4\pi\varepsilon_0}\left[\frac{1}{r} - \frac{1}{R}\right] & \text{for } 0 < r < R, \\ 0 & \text{for } r > R \end{cases}$$

where R is the radius of the proton, $R \ll a_0$. The shift in the ground state energy due to H' is

1. $\left(\frac{e^2}{4\pi\varepsilon_0 a_0}\right)\frac{4R^2}{3a_0^2}$
2. $\left(\frac{e^2}{4\pi\varepsilon_0 a_0}\right)\frac{R}{a_0}$
3. $-\left(\frac{e^2}{4\pi\varepsilon_0 a_0}\right)\frac{2R^2}{a_0^2}$
4. $\left(\frac{e^2}{4\pi\varepsilon_0 a_0}\right)\frac{2R^2}{3a_0^2}$

Q56. [June 2025] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2025 June	5M	QM

The probability density of a free particle of mass m at time $t = 0$, is given by $A\exp\left(-\frac{x^2}{2\sigma^2(0)}\right)$. At $t > 0$, its probability density is proportional to $\exp\left(-\frac{x^2}{2\sigma^2(t)}\right)$, where $\sigma^2(t)$ is

1. $\sigma^2(0) + \frac{\hbar^2 t^2}{\sigma^2(0)m^2}$
2. $\sigma^2(0) + \frac{\hbar^2 t^2}{4\sigma^2(0)m^2}$
3. $\sigma^2(0) + \frac{4\hbar^2 t^2}{\sigma^2(0)m^2}$
4. $\sigma^2(0) + \frac{2\hbar^2 t^2}{\sigma^2(0)m^2}$

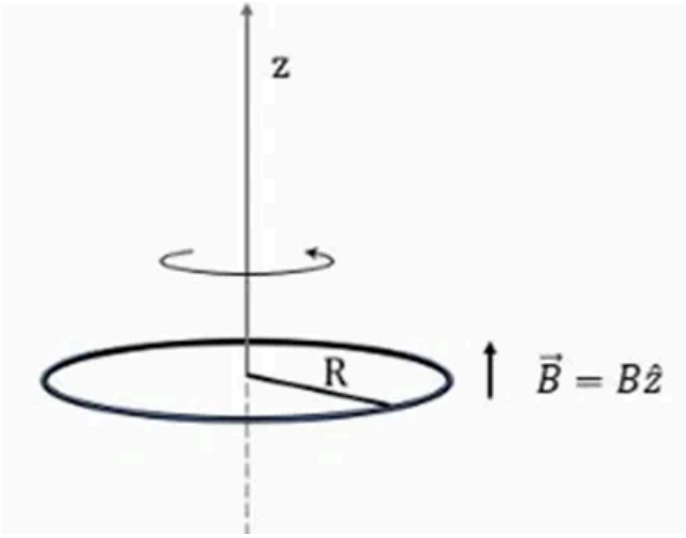
Q57. [June 2025] . 5.0 marks

Electromagnetism > Electrodynamics

CSIR NET	2025 June	5M	EMT

A thin circular wire loop of mass M, having radius R, carries a static charge Q. The plane of the loop is held perpendicular to a uniform magnetic field $\vec{B}$ along the z-axis passing through its centre, as shown in the figure. The loop, initially at rest, can freely rotate about the z-axis. When the magnetic field is switched off the loop starts rotating with an angular frequency

1. $\frac{QB}{M}$
2. $\frac{QB}{2M}$
3. $\frac{\pi QB}{M}$
4. $\frac{\pi QB}{2M}$



Q58. [June 2025] . 5.0 marks

Electromagnetism > Electrostatics

CSIR NET	2025 June	5M	EMT

The charge density of the electron cloud of a hydrogen atom is given by $\rho(\vec{r}) = -\frac{e}{8\pi a^3}\exp(-r/a)$, where a is some characteristic length. The potential energy due to the interaction between the proton (sitting at the origin) and the electron cloud is given by

