PhysicsByAaryan

CSIR NET · GATE · JEST · BARC – Physics

GATE Physics 2012 — Full Question Paper

Previous Year Questions with Official Answer Key

Inside this PDF

- Every GATE Physics (PH) 2012 question, in order
- Marking scheme + question type (MCQ/MSQ/NAT) on every question
- Subject & topic classification per question
- Official answer key at the end

65 Questions with answer key

Questions taken from official GATE Physics (PH) papers conducted by IITs / IISc.
Compiled by PhysicsByAaryan for free use by aspirants. Answer key at the end of this PDF.

Q1. [Marks: 1 | MCQ] Mathematical Physics · Vector Analysis

GATE 2012	MCQ	1M

Identify the CORRECT statement for the following vectors $\vec{a} = 3\hat{i} + 2\hat{j}$ and $\vec{b} = \hat{i} + 2\hat{j}$

(A) The vectors $\vec{a}$ and $\vec{b}$ are linearly independent

(B) The vectors $\vec{a}$ and $\vec{b}$ are linearly dependent

(C) The vectors $\vec{a}$ and $\vec{b}$ are orthogonal

(D) The vectors $\vec{a}$ and $\vec{b}$ are normalized

Q2. [Marks: 1 | MCQ] Classical Mechanics · Rotation Motion

GATE 2012	MCQ	1M

Two uniform thin rods of equal length, L, and masses M_1 and M_2 are joined together along the length. The moment of inertia of the combined rod of length $2L$ about an axis passing through the mid-point and perpendicular to the length of the rod is,

(A) $(M_1 + M_2)\frac{L^2}{12}$

(B) $(M_1 + M_2)\frac{L^2}{6}$

(C) $(M_1 + M_2)\frac{L^2}{3}$

(D) $(M_1 + M_2)\frac{L^2}{2}$

Q3. [Marks: 1 | MCQ] Electromagnetism · EM Waves

GATE 2012	MCQ	1M

The space-time dependence of the electric field of a linearly polarized light in free space is given by $xE_0\cos(\omega t - kz)$ where E_0, ω and k are the amplitude, the angular frequency and the wavevector, respectively. The time averaged energy density associated with the electric field is

(A) $\frac{1}{4}\varepsilon_0 E_0^2$

(B) $\frac{1}{2}\varepsilon_0 E_0^2$

(C) $\varepsilon_0 E_0^2$

(D) $2\varepsilon_0 E_0^2$

Q4. [Marks: 1 | MCQ] Electronics · Diodes

GATE 2012	MCQ	1M

If the peak output voltage of a full wave rectifier is 10 V , its d.c. voltage is

(A) 10.0 V

(B) 7.07 V

(C) 6.36 V

(D) 3.18 V

Q5. [Marks: 1 | MCQ] Quantum Mechanics · Potential Well

GATE 2012	MCQ	1M

A particle of mass m is confined in a two dimensional square well potential of dimension a. This potential $V(x, y)$ is given by

$$V(x, y) = 0 \text{ for } -a < x < a \text{ and } -a < y < a$$
$$= \infty \text{ elsewhere}$$

The energy of the first excited state for this particle is given by,

(A) $\frac{\pi^2\hbar^2}{ma^2}$

(B) $\frac{2\pi^2\hbar^2}{ma^2}$

(C) $\frac{5\pi^2\hbar^2}{2ma^2}$

(D) $\frac{4\pi^2\hbar^2}{ma^2}$

Q6. [Marks: 1 | MCQ] Thermodynamics · Laws of thermodynamics

GATE 2012	MCQ	1M

The isothermal compressibility, κ of an ideal gas at temperature T_0 and volume V_0, is given by

(A) $-\frac{1}{V_0}\frac{\partial V}{\partial P}\Big|_{T_0}$

(B) $\frac{1}{V_0}\frac{\partial V}{\partial P}\Big|_{T_0}$

(C) $-V_0\frac{\partial P}{\partial V}\Big|_{T_0}$

(D) $V_0\frac{\partial P}{\partial V}\Big|_{T_0}$

Q7. [Marks: 1 | MCQ] Atomic and Molecular Physics · Effects in atomic physics

GATE 2012	MCQ	1M

The ground state of sodium atom ($^{11}\mathrm{Na}$) is a $^{2}S_{1/2}$ state. The difference in energy levels arising in the presence of a weak external magnetic field B, given in terms of Bohr magneton, μ_B, is

(A) $\mu_B B$

(B) $2\mu_B B$

(C) $4\mu_B B$

(D) $6\mu_B B$

Q8. [Marks: 1 | MCQ] Solid State Physics · Free electron model

GATE 2012	MCQ	1M

For an ideal Fermi gas in three dimensions, the electron velocity v_F at the Fermi surface is related to electron concentration n as,

(A) $v_F \propto n^{2/3}$

(B) $v_F \propto n$

(C) $v_F \propto n^{1/2}$

(D) $v_F \propto n^{1/3}$

Q9. [Marks: 1 | MCQ] Nuclear and Particle Physics · Particle Physics

GATE 2012	MCQ	1M

Which one of the following sets corresponds to fundamental particles?

(A) proton, electron and neutron

(B) proton, electron and photon

(C) electron, photon and neutrino

(D) quark, electron and meson

Q10. [Marks: 1 | MCQ] Nuclear and Particle Physics · Particle detector and accelerator

GATE 2012	MCQ	1M

In case of a Geiger-Muller (GM) counter, which one of the following statements is CORRECT?

(A) Multiplication factor of the detector is of the order of 10^{10}

(B) Type of the particles detected can be identified

(C) Energy of the particles detected can be distinguished

(D) Operating voltage of the detector is few tens of Volts

Q11. [Marks: 1 | MCQ] Electromagnetism · EM Waves

GATE 2012	MCQ	1M

A plane electromagnetic wave traveling in free space is incident normally on a glass plate of refractive index $3/2$. If there is no absorption by the glass, its reflectivity is

(A) 4%

(B) 16%

(C) 20%

(D) 50%

Q12. [Marks: 1 | MCQ] Solid State Physics · Semiconductor Physics

GATE 2012	MCQ	1M

A Ge semiconductor is doped with acceptor impurity concentration of 10^{15} atoms $/\mathrm{cm}^3$. For the given hole mobility of $1800\ \mathrm{cm}^2/\mathrm{V}-\mathrm{s}$, the resistivity of this material is

(A) $0.288\Omega\ \mathrm{cm}$

(B) $0.694\Omega\ \mathrm{cm}$

(C) $3.472\Omega\ \mathrm{cm}$

(D) $6.944\Omega\ \mathrm{cm}$

Q13. [Marks: 1 | MCQ] Thermodynamics · Kinetic theory of gases

GATE 2012	MCQ	1M

A classical gas of molecules, each of mass m, is in thermal equilibrium at the absolute temperature, T. The velocity components of the molecules along the Cartesian axes are v_x, v_y and v_z. The mean value of $\left(v_x + v_y\right)^2$ is

(A) $\frac{k_B T}{m}$

(B) $\frac{3}{2}\frac{k_B T}{m}$

(C) $\frac{1}{2}\frac{k_B T}{m}$

(D) $\frac{2k_B T}{m}$

Q14. [Marks: 1 | MCQ] Classical Mechanics · Central Forces

GATE 2012	MCQ	1M

In a central force field, the trajectory of a particle of mass m and angular momentum L in plane polar coordinates is given by,

$$\frac{1}{r} = \frac{m}{L^2}(1 + \varepsilon\cos\theta)$$

where, ε is the eccentricity of the particle's motion. Which one of the following choices for ε gives rise to a parabolic trajectory?

