## PU Ph D Physics

### 1 of 100
195 PU_2015_122
Consider the electrical conductivity of silver, copper, gold and aluminum. Then, arrange them in the decreasing order of decreasing conductivity.

- Ag > Cu >Al > Au
- Ag > Cu >Au > Al
- Cu > Ag > Al > Au
- Cu > Au > Ag > Al

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112 PU_2015_122

If we substitute $u=\sqrt{y}$ in the differential equation

$$\frac{dy}{dx}-2y=x\sqrt{y}$$

we get _____.

- $\frac{du}{dx}-u=\frac{x}{2}$.
- $\frac{du}{dx}-u=-\frac{x}{2}$.
- $\frac{du}{dx}=2u\frac{dy}{dx}$.
- $\frac{du}{dx}-y=\frac{x}{2}$.

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101 PU_2015_122
What is a red shift?

- The shifting of an absorption to shorter wavelength.
- The shifting of an absorption to higher energy.
- The shifting of an absorption to lower energy.
- The shifting of an absorption towards the blue end of the spectrum.

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SI unit of electric flux density $\vec{E}$ is :-

- $C/m^2$

- N / C
- Ampere/$m^2$
- Ampere/m

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168 PU_2015_122

Let $0 \le \phi \le 2\pi$ . Determine the nature of the operator $\hat{Q}$ where

$$\hat{Q} = i\frac{d}{d\phi}$$

- Hermitian and real eigenvalues
- Hermitian and complex eigenvalues
- Non Hermitian and complex eigenvalues
- Non Hermitian

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142 PU_2015_122

The Hamiltonian for a collection of anharmonic oscillators of a solid is

$$H = \sum_{i=1}^{3N} \frac{p_i^2}{2m} + \frac{\lambda}{4} x_i^4 \ .$$

Molar specific heat of such a solid is

- $\frac{3}{4}R$
- $\frac{9}{4}R$
- $\frac{5}{2}R$
- $\frac{3}{2}R$

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181 PU_2015_122

The electric charge labels a representation of a local gauge symmetry group that is gauged to give QED. What is it?

- SU(2)

- U(1)
- SU(3)
- SU(1)

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105 PU_2015_122

Which quantum number describes the shape of the region of space occupied by the electron?

- Azimuthal quantum number, *l*
- Principal quantum number, *n*
- Magnetic quantum number, $m_l$
- All of the above

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125 PU_2015_122

The Lagrangian of a particle moving in a central potential $V(\vec{r})$ is given by

$$L = \frac{1}{2}m\left(\dot{r}^2 + r^2\dot{\theta}^2\right) - V(\vec{r}).$$

In addition to this potential, if a velocity dependent potential of the form $V(\vec{r}, \vec{v}) = \lambda r|\vec{v}|$ where $\lambda$ is some constant, is introduced, then

- only the equation of motion in θ is changed.
- only the equation of motion in r is changed.
- both equations of motion are changed.
- equations of motion remain the same.

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The Rutherford scattering experiment is used to determine the atomic number $Z_x$ of an unknown target nucleus. Cadmium with atomic number $Z_{Cd} = 48$ is taken as a reference nucleus. A beam of $\alpha$ particles of same energy is used as incident beam and the scattering cross sections for cadmium and the unknown element are respectively denoted by $\sigma_{Cd}$ and $\sigma_x$. If $\sigma_{Cd}/\sigma_x$ is equal to 9/4, then $Z_x$ is equal to

- 30

- 26
- 32
- 72

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104 PU_2015_122

Which is the correct order that electrons will fill orbitals?

- 3*s* 3*p* 4*s* 4*d*
- 3*d* 4*p* 5*s* 4*d*
- 3*d* 3*p* 4*s* 4*d*
- 4*s* 4*p* 4*d* 5*s*

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149 PU_2015_122

The use of negative feedback in the op-amp is to:-

- A) Reduce the voltage gain of an op-amp
- B) Make linear operation possible
- C) Both (A) & (B)
- D) Make the op-amp oscillate

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106 PU_2015_122

How many normal modes of vibrational are possible for a benzene molecule?

- 31
- 30
- 12
- 6

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205 PU_2015_122

The magnetic vector potential $\bar{A}$ in some region of space is equal to $10\hat{a}_\phi$ where $\hat{a}_\phi$ is the unit vector in the $\phi$-direction in cylindrical polar coordinate system $(\rho, \phi, z)$. Then, the magnetic field in that region is:-

- Inversely proportional to radial distance ρ
- Zero.
- Inversely proportional to the square radial distance, $\rho^2$
- Uniform or non-zero constant.

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174 PU_2015_122
Lasers rod have to have cut at _____angle to produce polarized light

- At an angle of 45° to that of the optic axis
- Perpendicular to the optic axis
- Brewster angle
- Critical angle

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193 PU_2015_122
Consider a process A + B → C + D. Assuming that C and D belong to isospin zero multiplets and further that, A and B each belong to an isospin 1/2 multiplet and if $I_3$ for A is +1/2, then:-

- can go only via electromagnetic interactions
- this reaction cannot go via strong interaction
- this reaction can go via strong interaction
- can go via strong and electromagnetic interactions

**17 of 100**
180 PU_2015_122
The color group SU(3) corresponds to a local gauge symmetry. Its gauging gives rise to:-

- QED
- Electro weak
- QCD.
- GUT

**18 of 100**
156 PU_2015_122
Which of the following type of bonds are directional?

- Van Der Waals.
- Covalent.
- Metallic.
- Ionic.

**19 of 100**
144 PU_2015_122

An n-channel FET having a pinch-off voltage $V_p$ = -5$V$ shows a trans-conductance $g_m$ of 1mA/V, when the applied gate to source voltage $V_{GS}$ = -3$V$. Its maximum trans-conductance (in mA/V) will be:-

- 2.0

- 2.5
- 1.5
- 3.0

**20 of 100**

100 PU_2015_122

A solution of 0.001 mol $dm^{-3}$ $NiSo_4$ is placed in an optical cell of path length 1 cm, and the absorption spectrum is recorded. The absorptions have characteristic $\lambda$max and $\epsilon$max values. What is the correct unit of $\epsilon$max?

- cm mol $dm^{-3}$
- cm $dm^3$ $mol^{-1}$
- mol $dm^{-3}$ $cm^{-1}$
- $dm^3$ $mol^{-1}$ $cm^{-1}$

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219 PU_2015_122

If light (electromagnetic wave) falls on a perfect conductor, then:-

- Any magnetic field, if present, on the surface of the perfect conductor should be normal to its surface.
- The tangential component of magnetic field $\vec{H}$ on the surface of the perfect conductor is zero.
- The tangential component of electric field $\vec{E}$ on the surface of the perfect conductor is zero.
- Electric field, if present, on the surface of the perfect conductor should be normal to its surface.

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147 PU_2015_122

The depletion region in diode is created by:-

- Ionization
- Recombination
- Diffusion
- All of these

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200 PU_2015_122

Differentiate with respect to $x$ the function $y(x)$ where

$$y(x) = 3^{\log(x)}$$

- $\frac{3^{\log x}}{x} \log 3$

- $(\log x)3^{\log x-1}$
- $\log\frac{3}{x}$
- $3^{\log x}/x$

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118 PU_2015_122

Let $f(t)$ be defined and integrable over intervals within $0 \le t \le \infty$ and let $\delta$ represent delta function. Then, the value of $\int_0^\infty f(t)\,\delta(t-a)dt$ is equal to

- $a$
- $1$
- $f(a)$
- $0$

**25 of 100**
207 PU_2015_122
When compared to experimental values of heat capacity of solids, the Einstein's theory gives lower values at:-

- Absolute zero of temperature.
- All temperatures
- Low temperatures
- High temperatures

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204 PU_2015_122

Consider an unpolarized solid dielectric sphere of radius $a$ and permittivity $\epsilon$ which is uniformely charged with a volume charge density $\rho_0$. Then, the electric displacement vector $\vec{D}$ on the surface of the sphere is-

- A constant and proportional to the radius of the sphere.
- A constant independent of permittivity of the sphere.
- Directly proportional to dielectric constant and radius of the sphere.
- Inversely proportional to square of the radius of the sphere.

**27 of 100**
117 PU_2015_122

Let $L[f(t)] = F(s)$ represent the Laplace transform. If $k > 0$ then:-

- $L[f(kt)] = \frac{1}{k} F\left(\frac{k}{s}\right)$
- $L[f(kt)] = \frac{1}{s} F\left(\frac{s}{k}\right)$
- $L[f(kt)] = \frac{1}{k} F\left(\frac{s}{k}\right)$
- $L[f(kt)] = \frac{1}{s} F\left(\frac{k}{s}\right)$

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159 PU_2015_122

At absolute zero of temperature, all the allowed states of energy up to Fermi level will be:-

- Partially filled.
- Half filled.
- Empty.
- Occupied.

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196 PU_2015_122

An anisotropic dielectric material is characterized by the electric permittivity tensor

$$[\epsilon] = \epsilon_0 \begin{pmatrix} 7 & 2 & 0 \\ 2 & 4 & 0 \\ 0 & 0 & 3 \end{pmatrix}$$

If we apply an electric field $\vec{E} = E_0 \hat{a}_z$ to this material, then the electric displacement vector $\vec{D}$ will be

- Parallel to $\left(\hat{a}_x + \hat{a}_y\right)$ vector.
- Equal to $\epsilon_0 \vec{E}\, \hat{a}_y$.
- Paralled to $\vec{E}$.
- Parallel to $\left(7\hat{a}_x + 4\hat{a}_y + 3\hat{a}_z\right)$ vector.

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126 PU_2015_122

A rod moves at a relativistic speed. The direction of its velocity makes an angle of 45° with its length in its rest frame. If $l_0$ is the proper length of the rod and $l$ is its contracted length, then the condition that maximum speed cannot exceed $c$ corresponds to:-

- $l$ cannot be less than $\sqrt{2}\,l_0$.
- $l$ cannot be less than $l_o/\sqrt{2}$
- $l$ cannot be greater than $l_o/\sqrt{2}$
- $l$ cannot be less than $l_0$.

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Two operators $\hat{O}_1$ and $\hat{O}_2$ are found to be commuting. The eigenstates of operator $\hat{O}_1$ are non-degenerate. Then what can you say about the eigenstates/eigenvalues of operator $\hat{O}_2$?

- Eigenstates of $\hat{O}_2$ are not orthogonal to each other.
- Eigenvalues of $\hat{O}_2$ are necessarily the same as that of $\hat{O}_1$
- Eigenstates of $\hat{O}_2$ are not the same as the eigenstates of $\hat{O}_1$.
- Every eigenstate of $\hat{O}_1$ is also an eigenstate of $\hat{O}_2$.

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145 PU_2015_122

If $A$ and $B$ are two numbers, then, in C or C++ language, $A^B$ can be programmed as:-

- $A**B$
- $\mathrm{pwr}(A, B)$
- $A\hat{}B$
- $\mathrm{pow}(A, B)$

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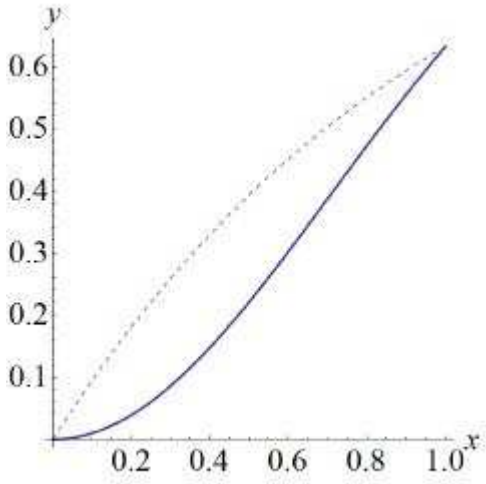
215 PU_2015_122

Two functions f(x) = 1 - e-$x^2$ and g(x) = 1 -$e^{-x}$ are plotted in the graph shown. Identify the curves in the plot.




- The dotted curve is g(x) while that below dotted curve is f(x)
- The dotted curve is f(x) while that below dotted curve is g(x)
- The smooth curve is f(x) and the dotted curve is not g(x)
- The plots should be shown for larger values of x in order to identify them.

