THE OPTIMIST CLASSES
IIT-JAM TOPPERS

MANOJ KUMAR SINGH

ABHAY

PAWAN

SATYAM

SOUMIL GIRISH SAHU

BHOOMIJA

AKSHIT AGGARWAL

SHIKHAR CHAMOLI

RAVI SINGH ADHIKARI

GAURAV JHA

SWAPNIL JOSHI

LOKESH BHATT

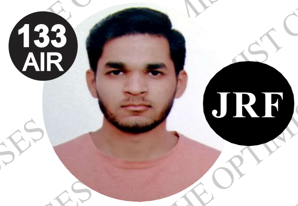
GOPESH VISHVAKARMA

VAIBHAV

SHASWAT CHAMOLI

CSIR-NET-JRF RESULTS 2022

ANNU
DL01000308



ALANKAR
UP15000162

SAHIL RANA
HR09000108

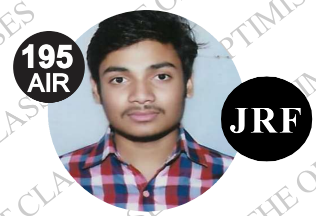
JAYESTHI
RJ11000161

DASRATH
RJ06000682

VIVEK
UK01000439

UZAIR AHMED
UP02000246

SURYA PRATAP SINGH
RJ06000232



HIMANSHU
UP10000095

CHANDAN
RJ09000159

SAIKHOM JOHNSON
MN01000196

AJAY SAINI
RJ06001744

VIKAS YADAV
RJ06001102

JYOTSNA KOHLI
UK02000262

SHYAM SUNDAR
RJ06000615

GATE PAPER 2013

Q.1 - Q.25 : Carry ONE mark each.

Q1. $f(x)$ symmetirc periodic function of x i.e $f(x) = f(-x)$. Then, in general, the Fourier series of the function $f(x)$ will be of the form

(a) $f(x)=\sum_{n=1}^{\infty}(a_n \cos nkx + b_n \sin nkx)$ (b) $f(x)=a_0+\sum_{n=1}^{\infty}(a_n \cos nkx)$

(c) $f(x)=\sum_{n=1}^{\infty}(b_n \sin nkx)$ (d) $f(x)=a_0+\sum_{n=1}^{\infty}(b_n \sin nkx)$

Q2. In the most general case, which one of the following quanties is NOT a second order tensor?

(a) Stress (b) Strain (c) Moment of inertia (d) Pressure

Q3. An electron is moving with a velocity of 0.85 c in the same direction as that of a moving photon. The relative velocity of the electron with respect to photon is

(a) c (b) $-c$ (c) 0.15 c (d) -0.15 c

Q4. If Planck's constant were zero, then the total energy contained in a box filled with radiation of all frequencies at temperature T would be (k is the Boltzmann constant and T is non zero)

(a) Zero (b) Infinite (c) $\frac{3}{2}kT$ (d) kT

Q5. Across a first order phase transition, the free energy is

(a) proportional to the temperature

(b) a discontinuous function of the temperature

(c) a continuous function of the temperature but its derivative is discontinous

(d) such that the first derivative with respect to temperature is continuous

Q6. Two gases separated by an impermeable but movable partition are allowed to freely exhange energy. At equilibrium, the two sides will have the same

(a) pressure and temperature (b) volume and temperature

(c) pressure and volume (d) volume and energy

Q7. The entropy function of a system is given by $S(E)=aE(E_0-E)$ where a and E_0 are positive constants. The temperature of the system is

(a) negative for some energies (b) increases monotonically with energy

(c) decreases monotonically with energy (d) zero

Q8. Consider a linear collection of N independent spin 1/2 particles, each at a fixed location. The entropy of this system is (k is the Boltzmann constant)

(a) Zero (b) Nk (c) $\frac{1}{2}Nk$ (d) $Nk\ In(2)$

Q9. The decay process $n \to p^{+} + e^{-} + \overline{\nu}_{e}$ violates

(a) baryon number (b) lepton number (c) isospin (d) strangeness

Q10. The isospin (I) and baryon number (B) of the upquark is

(a) $I = 1, B = 1$ (b) $I = 1, B = 1/3$ (c) $I = 1/2, B = 1$ (d) $I = 1/2, B = 1/3$