1. $-\frac{e^2}{2\pi\varepsilon_0 a}$
2. $-\frac{e^2}{4\pi\varepsilon_0 a}$
3. $-\frac{e^2}{\pi\varepsilon_0 a}$
4. $-\frac{e^2}{8\pi\varepsilon_0 a}$

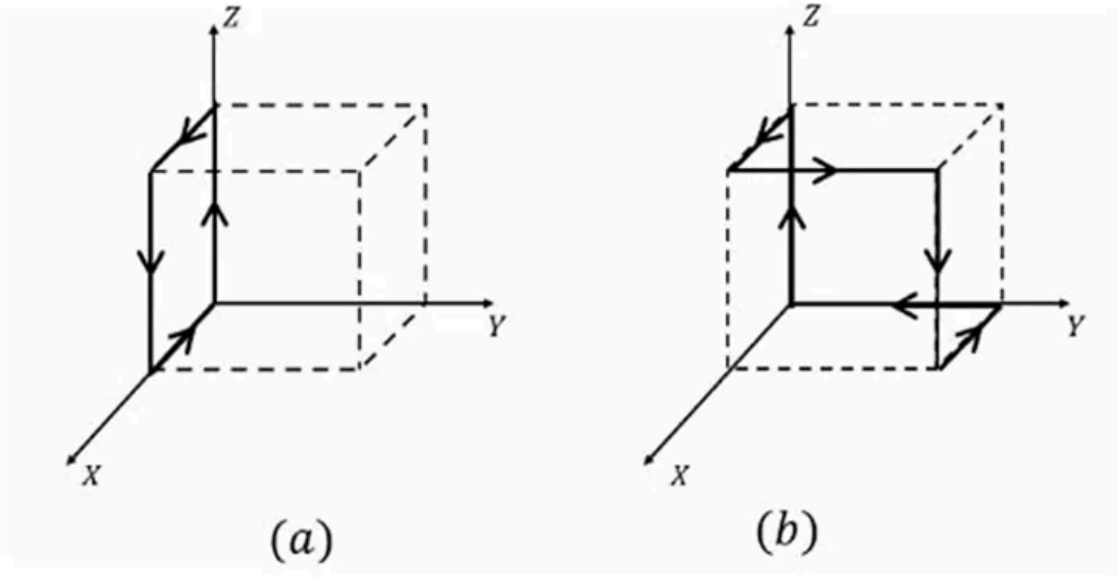
Q59. [June 2025] . 5.0 marks

Electromagnetism > Magetostatics

CSIR NET	2025 June	5M	EMT

Two identical cubes are shown in figures (a) and (b). The magnitude of the magnetic field at the centre of the cube in (a), produced by the currents as shown, is B_o. The magnitude of the magnetic field at the centre of the cube in (b) will be