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155 PU_2015_122

In a certain crystal, the volume of primitive cell is V. Then, the volume of the first Brillouin zone is:-

- $8\pi^3/V$
- $2\pi^3/V$
- $1/V$
- $2\pi^3 V$

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166 PU_2015_122

For a free particle, its classical and quantum speeds are related by:-

- $v_{classical} = v_{quantum}$
- $v_{classical} = 2v_{quantum}$
- $v_{classical} << v_{quantum}$
- $v_{classical} >> v_{quantum}$

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203 PU_2015_122

The circle of convergence of the power series

$$S=\sum_{n=1}^{\infty}\frac{(z-i)^n}{n}$$

is given by

- $|z-i|^n<1$
- $\frac{|z-1|^n}{n}<1$
- $|z|<1$
- $|z-i|<1$

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198 PU_2015_122

The problem of determining a polynomial of degree *n* - 1 that will pass through *n* number of data points ($x_i$, $y_i$) is known as:-

- Method of divided differences.
- Interpolation.
- Polynomial curve fitting.
- Lagrange polynomial.

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143 PU_2015_122

An ideal gas of particle density n approaches equilibrium because of collisions. Consider each particle to be a hard sphere of radius r. If the mean free path (distance travelled between two successive collisions) is what is the mean free path if the radius is λ reduced to r/2?

- λ/4
- λ/2
- 4λ
- 2λ

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116 PU_2015_122

The eigenvector $\mathbf{x}$ corresponding to eigenvalue $\lambda=-i$ of $A$ is ___ where

$$A=\begin{pmatrix}1 & 2 & 1\\ 0 & 1 & 1\\ 2 & 0 & 1\end{pmatrix}.$$

- $[i \quad 1 \quad (1+i)]^T$
- $[i \quad 1 \quad -(1+i)]^T$
- $[2 \quad 1 \quad 2]^T$
- $[-i \quad 1 \quad -1+i]^T$

**40 of 100**
197 PU_2015_122

Consider the evaluation of roots of a nonlinear algebraic equation f(x) = 0 in the region a ≤ x ≤ b, by bisection method.

- This method requires the condition f(a) . f(b) > 0
- This method requires the condition f(a) . f(b) < 0
- This method requires the condition f(a) . f(b) ≈ 0
- No such condition is required.

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185 PU_2015_122
Because of their charge and large mass, alpha particles are easily:-

- Travel only a few cm in air.
- Absorbed by materials, and they can travel only a few cm in air.
- Absorbed by materials, and they cannot travel only a few cm in air.
- Not absorbed by materials, and they can travel only a few cm in air.

**42 of 100**
176 PU_2015_122
Polarization of light proves the:-

- Quantum nature of light
- Corpuscular nature of light
- Longitudinal nature of light
- Transverse nature of light

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102 PU_2015_122
What is a chromophore?

- A coloured compound.
- A group of atoms in a coloured compound.

- A group of atoms in a compound responsible for the absorption of electromagnetic radiation.
- A group of atoms in a compound responsible for smell.

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158 PU_2015_122

In the absence of Umklapp process, the thermal conductivity of an insulating crystal is:-

- Infinite.
- Zero.
- Equal to thermal conductivity of a conducting crystal.
- Non-zero, but finite.

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165 PU_2015_122

Let $\psi_n(x)$ be the eigenfunction of the Hamiltonian $\hat{H}$. Then, the expected value $\langle \hat{H} \rangle$ in the state $\sum_{n=1}^{\infty} c_n \psi_n(x)$ is equal to

- $\sum_n E_n^{\,2}$
- $\sum_n |c_n|^2$
- $E_n \psi_n$
- $\sum_n |c_n|^2 E_n$

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113 PU_2015_122

Simplify the determinant.

$$\begin{vmatrix} \cosh x & \sinh x & 1 \\ \sinh x & \cosh x & 0 \\ \cosh x & \sinh x & 0 \end{vmatrix}$$

- -1
- 1
- $\sinh^2 x + \cosh^2 x$
- 0

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164 PU_2015_122

If three angular momenta are given by $j_1 = j_2 = j_3 = 1/2$, what are the allowed values of total angular momentum **J**?

- 0, 1
- 1/2, 3/2
- 0, 1, 2
- 1/2, 3/2, 5/2

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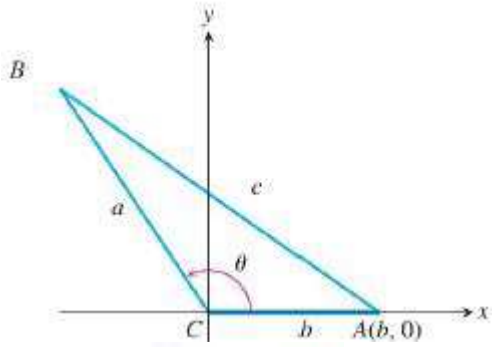
169 PU_2015_122

In the figure shown here, consider C as the origin. Then, the coordinates of the point B(*x*,*y*) is found to be _____.




- $(a\cos\theta + b,\ a\sin\theta)$
- $(a\cos\theta,\ a\sin\theta)$
- $(c\cos\theta - b,\ a\sin\theta)$
- $(a\sin\theta,\ a\cos\theta)$

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167 PU_2015_122

In a finite square-well potential $V_0$ the number of bound states is:-

- 1
- Finite
- Infinite
- Zero

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114 PU_2015_122

If $a$ and $b$ are constants, the differential equation $x^2\frac{d^2y}{dx^2}+ax\frac{dy}{dx}+by=0$ will be classified as:-

- Linear second order variable coefficient homogeneous differential equation.
- Linear second order variable coefficient inhomogeneous differential equation.
- Nonlinear homogeneous differential equation with variable coefficients.
- Nonlinear homogeneous differential equation with constant coefficients.

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208 PU_2015_122

At T = 0 K, silicon act as a:-

- Insulator
- Semi-conductor
- Metal
- Superconductor

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182 PU_2015_122

The octet of light spin-1/2 baryons described in SU(3) are n = neutron, p = proton, Ξ = Xi baryon and other particles such as

- Quarks and colors.
- Tau and theta particles
- pi = pi meson and omega hadron
- Λ = Lambda baryon and ∑ = Sigma baryon,

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191 PU_2015_122

A quantum particle undergoes small oscillations about its mean position and the force acting on is given by Hooke's law. What can you say about the degeneracy of the energy eigenstate corresponding to nth excited state?

- Degeneracy is equal to *n*
- Non-degenerate
- Degeneracy is equal to *n* + 1
- Infinitely degenerate.

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157 PU_2015_122

Phonon is a quantum of:-

- Electromagnetic wave.
- Micro wave.
- Elastic wave.
- Magnetization wave.

**55 of 100**

209 PU_2015_122

How must the two junctions of transistor be biased to be operated in cut-off region?

- $V_{BE}$ forward-biased & $V_{CB}$ forward-biased
- $V_{BE}$ reverse-biased & $V_{CB}$ forward-biased
- $V_{BE}$ forward-biased & $V_{CB}$ reverse-biased
- $V_{BE}$ reverse-biased & $V_{CB}$ reverse-biased

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132 PU_2015_122

Ohm's law gives the relation between current density J, electrical conductivity σ and electric field $\vec{E}$

- $\vec{E} = \vec{J}/\sigma$
- $\vec{E} = \sigma\vec{J}$
- $\vec{E} = \sigma/\vec{J}$
- $\vec{E} = \vec{J}/\sigma^2$

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187 PU_2015_122

The SI units for Stefan-Boltzmann constant is:-

- $J \cdot S \cdot m^{-2} \cdot K^{-4}$
- $Wm^{-2}K^4$
- $Wm^2K^{-4}$
- $Wm^{-2}K^{-4}$

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115 PU_2015_122

Given that $y_1(x) = x^2$ is one solution of $x^2y'' - 3xy' + 4y = 0,\ x > 0$, then, the second linearly independent solution is :-

- $y_2(x) = x^2(A + Bx)$
- $y_2(x) = x^2(A + B\log x)$
- $y_2(x) = \log x$
- $y_2(x) = x^2 \log x$

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103 PU_2015_122

The Lyman series of lines in the emission spectrum of hydrogen correspond to transitions from various excited states to the *n* =1 orbit. Calculate the wavelength, in nm, of the transition from the *n* = 3 to the *n* = 1 energy level.

- 102.6 nm
- 975.1 nm
- 452.7 nm
- 678.8 nm

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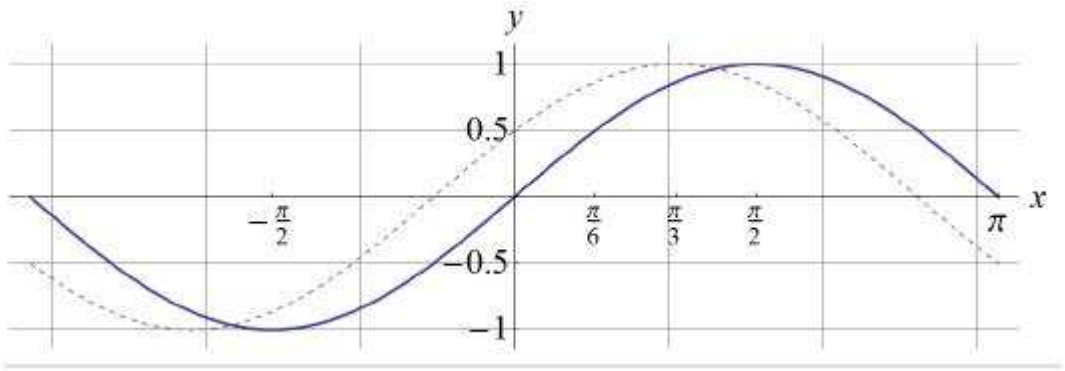
216 PU_2015_122

Find the phase difference between two waveforms shown in the figure.




- π/9
- π/12
- π/3
- π/6

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245 PU_2015_122

The calcite crystal is placed over a dot on a piece of paper and then rotated. On viewing through calcite, we observe:-

- A single dot
- Two rotating dots
- Two stationary dots

- One dot rotating about the other

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259 PU_2015_122

A multiplet of particles consists of two baryons with strangeness S=0 The charge of each member of this multiplet is:-

- 1/2 and 0
- 1 and -1
- 1/2 and-1/2
- 1 and 0

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222 PU_2015_122

In the case of harmonic oscillator, the normalized ground state wave function $\psi(x)$ is equal to

- $\left(\frac{m\hbar}{\pi\omega}\right)^{1/4} e^{-\frac{m\omega}{2\hbar}x^2}$
- $\left(\frac{\pi\hbar}{m\omega}\right)^{1/4} e^{-\frac{m\omega}{2\hbar}x^2}$
- $\left(\frac{m\omega}{\pi\hbar}\right)^{1/4} e^{-\frac{m\omega}{2\hbar}x^2}$
- $\left(\frac{m\pi}{\hbar\omega}\right)^{1/4} e^{-\frac{m\omega}{2\hbar}x^2}$

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249 PU_2015_122

The strongest bond is:-

- Covalent
- Metallic
- Ionic
- Van der Waals

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227 PU_2015_122

The Rank of the matrix

$$\begin{pmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 3 & 6 & 9 \end{pmatrix}$$ is:-

- 2
- 1
- 3
- 0

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225 PU_2015_122

The dielectric constant of a linear, homogeneous and isotropic medium is 10, while its relative permeability is 0.7. Then, the refractive index of the material is:-

- 3.78
- 3.16
- 2.65
- 1.325

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256 PU_2015_122

Under parity or space inversion transformation, the spherical harmonics $Y_l^m(\theta,\phi)$ becomes

- $-Y_l^m(\theta,\phi)$
- $(-1)^{l+|m|}Y_l^m(\theta,\phi)$
- $Y_l^m(\theta,\phi)$
- $(-1)^l Y_l^m(\theta,\phi)$

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223 PU_2015_122

In the rest frame of the positronium atom, after annihilation of the $e^-$ and $e^+$ which of the following statements is correct?