Q11. Consider the scattering of neutrons by protons at very low energy due to a nuclear potential of range r_0. Given that, $\cot(kr_0 + \delta) \approx -\frac{\gamma}{k}$ where δ is the phase shift, k the wave number and $(-\gamma)$ the logarithimic derivative of the deuteron ground state wave function, the phase shift is

(a) $\delta \approx -\frac{k}{\gamma} - kr_0$ (b) $\delta \approx -\frac{\gamma}{k} - kr_0$ (c) $\delta \approx \frac{\pi}{2} - kr_0$ (d) $\delta \approx -\frac{\pi}{2} - kr_0$

Q12. In the β-decay process, the transition $2^{+} \to 3^{+}$, is

(a) allowed both by Fermi and Gamow-Teller selecction rule

(b) allowed by Fermi and but not by Gamow-Teller selection rule

(c) not allowed by Fermi but allowed by Gamow-Teller selection rule

(d) Not allowed both by Fermi and Gamow-Teller selection rule

Q13. At a surface current, which one of the magnetostatic boundary condition is NOT CORRECT?

(a) Normal component of the magnetic field is continuous.

(b) Normal component of the magnetic vector potential is continuous.

(c) Tangential component of the magnetic vector potential is continuous.

(d) Tangential component of the magnetic vector potential is not continuous.

Q14. Interference fringes are seen at an observation plane $z = 0$, by the superposition of two plane waves $A_1 \exp\left[i\left(\vec{k}_1.\vec{r} - \omega t\right)\right]$ and $A_2 \exp\left[i\left(\vec{k}_2.\vec{r} - \omega t\right)\right]$, where A_1 and A_2 are real amplitudes. The condition for interference maximum is

(a) $\left(\vec{k}_1 - \vec{k}_2\right).\vec{r} = (2m+1)\pi$ (b) $\left(\vec{k}_1 - \vec{k}_2\right).\vec{r} = 2m\pi$

(c) $\left(\vec{k}_1 + \vec{k}_2\right).\vec{r} = (2m+1)\pi$ (d) $\left(\vec{k}_1 + \vec{k}_2\right).\vec{r} = 2m\pi$

Q15. For a scalar function φ satisfying the Laplace equation, $\nabla\varphi$ has

(a) zero curl and non-zero divergence (b) non-zerocurl and zero divergence

(c) zero curl and zero deivergence (d) non-zero curl and non-zero divergence

Q16. A circularly polarized monochromatic plane wave is incident on a dielectric interface at Brewster angle. Which one of the following statements is CORRECT?

(a) The reflected light is plane polarized in the plane of incidence and the transmitted light is circularly polarized

(b) The reflected light is plane polarized perpendicular to the plane of incidence and the transmitted light is plane polarized in the plane of incidence.

(c) The reflected light is plane polarized perpendicular to the plane of incidence and the transmitted light is elliptically polarized.

(d) There will be no reflected light and the transmitted light is circularly polarized.

Q17. Which one of the following commutation relations is not correct?

(a) $\left[L^2, Lz\right] = 0$ (b) $\left[L_x, L_y\right] = i\hbar L_z$ (c) $\left[L_z, L_+\right] = \hbar L_+$ (d) $\left[L_z, L_-\right] = \hbar L_-$

Q18. The Lagrangian of a system with one degree of freedom q is given by $L = \alpha\dot{q}^2 + \beta q^2$, where α and β are non-zero constants. If p_q denotes the canonical momentum conjugate to q then which one of the following statements is CORRECT?

(a) $p_q = 2\beta q$ and it is a conserved quantity. (b) $p_q = 2\beta q$ and it is not a conserved quantity.

(c) $p_q = 2\beta \dot{q}$ and it is a conserved quantity. (d) $p_q = 2\beta \dot{q}$ and it is not a conserved quantity.

Q19. What should be the clock frequency of a 6-bit A/D converter so that its maximum conversion time is $32\mu s$?
(a) $1MHz$ (b) $2MHz$ (c) $0.5MHz$ (d) $4MHz$

Q20. A phosphorous doped silicon semiconductor (doping density: $10^{17}/cm^3$) is heated from $100°C$ to $200°C$. Which one of the following statements is CORRECT?
(a) Position of Fermi level moves towards conduction band
(b) Position of dopant level moves towards conduction band
(c) Position of Fermi level moves towards middle of energy gap
(d) Position of dopant level moves towards middle of energy gap

Q21. Considering the BCS theory of superconductors, which one of the following statements is NOT CORRECT?
(h is the Planck's constant and e is the electronic charge)
(a) Presence of energy gap at temperatures below the critical temperature
(b) Different critical temperatures or isotopes
(c) Quantization of magnetic flux in superconducting ring in the unit of $\left(\frac{h}{e}\right)$
(d) Presence of Meissner effect

Q22. Group I contains elementary excitations in solids. Group II gives the associated fields with these excitations. MATCH the excitations with their associated field and select your answer as per codes given below.