(A) $\varepsilon = 0$

(B) $\varepsilon = 1$

(C) $0 < \varepsilon < 1$

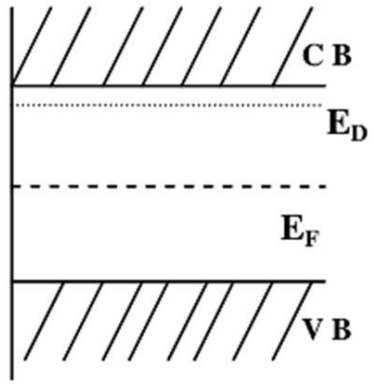
(D) $\varepsilon > 1$

Q15. [Marks: 1 | MCQ] Solid State Physics · Semiconductor Physics

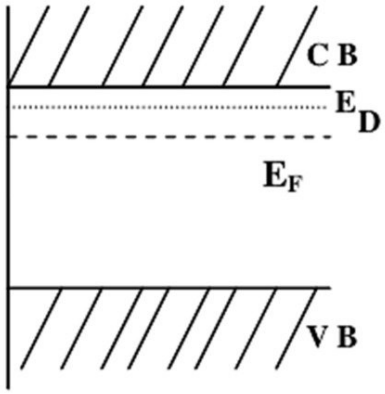
GATE 2012	MCQ	1M

Identify the CORRECT energy band diagram for Silicon doped with Arsenic. Here CB, VB, E_D and E_F are conduction band, valence band, impurity level and Fermi level, respectively.

(A)



(B)



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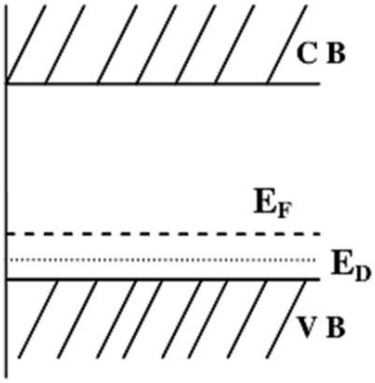

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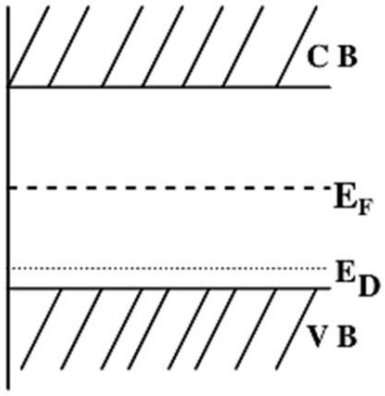


Q16. [Marks: 1 | MCQ] Atomic and Molecular Physics · Molecular Physics

GATE 2012	MCQ	1M

The first Stokes line of a rotational Raman spectrum is observed at $12.96\ \text{cm}^{-1}$. Considering the rigid rotor approximation, the rotational constant is given by

(A) $6.48\ \text{cm}^{-1}$

(B) $3.24\ \text{cm}^{-1}$

(C) $2.16\ \text{cm}^{-1}$

(D) $1.62\ \text{cm}^{-1}$

Q17. [Marks: 1 | MCQ] Statistical Mechanics · Quantum Statistical Mechanics

GATE 2012	MCQ	1M

The total energy, E of an ideal non-relativistic Fermi gas in three dimensions is given by $E \propto \frac{N^{5/3}}{V^{2/3}}$ where N is the number of particles and V is the volume of the gas. Identify the CORRECT equation of state (P being the pressure),

(A) $PV = \frac{1}{3}E$

(B) $PV = \frac{2}{3}E$

(C) $PV = E$

(D) $PV = \frac{5}{3}E$

Q18. [Marks: 1 | MCQ] Quantum Mechanics · Spin and Total Angular momentum

GATE 2012	MCQ	1M

Consider the wavefunction $\Psi = \psi(\vec{r}_1, \vec{r}_2)\chi_s$ for a fermionic system consisting of two spin-half particles. The spatial part of the wavefunction is given by,

$$\psi(\vec{r}_1, \vec{r}_2) = \frac{1}{\sqrt{2}}[\phi_1(\vec{r}_1)\phi_2(\vec{r}_2) + \phi_2(\vec{r}_1)\phi_1(\vec{r}_2)]$$

where ϕ_1 and ϕ_2 are single particle states. The spin part χ_s of the wavefunction with spin states $\alpha(+1/2)$ and $\beta\left(-\frac{1}{2}\right)$ should be

(A) $\frac{1}{\sqrt{2}}(\alpha\beta + \beta\alpha)$

(B) $\frac{1}{\sqrt{2}}(\alpha\beta - \beta\alpha)$

(C) $\alpha\alpha$

(D) $\beta\beta$

Q19. [Marks: 1 | MCQ] Electromagnetism · Potential formulation

GATE 2012	MCQ	1M

The electric and the magnetic fields $\vec{E}(z,t)$ and $\vec{B}(z,t)$, respectively corresponding to the scalar potential $\phi(z,t) = 0$ and vector potential $\vec{A}(z,t) = \hat{i}tz$ are

(A) $\vec{E} = \hat{i}z$ and $\vec{B} = -jt$

(B) $\vec{E} = \hat{i}z$ and $\vec{B} = jt$

(C) $\vec{E} = -\hat{i}z$ and $\vec{B} = -jt$

(D) $\vec{E} = -\hat{i}z$ and $\vec{B} = jt$

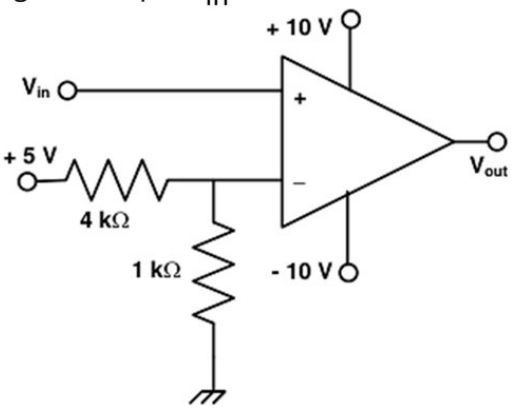
Q20. [Marks: 1 | MCQ]

Electronics · OPAMP

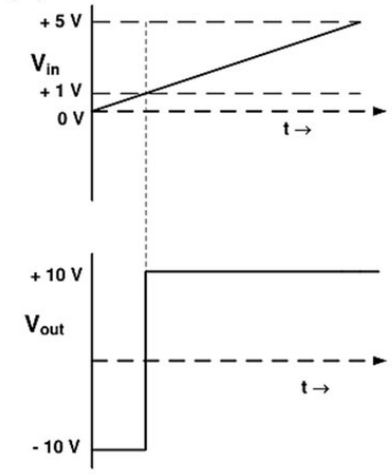
GATE 2012	MCQ	1M

Consider the following OP-AMP circuit.

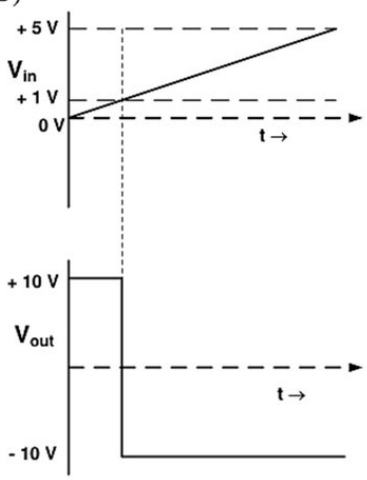
Which one of the following correctly represents the output V_{out} corresponding to the input V_{in} ?