- two photons are emitted and their wavelength is $h/(2m_ec)$
- only one photon is emitted with wavelength $h/(m_ec)$

- two photons are emitted and their wavelength is $h/(m_e c)$
- only one photon is emitted with wavelength $h/(2m_e c)$

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232 PU_2015_122

If $f(t) = t^{-1/2}$ then its Laplace transform is:-

- $\sqrt{\frac{s}{\pi}}$
- $\sqrt{\frac{\pi}{s}}$
- $\frac{\pi}{s^{3/2}}$
- $-\sqrt{\frac{s}{\pi}}$

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235 PU_2015_122
The Legendre polynomial $P_n(x)$ for $n$ =1 is equal to:-

- $1 - x$
- $x$
- 1
- $1 - x^2$

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220 PU_2015_122

If $\alpha$ is fine structure constant and $m$ the mass of electron and $c$ the speed of light, then the Bohr radius $a$ can be written as

- $\frac{\alpha\hbar^2}{mc^2}$
- $\frac{\hbar c}{m\alpha}$
- $\frac{\hbar}{mc\alpha}$

- $\frac{\alpha^2\hbar^2}{mc^2}$

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229 PU_2015_122

The independent solutions of the equation $y'' - 7y' + 12y = 0$ are:-

- $e^{3x}$ and $e^{-3x}$
- $e^{-x}$ and $e^{-3x}$
- $\frac{1}{x}$ and $x^3$
- $sin(3x)$ and $cos(4x)$

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238 PU_2015_122

Working in the cylindrical coordinates ($r$, θ ,$z$) a particle is found to be moving in a potential of the form $V = ar^2$ where is a constant. Which of the following quantities are conserved?

- $p_\theta$ and $p_z$
- $p_r$ and $p_\theta$
- $p_r$ and $rp_\theta$
- $p_r$ and $p_z$

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253 PU_2015_122

The Hilbert space corresponding to a wave function $\psi(x)$ is

- A three dimensional Euclidean space.
- An infinite dimensional linear vector space.
- A two dimensional phase-space with coordinates $x$ and $p$
- A finite dimensional liner vector space.

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258 PU_2015_122

If $\pi^0 \to \gamma + \gamma$ and $\pi^+ \to \mu^+ + \nu_\mu$ their lifetimes would be :-

- $\approx 10^{-16}$ sec and $\approx 10^{-23}$ sec respectively
- $\approx 10^{-8}$ sec and $\approx 10^{-23}$ sec respectively
- $\approx 10^{-16}$ sec and $\approx 10^{-8}$ sec respectively
- Almost equal.

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255 PU_2015_122

In quantum mechanics, the total probability of finding a particle in the possible region of space is obviously given by the normalization condition. What is the physical dimension of the wave function of a particle moving in two dimensional space?

- Mass x length x $(\text{Time})^{-1}$
- $(\text{Length})^{-1}$
- $(\text{Length})^{2}$
- It is dimensionless.

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251 PU_2015_122

Let the complex number be $i = \sqrt{-1}$. Then, simplify the expression

$$\left(\sqrt{3}+i\right)^{14}+\left(\sqrt{3}-i\right)^{14}$$

- $2^{14}$
- $-2^{14}$
- 1
- $-2^{12}$

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257 PU_2015_122

Which of the following statements is incorrect?

- **No eigenstate can be constructed in such a way that it is an eigenstate for both the position and momentum operators.**
- A non-trivial eigenstate cannot be constructed in such a way that it gives non-zero eigenvalue for the $x$-component of spin angular momentum operator $\hat{S}_x$, and zero eigenvalue for other two components $\hat{S}_y$ and $\hat{S}_z$
- An non-trivial eigenstate can be constructed in such a way that it gives non-zero eigenvalue for the $x$-component of angular momentum operator $\hat{L}_x$, and zero eigenvalue for other two components $\hat{L}_y$ and $\hat{L}_z$

- **A nontrivial eigenstate can be constructed in such a way that the eigenvalues of all the three components of angular momentum operator are zero.**

**79 of 100**
236 PU_2015_122

Consider the Levi-Civita tensor $\epsilon_{\mu\nu\lambda}$. If $\mu, \nu, \lambda$ are even-permuting, then the value of the tensor $\epsilon_{\mu\nu\lambda}$ is equal to

- 2
- 0
- -1
- 1

**80 of 100**
244 PU_2015_122
Polarization cannot occur in:-

- Sound waves
- Light waves
- X-Ray
- Radio waves

**81 of 100**
282 PU_2015_122
Since the nuclei have a definite parity, ignoring the weak interactions:-

- only the nuclear electric quadrupole moment vanishes
- both the nuclear electric quadrupole and magnetic moments vanish
- only the nuclear magnetic moment vanishes
- nuclear electric dipole moment vanishes

**82 of 100**
262 PU_2015_122
Consider a spherical capacitor whose inner conducting surface has a radius of 1 cm while the outer surface has a radius of 2 cm Also, consider a cylindrical capacitor of length *L* whose inner and outer conducting cylinders have 1 cm and 2 cm radii respectively. If the capacitance of these two capacitors should be equal, what should the length of the cylindrical capacitor (in cm)?

- $2 \log_e 2$
- $4 \log_{10} 2$
- $4 \log_e 2$
- 2 cm

**83 of 100**

270 PU_2015_122

A rigid cubical block rotates in such a way that one corner of the cube is always in contact with the surface on which it rotates. If that point of contact does not move, then how many generalized coordinates do we need to describe its motion?

- 1
- 4
- 2
- 3

**84 of 100**

297 PU_2015_122

Let $Q$ be an orthogonal matrix. Then:-

- $QQ^T = Q^TQ = I$
- $Q^T = -Q$
- $Q = Q^T$
- $QQ^{-1} = Q^TQ$

**85 of 100**

298 PU_2015_122

Let $\mathbf{x}$ be a coordinate system and $\mathbf{x}'$ be rotated coordinate system through an angle $\theta$ such that $\mathbf{x} = \mathbf{R}\mathbf{x}'$. Then, the corresponding rotation matrix $\mathbf{R}$ is given by

- $\begin{pmatrix} -\cos\theta & \sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$
- $\begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$
- $\begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix}$
- $\begin{pmatrix} \cos\theta & -\sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix}$

**86 of 100**

266 PU_2015_122

Let $S$ be a oriented piecewise smooth surface and $C$ be a simple, closed, piecewise smooth curve that bounds the surface $S$. If $\vec{A}$ is a vector function whose components have continuous derivatives, then, the Stokes theorem states that

- $\iint_S \vec{A}\cdot\overrightarrow{ds} = \iiint_V \operatorname{curl}\vec{A}\,dV$
- $\int_C \vec{A}\cdot\overrightarrow{dr} = \iint_S \left(\operatorname{curl}\vec{A}\right)\cdot\overrightarrow{ds}$
- $\int_C \vec{A}\cdot\overrightarrow{dr} = \iiint_V \left(\operatorname{curl}\vec{A}\right)dV$
- $\iint_S \vec{A}\cdot\overrightarrow{ds} = -\oint \operatorname{div}\vec{A}\,dr$

**87 of 100**

296 PU_2015_122

Let four different vectors in a certain vector space be given by

$\mathbf{x}_1 = (4,\ 0,\ 2),\ \mathbf{x}_2 = (2,\ 2,\ 0),$

$\mathbf{x}_3 = (1,\ 1,\ 0),\ \mathbf{x}_4 = (5,\ 1,\ 2).$

Then, choose the correct option.

- The set of vectors form a basis for the 4-dimensional vector space.
- The information is insufficient to evaluate.
- The set of vectors are linearly independent.
- The set of vectors are linearly dependent.

**88 of 100**

283 PU_2015_122

The four types of Bravais lattices viz., primitive, body centered, base centered and face centered exists in only one crystal system. Identify the crystal system.

- Cubic
- Trigonal
- Orthorhombic
- Tetragonal

**89 of 100**

294 PU_2015_122

A scalar is a tensor of rank:-

- One
- Zero
- Three
- Two

**90 of 100**
269 PU_2015_122

The value of integral $\int_0^{2\pi} \frac{d\theta}{2+\cos\theta}$ is

- $\frac{2\pi}{\sqrt{3}}$
- $\frac{4\pi}{\sqrt{3}}$
- $\frac{\pi}{\sqrt{2}}$
- $\pi$

**91 of 100**
281 PU_2015_122

Given, one $^{235}U$ nucleus yields an energy of ≈ 200 MeV the complete fission of one gram of $^{235}U$ nucleus can yield a total energy of:-

- $10^{11}J$
- $10^{11}eV$
- $10^{5}eV$
- $10^{5}J$

**92 of 100**
289 PU_2015_122
The units of dielectric constant is:-

- $FC^{-1}$
- $Fm^{-1}$

- Dimensionless
- $CV^{-1}$

**93 of 100**

271 PU_2015_122

Two particles are constrained to move on the surface of a sphere of constant radius. The number of degrees of freedom to describe their motion is equal to:-

- 2
- 3
- 6
- 4

**94 of 100**

265 PU_2015_122

What is the degeneracy of the energy level with $n$ = 6 in a hydrogenic atom or ion?

- 16
- 25
- 36
- 9

**95 of 100**

272 PU_2015_122

A particle undergoes simple harmonic oscillation and its motion is described by the equation $\frac{d^2x}{dt^2} + \omega^2 x = 0$. If $A$ and $B$ are two real numbers, then the general trajectory of the particle as a function of time may be written as

- $x(t) = Ae^{i\omega t} + Be^{-i\omega t}$
- $x(t) = Ae^{i\omega t}$
- $x(t) = A\sin(\omega t) + B\cos(\omega t)$
- $x(t) = Be^{-i\omega t}$

**96 of 100**

295 PU_2015_122

What is the value of Lande $g$ - factor for the state with $L$=1 and $J$ = 3/2?

- 4/3
- 2/3
- 2
- 1

**97 of 100**

293 PU_2015_122

A real matrix is unitary if and only if it is:-

- Unitary
- Diagonal
- Orthogonal
- Skew Hermitian

**98 of 100**

290 PU_2015_122

If f(x) is continuous and even-periodic, then, the trigonometric Fourier series of the function will be:-

- A pure sine series.
- Non-converging series.
- A pure cosine series.
- A series containing both sine and cosine terms.

**99 of 100**

299 PU_2015_122

Choose the correct statement.

- A matrix $A$ is said to be in echelon form if the nonzero elements in each row is one.
- The determinant of a square matrix of size $n \times n$ has $n$ cofactors.
- If $A$ is a non-singular matrix, then $\left(A^{-1}\right)^m = \left(A^m\right)^{-1}$ for $m = 1, 2, \ldots$
- Let $A$ be any matrix. Then, $\text{rank}(A) \neq \text{rank}\left(A^T\right)$.

**100 of 100**

275 PU_2015_122

For a rigid body, the sum of the diagonal elements of moment of inertia tensor is found to be equal to 8. After the principal axis transformation, two of the principal moments of inertia are found to be 3 and 1. The third principal moment of inertia is equal to:-

- 1
- 8
- 4
- 2

## 122 PU Ph D Physics

### 1 of 100

171 PU_2016_122_E

Which of the following is the definition of a Hermitian operator considering two arbitrary functions $\psi_m$ and $\psi_n$

- $(\psi_m, A\psi_n) = -(\psi_n, A\psi_m)^*$
- $(\psi_m, A\psi_n) = (A\psi_n, \psi_m)^*$
- $(\psi_m, A\psi_n) = -(\psi_n, A\psi_m)^*$
- $(\psi_m, A\psi_n) = (\psi_n, A\psi_m)$

### 2 of 100

170 PU_2016_122_E

An electron moving at a speed of 500 m/s measured with an accuracy of 0.004 %. The certainty with which the position of the electron can be located is :-

- 1.82 m
- 0.0364 m
- 10 m
- 1 m

### 3 of 100

176 PU_2016_122_E

The possible values total angular momentum resulting from combining three individual angular momenta, $s_1 = 1/2$, $s_2 = 1/2$ and $s_3 = 1/2$ are:-

- (-1, 0, 1)
- (1/2, 1/2, 3/2)
- (1, 0, 1/2)
- (1/2, 1/2, 1/2)

### 4 of 100

180 PU_2016_122_E

Wave function of a scattered particle for large distances from the scattering potential is given by $\psi(\vec{r}) = \exp(i\vec{k}\vec{r}) + \cos^2\theta \frac{\exp(ikr)}{r}$. What is the total cross section?