Group-I	**Group-II**
(P) phonon	(i) photon + lattice vibration
(Q) plasmon	(ii) electron + elastic deformation
(R) polaron	(iii) collective electron oscillations
(S) polariton	(iv) elastic wave

Codes :
(a) (P-iv), (Q-iii), (R-i), (S-ii) (b) (P-iv), (Q-iii), (R-ii), (S-i)
(c) (P-i), (Q-iii), (R-ii), (S-iv) (d) (P-iii), (Q-iv), (R-ii), (S-i)

Q23. The number of distinct ways of placing four indistinguishable balls into five distinguishable boxes is________.

Q24. A voltage regulator has ripple rejection of $-50dB$. If input ripple is $1mV$, what is the output ripple voltage in μV ? The answer should be up to two decimal places____________.

Q25. The number of spectral lines allowed in the spectrum for the $3^2D \to 3^2P$ transition in sodium is_______

Q.26 -Q.55 : Carry TWO marks each.

Q26. Which of the following pairs of the given function $F(t)$ and its Laplace transformation $f(s)$ is NOT CORRECT?
(a) $F(t) = \delta(t), f(s) = 1$, (Singularity at +0)
(b) $F(t) = 1, f(s) = \frac{1}{s}, (s > 0)$
(c) $F(t) = \sin kt, f(s) = \frac{s}{s^2 + k^2}, (s > 0)$

(d) $F(t) = te^{kt}, f(s) = \dfrac{1}{(s-k)^2}$, $(s > k, s > 0)$

Q27. If $\vec{A}$ and $\vec{B}$ are constant vectors, then $\nabla\left(\vec{A}.\vec{B}\times\vec{r}\right)$ is

(a) $\vec{A}.\vec{B}$ (b) $\vec{A}\times\vec{B}$ (c) $\vec{r}$ (d) zero

Q28. $\Gamma\left(n+\dfrac{1}{2}\right)$ is equal to [Given $\Gamma(n+1) = n\Gamma(n)$ and $\Gamma(1/2) = \sqrt{\pi}$]

(a) $\dfrac{n!}{2^n}\sqrt{\pi}$ (b) $\dfrac{2n!}{n!2^n}\sqrt{\pi}$ (c) $\dfrac{2n!}{n!2^{2n}}\sqrt{\pi}$ (d) $\dfrac{n!}{2^{2n}}\sqrt{\pi}$

Q29. The relativistic form of Newton's second law of motion is

(a) $F = \dfrac{mc}{\sqrt{c^2 - v^2}}\dfrac{dv}{dt}$ (b) $F = \dfrac{m\sqrt{c^2 - v^2}}{c}\dfrac{dv}{dt}$ (c) $F = \dfrac{mc^2}{c^2 - v^2}\dfrac{dv}{dt}$ (d) $F = m\dfrac{c^2 - v^2}{c^2}\dfrac{dv}{dt}$

Q30. Consider a gas of atoms obeying Maxwell-Boltzman statistics. The average value of $e^{i\vec{a}.\vec{p}}$ over all the momenta $\vec{p}$ of each of the particles (where $\vec{a}$ is a constant vector and a is its magnitude, m is the mass of each atom, T is temperature and k is Boltzmann's constant) is,

(a) One (b) Zero (c) $e^{-\frac{1}{2}a^2 mkT}$ (d) $e^{-\frac{3}{2}a^2 mkT}$

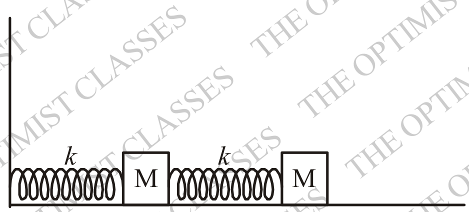
Q31. The electromagnetic form factor $F(q^2)$ of a nucleus is given by, $F(q^2) = \exp\left|-\dfrac{q^2}{2Q^2}\right|$ where Q is a constant. given that $F(q^2) = \dfrac{4\pi}{q}\int_0^\infty rdr\,\rho(r)\sin qr$ $\int d^3r\rho(r) = 1$. Where $\rho(r)$ is the charge density, the root mean square radius of the nucleus is given by

