# E OPTIMIST CLASSES



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# CSIR-NET-JRF RESULTS 2022



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## THE OPTIMIST CLASSES

AN INSTITUTE FOR NET-JRF/GATE/IIT-JAM/JEST/TIFR/M.Sc ENTRANCE EXAMS

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## GATE PAPER 2013

MSI	ASS COR MST ASS TO MIST ASS THE OPTION
MST	Q.1-Q.25: Carry ONE mark each.
Q1.	f(x) symmetric periodic function of $x$ i.e. $f(x) = f(-x)$ . Then, in general, the Fourier series of the function $f(x)$
DIIM	will be of the form
TIE OI	(a) $f(x) = \sum_{n=1}^{\infty} (a_n \cos nkx + b_n \sin nkx)$ (b) $f(x) = a_0 + \sum_{n=1}^{\infty} (a_n \cos nkx)$
OP!	(a) $f(x) = \sum_{n=1}^{\infty} (a_n \cos nkx + b_n \sin nkx)$ (b) $f(x) = a_0 + \sum_{n=1}^{\infty} (a_n \cos nkx)$
THE	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) $f(x) = a_0 + \sum_{n=1}^{\infty} (b_n \sin nkx)$
THE	(c) $f(x) = \sum_{n=0}^{\infty} (b_n \sin nkx)$ (d) $f(x) = a_0 + \sum_{n=0}^{\infty} (b_n \sin nkx)$
155 02	$f(x)$ symmetric 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) $f(x) = a_0 + \sum_{n=1}^{\infty} (b_n \sin nkx)$ 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  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
55° Q2.	In the most general case, which one of the following quanties is NO1 a second order tensor?  (a) Strong (b) Strong (c) Manager of inpution (d) Progguero
SO3	An electron is moving with a velocity of 0.85 c in the same direction as that of a moving photon. The relative
OLA QJ.	velocity of the electron with respect to photon is
CLASS	
94.	If Planck's constant were zero, then the total energy contained in a box filled with radiation of all frequencies
CT CL	at temperature $T$ would be ( $k$ is the Boltzmann constant and $T$ is non zero)
TIMIS	CLAS (15) (THE A) TOURS (15) (THE THEORY IN THE CLASS (S. T. OR)
MS	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) $kT$ Across a first order phase transition, the free energy is
Q5.	Across a first order phase transition, the free energy is
E DIT	(a) proportional to the temperature
CLIEON	(b) a discontinuous function of the temperature
Tr C	(a) proportional to the temperature (b) a discontinuous function of the temperature (c) a continuous function of the temperature but its derivative is discontinuous (d) such that the first derivative with respect to temperature is continuous  Two cases reperated by an importance blo but moved by partition are allowed to freely expanse one ray. At
Q6.	(d) such that the first derivative with respect to temperature is continuous  Two cases separated by an impermeable but movable partition are allowed to freely exhause energy. At
ES QU.	equilibrium, the two sides will have the same
is ,	(a) pressure and temperature (b) volume and temperature
ASSI	(c) pressure and volume (d) volume and energy
Q7.	(b) a discontinuous function of the temperature (c) a continuous function of the temperature but its derivative is discontinuous (d) such that the first derivative with respect to temperature is continuous 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  The entropy function of a system is given by $S(E) = aE(E_0 - E)$ where $a$ and $E_0$ are positive constants. The
Cor	S temperature of the system is
CLA	(a) negative for some energies (b) increases monotonically with energy
MISI	(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
PIMI	temperature of the system is  (a) negative for some energies  (b) increases monotonically with energy  (c) decreases monotonically with energy  (d) zero  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) $Nk$ $In(2)$
J.	(a) Zero (b) $Nk$ (c) $\frac{1}{Nk}$ (d) $Nk$ $In(2)$
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H	The of the office of the offic

- 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 = 1/3Q11. Consider the scattering of neutrons by protons at very low energy due to a nuclear potential of
- 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  $\delta$  is the phase shift, k the wave number and  $(-\gamma)$  the logarithmic 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  $\beta$ -decay process, the transition  $2^+ \rightarrow 3^+$ , 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) 
$$(\vec{k}_1 - \vec{k}_2) \cdot \vec{r} = (2m+1)\pi$$
 (b)  $(\vec{k}_1 - \vec{k}_2) \cdot \vec{r} = 2m\pi$ 