- $\frac{4\pi}{5}$
- 0
- $\frac{\pi}{4}$
- $\frac{5\pi}{4}$

**5 of 100**

200 PU_2016_122_E

The average kinetic energy of a Fermi gas is:-

- $\frac{3}{2}E_F$
- $\frac{2}{3}E_F$
- $\frac{3}{5}E_F$
- $\frac{5}{3}E_F$

**6 of 100**

178 PU_2016_122_E

The Hermitian conjugate of d/dx (partial) is:-

- -i d/dx
- -d/dx
- d/dx
- i d/dx

**7 of 100**

174 PU_2016_122_E

For a harmonic oscillator, the probability density at X = 0 is:-

- Decreases exponentially
- Maximum
- Minimum
- Zero

**8 of 100**

158 PU_2016_122_E

Consider a charged particle moving with a uniform velocity. In a frame which is moving with the same velocity as that of the particle, we have

- Electric field
- Magnetic field
- Both Electric and Magnetic fields
- No Electric or Magnetic fields

**9 of 100**

154 PU_2016_122_E

An unpolarized light of intensity $I_0$ passes first through a polarizer and then through an analyzer whose axis of polarization is at angle $\pi/3$ to the axis of the polarizer. The intensity of the light after analyzer is

- $\frac{3I_0}{8}$
- $\frac{I_0}{2}$
- $\pi/2$
- $\frac{I_0}{8}$

**10 of 100**

183 PU_2016_122_E

An electron-positron pair was created as photons pass through matter. The electron and positron have opposite curvatures in the uniform magnetic field B of 0.2 tesla and each of their radii 'r' is 2.5 x 10-2 m. The energy of the photon is

- 10 MeV
- 3.2 MeV
- 1.6 MeV
- 6.4 MeV

**11 of 100**

211 PU_2016_122_E

The number of ways in which N identical bosons can be distributed in two energy levels is:-

- N
- $\frac{N(N-1)}{2}$
- N + 1
- $\frac{N(N+1)}{2}$

**12 of 100**

168 PU_2016_122_E

Four sides of a hollow metallic cube are grounded and the two other sides are insulated from the rest and are held at potential V. The potential at the center of the cube is:-

- V/3
- V
- V/6
- 0

**13 of 100**

204 PU_2016_122_E

At equilibrium, the Gibbs free energy of a system in contact with a bath at temperature and pressure is:-

- zero
- minimum
- maximum
- infinity

**14 of 100**

136 PU_2016_122_E

A particle is in motion under central force field defined by $a^2\cos 2\theta = r^2$, where a is constant, r and θ defined coordinates. The force is proportional to:-

- $1/r^5$
- $1/r^3$
- $1/r^7$
- $1/r$

**15 of 100**

100 PU_2016_122_E

The solution for the differential equation $\frac{dy}{dx} = \frac{1}{x^4}$ is

- $2x^2 + ax + b$
- $3yx^3 = -b$
- $\frac{x^2}{3} + ax + b$
- $x^2 + ax + b$

**16 of 100**

153 PU_2016_122_E

Consider a point charge q located at the center of a cube. The flux through one of the faces of the cube is:-

- $\frac{q}{\varepsilon_0}$
- $\frac{q}{24\varepsilon_0}$
- $\frac{q}{6\varepsilon_0}$
- $\frac{q}{12\varepsilon_0}$

**17 of 100**

157 PU_2016_122_E

A wave is incident normally on a good conductor. If the frequency of a plane electromagnetic wave increases four times, the skin depth will:-

- Decrease by a factor of 4
- increase by a factor of 2
- Decrease by a factor of 2
- Remains same

**18 of 100**

184 PU_2016_122_E

Which of the following wave functions leads to probability density that is oscillatory function of time?

- $\Psi(x) = (\psi_1(x) + \psi_2(x))\, e^{-iEt/\hbar}$
- $\Psi(x) = \psi_1(x) e^{iE_1 t/\hbar} + \psi_2(x) e^{iE_2 t/\hbar}$
- $\Psi(x) = \psi(x) e^{-iEt/\hbar}$
- Probability density is always independent of time

**19 of 100**

179 PU_2016_122_E

Which of the following statements is correct for an attractive delta function potential ?

- There are no bound states
- There is only one bound state
- There are two bound states
- There are infinite bound states

**20 of 100**

135 PU_2016_122_E

For a simple harmonic oscillator with spring constant k , defined by coordinates q,p, the value of Poisson bracket [p, H] is:-

- -kq
- 0
- 1
- p

**21 of 100**

207 PU_2016_122_E

Consider two different systems each with three identical non-interacting particles. Both have single particle states with energies $\varepsilon_0, 3\varepsilon_0, 5\varepsilon_0$, $(\varepsilon_0 > 0)$. One system is populated by spin 1/2 fermions and the other by bosons. Then the difference between the ground state energies of the fermionic and bosonic systems is

- $4\varepsilon_0$
- $2\varepsilon_0$

- $\varepsilon_0$
- $3\varepsilon_0$

**22 of 100**

185 PU_2016_122_E

The ionization energies (I.E) of H, He and Li are respectively, 13.6 eV, 24.6 eV and 5.4 eV. The reason for the I.E for Li being the least is :-

- Because the Li atom is in excited state most of the time, hence, the electrons of Li form a free electron sea.
- Effective nuclear charge increases and as a result, potential energy increases
- Due to the screening of the nuclear charge by electrons in inner shell and consequently the effective nuclear charge reduces
- Due to the screening of the nuclear charge by electrons, the potential energy increases

**23 of 100**

182 PU_2016_122_E

If the operator H is hermitian, which of the following is true for the function f(H) = exp(iH) ?

- f(H) is anti-unitary
- f(H) is unitary
- f(H) is anti-hermitian
- f(H) is also hermitian.

**24 of 100**

152 PU_2016_122_E

Consider the electrostatic energy due to a charged conducting sphere of radius R and charge Q. If the charge is halved and distance is doubled, what happens to electrostatic energy?

- Decreases by eight times
- Increases by four times
- Decreases by four times
- Increases by eight times

**25 of 100**

160 PU_2016_122_E

Two metallic infinite planes are located at x = ± a. A point charge +q located at x=0 is in equilibrium. If the charge is +q displaced slightly from the origin, the motion of the charge:-

- Remain at the origin
- Executes simple harmonic motion.
- Moves right
- Moves left

**26 of 100**

137 PU_2016_122_E

Total scattering cross section of a charge particle by an atom of diameter 4.1 nm is approximately:-

- 2 nm
- 16 nm
- 13 nm
- 4 nm

**27 of 100**

203 PU_2016_122_E

For a rigid magnetic material, the differential form of first law of thermodynamics is:-

- $\left(\frac{\partial T}{\partial M}\right)_S = \left(\frac{\partial S}{\partial B_0}\right)_M$
- $\left(\frac{\partial M}{\partial T}\right)_S = \left(\frac{\partial B_0}{\partial S}\right)_M$
- $\left(\frac{\partial T}{\partial M}\right)_S = -\left(\frac{\partial B_0}{\partial S}\right)_M$
- $\left(\frac{\partial T}{\partial M}\right)_S = \left(\frac{\partial B_0}{\partial S}\right)_M$

**28 of 100**

150 PU_2016_122_E

Two point charges of charge $+Q$ are located at $x = \pm a$. Another point charge $+q$ located at $x = 0$ is in equilibrium. If the charge $+q$ is displaced slightly from the origin, it executes simple harmonic motion. The period of oscillation $T \propto a^{\beta}$, where $\beta$ is

- - 2/3
- 2/3
- 3/2
- - 3/2

**29 of 100**

186 PU_2016_122_E

For a certain atom with atomic number Z = 2, the two electrons be replaced by two spin-1 particles with negative charge. The degeneracy of the ground state is:-

- Infinite
- 3
- 6
- Ground state is non-degenerate

**30 of 100**

214 PU_2016_122_E

The quantum statistics reduces to classical statistics under which of the following condition.

- $\rho\lambda^3 << 1$
- $\rho\lambda^3 >> 1$
- $\rho\lambda^3 \approx 1$
- $\rho\lambda^3 = 0$

**31 of 100**

208 PU_2016_122_E

For a particle in a Maxwell-Boltzmann distribution, its most probable speed is:-

- $\sqrt{2mk_BT}$
- $\sqrt{\frac{2mk_B}{T}}$
- $\sqrt{\frac{2mT}{k_B}}$
- $\sqrt{\frac{2k_BT}{m}}$

**32 of 100**

205 PU_2016_122_E

In low density oxygen gas at low temperature, only the translational and rotational modes of the molecules are excited. The specific heat per molecule of the gas is:-

- $\frac{3}{2}k_B$
- $\frac{5}{2}k_B$
- $k_B$
- $\frac{1}{2}k_B$

**33 of 100**

164 PU_2016_122_E

Magnetic field outside an infinite solenoid :-

- varies inversely with distance from the solenoid
- is zero
- varies inversely with square of the distance from the solenoid
- is constant

**34 of 100**

165 PU_2016_122_E

An electromagnetic field with electric field $\vec{E} = E_0 \cos(\omega t - kz)\hat{i}$ is passing through a disc of radius 2 m. What is the average power in Watt crossing the disc per unit time if $E_0 = 30V/m$?

- 120
- 60
- 30
- 15

**35 of 100**

212 PU_2016_122_E

If $r$ be the ratio of the probability that the two particles are found in the same state to the probability that two particles belong to different states, then the ratio $r_{MB} : r_{BE} : r_{FD}$ is

- 1:1: 2
- $\frac{1}{2} : 1 : 0$
- $1 : \frac{1}{2} : 0$
- 1: 0: 2

**36 of 100**

181 PU_2016_122_E

For the constant operator O = a + ib, which of the following is true ?

- $(a-ib)\langle\varphi|\psi\rangle = (a+ib)\langle\varphi|\psi\rangle$
- $\langle(a-ib)\varphi|\psi\rangle = (a-ib)\langle\varphi|\psi\rangle$
- $(a-ib)\langle\varphi|\psi\rangle = \langle\varphi|(a+ib)\psi\rangle$
- $(a-ib)\langle\varphi|\psi\rangle = -\langle\varphi|(a-ib)\psi\rangle$

**37 of 100**

188 PU_2016_122_E

If the angular momentum of an electron were an integer, the result of Stern-Gerlach experiment as observed on the screen would have been:-

- That the atomic beam would have split into odd number of components
- The atomic beam would not have split, but would have been uniformly distributed on the screen
- That the atomic beam would have into even number of components
- That the atomic beam would have split into exactly three components

**38 of 100**

175 PU_2016_122_E

The energy needed to turn a magnetic dipole of 1 Bohr magneton from a configuration where it is aligned parallel to the magnetic field of B = 1 tesla, to an anti-parallel configuration with respect to the magnetic field is:-

- 2.32 X $10^{-4}$ eV
- 1.16 X $10^{-4}$ eV

- 0.63 X $10^{-4}$ eV
- 0.58 X $10^{-4}$ eV

**39 of 100**

210 PU_2016_122_E

For a system of particles with partition function z , the relation between its average energy and z is:-

- $E = -\frac{\partial z}{\partial \beta}$
- $E = -\frac{\partial \ln z}{\partial \beta}$
- $E = \frac{\partial z}{\partial \beta}$
- $E = \frac{\partial \ln z}{\partial \beta}$

**40 of 100**

103 PU_2016_122_E

A general solution of the equation $\frac{d^2y}{dt^2} + \omega^2 y = 0$ is (where ω is not equal to zero)

- $y = A\cos\omega t + B\sin\omega t$
- $y = A\cos\omega t - B\sin\omega t$
- $y = A\cos\omega t + B$
- $y = A + B\sin\omega t$

**41 of 100**

201 PU_2016_122_E

The partition function of a system of harmonic oscillators with energies $E_n = n\hbar\omega,\ n = 0,1,2,...,\infty$ is

- $\frac{1}{\exp\left(\frac{\hbar w}{k_B T}\right) - 1}$
- $\frac{1}{1 - \exp\left(\frac{\hbar w}{k_B T}\right)}$
- $\exp\left(-\frac{\hbar w}{k_B T}\right)$
- $\exp\left(\frac{\hbar w}{k_B T}\right)$