(a) $1/Q$ (b) $\sqrt{2}/Q$ (c) $\sqrt{3}/Q$ (d) $\sqrt{6}/Q$

Q32. A uniform circular disk of radius R and mass M is rotating with angular speed ω about an axis, passing through its center and inclined at an angle 60 degrees with respect to its symmery axis. The magnitude of the angular momentum of the disk is ,

(a) $\dfrac{\sqrt{3}}{4}\omega MR^2$ (b) $\dfrac{\sqrt{3}}{8}\omega MR^2$ (c) $\dfrac{\sqrt{7}}{8}\omega MR^2$ (d) $\dfrac{\sqrt{7}}{4}\omega MR^2$

Q33. Consider two small blocks, each of mass M, attached to two identical springs. One of the springs is attached to the wall, as shown in the figure. The spring constant of each spring is k. The masses slide along the surface and the friction is negligible. The frequency of one of the normal modes of the system is ,



(a) $\sqrt{\frac{3+\sqrt{2}}{2}}\sqrt{\frac{k}{M}}$ (b) $\sqrt{\frac{3+\sqrt{3}}{2}}\sqrt{\frac{k}{M}}$ (c) $\sqrt{\frac{3+\sqrt{5}}{2}}\sqrt{\frac{k}{M}}$ (d) $\sqrt{\frac{3+\sqrt{6}}{2}}\sqrt{\frac{k}{M}}$

Q34. A charge distribution has the charge denisty given by $\rho = Q\left\{\delta\left(x-x_0\right)-\delta\left(x+x_0\right)\right\}$. For this charge distribution the electric field at $\left(2x_0, 0, 0\right)$

(a) $\frac{2Q\hat{x}}{9\pi \in_0 x_0^2}$ (b) $\frac{Q\hat{x}}{4\pi \in_0 x_0^3}$ (c) $\frac{Q\hat{x}}{4\pi \in_0 x_0^2}$ (d) $\frac{Q\hat{x}}{16\pi \in_0 x_0^2}$

Q35. A monochromatic plane wave at oblique incidence undergoes reflection at a dielctric interface. If $\hat{k}_i, \hat{k}_r$ and $\hat{n}$ are the unit vectors in the directions of incident wave, reflected wave and the normal to the surface respectively, which one of the following expression is correct?

(a) $\left(\hat{k}_i-\hat{k}_r\right)\times\hat{n}\neq 0$ (b) $\left(\hat{k}_i-\hat{k}_r\right).\hat{n}=0$ (c) $\left(\hat{k}_i\times\hat{n}\right).\hat{k}_r=0$ (d) $\left(\hat{k}_i\times\hat{n}\right).\hat{k}_r\neq 0$

Q36. In a normal Zeeman effect experiment, spectral splitting of the line at the wavelength 643.8*nm* corresponding to the transition $5^1D_2 \rightarrow 5^1P_1$ of cadmium atom is to be observed. The spectrometer has a resolution of 0.01 *nm*. The minimum mgnetic field needed to observe this is

$\left(m_e = 9.1\times10^{-31} kg, e = 1.6\times10^{-19} C, c = 3\times10^8 m/s\right)$

(a) 0.26 *T* (b) 0.52 *T* (c) 2.6 *T* (d) 5.2 *T*

Q37. The spacing between vibrational energy levels in *CO* molecule is found to be $8.441\times10^{-2} eV$. Given that reduced mass of *CO* is $1.14\times10^{-26} kg$, Planck's constant is $6.626\times10^{-34} Js$ and $1eV = 1.6\times10^{-19} J$. The force constant of the bond is *CO* molecule is

(a) 1.87 *N/m* (b) 18.7 *N/m* (c) 187 *N/m* (d) 1870 *N/m*

Q38. A lattice has the following primitive vectors (in *A*): $\vec{a}=2\left(\hat{j}+\hat{k}\right), \vec{b}=2\left(\hat{k}+\hat{i}\right), \vec{c}=2\left(\hat{i}+\hat{j}\right)$. The reciprocal lattice corresponding to the above laatice is