1. $\sqrt{3}B_o$
2. $2B_o$
3. $\frac{3}{2}B_o$
4. $\sqrt{2}B_o$

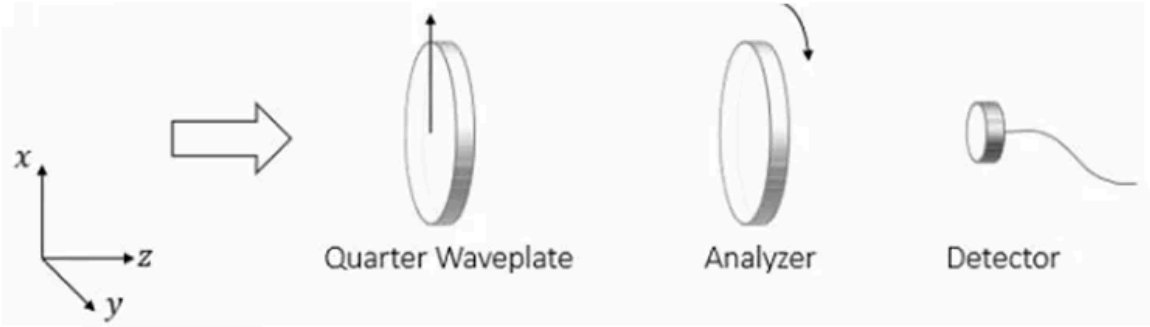


Q60. [June 2025] . 5.0 marks

Optics > Polarization

CSIR NET	2025 June	5M	Optics

A beam of light along the z-axis passes through a quarter wave plate and an analyzer as shown in the figure. The fast axis of the quarter wave plate is aligned with the x-axis. The light intensity is measured by a detector placed after the analyzer. Consider two scenarios where the incident light beam is (a) circularly polarized and (b) linearly polarized along the x-axis. If the polarization axis of the analyzer is rotated by one full cycle about the z-axis, the number of times the detector measures the maximum intensity in each case would be



1. (a) 4 and (b) 0
2. (a) 2 and (b) 0
3. (a) 4 and (b) 4
4. (a) 2 and (b) 2

Q61. [June 2025] . 5.0 marks

Statistical Mechanics > Ising model

CSIR NET	2025 June	5M	Stat. Mech.

Consider $2N$ Ising spins, $s_i (s_i = \pm 1)$ in a one-dimensional lattice with periodic boundary conditions. The Hamiltonian is given by

$$H = -J \sum_{i=1}^{2N} s_i s_{i+1}$$

where J denotes the strength of the nearest-neighbour interactions with $J > 0$. Let F be the fully ferromagnetic state and let A be the lowest energy state with zero magnetization. The energy difference between these two states is

1. $\frac{3J}{2}$ 2. 4J 3. $\frac{J}{2}$ 4. $2J$

Q62. [June 2025] . 5.0 marks

Statistical Mechanics > Random Walk/Brownian motion/Diffusion

CSIR NET	2025 June	5M	Stat. Mech.

Two discrete time random walkers start from the point $x = 0$ at time $t = 0$ taking discrete steps of unit length along the x axis. The first walker is unbiased and the second walker is biased to move towards the right with probability p. The probability that they are at a distance of 2 units from each other at both time steps $t = 1$ and $t = 2$ is

1. $\frac{1}{4}$
2. $\frac{1}{2} - \frac{p}{2}$
3. $1 - \frac{3p}{4}$
4. $\frac{p}{2}$

Q63. [June 2025] . 5.0 marks

Statistical Mechanics > Canonical Ensemble

CSIR NET	2025 June	5M	Stat. Mech.

A rigid molecule can have two possible rotational states: $j = 0$ or $j = 1$. Its rotational energies are given by $\epsilon_J = \frac{\hbar^2}{2I} j(j+1)$, where I is its moment of inertia. For an ensemble of such molecules in thermal equilibrium at temperature T, the ratio of the number of molecules in the $j = 1$ state (N_1), to those in $j = 0$ state (N_0), is $\frac{N_1}{N_0} = 0.003$. The temperature T (in units of $\frac{\hbar^2}{2Ik_B}$, where k_B is the Boltzmann constant) is closest to

1. 0.29 2. 0.21 3. 0.15 4. 0.34

Q64. [June 2025] . 5.0 marks

Statistical Mechanics > Canonical Ensemble

CSIR NET	2025 June	5M	Stat. Mech.