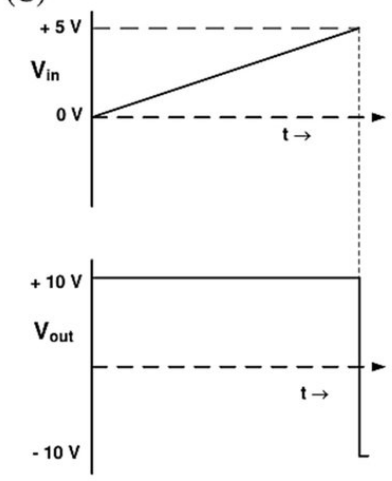
(A)



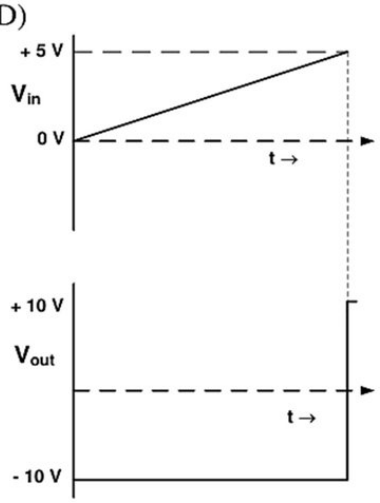
(B)



(C)



(D)



Q21. [Marks: 1 | MCQ] Nuclear and Particle Physics · Nuclear Force, deuteron problem and scatteri

GATE 2012	MCQ	1M

Deuteron has only one bound state with spin parity 1^+, isospin 0 and electric quadrupole moment 0.286efm^2. These data suggest that the nuclear forces are having

(A) only spin and isospin dependence

(B) no spin dependence and no tensor components

(C) spin dependence but no tensor components

(D) spin dependence along with tensor components

Q22. [Marks: 1 | MCQ] Classical Mechanics · Small Oscillations

GATE 2012	MCQ	1M

A particle of unit mass moves along the x-axis under the influence of a potential, $V(x) = x(x-2)^2$. The particle is found to be in stable equilibrium at the point $x = 2$. The time period of oscillation of the particle is

(A) $\frac{\pi}{2}$

(B) π

(C) $\frac{3\pi}{2}$

(D) 2π

Q23. [Marks: 1 | MCQ] Solid State Physics · Lattice vibration

GATE 2012	MCQ	1M

Which one of the following CANNOT be explained by considering a harmonic approximation for the lattice vibrations in solids?

(A) Debye's T^3 law

(B) Dulong Petit's law

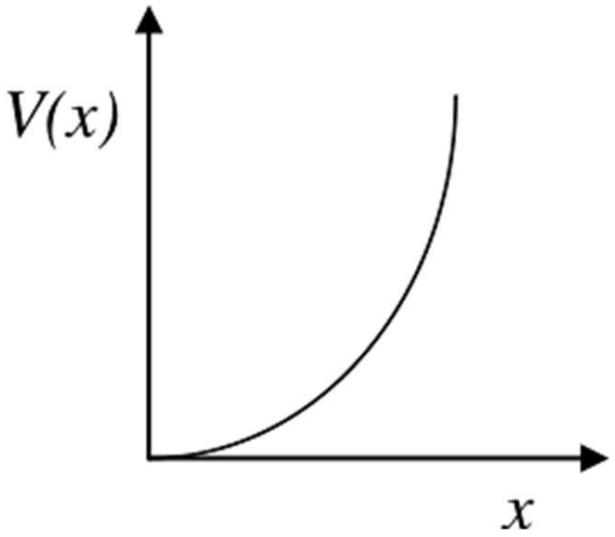
(C) Optical branches in lattices

(D) Thermal expansion

Q24. [Marks: 1 | MCQ] Quantum Mechanics · Quantum Harmonic Oscillator

GATE 2012	MCQ	1M

A particle is constrained to move in a truncated harmonic potential well $(x > 0)$ as shown in the figure.



Which one of the following statements is CORRECT?

(A) The parity of the first excited state is even

(B) The parity of the ground state is even

(C) The ground state energy is $\frac{1}{2}\hbar\omega$

(D) The first excited state energy is $\frac{7}{2}\hbar\omega$

Q25. [Marks: 1 | MCQ] Mathematical Physics · Tensors

GATE 2012	MCQ	1M

The number of independent components of the symmetric tensor A_{ij} with indices $i, j = 1,2,3$ is

(A) 1

(B) 3

(C) 6

(D) 9

Q26. [Marks: 2 | MCQ] Quantum Mechanics · Perturbation Theory

GATE 2012	MCQ	2M

Consider a system in the unperturbed state described by the Hamiltonian, $H_0 = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$. The system is subjected to a perturbation of the form $H' = \begin{pmatrix} \delta & \delta \\ \delta & \delta \end{pmatrix}$, where $\delta \ll 1$. The energy eigenvalues of the perturbed system using the first order perturbation approximation are

(A) 1 and $(1 + 2\delta)$

(B) $(1 + \delta)$ and $(1 - \delta)$

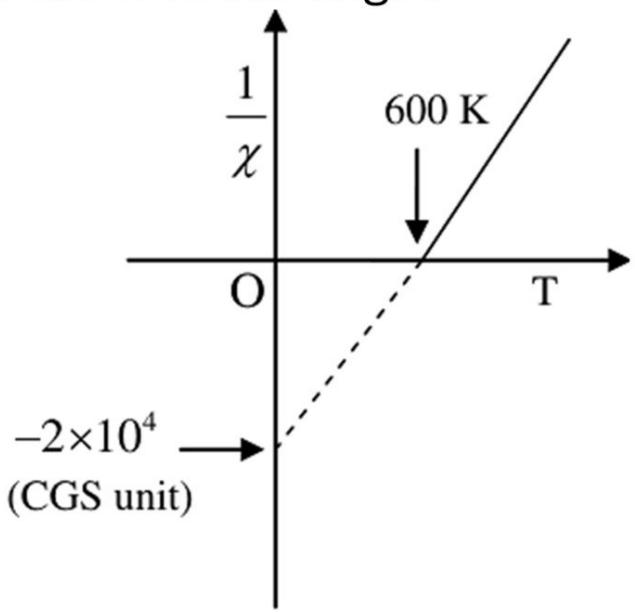
(C) $(1 + 2\delta)$ and $(1 - 2\delta)$

(D) $(1 + \delta)$ and $(1 - 2\delta)$

Q27. [Marks: 2 | MCQ] Solid State Physics · Magnetic properties of solids

GATE 2012	MCQ	2M

Inverse susceptibility ($1/\chi$) as a function of temperature, T for a material undergoing paramagnetic to ferromagnetic transition is given in the figure, where O is the origin.



The values of the Curie constant, C, and the Weiss molecular field constant, λ, in CGS units, are

(A) $C = 5 \times 10^{-5}, \lambda = 3 \times 10^{-2}$

(B) $C = 3 \times 10^{-2}, \lambda = 5 \times 10^{-5}$

(C) $C = 3 \times 10^{-2}, \lambda = 2 \times 10^{4}$

(D) $C = 2 \times 10^{4}, \lambda = 3 \times 10^{-2}$

Q28. [Marks: 2 | MCQ] Electromagnetism · EM Waves

GATE 2012	MCQ	2M

A plane polarized electromagnetic wave in free space at time $t = 0$ is given by

$\vec{E}(x, z) = 10j\exp[i(6x + 8z)]$. The magnetic field $\vec{B}(x, z, t)$ is given by

(A) $\vec{B}(x, z, t) = \frac{1}{c}(6k - 8\hat{i})\exp[i(6x + 8z - 10ct)]$

(B) $\vec{B}(x, z, t) = \frac{1}{c}(6k + 8\hat{i})\exp[i(6x + 8z - 10ct)]$

(C) $\vec{B}(x, z, t) = \frac{1}{c}(6k - 8\hat{i})\exp[i(6x + 8z - ct)]$

(D) $\vec{B}(x, z, t) = \frac{1}{c}(6k + 8\hat{i})\exp[i(6x + 8z + ct)]$

Q29. [Marks: 2 | MCQ] Mathematical Physics · Matrices

GATE 2012	MCQ	2M

The eigenvalues of the matrix $\begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix}$ are

(A) 0,1,1

(B) $0, -\sqrt{2}, \sqrt{2}$

(C) $\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 0$

(D) $\sqrt{2}, \sqrt{2}, 0$

Q30. [Marks: 2 | MCQ] Electromagnetism · EM Waves

GATE 2012	MCQ	2M

Match the typical spectroscopic regions specified in Group I with the corresponding type of transitions in Group II.