(a) BCC lattice with cube edge of $\left(\frac{\pi}{2}\right)\AA^{-1}$ (b) BCC lattice with cube edge of $\left(2\pi\right)\AA^{-1}$

(c) FCC lattice with cube edge of $\left(\frac{\pi}{2}\right)\AA^{-1}$ (d) FCC lattice with cube edge of $\left(2\pi\right)\AA^{-1}$

Q39. The total energy of an ionic solid is given by an expression $E = -\frac{\alpha e^2}{4\pi\varepsilon_0 r}+\frac{B}{r^9}$ where α is Madelung constant, r is the distance between the nearest neighbours in the crystal and B is a constant. If r_0 is the equillibrium separation between the nearest neighbours then the value of B is

(a) $\frac{\alpha e^2 r_0^8}{36\pi \in_0}$ (b) $\frac{\alpha e^2 r_0^8}{4\pi \in_0}$ (c) $\frac{2\alpha e^2 r_0^{10}}{9\pi \in_0}$ (d) $\frac{\alpha e^2 r_0^{10}}{36\pi \in_0}$

Q40. A proton is confined to a cubic box, whose sides have length $10^{-12} m$. What is the minimum kinetic energy of the proton? The mass of proton is $1.67\times10^{-27}\,kg$ and Planck's constant is $6.63\times10^{-34}\,Js$.

(a) $1.1\times10^{-17}\,J$ (b) $3.3\times10^{-17}\,J$ (c) $9.9\times10^{-17}\,J$ (d) $6.6\times10^{-17}\,J$

Q41. For the function $f(z)=\dfrac{16z}{(z+3)(z-1)^2}$, the residue at the pole $z=1$ is________________

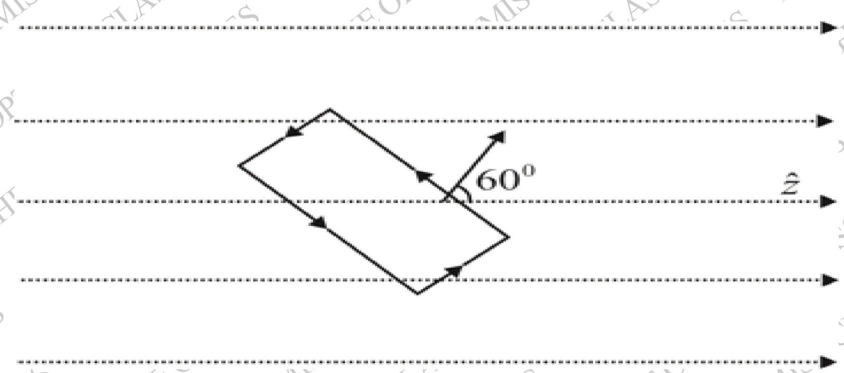
(your answer should be an integer)

Q42. The degenerate eigenvalues of the matrix $M=\begin{pmatrix}4 & -1 & -1\\ -1 & 4 & -1\\ -1 & -1 & 4\end{pmatrix}$ is__________

(your answer should be an integer)

Q43. Consider the decay of a pion into a muon and an anti-neutrino $\pi^-\rightarrow\mu^-+\bar{v}_\mu$ in the pion rest frame. $m_\pi=139.6\,MeV/c^2$, $m_\mu=105.7\,MeV/c^2$, $m_v\approx0$. The energy (in *MeV*) of the emitted neutrino, to the nearest integer is _________.

Q44. In a constant magnetic field of 0.6 Tesla along the *z* direction, find the value of the path integral $\oint\vec{A}.d\vec{l}$ in the units of (Tesla m^2) on a square loop of side length $(1/\sqrt{2})$ meters. The normal to the loop makes an angle of 60^0 to the *z*-axis, as shown in he figure. The answer should be up to two decimal places.__________



Q45. A spin-half particle is in a linear superposition $0.8|\uparrow\rangle+0.6|\downarrow\rangle$ of its spin-up and spin-down states. If $|\downarrow\rangle$ and $|\downarrow\rangle$ are the eigen states of σ_z then what is the expectation value, up to one decimal place, of the operators $10\sigma_z+5\sigma_x$?............ Here, symbols have their usual meanings.