A thermodynamic system (at temperature T and volume V), is described by its internal energy $U = AT^4V$ and pressure $p = \frac{1}{3}AT^4$, where A is a constant of appropriate dimension. The Helmholtz free energy of the system is

1. $\frac{4}{3}AT^4V$
2. $\frac{1}{3}AT^4V$
3. $-\frac{1}{3}AT^4V$
4. $-\frac{4}{3}AT^4V$

Q65. [June 2025] . 5.0 marks

Solid State Physics > Superconductivity

CSIR NET	2025 June	5M	SSP

The current $I_J(t)$ through a Josephson junction (shown by the crossed box in the figure) and the voltage $V(t)$ across it, are given by

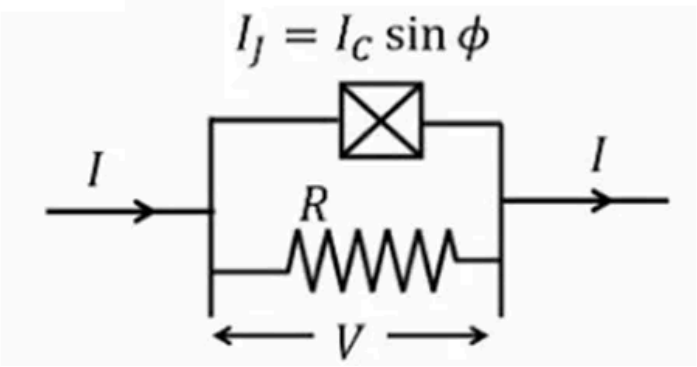
$$I_J(t) = I_C \sin\phi(t)$$

$$\frac{d\phi(t)}{dt} = \frac{2eV(t)}{\hbar}$$

where I_C is the critical current of the junction and $\phi(t)$ is the phase difference across the junction. A resistor R is connected in parallel to the junction and a constant current $I > I_C$ flows through the combination as shown.

The energy dissipated in R in the time ϕ changes by 2π is

1. $\frac{h}{2e} I$
2. $\frac{h}{2e} I_C$
3. $\frac{h}{2e} (I - I_C)$
4. $\frac{h}{2e} (I + I_C)$



Q66. [June 2025] . 5.0 marks

Solid State Physics > Semiconductor Physics

CSIR NET	2025 June	5M	SSP

A semiconductor has the dispersion relation $E = E_0 - A\cos(\alpha k_x)$, where A and α are positive constants. The effective electron mass close to the minimum energy is

1. $\frac{\hbar^2}{A^2\alpha}$
2. $\frac{1}{4}\frac{\hbar^2}{A^2\alpha}$
3. $\frac{\hbar^2}{A\alpha^2}$
4. $\frac{1}{2}\frac{\hbar^2}{A\alpha^2}$

Q67. [June 2025] . 5.0 marks

Electromagnetism > Plasma

CSIR NET	2025 June	5M	EMT

A gas of electrons (with no source of scattering) is placed in an electric field $\vec{E} = Ee^{i\omega t}(\hat{\imath} + \hat{k})$ and a magnetic field $\vec{B} = B\hat{k}$, where E and B are constants. The frequency at which the conductivity in the z-direction, given by the ratio of the current and the electric field, both in the z-direction, diverges is

1. 0
2. $\frac{eB}{m}$
3. $-\frac{eB}{m}$
4. $\frac{eB}{2m}$

Q68. [June 2025] . 5.0 marks

Electronics > Digital Electronics

CSIR NET	2025 June	5M	Electronics

The minimum number of two input NOR gates required to obtain the following output for three digital inputs A, B and C

$$Y = (\bar{A} + \bar{B} + \bar{C})(\bar{A} + B + \bar{C})(\bar{A} + \bar{B} + C)$$

would be

1. 4
2. 3
3. 5
4. 6

Q69. [June 2025] . 5.0 marks

Atomic and Molecular Physics > Lasers

CSIR NET	2025 June	5M	AMP

A highly collimated laser beam with a diameter of 1 cm and wavelength 500 nm is directed from the earth's surface towards the moon ($\sim 384{,}000$ km away from the earth). Assuming ideal diffraction limited propagation in vacuum, which of the following best estimates the diameter of the beam upon returning to the earth after reflection from an ideal reflector installed on the moon.