Group I

(P) Infra-red region

(Q) Ultraviolet-visible region

(R) X-ray region

(S) γ-ray region

Group II

(i) electronic transitions involving valence electrons

(ii) nuclear transitions

(iii) vibrational transitions of molecules

(iv) transitions involving inner shell electrons

(A) (P, i); (Q, iii); (R, ii); (S, iv)

(B) (P, ii); (Q, iv); (R, i); (S, iii)

(C) (P, iii); (Q, i); (R, iv); (S, ii)

(D) (P, iv); (Q, i); (R, ii); (S, iii)

Q31. [Marks: 2 | MCQ] Electronics · OPAMP

GATE 2012	MCQ	2M

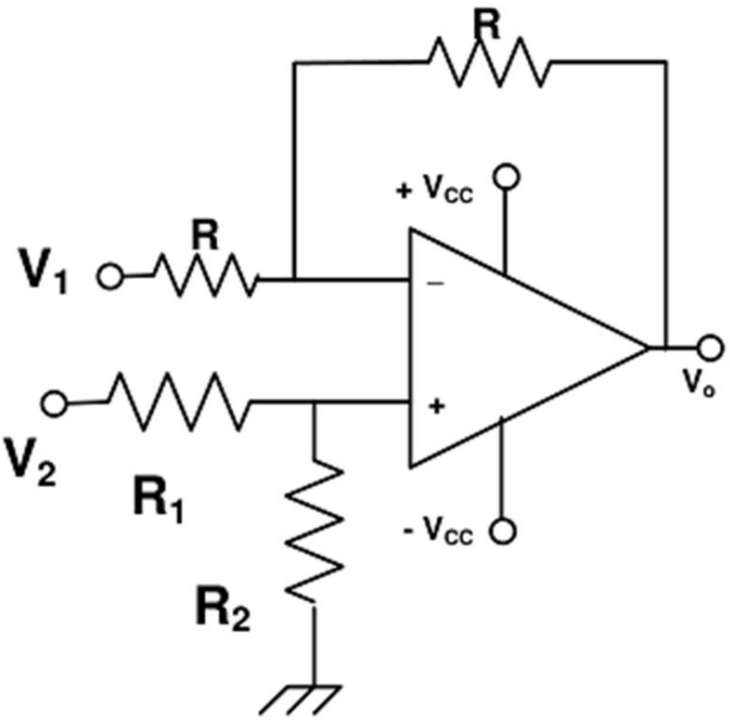
In the following circuit, for the output voltage to be $V_o = (-V_1 + V_2/2)$, the ratio R_1/R_2 is

(A) $1/2$

(B) 1

(C) 2

(D) 3



Q32. [Marks: 2 | MCQ] Quantum Mechanics · Spin and Total Angular momentum

GATE 2012	MCQ	2M

The terms $\{j_1, j_2\}_J$ arising from $2\,s^1 3\,d^1$ electronic configuration in j − j coupling scheme are

(A) $\left\{\frac{1}{2}, \frac{3}{2}\right\}_{2,1}$ and $\left\{\frac{1}{2}, \frac{5}{2}\right\}_{3,2}$

(B) $\left\{\frac{1}{2}, \frac{1}{2}\right\}_{1,0}$ and $\left\{\frac{1}{2}, \frac{3}{2}\right\}_{2,1}$

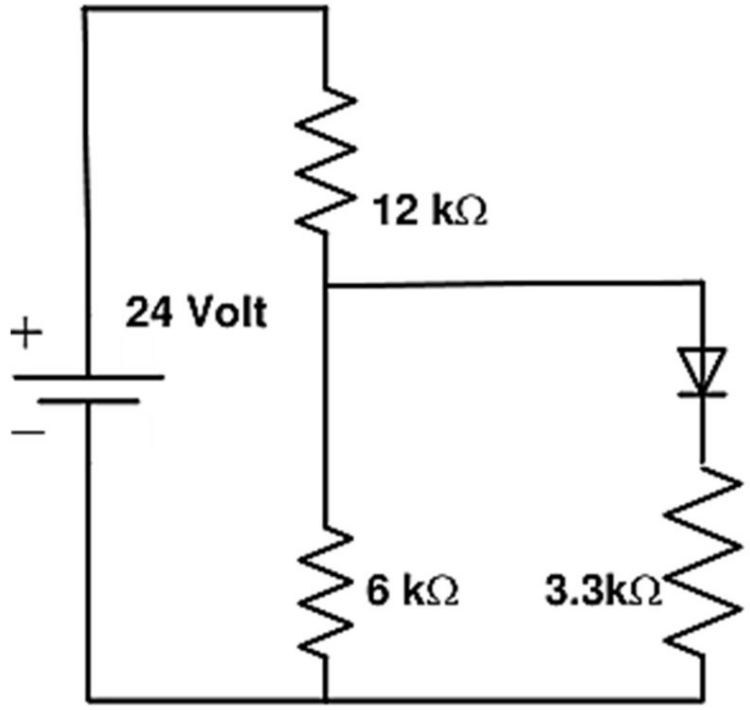
(C) $\left\{\frac{1}{2}, \frac{1}{2}\right\}_{1,0}$ and $\left\{\frac{1}{2}, \frac{5}{2}\right\}_{3,2}$

(D) $\left\{\frac{3}{2}, \frac{1}{2}\right\}_{2,1}$ and $\left\{\frac{1}{2}, \frac{5}{2}\right\}_{3,2}$

Q33. [Marks: 2 | MCQ] Electronics · Diodes

GATE 2012	MCQ	2M

In the following circuit, the voltage drop across the ideal diode in forward bias condition is 0.7 V .



The current passing through the diode is

(A) 0.5 mA

(B) 1.0 mA

(C) 1.5 mA

(D) 2.0 mA

Q34. [Marks: 2 | MCQ] Nuclear and Particle Physics · Particle Physics

GATE 2012	MCQ	2M

Choose the CORRECT statement from the following.

(A) Neutron interacts through electromagnetic interaction

(B) Electron does not interact through weak interaction

(C) Neutrino interacts through weak and electromagnetic interaction

(D) Quark interacts through strong interaction but not through weak interaction

Q35. [Marks: 2 | MCQ] Classical Mechanics · Special theory of relativity

GATE 2012	MCQ	2M

A rod of proper length l_0 oriented parallel to the x-axis moves with speed $2c/3$ along the x-axis in the S-frame, where c is the speed of the light in free space. The observer is also moving along the x-axis with speed $c/2$ with respect to the S-frame. The length of the rod as measured by the observer is

(A) $0.35l_0$

(B) $0.48l_0$

(C) $0.87l_0$

(D) $0.97l_0$

Q36. [Marks: 2 | MCQ] Solid State Physics · Crystallography

GATE 2012	MCQ	2M

A simple cubic crystal with lattice parameter a_c undergoes transition into a tetragonal structure with lattice parameters $a_t = b_t = \sqrt{2}a_c$ and $c_t = 2a_c$, below a certain temperature. The ratio of the interplanar spacings of $(1 \quad 0 \quad 1)$ planes for the cubic and the tetragonal structures is