Q46. Consider the wave function $Ae^{ikr}(r_0/r)$, where *A* is the normalization constant. For $r=2r_0$, the magnitude of probability current density up to two decimal places, in units of $(A^2\hbar k/m)$, is __________.

Q47. An *n*-channel junction field effect transistor has 5 *m*A source to drain current at shorted gate (I_{DSS}) and 5*V* pinch off voltage (V_P). Calculate the drain current in *m*A for a gate-source voltage (V_{GS}) of –2.5*V*. The answer should be up to two decimal places____________

Common Data Questions

Common Data for Questions 48 and 49:

There are four energy levels E, $2E$, $3E$ and $4E$ (where $E > 0$). The canonical partition function of two particles is, if these particles are

Q48. Two identical fermions

(a) $e^{-2\beta E} + e^{-4\beta E} + e^{-6\beta E} + e^{-8\beta E}$ (b) $e^{-3\beta E} + e^{-4\beta E} + 2e^{-5\beta E} + e^{-6\beta E} + e^{-7\beta E}$

(c) $\left(e^{-\beta E} + e^{-2\beta E} + e^{-3\beta E} + e^{-4\beta E}\right)^2$ (d) $e^{-2\beta E} - e^{-4\beta E} + e^{-6\beta E} - e^{-8\beta E}$

Q49. Two distinguishable particles

(a) $e^{-2\beta E} + e^{-4\beta E} + e^{-6\beta E} + e^{-8\beta E}$ (b) $e^{-3\beta E} + e^{-4\beta E} + 2e^{-5\beta E} + e^{-6\beta E} + e^{-7\beta E}$

(c) $\left(e^{-\beta E} + e^{-2\beta E} + e^{-3\beta E} + e^{-4\beta E}\right)^2$ (d) $e^{-2\beta E} - e^{-4\beta E} + e^{-6\beta E} - e^{-8\beta E}$

Common Data for Q. 50 and Q. 51:

To the given unpertubed Hamiltonian

$$\begin{bmatrix} 5 & 2 & 0 \\ 2 & 5 & 0 \\ 0 & 0 & 2 \end{bmatrix}$$

we add a small pertubation given by

$$\varepsilon \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & -1 \\ 1 & -1 & 1 \end{bmatrix}$$

where ε is a small quantity.

Q50. The ground state eigen vector of the unpertubed Hamiltonian is

(a) $(1\sqrt{2}, 1/\sqrt{2}, 0)$ (b) $(1\sqrt{2}, -1/\sqrt{2}, 0)$

(c) $(0, 0, 1)$ (d) $(1, 0, 0)$

Q51. A pair of eigen values of the perturbed Hamiltonian, using first order perturbation theory, is

(a) $3 + 2\varepsilon, 7 + 2\varepsilon$ (b) $3 + 2\varepsilon, 2 + \varepsilon$ (c) $3, 7 + 2\varepsilon$ (d) $3, 2 + 2\varepsilon$

Linked Answer Questions

Statement for Linked Answer Questions 52 and 53:

In the schmidt model of nuclear magnetic moments we have $\vec{\mu} = \frac{e\hbar}{2Mc}\left(g_e\vec{l} + g_s\vec{s}\right)$ where the symbols have their usual meaings

Q52. For the case $J = l + 1/2$, where J is the total angular momentum, the expectation value of $\vec{S}\cdot\vec{J}$ in the nuclear ground state is equal to,

(a) $(J-1)/2$ (b) $(J+1)/2$ (c) $J/2$ (d) $-J/2$

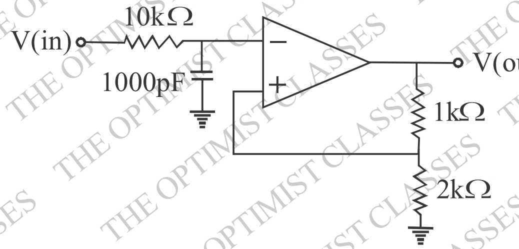
Q53. For the O^{17} nucleus ($A = 17, Z = 8$), the effective magnetic moment is given by, $\vec{\mu}_{eff} = \frac{e\hbar}{2Mc} g\vec{J}$

Where g is equal to, ($g_s = 5.59$ for proton and -3.83 for Neutron)

(a) 1.12 (b) -0.77 (c) -1.28 (d) 1.28

Statement for Linked Answer Questions 54 and 55 :