1. 200 m
2. 20 m
3. 20 km
4. 200 km

Q70. [June 2025] . 5.0 marks

Atomic and Molecular Physics > Lasers

CSIR NET	2025 June	5M	AMP

Consider a laser cooling experiment where atoms are slowed down by an inelastic process of absorption and subsequent emission of photons. If light of wavelength 776.5 nm is used to slow down potassium atoms (mass number 39) with initial speed $130\ \mathrm{ms}^{-1}$, the number of such absorption and emission cycles needed to bring the atoms to rest is closest to

1. 10^3

2. 10^2

3. 10^5

4. 10^4

Q71. [June 2025] . 5.0 marks

Atomic and Molecular Physics > Zeeman effect

CSIR NET	2025 June	5M	AMP

An atom is subjected to a weak magnetic field $B = 0.1T$. A spectral line of wavelength 184.9 nm corresponding to a $J = 1$ to $J = 0$ transition splits into three components. The highest and the lowest components are separated by 3.2×10^{-4} nm. The magnetic moment of the atom in $J = 1$ state (in units of Bohr magneton) is

1. 2.82
2. 0.71
3. 1.41
4. 4.23

Q72. [June 2025] . 5.0 marks

Atomic and Molecular Physics > Molecular physics

CSIR NET	2025 June	5M	AMP

In a rotational-vibrational spectrum of $\mathrm{HCl}\left(\mathrm{H}^{35}\mathrm{Cl}\right)$, the first R-branch line and the first P-branch line are observed at $\lambda^{-1} = 2906\ \mathrm{cm}^{-1}$ and $\lambda^{-1} = 2865\ \mathrm{cm}^{-1}$, respectively. The equilibrium bond length of this molecule would be closest to

1. 0.2Å
2. 1.3Å
3. 13Å
4. 2.1Å

Q73. [June 2025] . 5.0 marks

Nuclear and Particle Physics > Nuclear properties

CSIR NET	2025 June	5M	NPP

If the binding energies per nucleon of the nuclei $X(A = 240)$ and $Y(A = 120)$ are 7.6 MeV and 8.5 MeV respectively, the energy released in the symmetric fission, $X \rightarrow Y + Y$ is

1. 94 MeV
2. 9.4MeV
3. 108 MeV
4. 216 MeV

Q74. [June 2025] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2025 June	5M	NPP

When a neutron of 1 keV kinetic energy impinges on a ^{12}C target, the total scattering cross section is 1000 barns. The approximate value of the phase shift δ_0 is

1. 18°

2. 108°

3. 90°

4. 36°

Q75. [June 2025] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2025 June	5M	NPP

The ρ-mesons are $J^P = 1^-$ particles that decay strongly into pions. The ratio of the particle decay widths $\frac{\Gamma(\rho^0 \to \pi^0\pi^0)}{\Gamma(\rho^+ \to \pi^+\pi^0)}$ is closest to