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

- Q15. For a scalar function  $\varphi$  satisfying the Laplace equation,  $\nabla \varphi$  has
  - (a) zero curl and non-zero divergence (b) non-zero curl 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) 
$$\begin{bmatrix} L^2, Lz \end{bmatrix} = 0$$
 (b)  $\begin{bmatrix} L_x, L_y \end{bmatrix} = i\hbar L_z$  (c)  $\begin{bmatrix} L_z, L_+ \end{bmatrix} = \hbar L_+$  (d)  $\begin{bmatrix} L_z, L_- \end{bmatrix} = \hbar L_-$ 

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

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statements is CORRECT?

- (a)  $p_a = 2\beta q$  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)  $p_a = 2\beta \dot{q}$  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) 1*MHz*
- (b) 2*MHz*
- (c) 0.5MHz
- (d) 4*MH*2
- Q20. A phosphorous doped silicon semiconductor (doping density:  $10^{17} / cm^3$ ) is heated from  $100^{\circ}C$  to  $200^{\circ}C$  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  $\mu V$ ? The answer should be up to two decimal places
- Q25. The number of spectral lines allowed in the spectrum for the  $3^2 D \rightarrow 3^2 P$  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) 
$$F(t) = \sin kt$$
,  $f(s) = \frac{s}{s^2 + k^2}$ ,  $(s > 0)$ 

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

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

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

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

  (a)  $\frac{n!}{2^n}\sqrt{\pi}$ (c)  $\frac{2n!}{n!2^{2n}}\sqrt{\pi}$

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

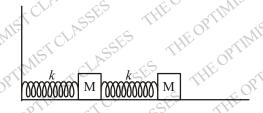
(a) 
$$F = \frac{mc}{\sqrt{c^2 - v^2}} \frac{dv}{dt}$$

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

(d) 
$$F = m \frac{c^2 - v^2}{c^2} \frac{dv}{dt}$$

- ativistic form of Newton's second law of motion is  $\frac{mc}{\sqrt{c^2 v^2}} \frac{dv}{dt} \quad \text{(b)} \quad F = \frac{m\sqrt{c^2 v^2}}{c} \frac{dv}{dt} \quad \text{(c)} \quad F = \frac{mc^2}{c^2 v^2} \frac{dv}{dt} \quad \text{(d)} \quad F = m\frac{c^2 v^2}{c^2} \frac{dv}{dt}$ The state of the sta Consider a gas of atoms obeying Maxwell-Boltzman statistics. The average value of  $e^{i\vec{a}\cdot\vec{p}}$  over all the momenta  $\vec{p}$  of each of the particles (where  $\vec{a}$  is a constant vector and  $\vec{a}$  is its magnitude,  $\vec{m}$  is the mass of each atom,  $\vec{T}$ is temperature and k is Boltzmann's constant) is,
  - (a) One
- (b) Zero
- (c)  $e^{-\frac{1}{2}a^2mkT}$
- (d)  $e^{-\frac{3}{2}a^2mkT}$
- The electromagnetic form factor  $F(q^2)$  of a nucleus is given by,  $F(q^2) = \exp\left|-\frac{q^2}{2Q^2}\right|$  where Q is a constant.
  - given that  $F(q^2) = \frac{4\pi}{q} \int_0^\infty r dr \, \rho(r) \sin qr \int d^3r \, \rho(r) = 1$ . Where  $\rho(r)$  is the charge density, the root mean square radius of the nucleus is given by
  - (a) 1/*Q*
- (b)  $\sqrt{2} / O$

- A uniform circular disk of radius R and mass M is rotating with angular speed  $\omega$  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,
- (b)  $\frac{\sqrt{3}}{8}\omega MR^2$
- (c)  $\frac{\sqrt{7}}{8}\omega MR^2$  (d)  $\frac{\sqrt{7}}{4}\omega MR^2$
- 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)  $\sqrt{\frac{3+\sqrt{6}}{2}}\sqrt{\frac{k}{M}}$ 