**42 of 100**

156 PU_2016_122_E
In an iron cored coil the iron core is removed so that the coil becomes an air cored coil. The inductance of the coil will:-

- Increase
- Decrease
- remain same
- initially increase and then decrease

## 43 of 100

177 PU_2016_122_E
If the ground state energy of the Hydrogen atom is ~ -13.6 eV, ignoring the electron-electron repulsion, the ground state energy of Helium atom is:-

- -3.4 eV
- -109 eV
- -54 eV
- -27.2 eV

## 44 of 100

161 PU_2016_122_E
What is the equipotential surface corresponding to a line charge of finite length?

- Cylinder
- Ellipsoid
- Cube
- Sphere

## 45 of 100

202 PU_2016_122_E
At a given temperature, the specific heat at constant volume $C_v$ of a van der Waals gas with a fixed number is particles is:-

- independent of fixed number of particles
- dependent on its volume
- dependent on fixed number of particles
- independent of its volume

## 46 of 100

167 PU_2016_122_E
A plane electromagnetic wave incident normally on the surface of a material is partly reflected. Measurement on the standing wave in the region in front of the interface show that the ratio of the electric field amplitude at the maxima and minima is 7. The ratio of reflected intensity to the incident intensity is :-

- 3/4
- 9/16

- 4/9
- 4/3

**47 of 100**

172 PU_2016_122_E

The operator $A\psi(x) = d\psi(x)/dx + 2\ \psi(x)$ is

- Linear
- Unitary
- Anti-linear
- Hermitian

**48 of 100**

169 PU_2016_122_E

A dielectric sphere of radius $R$ carries a polarization $P = kr^{4}\hat{r}$, where $r$ is the distance from the center and $k$ is constant. The bound volume charge density inside the sphere at a distance $r$ from the center is

- - 4 kR
- - 4 $kr^2$
- - 4 kr
- - 4 $kr^3$

**49 of 100**

209 PU_2016_122_E

Two classical particles have energy states E = 0, ε, 2ε with degeneracies 1, 2, 4 respectively. The total number of configurations possible for this system is:-

- 21
- 18
- 15
- 24

**50 of 100**

104 PU_2016_122_E

A general solution for the system of equations : $\frac{dy_1}{dt} = y_2$ and $\frac{dy_2}{dt} = y_1$ is

- $y_1 = C_1e^{-t} + C_2e^{t}$ and $y_2 = -C_1e^{t} + C_2e^{t}$
- $y_1 = C_1e^{-t} + C_2e^{t}$ and $y_2 = -C_1e^{-t} + C_2e^{t}$
- $y_1 = C_1e^{-t} + C_2e^{t}$ and $y_2 = C_1e^{-t} + C_2e^{t}$
- $y_1 = C_1e^{t} + C_2e^{t}$ and $y_2 = -C_1e^{-t} + C_2e^{t}$

**51 of 100**

213 PU_2016_122_E

For a simple harmonic oscillator, the average energy in three dimensions is:-

- $k_B T$
- $\frac{3}{2} k_B T$
- $\frac{2}{3} k_B T$
- $3 k_B T$

**52 of 100**

206 PU_2016_122_E

A random walker takes a step of unit length in the positive direction with probability 2/3 and a step of unit length in the negative direction with probability 1/3. The mean displacement of the walker after n steps is:-

- n / 2
- n / 3
- 0
- 2n / 3

**53 of 100**

162 PU_2016_122_E

Gauss's law cannot be used to obtain the electric field for which of the following sources?

- A point charge
- A conducting sphere
- An infinite line charge
- A finite surface charge

**54 of 100**

173 PU_2016_122_E

If H is the free-particle Hamiltonian, then the commutator : [x, [x, H]] =

- $\frac{\hbar^2}{m}$
- $-\frac{\hbar^2}{2m}$
- $\frac{\hbar^2}{2m}$
- $-\frac{\hbar^2}{m}$

**55 of 100**

101 PU_2016_122_E

The solution for the differential equation $\frac{dy}{dx} = \frac{xy}{2}$ is

- $Ce^{x^2}$
- $Ce^{x^{-2}/4}$
- $Ce^{x^2/2}$
- $Ce^{x^2/4}$

**56 of 100**

102 PU_2016_122_E

The exact solution for the differential equation $\frac{dy}{dx} = 1 + y^2,\ y(0) = 0$ is

- y = tanh x
- y = cosh x
- y = cos x
- y = tan x

**57 of 100**

166 PU_2016_122_E

Consider an infinite metallic plane grounded at z=0. A charge q is placed at (0,0,d), the electric field at (0,0,-d) is

- Zero
- $\frac{q}{16\pi\varepsilon_0 d^2}$
- Infinity
- $\frac{q}{4\pi\varepsilon_0 d^2}$

**58 of 100**

151 PU_2016_122_E

Consider a wedge, where $\beta$ is the angle of the wedge. If a charge $q$ is placed on the surface of the wedge, for which of the following values of $\beta$, the charge density at the corner of the wedge is maximum?

- $\pi/6$
- $\pi/2$
- $\pi$
- $3\pi/2$

**59 of 100**

163 PU_2016_122_E

Which of the following Maxwell's equation signifies the non-existence of magnetic monopole?

- $\nabla . \vec{E} = \frac{\rho}{\varepsilon_0}$
- $\nabla . \vec{B} = 0$
- $\nabla \times \vec{B} = \mu_0 \vec{J} + \mu_0 \varepsilon_0 \frac{\partial \vec{E}}{\partial t}$
- $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$

**60 of 100**

159 PU_2016_122_E

Which of the following is a source of electromagnetic radiation?

- An accelerating charge
- A charge in uniform motion
- A charged sphere
- A charge at rest

**61 of 100**

254 PU_2016_122_M

In Debye's theory of Specific heat of solids, the frequency of vibrations of the lattice has:-

- A continuous spectrum up to a finite value
- An infinite discrete spectrum
- A discrete spectrum up to a finite value
- An infinite continuous spectrum

**62 of 100**

238 PU_2016_122_M

The first Brillouin zone of a Body centered cubic crystal lattice is:-

- Body centered cubic
- Simple Cubic
- Rhombic dodecahedron
- Truncated octahedron

**63 of 100**

252 PU_2016_122_M

At frequencies around 5 * $10^{14}$Hz, the ionic polarization becomes:-

- 1
- Zero
- Infinite

- Negative

**64 of 100**

232 PU_2016_122_M

A molecule makes a transition between the ground state and excited state. The uncertainity in time of upper state is Δ t, then the width of spectral line is given by:-

- $\frac{1}{2\pi.\Delta t}$
- $\frac{1}{2\pi\nu\Delta t}$
- $\frac{\nu}{2\pi.\Delta t}$
- $\frac{h}{2\pi.\Delta t}$

**65 of 100**

242 PU_2016_122_M

Which of the following crystallographic symmetry is necessary for the material to show spontaneous polarization (Ferroelectric):-

- Centro symmetric
- Non- Centro symmetric
- Space inversion symmetry
- Time reversal symmetry

**66 of 100**

247 PU_2016_122_M

The Fermi level of an intrinsic semiconductor lies near the middle of the forbidden gap but for an n-type semiconductor it is nearer the :-

- Valance band
- As like intrinsic semiconductor
- Conduction band
- Above the Conduction band

**67 of 100**

226 PU_2016_122_M

The bond between two atoms are elastic in nature where μ is the reduced mass, r is the bond length and k is the force constant. Then the centrifugal distortion constant can be defined as:-

- $\frac{h^3}{32\pi^4\mu^2r^6ck}$
- $\frac{h}{32\pi^4\mu^2r^6ck}$

- $\frac{h^3}{32\pi\mu^2 r^6 ck}$
- $\frac{h^3}{32\pi^4 \mu r^6 ck}$

**68 of 100**

241 PU_2016_122_M

The Meissner effect of a bulk metal in the superconducting state indicates the magnetic nature of the material is as a:-

- Diamagnetic
- Paramagnetic
- Ferromagnetic
- Anti-ferromagnetic

**69 of 100**

227 PU_2016_122_M

An NMR spectrum of methyl formate taken on a 60 MHz spectrometer exhibit a chemical shift 8 ppm. Then NMR signal frequency in terms of Hz is :-

- 180Hz
- 480 Hz
- 60 Hz
- 120 Hz

**70 of 100**

246 PU_2016_122_M

The magnetic susceptibility of a Diamagnet is directly proportional to:-

- The square of the average atomic radius
- Inversely proportional to the Temperature
- The volume of the substance
- Directly proportional to the Temperature

**71 of 100**

231 PU_2016_122_M

The selection rule for a transition to observe in EPR spectra for system in triplet states is:-

- $\Delta$ ms =0, $\pm 1$ and $\pm 2$
- $\Delta$ ms = 0 and $\pm 1$
- $\Delta$ ms = $\pm 1, \pm 2$....
- $\Delta$ ms = $\pm 1$ and $\pm 2$

**72 of 100**

234 PU_2016_122_M

In X-ray spectra v is the frequency, Z is atomic number and σ is the screening constant, then according to Mosley's law v is defined as:-

- $\nu \propto (Z-\sigma)^2$
- $\nu \propto \frac{1}{(Z-\sigma)}$
- $\nu \propto \sqrt{(Z-\sigma)}$
- $\nu \propto (Z-\sigma)^4$

**73 of 100**

256 PU_2016_122_M

The fact that the binding energy per nucleon is roughly a constant over most of the range of stable nuclei is a consequence of the fact that the nuclear force is :-

- long range
- short range.
- weak
- strong.

**74 of 100**

248 PU_2016_122_M

Which is of the following indicates the range of first Brillouin zone:-

- $0 < k < 2\pi/a$
- $\pi/a < k < 2\pi/a$
- $-2\pi/a < k < 2\pi/a$
- $-\pi/a < k < \pi/a$

**75 of 100**

237 PU_2016_122_M

For which of the unit cell, the maximum packing fraction can be obtained:-

- Simple cubic
- Body centered cubic
- Primitive cell
- Face centered cubic

**76 of 100**

236 PU_2016_122_M

The Intensity of the X-Ray peaks in X-ray Diffractogram related to:-

- The scattering from positive charges
- Crystal structure
- Form factor of the free atoms
- The weight of the substance

## 77 of 100

244 PU_2016_122_M

Which phenomena is responsible for experimentally achieving the low-temperatures up to milli Kelvin in paramagnetic substances?

- Adiabatic Magnetization
- Adiabatic Demagnetization
- Using Liquid Helium bath
- Closed Cycle Refrigeration

## 78 of 100

251 PU_2016_122_M

Point defects in a crystal constitutes of :-

- Vacancies
- Interstitial atoms
- Impurity atoms
- Vacancies, Impurity atoms & Interstitials

## 79 of 100

257 PU_2016_122_M

A particle moves in such a way that its kinetic energy just = its rest energy. The velocity of this particle is:-

- c/4
- c
- 0.866c
- 0.707c

## 80 of 100

224 PU_2016_122_M

The recoil velocity of free Mossbauer nucleus is 36.98 $ms^{-1}$ while emitting a γ -ray of wavelength of 0.1 nm. Then the Doppler shift observed is:-

- 39.68 x $10^{-10}$ hertz
- 3.968 x $10^{10}$ hertz
- 3.968 x $10^{-10}$ hertz
- 39.68X $10^{10}$ Hertz

## 81 of 100

290 PU_2016_122_D

A Zener diode can be used as:-

- a.c. voltage regulator only
- Circuit breaker
- d.c. voltage regulator only

- Both a.c. and d.c. voltage regulator

**82 of 100**

275 PU_2016_122_D

The approximate energy gap between valence band and conduction band of an insulator and a metal are respectively _____

- 15.0 eV & 5.0 eV
- 5.0 eV & 0.0 eV
- 1.1 eV & 15.0 eV
- 15.0 eV & 1.1 eV

**83 of 100**

289 PU_2016_122_D

In TV transmission, sound signal is:-

- Phase modulated
- Frequency modulated
- Amplitude modulated
- Phase modulated and Amplitude modulated

**84 of 100**

278 PU_2016_122_D

A transistor with $\beta$ =50 and base current $I_B$= 20m$\mu$A; the emitter current $I_E$ = to _____

- 1.02 mA
- 0.02 mA
- 102 mA
- 10.2 mA

**85 of 100**

271 PU_2016_122_D

The energy released by the nuclear bomb that destroyed Hiroshima was equivalent to 12.4 kilotons of TNT. This is equivalent to 9.0 $10^{26}$ MeV. The mass that was converted into energy in this explosion was:

- 1.6 kg
- 1.6 $10^{-3}$ kg
- 1.4 $10^{14}$ kg
- 1.1 $10^{10}$ kg

**86 of 100**

293 PU_2016_122_D

Which of the expression is NOT correct according to Boolean theorem?