1. 1

2. $\frac{1}{2}$

3. 0

4. 2

Answer Key

75 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	General Aptitude	Reasoning	**3**
Q2	General Aptitude	Mathematical Analysis	**3**
Q3	General Aptitude	Mathematical Analysis	**2**
Q4	General Aptitude	Basic Physics	**1**
Q5	General Aptitude	Basic Physics	**1**
Q6	General Aptitude	Data Analysis	**3**
Q7	General Aptitude	Basic Physics	**2**
Q8	General Aptitude	Basic Physics	**4**
Q9	General Aptitude	Mathematical Analysis	**2**
Q10	General Aptitude	Mathematical Analysis	**2**
Q11	General Aptitude	Mathematical Analysis	**2**
Q12	General Aptitude	Reasoning	**3**
Q13	General Aptitude	Geometry	**2**
Q14	General Aptitude	Mathematical Analysis	**3**
Q15	General Aptitude	Reasoning	**4**
Q16	General Aptitude	Reasoning	**1**
Q17	General Aptitude	Mathematical Analysis	**1**
Q18	General Aptitude	Geometry	**3**
Q19	General Aptitude	Mathematical Analysis	**4**
Q20	General Aptitude	Reasoning	**2**
Q21	Mathematical Physics	Ordinary Differential Equations	**3**
Q22	Mathematical Physics	Complex analysis	**2**
Q23	Mathematical Physics	Matrices and Linear Algebra	**1**
Q24	Mathematical Physics	Dirac Delta Function	**1**
Q25	Classical Mechanics	Basic Mechanics	**1**
Q26	Classical Mechanics	Basic Mechanics	**2**
Q27	Classical Mechanics	Lagrangian and Hamiltonian	**3**
Q28	Classical Mechanics	Rotation Motion	**2**
Q29	Quantum Mechanics	Quantum Harmonic Oscillator	**4**
Q30	Quantum Mechanics	Two particle System	**1**
Q31	Quantum Mechanics	Spin Angular momentum	**1**
Q32	Quantum Mechanics	Basic Quantum Mechanics	**2**
Q33	Quantum Mechanics	Basic Quantum Mechanics	**4**
Q34	Optics	Ray Optics	**1**
Q35	Electromagnetism	EM Waves	**4**
Q36	Electromagnetism	Magetostatics	**4**
Q37	Electromagnetism	Relativistic electromagnetism	**2**
Q38	Statistical Mechanics	Microstates and Macrostates	**3**
Q39	Statistical Mechanics	Microcanonical Ensemble	**1**
Q40	Thermodynamics	Kinetic theory of Gases	**4**

Answer Key (cont.)

Q. No	Subject	Topic	Answer
Q41	Thermodynamics	Carnot Cycle	**4**
Q42	Electronics	Instruments	**3**
Q43	Electronics	Transistors	**3**
Q44	Electronics	Diodes	**2**
Q45	Electronics	Instruments	**2**
Q46	Mathematical Physics	Special Functions	**1**
Q47	Mathematical Physics	Complex analysis	**1**
Q48	Electromagnetism	Magnetism in matter	**2**
Q49	Mathematical Physics	Ordinary Differential Equations	**1**
Q50	Mathematical Physics	Probability	**4**
Q51	Classical Mechanics	Poisson brackets	**1**
Q52	Classical Mechanics	Lagrangian and Hamiltonian	**2**
Q53	Classical Mechanics	Special theory of relativity	**4**
Q54	Quantum Mechanics	Quantum Harmonic Oscillator	**2**
Q55	Quantum Mechanics	Pertubation theory	**4**
Q56	Quantum Mechanics	Basic Quantum Mechanics	**2**
Q57	Electromagnetism	Electrodynamics	**2**
Q58	Electromagnetism	Electrostatics	**4**
Q59	Electromagnetism	Magetostatics	**1**
Q60	Optics	Polarization	**4**
Q61	Statistical Mechanics	Ising model	**2**
Q62	Statistical Mechanics	Random Walk/Brownian motion/Diffusion	**1**
Q63	Statistical Mechanics	Canonical Ensemble	**1**
Q64	Statistical Mechanics	Canonical Ensemble	**3**
Q65	Solid State Physics	Superconductivity	**1**
Q66	Solid State Physics	Semiconductor Physics	**3**
Q67	Electromagnetism	Plasma	**1**
Q68	Electronics	Digital Electronics	**1**
Q69	Atomic and Molecular Physics	Lasers	**3**
Q70	Atomic and Molecular Physics	Lasers	**4**
Q71	Atomic and Molecular Physics	Zeeman effect	**3**
Q72	Atomic and Molecular Physics	Molecular physics	**2**
Q73	Nuclear and Particle Physics	Nuclear properties	**4**
Q74	Nuclear and Particle Physics	Particle physics	**4**
Q75	Nuclear and Particle Physics	Particle physics	**3**

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