(A) $\sqrt{\frac{1}{6}}$

(B) $\frac{1}{6}$

(C) $\sqrt{\frac{3}{8}}$

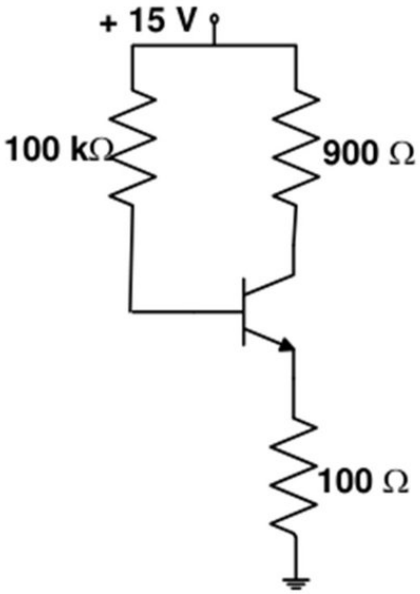
(D) $\frac{3}{8}$

Q37. [Marks: 2 | MCQ] Electronics · Transistors

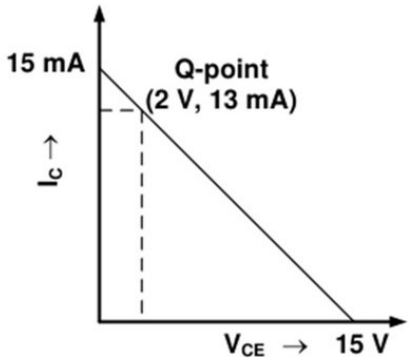
GATE 2012	MCQ	2M

Consider the following circuit in which the current gain β_{dc} of the transistor is 100 .

Which one of the following correctly represents the load line (collector current I_C with respect to collector-emitter voltage V_{CE}) and Q-point of this circuit?



(A)



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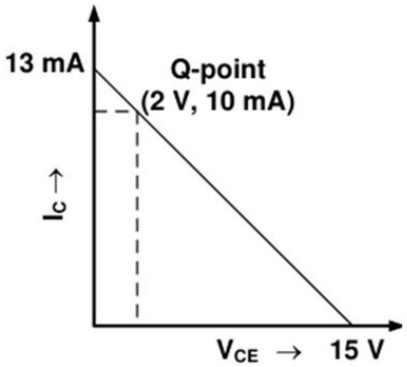
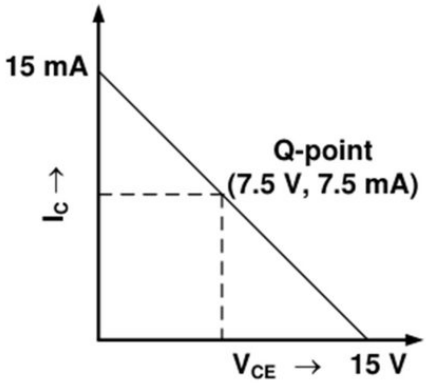
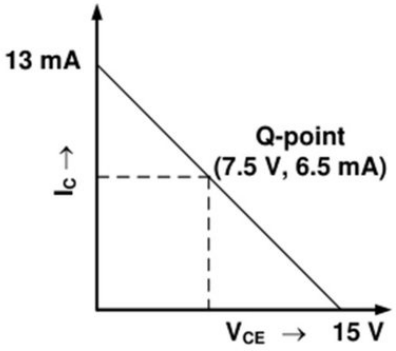


(C)



(D)



Q38. [Marks: 2 | MCQ] Statistical Mechanics · Canonical ensemble

GATE 2012	MCQ	2M

Consider a system whose three energy levels are given by 0, ε and 2ε. The energy level ε is two-fold degenerate and the other two are non-degenerate.

The partition function of the system with $\beta = \frac{1}{k_B T}$ is given by

(A) $1 + 2e^{-\beta\varepsilon}$

(B) $2e^{-\beta\varepsilon} + e^{-2\beta\varepsilon}$

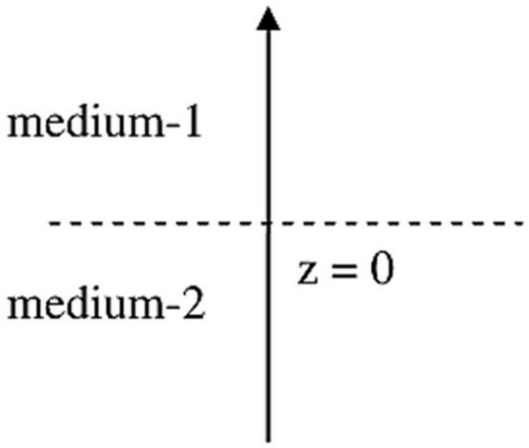
(C) $\left(1 + e^{-\beta\varepsilon}\right)^2$

(D) $1 + e^{-\beta\varepsilon} + e^{-2\beta\varepsilon}$

Q39. [Marks: 2 | MCQ] Electromagnetism · Electric field in matter

GATE 2012	MCQ	2M

Two infinitely extended homogeneous isotropic dielectric media (medium-1 and medium-2 with dielectric constants $\frac{\varepsilon_1}{\varepsilon_0} = 2$ and $\frac{\varepsilon_2}{\varepsilon_0} = 5$, respectively) meet at the $z = 0$ plane as shown in the figure. A uniform electric field exists everywhere.



For $z \geq 0$, the electric field is given by

$\vec{E}_1 = 2\hat{\imath} - 3j + 5k$. The interface separating the two media is charge free.

The electric displacement vector in the medium- 2 is given by

(A) $\overrightarrow{D_2} = \varepsilon_0[10\hat{\imath} + 15j + 10k]$

(B) $\overrightarrow{D_2} = \varepsilon_0[10\hat{\imath} - 15j + 10k]$

(C) $\overrightarrow{D_2} = \varepsilon_0[4\hat{\imath} - 6j + 10k]$

(D) $\overrightarrow{D_2} = \varepsilon_0[4\hat{\imath} + 6j + 10k]$

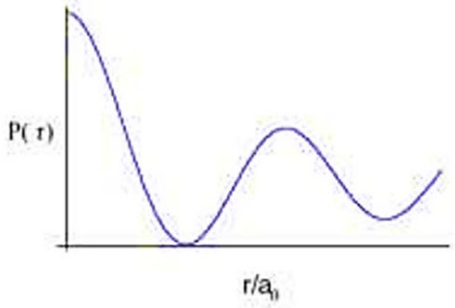
Q40. [Marks: 2 | MCQ] Quantum Mechanics · Orbital angular momentum and hydrogen atom

GATE 2012	MCQ	2M

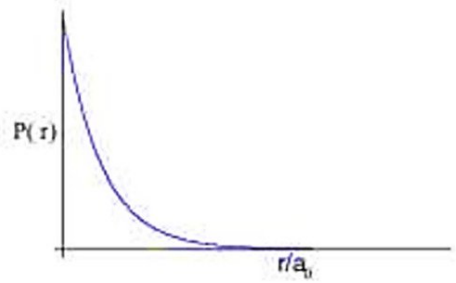
The ground state wavefunction for the hydrogen atom is given by $\psi_{100} = \frac{1}{\sqrt{4\pi}}\left(\frac{1}{a_0}\right)^{3/2} e^{-r/a_0}$, where a_0 is the Bohr radius.