(b) 
$$\sqrt{\frac{3+\sqrt{3}}{2}}\sqrt{\frac{k}{M}}$$

(c) 
$$\sqrt{\frac{3+\sqrt{5}}{2}}\sqrt{\frac{k}{M}}$$

(d) 
$$\sqrt{\frac{3+\sqrt{6}}{2}}\sqrt{\frac{k}{M}}$$

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

(a) 
$$\frac{2Q\hat{x}}{9\pi \in_{\Omega} x_0^2}$$

(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)  $\frac{Q\hat{x}}{16\pi \in_0 x_0^2}$ 

(c) 
$$\frac{Q\hat{x}}{4\pi \in_0 x_0^2}$$

(d) 
$$\frac{Q\hat{x}}{16\pi \in_0 x_0^2}$$

A monochromatic plane wave at oblique incidence undergoes reflection at a dielectric 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) 
$$(\hat{k}_i - \hat{k}_r) \times \hat{n} \neq 0$$

(a) 
$$(\hat{k}_i - \hat{k}_r) \times \hat{n} \neq 0$$
 (b)  $(\hat{k}_i - \hat{k}_r) \cdot \hat{n} = 0$  (c)  $(\hat{k}_i \times \hat{n}) \cdot \hat{k}_r = 0$ 

(c) 
$$(\hat{k}_i \times \hat{n}).\hat{k}_r = 0$$

(d) 
$$(\hat{k}_i \times \hat{n}) \cdot \hat{k}_r \neq 0$$

In a normal Zeeman effect experiment, spectral splitting of the line at the wavelength 643.8nm 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

$$(m_e = 9.1 \times 10^{-31} kg, e = 1.6 \times 10^{-19} C, c = 3 \times 10^8 m/s)$$

- The spacing between vibrational energy levels in CO molecule is found to be  $8.441 \times 10^{-2} \, eV$ . Given that reduced mass of CO is  $1.14 \times 10^{-26} kg$ , Planck's constant is  $6.626 \times 10^{-34} Js$  and  $1eV = 1.6 \times 10^{-19} J$ . force constant of the bond is CO molecule is
  - (a) 1.87 N/m
- (b) 18.7 *N/m*

- A lattice has the following primitive vectors (in A):  $\vec{a} = 2(\hat{j} + \hat{k}), \vec{b} = 2(\hat{k} + \hat{i}), \vec{c} = 2(\hat{i} + \hat{j})$ . The reciproc lattice corresponding to the above laatice is
  - (a) BCC lattice with cube edge of  $\left(\frac{\pi}{2}\right)^{\mathring{A}^{-1}}$  (b) BCC lattice with cube edge of  $(2\pi)^{\mathring{A}^{-1}}$
  - (c) FCC lattice with cube edge of  $\left(\frac{\pi}{2}\right) \mathring{A}^{-1}$  (d) FCC lattice with cube edge of  $\left(2\pi\right) \mathring{A}^{-1}$
- The total energy of an ionic solid is given by an expression  $E = -\frac{\alpha e^2}{4\pi\epsilon r} + \frac{B}{r^9}$  where  $\alpha$  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

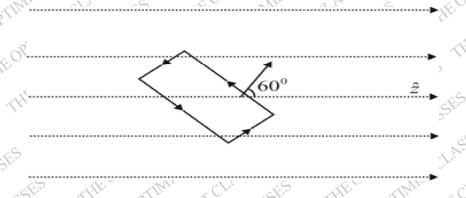
the proton? The mass of proton is  $1.67 \times 10^{-27} \, kg$  and Planck's constant is  $6.63 \times 10^{-34} \, J_S$ .