- A+A = 2A
- A+0 = A

- A+A = A
- A.1 = A

**87 of 100**

277 PU_2016_122_D

A light emitting diode (LED) producing GREEN light, is made of:-

- Gallium Arsenide
- Gallium Phosphide
- Pure Silicon
- Pure Germanium

**88 of 100**

262 PU_2016_122_D

Lists the four known types of forces in nature in order of their decreasing strength?

- strong nuclear, gravitational, weak nuclear, electromagnetic.
- electromagnetic, strong nuclear, weak nuclear, gravitational.
- strong nuclear, weak nuclear, electromagnetic, gravitational
- strong nuclear, electromagnetic, weak nuclear, gravitational.

**89 of 100**

276 PU_2016_122_D

A resistor in connected in series with Zener diode in the circuit to _____

- to protect the load
- to protect Zener
- increase current
- decrease current

**90 of 100**

279 PU_2016_122_D

A transistor is connected such that base-emitter junction is forward biased and base-collector junction is reversed biased. Which of the following statement is correct ?

- This type of connection is not valid for any transistor
- The transistor is an n-p-n transistor
- The transistor is an p-n-p transistor
- This type of connection is valid for all transistor

**91 of 100**

263 PU_2016_122_D

The conservation law violated by the reaction $p \rightarrow \pi^0 + e^+$ is the conservation of:-

- linear momentum.

- lepton number and baryon number.
- energy.
- charge.

**92 of 100**

265 PU_2016_122_D

According to Hubble's law, the age of the universe is :-

- approximately 6000 years
- less than 6000 years.
- between 10 and 15 billion years.
- roughly 1 billion years.

**93 of 100**

260 PU_2016_122_D

The interaction that describes the forces among nucleons that hold nuclei together is:-

- the leptonic interaction.
- the gravitational interaction.
- the hadronic interaction
- the electronic interaction.

**94 of 100**

273 PU_2016_122_D

In quantum electrodynamics (QED), electromagnetic forces are mediated by :-

- exchange of virtual photons.
- hadrons.
- Z bosons
- Gluons.

**95 of 100**

274 PU_2016_122_D

Maximum power is transferred from a source with internal resistance r to a load with resistance R when

_____

- r = 4R
- r = R/2
- r = 2R
- r = R

**96 of 100**

261 PU_2016_122_D

The following fusion reaction occurs in the sun:

$^{3}He_{2} + {}^{4}He_{2} \rightarrow {}^{7}Be_{4}$

The masses of the nuclei are $^{3}He$ = 3.016 049 a.m.u; $^{4}He$ = 4.002 604 a.m.u; $^{7}Be$ = 7.016 930 a.m.u. The energy released or absorbed by the reaction is

- 1.6 MeV, absorbed
- 1.6 MeV, released
- 920 MeV, absorbed
- 920 MeV, released

**97 of 100**

292 PU_2016_122_D

An UJT has _____

- No junctions
- Three pn junction
- Two pn junctions
- One pn junction

**98 of 100**

280 PU_2016_122_D

A carrier wave of 500W is subjected to 100% amplitude modulation, the total power of modulated wave is:-

- 100 W
- 500 W
- 250 W
- 750 W

**99 of 100**

291 PU_2016_122_D

If reverse bias on the gate of JEFET is increased, then the width of conducting channel _____

- It increases near the drain and decreases near the source
- Increased
- Is decreased
- Remains constant

**100 of 100**

264 PU_2016_122_D

The reaction $\mu^{-} \rightarrow e^{-}$ + anti $\nu_e + \nu_\mu$ conserves:-

- muon lepton number but not electron lepton number.
- both muon and electron lepton numbers.

- electron lepton number but not muon lepton number.
- neither muon lepton nor electron lepton number.

| Sr No. | PhD Physics |
|---|---|
| 1 | Find the missing term in the series: 3, 20, 63, 144, 275,? |
| Alt1 | 354 |
| Alt2 | 468 |
| Alt3 | 548 |
| Alt4 | 554 |

| | |
|---|---|
| 2 | Choose word from the given options which bears the same relationship to the third word, as the first two bears:<br>Anaemia: Blood :: Anarchy:? |
| Alt1 | Lawlesness |
| Alt2 | Government |
| Alt3 | Monarchy |
| Alt4 | Disorder |

| | |
|---|---|
| 3 | Teeth is related to Grit in the same way as Fist is related to.....?..... |
| Alt1 | Blow |
| Alt2 | Hand |
| Alt3 | Open |
| Alt4 | Clench |

| | |
|---|---|
| 4 | Select the lettered pair that has the same relationship as the original pair of words:<br>Reproof: Scold |
| Alt1 | Respite: Spite |
| Alt2 | Romantic: Strong |
| Alt3 | Salient: Prominent |
| Alt4 | Chastise: Erring |

| | |
|---|---|
| 5 | Choose the alternative, which is similar to the given words:<br>Bleat : Bray : Grunt |
| Alt1 | Bark |
| Alt2 | Croak |
| Alt3 | Cry |
| Alt4 | Scream |

| | |
|---|---|
| 6 | Spot the defective segment from the following: |
| Alt1 | I wish |
| Alt2 | I have a car |
| Alt3 | to go shopping |
| Alt4 | in the rain |

| | |
|---|---|
| 7 | Choose the meaning of the idiom/phrase from among the options given:<br>Out of sorts |
| Alt1 | unwell |
| Alt2 | irrelevant |
| Alt3 | in disorder |
| Alt4 | out of love |

| | |
|---|---|
| 8 | The rowdy was at last done -------. |
| Alt1 | over |
| Alt2 | off |
| Alt3 | away |
| Alt4 | away with |

| | |
|---|---|
| 9 | Choose the option closest in meaning to the given word:<br>BUCOLIC |
| Alt1 | rustic |
| Alt2 | utopian |
| Alt3 | peaceful |
| Alt4 | noisy |

| | |
|---|---|
| 10 | Choose the antonymous option you consider the best:<br>CALLOW |
| Alt1 | immature |
| Alt2 | green |
| Alt3 | clumsy |
| Alt4 | veteran |

| | |
|---|---|
| 11 | If the seventh day of a month is three days earlier than Friday, what day will it be on the nineteenth day of the month ? |
| Alt1 | Sunday |
| Alt2 | Monday |
| Alt3 | Wednesday |
| Alt4 | Friday |

| | |
|---|---|
| 12 | Water is related to Ocean in the same way as Snow is related to …… |
| Alt1 | Peaks |
| Alt2 | Hail |
| Alt3 | Glacier |
| Alt4 | Mountain |

| | |
|---|---|
| 13 | A's father's brother's father is D. how is D related to A ? |
| Alt1 | Father |
| Alt2 | Grandfather |
| Alt3 | Uncle |
| Alt4 | Son |

| | |
|---|---|
| 14 | Find the odd man out: |
| Alt1 | Squash |
| Alt2 | football |
| Alt3 | hockey |
| Alt4 | Cricket |

| | |
|---|---|
| 15 | In a certain code language, if CRICKET is coded as 3923564, ROCKET is coded as 913564 and KETTLE is coded as 564406, then how is LITTLE coded in that language ? |
| Alt1 | 024406 |
| Alt2 | 240406 |
| Alt3 | 20446 |
| Alt4 | 200446 |

| | |
|---|---|
| 16 | At what angles are he hands of a clock inclined at 20 minutes past 7 ? |
| Alt1 | 80 degrees |
| Alt2 | 90 degrees |
| Alt3 | 100 degrees |
| Alt4 | 120 degrees |

| | |
|---|---|
| 17 | Odd one out: 2,4,6,8 |
| Alt1 | 2 |
| Alt2 | 4 |
| Alt3 | 6 |
| Alt4 | 8 |

| | |
|---|---|
| 18 | Which is smallest: |
| Alt1 | Quarter of 140 |
| Alt2 | Double of 4*4 |
| Alt3 | 7*5 |
| Alt4 | Half of 72 |

| | |
|---|---|
| 19 | What is the next alphabet in the following series<br>Z D X H V L T ? |
| Alt1 | Q |
| Alt2 | N |
| Alt3 | P |
| Alt4 | O |

| | |
|---|---|
| 20 | How many times is the abbrevations FB shorter than the word FACEBOOK? |
| Alt1 | 4times |
| Alt2 | 3times |
| Alt3 | 5times |
| Alt4 | Many |

| | |
|---|---|
| 21 | Consider a one dimensional H atom with potential $V(x) = -\delta(x)$. Let $\phi_\alpha(x) = \exp(-\alpha\|x\|)$ be a trial wave function. For what value of $\alpha$ energy is minimum |
| Alt1 | 1 |
| Alt2 | ½ |
| Alt3 | 2 |
| Alt4 | 1/3 |

| | |
|---|---|
| 22 | The following series $\sum_{n=1}^{\infty} n^2 \left(\frac{i}{2}\right)^n$ is |
| Alt1 | Divergent upto a limit and then is convergent |
| Alt2 | Convergent upto a limit and then is divergent |
| Alt3 | Convergent |
| Alt4 | Divergent |

| | |
|---|---|
| 23 | The selection rules for transitions to occur for an diatomic vibrating rotator is:- |
| Alt1 | $\Delta v = \pm 1, \pm 2, \ldots$ and $\Delta J = \pm 1$ |
| Alt2 | $\Delta v = \pm 1, \pm 2, \ldots$ and $\Delta J = \pm 1, \pm 2, \ldots$ |
| Alt3 | $\Delta v = \pm 1, \pm 2, \ldots$ and $\Delta J = 0, \pm 1$ |
| Alt4 | $\Delta v = 0, \pm 1, \pm 2, \ldots$ and $\Delta J = \pm 1$ |

| | |
|---|---|
| 24 | If a particle moves on a circular path (r, θ), the generalized coordinates will be :- |
| Alt1 | r and θ |
| Alt2 | r |
| Alt3 | θ |
| Alt4 | x and y |

| | |
|---|---|
| 25 | The area of a triangle specified by the vertices (1,3,2), (3,-4,2) and (5,0,-5) is:- |
| Alt1 | $\frac{\sqrt{2723}}{2}$ |
| Alt2 | $\frac{\sqrt{3081}}{2}$ |
| Alt3 | $\frac{\sqrt{1810}}{2}$ |
| Alt4 | $\frac{\sqrt{1881}}{2}$ |

| | |
|---|---|
| 26 | The generator function (F1(q, Q, t)) for the time (t) dependent canonical transformations Q = p tan t and P = -p cot t is:- |
| Alt1 | F1(q, Q, t) = qQ cot t |

| | |
|---|---|
| Alt2 | F1(q, Q, t) = pQ sin t |
| Alt3 | F1(q, Q, t) = pQ cos t |
| Alt4 | F1(q, Q, t) = qQ sin t |

| | |
|---|---|
| 27 | The eigen values of the matrix $\begin{pmatrix} \frac{1}{2} & \frac{i\sqrt{3}}{2} \\ \frac{i\sqrt{3}}{2} & \frac{1}{2} \end{pmatrix}$ are |
| Alt1 | $\frac{1 \pm i\sqrt{3}}{2}$ |
| Alt2 | $\frac{1 \pm \sqrt{3}}{2}$ |
| Alt3 | $\frac{1 \pm \sqrt{3}}{4}$ |
| Alt4 | $\frac{1 \pm \sqrt{3}}{4}$ |

| | |
|---|---|
| 28 | The term symbol corresponding to an nd10 electronics configurations is :- |
| Alt1 | 3P0 |
| Alt2 | 2S1/2 |
| Alt3 | 2P1/2 |
| Alt4 | 1S0 |