The plot of the radial probability density, $P(r)$ for the hydrogen atom in the ground state is

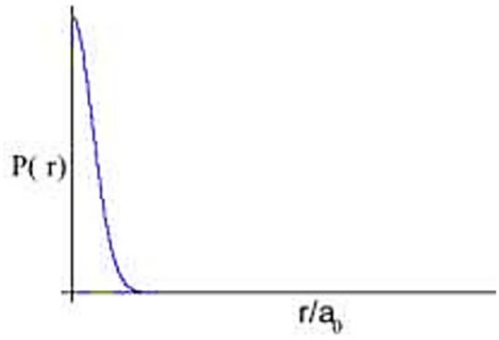
(A)



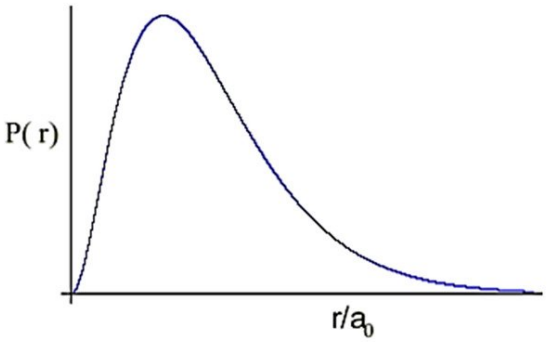
(B)



(C)



(D)



Q41. [Marks: 2 | MCQ] Nuclear and Particle Physics · Shell Model

GATE 2012	MCQ	2M

Total binding energies of O^{15}, O^{16} and O^{17} are $111.96\text{MeV}, 127.62\text{MeV}$ and 131.76 MeV , respectively. The energy gap between $1p_{1/2}$ and $1d_{5/2}$ neutron shells for the nuclei whose mass number is close to 16 , is

(A) 4.1 MeV

(B) 11.5 MeV

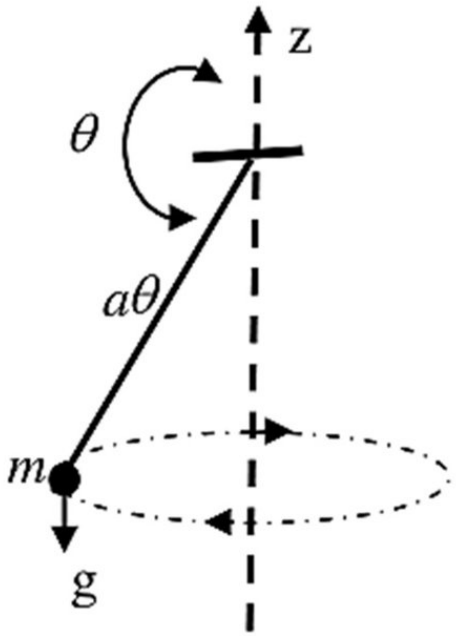
(C) 15.7 MeV

(D) 19.8 MeV

Q42. [Marks: 2 | MCQ] Classical Mechanics · Lagrangian and Hamiltonian

GATE 2012	MCQ	2M

A particle of mass m is attached to a fixed point O by a weightless inextensible string of length a. It is rotating under the gravity as shown in the figure.



The Lagrangian of the particle is

$$L(\theta,\phi)=\frac{1}{2}ma^2\left(\dot{\theta}^2+\sin^2\theta\dot{\phi}^2\right)-mga\cos\theta$$

where θ and ϕ are the polar angles.

The Hamiltonian of the particle is

(A) $H=\frac{1}{2ma^2}\left(p_\theta^2+\frac{p_\phi^2}{\sin^2\theta}\right)-mga\cos\theta$

(B) $H=\frac{1}{2ma^2}\left(p_\theta^2+\frac{p_\phi^2}{\sin^2\theta}\right)+mga\cos\theta$

(C) $H=\frac{1}{2ma^2}\left(p_\theta^2+p_\phi^2\right)-mga\cos\theta$

(D) $H=\frac{1}{2ma^2}\left(p_\theta^2+p_\phi^2\right)+mga\cos\theta$

Q43. [Marks: 2 | MCQ] Mathematical Physics · Vector Analysis

GATE 2012	MCQ	2M

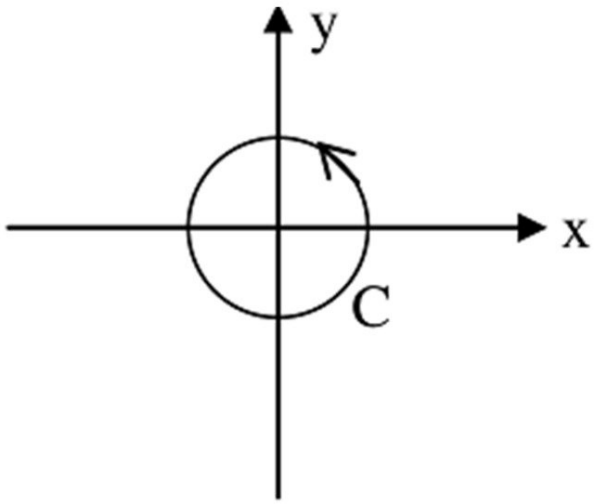
Given $\vec{F} = \vec{r} \times \vec{B}$, where $\vec{B} = B_0(\hat{i} + \hat{j} + \hat{k})$ is a constant vector and $\vec{r}$ is the position vector. The value of $\oint_C \vec{F} \cdot d\vec{r}$, where C is a circle of unit radius centered at origin is,

(A) 0

(B) $2\pi B_0$

(C) $-2\pi B_0$

(D) 1



Q44. [Marks: 2 | MCQ] Mathematical Physics · Complex Analysis

GATE 2012	MCQ	2M

The value of the integral $\oint_C e^{1/z} dz$, using the contour C of circle with unit radius $|z| = 1$ is

(A) 0

(B) $1 - 2\pi i$

(C) $1 + 2\pi i$

(D) $2\pi i$

Q45. [Marks: 2 | MCQ] Statistical Mechanics · Microstates

GATE 2012	MCQ	2M

A paramagnetic system consisting of N spin-half particles, is placed in an external magnetic field. It is found that $N/2$ spins are aligned parallel and the remaining $N/2$ spins are aligned antiparallel to the magnetic field. The statistical entropy of the system is,

(A) $2Nk_B\ln 2$

(B) $\frac{N}{2}k_B\ln 2$

(C) $\frac{3N}{2}k_B\ln 2$

(D) $Nk_B\ln 2$

Q46. [Marks: 2 | MCQ] Atomic and Molecular Physics · Molecular Physics

GATE 2012	MCQ	2M

The equilibrium vibration frequency for an oscillator is observed at $2990\ \mathrm{cm}^{-1}$. The ratio of the frequencies corresponding to the first and the fundamental spectral lines is 1.96 . Considering the oscillator to be anharmonic, the anharmonicity constant is

(A) 0.005

(B) 0.02

(C) 0.05

(D) 0.1

Q47. [Marks: 2 | MCQ] Thermodynamics · Kinetic theory of gases

GATE 2012	MCQ	2M

At a certain temperature T, the average speed of nitrogen molecules in air is found to be $400\ \mathrm{m/s}$. The most probable and the root mean square speeds of the molecules are, respectively,

(A) $355\ \mathrm{m/s}, 434\ \mathrm{m/s}$

(B) $820\ \mathrm{m/s}, 917\ \mathrm{m/s}$

(C) $152\ \mathrm{m/s}, 301\ \mathrm{m/s}$

(D) $422\ \mathrm{m/s}, 600\ \mathrm{m/s}$

Q48. [Marks: 2 | MCQ] Quantum Mechanics · Basics Quantum Mechanics

GATE 2012	MCQ	2M

The wavefunction of a particle moving in free space is given by, $\psi = e^{ikx} + 2e^{-ikx}$

The energy of the particle is

(A) $\frac{5\hbar^2k^2}{2m}$

(B) $\frac{3\hbar^2k^2}{4m}$

(C) $\frac{\hbar^2k^2}{2m}$

(D) $\frac{\hbar^2k^2}{m}$

Q49. [Marks: 2 | MCQ] Quantum Mechanics · Basics Quantum Mechanics

GATE 2012	MCQ	2M

The wavefunction of a particle moving in free space is given by, $\psi = e^{ikx} + 2e^{-ikx}$

The probability current density for the real part of the wavefunction is

(A) 1

(B) $\frac{\hbar k}{m}$

(C) $\frac{\hbar k}{2m}$

(D) 0

Q50. [Marks: 2 | MCQ] Solid State Physics · Tight binding model

GATE 2012	MCQ	2M

The dispersion relation for a one dimensional monatomic crystal with lattice spacing a, which interacts via nearest neighbour harmonic potential is given by

$$\omega = A\left|\sin\frac{Ka}{2}\right|,$$

where A is a constant of appropriate unit.