- (a)  $1.1 \times 10^{-17} J$
- (b)  $3.3 \times 10^{-17} J$
- (c)  $9.9 \times 10^{-17} J$
- $\begin{array}{c} 34 J_{S} \\ \text{(d) } 6.6 \times 10^{-17} J_{S} \\ \end{array}$ For the function  $f(z) = \frac{16z}{(z+3)(z-1)^2}$ , the residue at the pole z=1 is\_

  (your answer should be an integer)
- -1)s -1 4 4 is\_ Q42. The degenerate eigenvalues of the matrix  $M = \begin{bmatrix} -1 \end{bmatrix}$

(your answer should be an integer)

- Consider the decay of a pion into a muon and an anti-neutrino  $\pi^- \to \mu^- + \overline{\nu}_{\mu}$  in the pion rest frame.  $m_{\pi} = 139.6 \, MeV / c^2$ ,  $m_{\mu} = 105.7 \, MeV / c^2$ ,  $m_{\nu} \approx 0$ . The energy (in MeV) of the emitted neutrino, to the nearest integer is est integer is
- In a constant magnetic field of 0.6 Tesla along the z direction, find the value of the path integral  $\oint \vec{A} \cdot d\vec{l}$  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  $60^{\circ}$  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  $0.8 \uparrow \uparrow + 0.6 \downarrow \downarrow$  of its spin-up and spin-down states. If  $|\downarrow \downarrow \rangle$  and  $|\downarrow\rangle$  are the eigen states of  $\sigma_z$  then what is the expectation value, up to one decimal place, of the operators
- 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
- An *n*-channel junction field effect transistor has 5 mA source to drain current at shorted gate  $(I_{DSS})$  and 5Vpinch off voltage  $(V_p)$ . Calculate the drain current in mA for a gate-source voltage  $(V_{GS})$  of -2.5V. The answer should be up to two decimal places  $\dots$  voltage  $(V_P)$ . Calculate the drai answer should be up to two decimal places\_

  Common Data Questions

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 (a)  $e^{-2\beta E} + e^{-4\beta E} + e^{-6\beta E} + e^{-8\beta E}$ (c)  $(e^{-\beta E} \perp e^{-2\beta E})$ 

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

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

Two identical fermions
(a) 
$$e^{-2\beta E} + e^{-4\beta E} + e^{-6\beta E} + e^{-8\beta E}$$
 (b)
(c)  $\left(e^{-\beta E} + e^{-2\beta E} + e^{-3\beta E} + e^{-4\beta E}\right)^2$  (d)
Two distinguishable particles
(a)  $e^{-2\beta E} + e^{-4\beta E} + e^{-6\beta E} + e^{-8\beta E}$  (b)

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

(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) 
$$e^{-2\beta E} - e^{-4\beta E} + e^{-6\beta E} - e^{-8\beta E}$$

To the given unpertubed Hamiltonian

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

(b) 
$$e^{-3\beta E} + e^{-4\beta E} + 2e^{-5\beta E} + e^{-6\beta E} + e^{-7\beta E}$$
  
(d)  $e^{-2\beta E} - e^{-4\beta E} + e^{-6\beta E} - e^{-8\beta E}$   
(b)  $e^{-3\beta E} + e^{-4\beta E} + 2e^{-5\beta E} + e^{-6\beta E} + e^{-7\beta E}$   
(d)  $e^{-2\beta E} - e^{-4\beta E} + e^{-6\beta E} - e^{-8\beta E}$   
51:

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

$$\varepsilon \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & -1 \\ 1 & -1 & 1 \end{bmatrix}$$
unpertubed Hamiltonian is
(b)  $(1\sqrt{2}, -1/\sqrt{2}, 0)$ 

we add a small pertubation given by the second small  $\varepsilon$  is a small  $\varepsilon$  here  $\varepsilon$  is a small  $\varepsilon$ 

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

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

where  $\varepsilon$  is a small quantity.

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

(a)  $(1\sqrt{2}, 1/\sqrt{2}, 0)$ (b)  $(1\sqrt{2}, -1)^{-1/2}$ (a)  $3 + 2\varepsilon$ ,  $7 + 2\varepsilon$ (b) 3Linked Answer Ostatemer\*

(a) 
$$3+2\varepsilon, 7+2\varepsilon$$

(b) 
$$3 + 2\varepsilon, 2 + \varepsilon$$

(c) 
$$3,7+2\varepsilon$$

(d) 
$$3, 2 + 2\varepsilon$$

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

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 (c) J/2/151 CL ground state is equal to,