Consider the following circuit



Q54. For this circuit the frequency above which the gain will decrease by 20 *dB* per decade is
(a) 15.9 *kHz* (b) 1.2 *kHz* (c) 5.6 *kHz* (d) 22.5 *kHz*

Q55. At 1.2 *kHz* the closed loop gain is
(a) 1 (b) 1.5 (c) 3 (d) 0.5

General Aptitude (GA) Questions

Q1. A number is as much greater then 75 as it is smaller than 117. The number is
(a) 91 (b) 93 (c) 89 (d) 96

Q2. The professor ordered to the students to go out of the class
I II III IV
Which of the above underlined parts of the sentence is grammatically incorrect?
(a) I (b) II (c) III (d) IV

Q3. Which of the following options is the closest in meaning to the word given below
Primeval
(a) Modern (b) Historic (c) Primitive (d) Antique

Q4. Friendship, no matter how___________ it is, has its limitations
(a) cordial (b) intimate (c) secret (d) pleasant

Q5. Select the pair that best expresses a relationship similar to that expressed in the pair:
Medicine: Health
(a) Science: Experiment (b) Wealth: Peasce
(c) Education: Knowledge (d) Money: Happiness

Q6. *X* and *Y* are two positive real numbers such that $2X + Y \le 6$ and $X + 2Y \le 8$. For which of the following values of (*X*, *Y*) the function f(*X*, *Y*) = 3*X* + 6*Y* will given maximum value?
(a) (4/3, 10/3) (b) (8/3, 20/3) (c) (8/3, 10/3) (d) (4/3, 20/3)

Q7. If $|4X - 7| = 5$ then the values of $2|X| - |-X|$ is
(a) 2, 1/3 (b) 1/2, 3 (c) 3/2, 9 (d) 2/3, 9

Q8. Following table provides figures (in rupees) on annual expenditure of a firm for two years - 2010 and 2011.

Category	2010	2011
Raw material	5200	6240
Power & fuel	7000	9450
Salary & wages	9000	12600
Plant & machinery	20000	25000
Advertising	15000	19500
Research & Development	22000	26400

In 2011, which of the following two categories have registered increases by same percentage?
(a) Raw material and Salary & wages
(b) Salary & wages and Advertising

(c) Power & fuel and Advertising
(d) Raw material and Research & Development

Q9. A firm is selling its product at Rs. 60 per unit. The total cost of production is Rs. 100 and firm is earning total profit of Rs. 500. Later, the total cost increases by 30%. By what percentage the price should be increased to maintained the same profit level

(a) 5 (b) 10 (c) 15 (d) 30

10. Abhishek is elder to Savar
Savar is younger to Anshul
Which of the given conclusions is logically valid and is inferred from the above statements?

(a) Abhishek is elder to Anshul (b) Anshul is elder to Abhishek
(c) Abhishek and Anshul are of the same age (d) No conclusion follows

ANSWER KEY

1.	**(b)**	**2.**	**(d)**	**3.**	**(b)**	**4.**	**(d)**	**5.**	**(c)**
6.	**(a)**	**7.**	**(a)**	**8.**	**(d)**	**9.**	**(c)**	**10.**	**(d)**
11.	**(a)**	**12.**	**(c)**	**13.**	**(d)**	**14.**	**(b)**	**15.**	**(c)**
16.	**(c)**	**17.**	**(d)**	**18.**	**(d)**	**19.**	**(*)**	**20.**	**(c)**
21.	**(c)**	**22.**	**(b)**	**23.**	**(70)**	**24.**	**(3.16)**	**25.**	**(3)**
26.	**(c)**	**27.**	**(b)**	**28.**	**(c)**	**29.**	**(c)**	**30.**	**(c)**
31.	**(c)**	**32.**	**(c)**	**33.**	**(c)**	**34.**	**(a)**	**35.**	**(c)**
36.	**(b)**	**37.**	**(c)**	**38.**	**(a)**	**39.**	**(a)**	**40.**	**(c)**
41.	**(3)**	**42.**	**(5)**	**43.**	**(30)**	**44.**	**(0.15)**		
45.	**(7.6)**	**46.**	**(0.25)**	**47.**	**(1.25)**	**48.**	**(b)**	**49.**	**(c)**
50.	**(c)**	**51.**	**(c)**	**52.**	**(b)**	**53.**	**(b)**	**54.**	**(a)**
55.	**(b)**								