The group velocity at the boundary of the first Brillouin zone is

(A) 0

(B) 1

(C) $\sqrt{\frac{Aa^2}{2}}$

(D) $\frac{1}{2}\sqrt{\frac{Aa^2}{2}}$

Q51. [Marks: 2 | MCQ] Solid State Physics · Tight binding model

GATE 2012	MCQ	2M

The dispersion relation for a one dimensional monatomic crystal with lattice spacing a, which interacts via nearest neighbour harmonic potential is given by

$$\omega = A\left|\sin\frac{Ka}{2}\right|,$$

where A is a constant of appropriate unit.

The force constant between the nearest neighbour of the lattice is (M is the mass of the atom)

(A) $\frac{MA^2}{4}$

(B) $\frac{MA^2}{2}$

(C) MA^2

(D) $2MA^2$

Q52. [Marks: 2 | MCQ] Electromagnetism · Electric field in matter

GATE 2012	MCQ	2M

In a hydrogen atom, consider that the electronic charge is uniformly distributed in a spherical volume of radius $a\left(= 0.5 \times 10^{-10}\ \mathrm{m}\right)$ around the proton. The atom is placed in a uniform electric field $E = 30 \times 10^{5}\ \mathrm{V/m}$. Assume that the spherical distribution of the negative charge remains undistorted under the electric field.

In the equilibrium condition, the separation between the positive and the negative charge centers is

(A) $8.66 \times 10^{-16}\ \mathrm{m}$

(B) $2.60 \times 10^{-15}\ \mathrm{m}$

(C) $2.60 \times 10^{-16}\ \mathrm{m}$

(D) $8.66 \times 10^{-15}\ \mathrm{m}$

Q53. [Marks: 2 | MCQ] Electromagnetism · Electric field in matter

GATE 2012	MCQ	2M

In a hydrogen atom, consider that the electronic charge is uniformly distributed in a spherical volume of radius $a\left(= 0.5 \times 10^{-10}\ \mathrm{m}\right)$ around the proton. The atom is placed in a uniform electric field $E = 30 \times 10^{5}\ \mathrm{V/m}$. Assume that the spherical distribution of the negative charge remains undistorted under the electric field.

The polarizability of the hydrogen atom in unit of $\left(\mathrm{C}^2\ \mathrm{m/N}\right)$ is

(A) 2.0×10^{-40}

(B) 1.4×10^{-41}

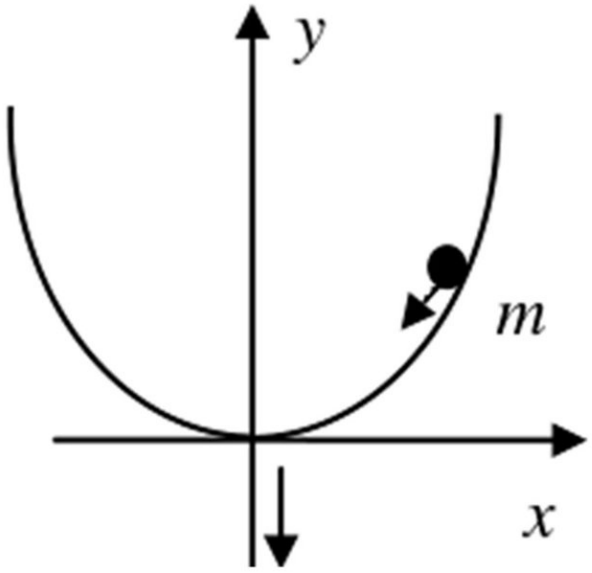
(C) 1.4×10^{-40}

(D) 2.0×10^{-39}

Q54. [Marks: 2 | MCQ] Classical Mechanics · Lagrangian and Hamiltonian

GATE 2012	MCQ	2M

A particle of mass m slides under the gravity without friction along the parabolic path $y = ax^2$ as shown in the figure.



Here a is a constant.

The Lagrangian for this particle is given by,

(A) $L = \frac{1}{2}m\dot{x}^2 - mgax^2$

(B) $L = \frac{1}{2}m\left(1 + 4a^2x^2\right)\dot{x}^2 - mgax^2$

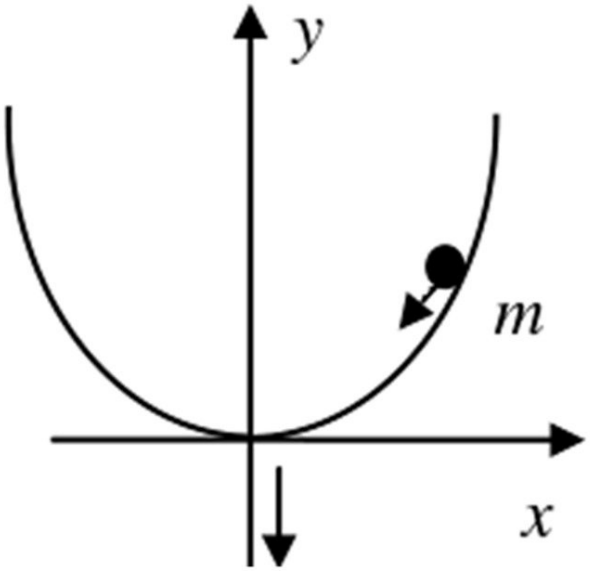
(C) $L = \frac{1}{2}m\dot{x}^2 + mgax^2$

(D) $L = \frac{1}{2}m\left(1 + 4a^2x^2\right)\dot{x}^2 + mgax^2$

Q55. [Marks: 2 | MCQ] Classical Mechanics · Lagrangian and Hamiltonian

GATE 2012	MCQ	2M

A particle of mass m slides under the gravity without friction along the parabolic path $y = ax^2$ as shown in the figure.



Here a is a constant.

The Lagrange's equation of motion of the particle is

(A) $\ddot{x} = 2gax$

(B) $m(1 + 4a^2x^2)\ddot{x} = -2mgax - 4ma^2x\dot{x}^2$

(C) $m(1 + 4a^2x^2)\ddot{x} = 2mgax + 4ma^2x\dot{x}^2$

(D) $\ddot{x} = -2gax$

Q56. [Marks: 1 | MCQ] General Aptitude · English

GATE 2012	MCQ	1M

Choose the grammatically INCORRECT sentence:

(A) They gave us the money back less the service charges of Three Hundred rupees.

(B) This country's expenditure is not less than that of Bangladesh.

(C) The committee initially asked for a funding of Fifty Lakh rupees, but later settled for a lesser sum.

(D) This country's expenditure on educational reforms is very less.

Q57. [Marks: 1 | MCQ] General Aptitude · English

GATE 2012	MCQ	1M

Which one of the following options is the closest in meaning to the word given below?

Mitigate

(A) Diminish

(B) Divulge

(C) Dedicate

(D) Denote

Q58. [Marks: 1 | MCQ] General Aptitude · English

GATE 2012	MCQ	1M

Choose the most appropriate alternative from the options given below to complete the following sentence:

Despite several _____ the mission succeeded in its attempt to resolve the conflict.

(A) attempts

(B) setbacks

(C) meetings

(D) delegations

Q59. [Marks: 1 | MCQ] General Aptitude · Mathematical Analysis

GATE 2012	MCQ	1M

The cost function for a product in a firm is given by $5q^2$, where q is the amount of production. The firm can sell the product at a market price of ₹ 50 per unit. The number of units to be produced by the firm such that the profit is maximized is

(A) 5

(B) 10

(C) 15

(D) 25

Q60. [Marks: 1 | MCQ] General Aptitude · English

GATE 2012	MCQ	1M

Choose the most appropriate alternative from the options given below to complete the following sentence:

Suresh's dog is the one _____ was hurt in the stampede.