| | |
|---|---|
| 29 | The relationship between the average photon energy of a Bose-Einstein gas and its temperature is:- |
| Alt1 | $E \propto T$ |
| Alt2 | $E \propto \sqrt{T}$ |
| Alt3 | $E \propto \frac{1}{\sqrt{T}}$ |
| Alt4 | $E \propto \frac{1}{T}$ |

| | |
|---|---|
| 30 | The moment of inertia of a rigid body about the X axis (Ixx) with mass for ith particle 'mi'at (x, y, z) is:- |
| Alt1 | $\sum_i m_i (x^2+z^2)$ |
| Alt2 | $\sum_i m_i (x^2+y^2+z^2)$ |
| Alt3 | $\sum_i m_i (z^2+y^2)$ |
| Alt4 | $\sum_i m_i (x^2+y^2)$ |

| | |
|---|---|
| 31 | The Rank of the matrix $\begin{pmatrix} 8 & -4 \\ -2 & 1 \\ 6 & -3 \end{pmatrix}$ is |
| Alt1 | Zero |
| Alt2 | Two |
| Alt3 | Three |
| Alt4 | One |

| | |
|---|---|
| 32 | The Levi-Civita symbol satisfies :- |
| Alt1 | $\varepsilon_{132} = \varepsilon_{213} = \varepsilon_{321} = -1$ |
| Alt2 | $\varepsilon_{132} = \varepsilon_{213} = \varepsilon_{321} = 1$ |
| Alt3 | $\varepsilon_{312} = \varepsilon_{321} = \varepsilon_{213} = 1$ |
| Alt4 | $\varepsilon_{312} = \varepsilon_{231} = \varepsilon_{213} = -1$ |

| | |
|---|---|
| 33 | To satisfy the canonical transformations (q,p →Q,P) Q = $q^{\alpha}\cos\beta p$ and P = $q^{\alpha}\sin\beta p$, the conditions are |
| Alt1 | $\alpha = 1/2\ ,\ \beta = 0$ |
| Alt2 | $\alpha = 1/2\ ,\ \beta = 1$ |
| Alt3 | $\alpha = 1/2,\ \beta = 2$ |

| | |
|---|---|
| Alt4 | $\alpha = 1/2$ , $\beta = ½$ |

| | |
|---|---|
| 34 | The partition function of a system that obeys Maxwell-Boltzmann statistics is given by z= aVT4,where ais a constant. The internal energy of the system is:- |
| Alt1 | 4NkBT |
| Alt2 | 3NkBT |
| Alt3 | 2NkBT |
| Alt4 | NkBT |

| | |
|---|---|
| 35 | In a grand canonical ensemble, a system S of fixed volume is in contact with a large reservoir R. Then which of the following is correct? |
| Alt1 | S can exchange neither energy nor particles with R |
| Alt2 | S can exchange both energy and particles with R |
| Alt3 | S can exchange only energy with R |
| Alt4 | S can exchange only particles with R |

| | |
|---|---|
| 36 | The bob of a pendulumof mass 'm' and length'l' makes angle 'θ' while oscillating. The Lagrange's equation of the bob is:- |
| Alt1 | $1\ddot{\theta} + g\theta = 0$ |
| Alt2 | $1\ddot{\theta} - g\theta = 0$ |
| Alt3 | $m\ddot{\theta} + g\theta = 0$ |
| Alt4 | $1\ddot{\theta} - m\theta = 0$ |

| | |
|---|---|
| 37 | Fourth momentum vector ($p_4$) of a particle with rest mass $m_0$ and relativistic mass 'm' moving with velocity 'v' in relativistic mechanics is, given $i = \sqrt{-1}$ |
| Alt1 | i m0c2 |
| Alt2 | i mc |
| Alt3 | m0c |
| Alt4 | i mc2 |

| | |
|---|---|
| 38 | The polar form of $\left(\frac{6+8i}{4-3i}\right)^2$ is |
| Alt1 | $4(\cos\pi + i\sin\pi)$ |

| | |
|---|---|
| Alt2 | $4(\cos\pi - i\sin\pi)$ |
| Alt3 | $2(\cos\pi - i\sin\pi)$ |
| Alt4 | $2(\cos\pi + i\sin\pi)$ |

| | |
|---|---|
| 39 | The rotational spectra of polyatomic molecule falls in :- |
| Alt1 | Microwave region |
| Alt2 | Visible region |
| Alt3 | Infrared region |
| Alt4 | X-ray region |

| | |
|---|---|
| 40 | Consider the following vectors (a) [2,-4], (b) [1,9] and (c) [3,5] |
| Alt1 | (a) and (b) are linearly dependent and (c) is independent of other two |
| Alt2 | All are linearly dependent |
| Alt3 | (a) and (c) are linearly dependent and (b) is independent of other two. |
| Alt4 | All are linearly independent |

| | |
|---|---|
| 41 | The Laplace transform of tet is:- |
| Alt1 | (s + 1) -2 |
| Alt2 | (s + 1) 2 |
| Alt3 | (s - 1) 2 |
| Alt4 | (s - 1) -2 |

| | |
|---|---|
| 42 | For small oscillation of a particle in rigid body, the potential energy must satisfy the condition:- |
| Alt1 | $\frac{\partial^2 V}{\partial q_i q_j} < 0$ |
| Alt2 | $\frac{\partial V}{\partial q} > 0$ |
| Alt3 | $\frac{\partial V}{\partial q} < 0$ |
| Alt4 | $\frac{\partial^2 V}{\partial q_i q_j} > 0$ |

| | |
|---|---|
| 43 | A typical differential equation for damping oscillator with displacement '$\eta(t)$' can be represented as |

| | |
|---|---|
| Alt1 | $\alpha\ddot{\eta} - \beta\dot{\eta} + \gamma\eta = 0$ |
| Alt2 | $\alpha\ddot{\eta} + \beta\dot{\eta} - \gamma\eta = 0$ |
| Alt3 | $\alpha\ddot{\eta} - \beta\dot{\eta} - \gamma\eta = 0$ |
| Alt4 | $\alpha\ddot{\eta} + \beta\dot{\eta} + \gamma\eta = 0$ |

| | |
|---|---|
| 44 | For large $N$, the Stirling's approximation of $\log(N!)$ is |
| Alt1 | $N\ln(n) + N - 1$ |
| Alt2 | $N\ln(N) - N + 1$ |
| Alt3 | $N\ln(N) + N$ |
| Alt4 | $N\ln(N) - N$ |

| | |
|---|---|
| 45 | Consider a normalized wave function $\Psi(x)$. Assume that a system is in a state described by $\Psi(x) = A\psi(x) + B\psi^*(x)$, where A and B are complex numbers. The normalization condition is of $\Psi(x)$ is (where $D = \int dx\lvert\psi(x)\rvert^2$). |
| Alt1 | $\lvert A\rvert^2 + \lvert B\rvert^2 = 1$ |
| Alt2 | $\lvert A\rvert^2 + \lvert B\rvert^2 + A^* B D^* + A B^* D = 1$ |
| Alt3 | $\lvert A\rvert^2 + \lvert B\rvert^2 + \lvert D\rvert^2 = 1$ |
| Alt4 | $\lvert A\rvert^2 + \lvert B\rvert^2 + A^* B D + A B^* D^* = 1$ |

| | |
|---|---|
| 46 | Find the Fourier transform of the following equation: $f(x) = \begin{cases} xe^{-x}, x > 0 \\ 0, x < 0 \end{cases}$ |

| | |
|---|---|
| Alt1 | $1/(1-iw)^2\sqrt{2\pi}$ |
| Alt2 | $1/(1+iw)^2\sqrt{2\pi}$ |
| Alt3 | $1/(1-iw)^2\sqrt{\pi}$ |
| Alt4 | $1/(1+iw)^2\sqrt{\pi}$ |

| | |
|---|---|
| 47 | Functions $f_1(x), f_2(x), \ldots$ defined on some interval $a \le x \le b$ can be called to be orthogonal on this interval if $\int_a^b p(x) f_m(x) f_n(x) dx = 0$, where p(x) is the weight function which has to satisfy |
| Alt1 | p(x) can be any real value |
| Alt2 | p(x) > 0 |
| Alt3 | p(x) = 0 |
| Alt4 | p(x) < 0 |

| | |
|---|---|
| 48 | The number of degenerate states in the case of a hydrogen atom, for a given value of the principal quantum number N is |
| Alt1 | N2 /2 |
| Alt2 | N2 - 1/2 |
| Alt3 | 4 N2 |
| Alt4 | 2N2 |

| | |
|---|---|
| 49 | Integrate the function $\frac{Z^3}{2Z-i}$ counter clock wise around an unit circle and the outcome is |
| Alt1 | $\pi / 2$ |
| Alt2 | $\pi / 8$ |
| Alt3 | $\pi / 4$ |

| | |
|---|---|
| Alt4 | $\pi/16$ |

| | |
|---|---|
| 50 | A particle of mass m is moving on a spherical surface. The angular momentum corresponding to ϕ:- |
| Alt1 | $mr^2 sin^2\theta\dot{\varphi}$ |
| Alt2 | $mr^2\theta\dot{\varphi}$ |
| Alt3 | $mr^2\dot{\theta}$ |
| Alt4 | $mr^2 sin^2\theta\dot{\theta}$ |

| | |
|---|---|
| 51 | The solution for the initial value problem : $L\frac{dI}{dt}+RI=0$ with $I(0)=I_O$ is : |
| Alt1 | $I=I_O\exp\{-RLt\}$ |
| Alt2 | $I=I_O\exp\left\{-\frac{R}{L}t\right\}$ |
| Alt3 | $I=I_O\exp\left\{\frac{R}{L}t\right\}$ |
| Alt4 | $I=I_O\exp\{RLt\}$ |

| | |
|---|---|
| 52 | Find the function $f(t)$ for the Laplace transform $L(f)=\frac{6}{(s+2)(s-4)}$ using partial fractions. |
| Alt1 | exp(4t) - exp(-2t) |
| Alt2 | exp(4t) + exp(-2t) |
| Alt3 | exp(-4t) - exp(-2t) |
| Alt4 | exp(4t) - exp(2t) |

| | |
|---|---|
| 53 | What is the energy of the particles that have successfully escaped by tunnelling process ? |
| Alt1 | Greater than initial energy |
| Alt2 | Less than initial energy |
| Alt3 | Zero |

| | |
|---|---|
| Alt4 | Same as initial energy |

| | |
|---|---|
| 54 | For an infinite square well centered at the origin and that centered at x = a/2 which of the following statements is true about their energy and parity eigen states ? |
| Alt1 | For both the cases, the energy eigen states are also parity eigen states |
| Alt2 | For the well centered at x = 0, the energy eigen states are also parity eigen states, but not so for the well centered at x = a/2. |
| Alt3 | The energy eigen states are not the same as parity eigenstates |
| Alt4 | For the well centered at x = a/2, the energy eigen states are also parity eigen states, but not so for the well centered at x = 0. |

| | |
|---|---|
| 55 | Hamilton-Jacobi equation is:- |
| Alt1 | + ∂H/ ∂q = 0 |
| Alt2 | S + ∂H/ ∂t = 0 |
| Alt3 | H + ∂S/ ∂t = 0 |
| Alt4 | + ∂H/ ∂p = 0 |

| | |
|---|---|
| 56 | The function $x\|x\|$ is |
| Alt1 | An even function |
| Alt2 | It exhibits both the properties |
| Alt3 | It is an odd function only for real values |
| Alt4 | An odd function |

| | |
|---|---|
| 57 | Given the vectors $\vec{A}=[1 \quad 1 \quad 0]$, $\vec{B}=[3 \quad 2 \quad 1]$ and $\vec{C}=[1 \quad 0 \quad 2]$. The angle between the vectors $\vec{A}$ and $\vec{B}+\vec{C}$ is |
| Alt1 | 68 degrees |
| Alt2 | 58 degrees |
| Alt3 | 48 degrees |
| Alt4 | 38 degrees |

| | |
|---|---|
| 58 | The ground state energy of a proton confined to a one-dimensional infinite potential well of width 100 pm is |
| Alt1 | 0.00515 eV |
| Alt2 | 0.0206 eV |
| Alt3 | 0.0824 eV |
| Alt4 | 0.0103 eV |