(a) 
$$(J-1)/2$$

(b) 
$$(J + 1)/2$$

(c) 
$$J/2$$

(d) 
$$-J/2$$

THE OPTIMIST CLASSES THE OPTIMIST CLASSES 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,  $(g_s = 5.59 \text{ for proton and } -3.83 \text{ for Neutron})$ (a) 1.12 (b) -0.77 (c) -1.28 (d) 1.29 Statement for Linked Answer Question 7.1 7. THE OPTIMI(d) 1.28 ASSES

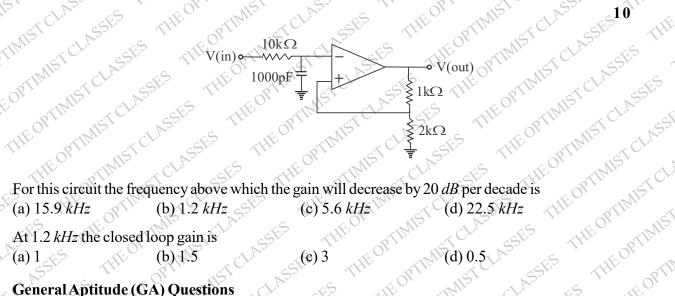
(c) 
$$-1.28$$

Consider the following circuit

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- THE OPTIMIST CLASSES

- PIIMSTQ55.

- ASSITE 3

#### General Aptitude (GA) Questions

- QLIIS A number is as much greater then 75 as it is smaller than 117. The number is
- (b) 93
- (c) 89
- IV OPTIMIST CLASSES
- The professor ordered to the students to go out of the class

Which of the above underlined parts of the sentence is grammatically incorrect?

 $\Pi$ 

(b) H

(c) III

- orrect?
  (d) IV
  n belov ASSES 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
- it is, has its limitations Friendship, no matter how
  - (a) cordial
- (b) intimate
- (c) secret
- (d) pleasant
- Select the pair that best expresses a relationship similar to that expressed in the pair:

Medicine: Health

- (b) Wealth: Peasce (d) Money: Happiness 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) = 3X + 6Y will given maximum value? (a) (4/3, 10/3) (b) (8/3, 20/3) (c) (8/3, 10/3) (d) (4/2, 20/3) If |4X 7| = 5 then the values of  $(3/3)^{1/3}$

HE OPTIMIST C

- (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.

(a) 2, 1/3 (b) 1/2			(a) 2/3, 9
Following table provides figur	es (in rup	ees) on a	annual expenditure of a firm for two years - 2010 and 2011.
EOI TIME CLAS		SOX	TOP MIST STATE
Category	2010	2011	I METO ASSET THE OPTIME ISTOCKASSED
Raw material	5200	6240	OPTIME STOLE SSES THE OPTIME STOLE SSE
Power & fuel	7000	9450	DETIME TOLK SEES THE DETIME TOLK
Salary & wages	9000	12600	THE OF STIMILS I CLASS SES THE OF TIMIS! CLAS
Plant & machinery	20000	25000	TEOP MIST CLASS IS IT TOP I MISTE
Advertising	15000	19500	S THE OPTIMEST ASSET THE OPTIMEST
Research & Development	22000	26400	THE PITTER STOLL SSES THE PRIME
TOWN SEED OF THE OP	LIMI	Chr	SSES THE BIME TOLK SSES THEO TIME
In 2011, which of the following	g two cate	egories h	ave registered increases by same percentage?
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(b) Salary & wages and Advert	ising	MI	CLA TES TEO, THUS CLAS TEO
TIMIST CLASS IS	TEOPI	MIS	TO CLASSIC STILL TOPPING TARSEL STILL
233, FIR	ST FLC	OR, L	AXMI NAGAR DELHI-110092
CALL@ 09871044043	www.the	eoptimis	tclasses.com Email: info@theoptimistclasses.com

- (b) Salary & wages and Advertising

IE OPTIMIST CLAS

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

  A firm is selling its product at Bo 60 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 THE OPTIMIST CLASSES maintained the same profit level THE OPTIMIST CLASSES
  - (a) 5

- (c) 15
- (d) 30

ASS<sup>15</sup>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

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