(A) that

(B) which

(C) who

(D) whom

Q61. [Marks: 2 | MCQ] General Aptitude · Reasoning

GATE 2012	MCQ	2M

Which of the following assertions are CORRECT?

P: Adding 7 to each entry in a list adds 7 to the mean of the list

Q: Adding 7 to each entry in a list adds 7 to the standard deviation of the list

R: Doubling each entry in a list doubles the mean of the list

S: Doubling each entry in a list leaves the standard deviation of the list unchanged

(A) P, Q

(B) Q, R

(C) P, R

(D) R, S

Q62. [Marks: 2 | MCQ] General Aptitude · Mathematical Analysis

GATE 2012	MCQ	2M

An automobile plant contracted to buy shock absorbers from two suppliers X and Y. X supplies 60% and Y supplies 40% of the shock absorbers. All shock absorbers are subjected to a quality test. The ones that pass the quality test are considered reliable. Of X's shock absorbers, 96% are reliable. Of Y's shock absorbers, 72% are reliable.

The probability that a randomly chosen shock absorber, which is found to be reliable, is made by Y is

(A) 0.288

(B) 0.334

(C) 0.667

(D) 0.720

Q63. [Marks: 2 | MCQ] General Aptitude · Mathematical Analysis

GATE 2012	MCQ	2M

A political party orders an arch for the entrance to the ground in which the annual convention is being held. The profile of the arch follows the equation $y = 2x - 0.1x^2$ where y is the height of the arch in meters. The maximum possible height of the arch is

(A) 8 meters

(B) 10 meters

(C) 12 meters

(D) 14 meters

Q64. [Marks: 2 | MCQ] General Aptitude · Reasoning

GATE 2012	MCQ	2M

Wanted Temporary, Part-time persons for the post of Field Interviewer to conduct personal interviews to collect and collate economic data.
Requirements: High School-pass, must be available for Day, Evening and Saturday work.
Transportation paid, expenses reimbursed.

Which one of the following is the best inference from the above advertisement?

(A) Gender-discriminatory

(B) Xenophobic

(C) Not designed to make the post attractive

(D) Not gender-discriminatory

Q65. [Marks: 2 | MCQ] General Aptitude · Reasoning

GATE 2012	MCQ	2M

Given the sequence of terms, AD CG FK JP, the next term is

(A) OV

(B) OW

(C) PV

(D) PW

Answer Key

65 questions · Subject & topic for quick revision · Official keys (IIT/IISc)

Q.No	Subject	Topic	Type	Marks	Answer
Q1	Mathematical Physics	Vector Analysis	MCQ	1	**A**
Q2	Classical Mechanics	Rotation Motion	MCQ	1	**C**
Q3	Electromagnetism	EM Waves	MCQ	1	**A**
Q4	Electronics	Diodes	MCQ	1	**C**
Q5	Quantum Mechanics	Potential Well	MCQ	1	**
Q6	Thermodynamics	Laws of thermodynamics	MCQ	1	**A**
Q7	Atomic and Molecular Ph…	Effects in atomic physics	MCQ	1	**B**
Q8	Solid State Physics	Free electron model	MCQ	1	**D**
Q9	Nuclear and Particle Phy…	Particle Physics	MCQ	1	**C**
Q10	Nuclear and Particle Phy…	Particle detector and accelerator	MCQ	1	**A**
Q11	Electromagnetism	EM Waves	MCQ	1	**A**
Q12	Solid State Physics	Semiconductor Physics	MCQ	1	**C**
Q13	Thermodynamics	Kinetic theory of gases	MCQ	1	**D**
Q14	Classical Mechanics	Central Forces	MCQ	1	**B**
Q15	Solid State Physics	Semiconductor Physics	MCQ	1	**
Q16	Atomic and Molecular Ph…	Molecular Physics	MCQ	1	**C**
Q17	Statistical Mechanics	Quantum Statistical Mechanics	MCQ	1	**B**
Q18	Quantum Mechanics	Spin and Total Angular momentum	MCQ	1	**B**
Q19	Electromagnetism	Potential formulation	MCQ	1	**D**
Q20	Electronics	OPAMP	MCQ	1	**A**
Q21	Nuclear and Particle Phy…	Nuclear Force, deuteron problem an…	MCQ	1	**D**
Q22	Classical Mechanics	Small Oscillations	MCQ	1	**B**
Q23	Solid State Physics	Lattice vibration	MCQ	1	**D**
Q24	Quantum Mechanics	Quantum Harmonic Oscillator	MCQ	1	**D**
Q25	Mathematical Physics	Tensors	MCQ	1	**C**
Q26	Quantum Mechanics	Perturbation Theory	MCQ	2	**A**
Q27	Solid State Physics	Magnetic properties of solids	MCQ	2	**C**
Q28	Electromagnetism	EM Waves	MCQ	2	**A**
Q29	Mathematical Physics	Matrices	MCQ	2	**B**
Q30	Electromagnetism	EM Waves	MCQ	2	**C**
Q31	Electronics	OPAMP	MCQ	2	**D**
Q32	Quantum Mechanics	Spin and Total Angular momentum	MCQ	2	**A**
Q33	Electronics	Diodes	MCQ	2	**B**
Q34	Nuclear and Particle Phy…	Particle Physics	MCQ	2	**A**
Q35	Classical Mechanics	Special theory of relativity	MCQ	2	**D**
Q36	Solid State Physics	Crystallography	MCQ	2	**C**

Answer Key

65 questions · Subject & topic for quick revision · Official keys (IIT/IISc)

Q.No	Subject	Topic	Type	Marks	Answer
Q37	Electronics	Transistors	MCQ	2	**A**
Q38	Statistical Mechanics	Canonical ensemble	MCQ	2	**C**
Q39	Electromagnetism	Electric field in matter	MCQ	2	**B**
Q40	Quantum Mechanics	Orbital angular momentum and hydr…	MCQ	2	**D**
Q41	Nuclear and Particle Phy…	Shell Model	MCQ	2	**B**
Q42	Classical Mechanics	Lagrangian and Hamiltonian	MCQ	2	**B**
Q43	Mathematical Physics	Vector Analysis	MCQ	2	**C**
Q44	Mathematical Physics	Complex Analysis	MCQ	2	**D**
Q45	Statistical Mechanics	Microstates	MCQ	2	**D**
Q46	Atomic and Molecular Ph…	Molecular Physics	MCQ	2	**B**
Q47	Thermodynamics	Kinetic theory of gases	MCQ	2	**A**
Q48	Quantum Mechanics	Basics Quantum Mechanics	MCQ	2	**C**
Q49	Quantum Mechanics	Basics Quantum Mechanics	MCQ	2	**D**
Q50	Solid State Physics	Tight binding model	MCQ	2	**A**
Q51	Solid State Physics	Tight binding model	MCQ	2	**A**
Q52	Electromagnetism	Electric field in matter	MCQ	2	**C**
Q53	Electromagnetism	Electric field in matter	MCQ	2	**B**
Q54	Classical Mechanics	Lagrangian and Hamiltonian	MCQ	2	**B**
Q55	Classical Mechanics	Lagrangian and Hamiltonian	MCQ	2	**B**
Q56	General Aptitude	English	MCQ	1	**D**
Q57	General Aptitude	English	MCQ	1	**A**
Q58	General Aptitude	English	MCQ	1	**B**
Q59	General Aptitude	Mathematical Analysis	MCQ	1	**A**
Q60	General Aptitude	English	MCQ	1	**
Q61	General Aptitude	Reasoning	MCQ	2	**C**
Q62	General Aptitude	Mathematical Analysis	MCQ	2	**B**
Q63	General Aptitude	Mathematical Analysis	MCQ	2	**B**
Q64	General Aptitude	Reasoning	MCQ	2	**D**
Q65	General Aptitude	Reasoning	MCQ	2	**A**