| | |
|---|---|
| 59 | The degrees of freedom of 3 particles fixed at the vertices of a triangle is:- |
| Alt1 | 1 |
| Alt2 | 3 |
| Alt3 | 9 |
| Alt4 | 6 |

| | |
|---|---|
| 60 | Two electrons are ejected in opposite direction from a radioactive source at rest in laboratory and speed of each electron is 0.67c. The speed of one electron seen by other in relativistic mechanics is:- |
| Alt1 | 0.67c |
| Alt2 | 0.92c |
| Alt3 | 0 |
| Alt4 | 1.34c |

| | |
|---|---|
| 61 | Consider a system of two particles with mass ratio as 3:4 moving in one dimension. If the smaller mass moves with velocity 60m/s, the velocity of larger mass in center of mass frame is :- |
| Alt1 | +60 m/s |
| Alt2 | -45 m/s |
| Alt3 | -30 m/s |
| Alt4 | -60 m/s |

| | |
|---|---|
| 62 | The solution $u(x,y)$ of the equation $u_x - u_y = 0$ , obtained using separation of variables is |
| Alt1 | $u = C\exp(-k(x-y))$ |
| Alt2 | $u = C\exp(-k(x+y))$ |
| Alt3 | $u = C\exp(k(x-y))$ |
| Alt4 | $u = C\exp(k(x+y))$ |

| | |
|---|---|
| 63 | If a rigid body rotates about z axis by velocity $\bar{\Omega}$ , the rate of change of unit vector along x axis is |
| Alt1 | $\bar{\Omega}x\bar{k}$ |
| Alt2 | $\bar{\Omega}x\bar{i}$ |
| Alt3 | $\bar{\Omega}x\bar{j}$ |
| Alt4 | $\bar{0}$ |

| | |
|---|---|
| 64 | For a particle moving under the influence of a central force, which of the following is not true? |
| Alt1 | Total energy is conserved |
| Alt2 | Linear momentum is conserved |
| Alt3 | Areal velocity is conserved |

| | |
|---|---|
| Alt4 | Angular momentum is conserved |

| | |
|---|---|
| 65 | Assume that you are dropping a metallic sphere from a height of 10 meters and the time taken for the fall is T1 seconds. Let the time taken for the fall from 20 meters is T2 meters. Which of the following is true? |
| Alt1 | T2 is more than twice T1 |
| Alt2 | T2 is equal to T1 |
| Alt3 | T2 is equal to twice T1 |
| Alt4 | T2 is less than twice T1 |

| | |
|---|---|
| 66 | The general solution of the equation $x^2 \frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$ is |
| Alt1 | A sin(ln(x)) + B sin (ln(x)) |
| Alt2 | A cos(ln(-x)) + B cos (ln(-x)) |
| Alt3 | A cos(ln(x)) + B cos (ln(x)) |
| Alt4 | A cos(ln(x)) + B sin (ln(x)) |

| | |
|---|---|
| 67 | The Euclidean norm of the vector [3 2 -2 4 0] T:- |
| Alt1 | $\sqrt{26}$ |
| Alt2 | $\sqrt{33}$ |
| Alt3 | $\sqrt{36}$ |
| Alt4 | $\sqrt{23}$ |

| | |
|---|---|
| 68 | Consider an ideal gas of monatomic molecules in a volume . Then the number of micro-states and its energy are related by:- |
| Alt1 | $\Omega(E) \propto E$ |
| Alt2 | $\Omega(E) \propto E^{\frac{3N}{2}}$ |
| Alt3 | $\|A\|^2 + \|B\|^2 + \|D\|^2 = 1$ |
| Alt4 | $\Omega(E) \propto E^{\frac{N}{2}}$ |

| | |
|---|---|
| 69 | Calculate the effective magnetic moments of Ho3+ and the identify from the following:- |
| Alt1 | 16.3 B |
| Alt2 | 10.63 B |
| Alt3 | 1.63 B |

| | |
|---|---|
| Alt4 | 5.63 B |

| | |
|---|---|
| 70 | The line spacing between rotational levels of CO2 molecule is:- |
| Alt1 | 4B |
| Alt2 | 2B |
| Alt3 | 12B |
| Alt4 | 6B |

| | |
|---|---|
| 71 | The experimental mapping of the Fermi surface is carried out using:- |
| Alt1 | De Haas Alphen effect |
| Alt2 | Bose-Einstein Condensation effect |
| Alt3 | Quantum Tunnelling effect |
| Alt4 | Rontgen effect |

| | |
|---|---|
| 72 | Melting point of a nano-material (<100 nm particle size) as compared to the melting point of the same bulk material would :- |
| Alt1 | Decrease |
| Alt2 | Increase |
| Alt3 | Double |
| Alt4 | No change |

| | |
|---|---|
| 73 | The diffraction pattern mapping of a crystal corresponds to its:- |
| Alt1 | Direct Lattice |
| Alt2 | Reciprocal Lattice |
| Alt3 | Neither Direct & Reciprocal Lattice |
| Alt4 | Both Direct & Reciprocal Lattice |

| | |
|---|---|
| 74 | Among single, double and triple bonds, the molecular vibrational frequency of _____ bond is high. |
| Alt1 | Single |
| Alt2 | Independent of bond nature |
| Alt3 | Double |
| Alt4 | Triple |

| | |
|---|---|
| 75 | The maximum population of rotational level of a diatomic molecule whose rotational constant B is given by :- |
| Alt1 | $J = \sqrt{\frac{kT^2}{2hcB}} - \frac{1}{2}$ |
| Alt2 | $J = \sqrt{\frac{kT^2}{2hcB}} - \frac{1}{2}$ |

| | |
|---|---|
| Alt3 | $J = \sqrt{\frac{kT}{2hcB}} - \frac{1}{2}$ |
| Alt4 | $J = \sqrt{\frac{T}{2hcB}} - \frac{1}{2}$ |

| | |
|---|---|
| 76 | The electron density in a metal A at absolute zero is twice that in a metal B, their Fermi energies are in the ratio:- |
| Alt1 | (0.7) 2/3 |
| Alt2 | (0.5) 2/3 |
| Alt3 | (2.0) 2/3 |
| Alt4 | (0.2) 2/3 |

| | |
|---|---|
| 77 | The number of distinct ways to assign N electrons to G spin orbitals is:- |
| Alt1 | $\frac{1}{N!(G-N)!}$ |
| Alt2 | $\frac{G+1}{N!(G-N)!}$ |
| Alt3 | $\frac{G!}{N!(G-N)!}$ |
| Alt4 | $\frac{N!}{(G-N)!}$ |

| | |
|---|---|
| 78 | The ESR spectrum of an unpaired electrons with two equivalent protons shows three lines whose intensities are in the ratio of :- |
| Alt1 | 1:1:1 |
| Alt2 | 1:3:1 |
| Alt3 | 1:2:1 |
| Alt4 | 3:2:1 |

| | |
|---|---|
| 79 | The total yearly world consumption of energy is approximately 4.0 X1020 J. How much mass would have to be completely converted into energy to provide this amount of energy? |
| Alt1 | 1.3 X1012 kg |
| Alt2 | 1.3X 104 kg |
| Alt3 | 4.4X 103 kg |
| Alt4 | 4.4 X105 kg |

| | |
|---|---|
| 80 | The curvature at the edges of band diagram (E vs k) is essentially due to the change in:- |
| Alt1 | Conductivity |
| Alt2 | Crystallographic structure |
| Alt3 | Relaxation time of the electrons |
| Alt4 | Effective mass of the electron |

| | |
|---|---|
| 81 | In a rotational fine structure of electronic vibrational spectra, B' and B are rotational constants of higher and lower levels. If B' > B'', P branch will converge to a band head on the _____ side of the band origin with the band head at the ___ end of spectrum. |
| Alt1 | High wave number, red |
| Alt2 | Low wave number, red |
| Alt3 | Low wave number, violet |
| Alt4 | High wave number violet |

| | |
|---|---|
| 82 | According to Free electron model, the average K.E of the electron at an absolute temperature T is :- |
| Alt1 | 2 KT |
| Alt2 | 1/2 KT |
| Alt3 | 3/2 KT |
| Alt4 | KT |

| | |
|---|---|
| 83 | If the Fermi energy of a metal is 2eV, the Fermi temperature of the metal is:- |
| Alt1 | 0.32X104 K |
| Alt2 | 2.32 X104 K |
| Alt3 | 1.32 X104 K |
| Alt4 | 3 X104 K |

| | |
|---|---|
| 84 | Rutherford's experiments, in which he bombarded a very thin gold foil with alpha particles, showed that :- |
| Alt1 | none of the α particles were able to penetrate the foil. |
| Alt2 | most of the α particles passed through the foil with negligible deflection but some were deflected through large angles. |
| Alt3 | all of the α particles passed through the foil and were deflected through large angles |
| Alt4 | all of the α particles passed through the foil without significant deflection. |

| | |
|---|---|
| 85 | During collision if molecule gain rotational energy from the photon, it give rise to series of lines on low frequency side of excited line. Such spectral lines are known as :- |
| Alt1 | Stokes lines |
| Alt2 | Anti-stokes lines |
| Alt3 | Overtones |
| Alt4 | Rayleigh lines |

| | |
|---|---|
| 86 | The magnetic susceptibility of a Diamagnet is directly proportional to:- |
| Alt1 | The mean square of the atomic radius |
| Alt2 | Inversely proportional to the Temperature |
| Alt3 | The volume of the substance |
| Alt4 | Directly proportional to the Temperature |

| | |
|---|---|
| 87 | An oscillator converts :- |
| Alt1 | a.c. power to d.c. power |
| Alt2 | d.c. power to a.c. power |
| Alt3 | mechanical power to d.c. power |
| Alt4 | mechanical power to a.c. power |

| | |
|---|---|
| 88 | The cosmic microwave background radiation is:- |
| Alt1 | produced from processes going on all over the present universe |
| Alt2 | radiation from the quasars that is redshifted |
| Alt3 | radiation from the Sun. |
| Alt4 | radiation from the Big Bang that was around when electons and protons conbined to form neutral hydrogen atoms. |

| | |
|---|---|
| 89 | A moderator in a nuclear reactor is used to slow down:- |
| Alt1 | alpha particles |
| Alt2 | beta particles |
| Alt3 | protons |
| Alt4 | neutrons |

| | |
|---|---|
| 90 | What are the number of protons Z and neutrons N in the missing fragment X of the following fission reaction? ${}^{1}n_0 + {}^{235}U_{92} \rightarrow {}^{140}Cs_{55} + 4\ {}^{1}n_0$ |
| Alt1 | Z = 37 and N = 92 |
| Alt2 | Z = 92 and N = 37 |
| Alt3 | Z = 55 and N = 37 |
| Alt4 | Z = 37 and N = 55 |

| | |
|---|---|
| 91 | In a transistor, the base current is about . of the emitter. |
| Alt1 | 0.25 |
| Alt2 | 1 |
| Alt3 | 0.05 |
| Alt4 | 0.5 |

| | |
|---|---|
| 92 | A p-n-p-n diode when forward-biased has two stable states. One is very high resistance state and other has very low resistance state respectively, of the order of:- |
| Alt1 | 100 M Ω and 10 Ω |
| Alt2 | 10 Ω and 1 Ω |
| Alt3 | 100 GΩ and 100 M Ω |
| Alt4 | 0.1 Ω and 10 Ω |

| | |
|---|---|
| 93 | A single stage amplifier contains _____ and associated circuitry |
| Alt1 | Two transistor |
| Alt2 | One transistor |
| Alt3 | One p-n-p transistor and one n-p-n transistor |

| | |
|---|---|
| Alt4 | Four transistors |

| | |
|---|---|
| 94 | In a transistor _____ |
| Alt1 | IE = IC+IB |
| Alt2 | IC = IE+IB |
| Alt3 | IC = IE-3IB |
| Alt4 | IC = IE+4IB |

| | |
|---|---|
| 95 | In the decay scheme AXZ → AYZ-1 + _____ + _____the blanks should contain |
| Alt1 | β- and p |
| Alt2 | β+ and v |
| Alt3 | β+ and n |
| Alt4 | β- and v |

| | |
|---|---|
| 96 | Which of the expression is NOT correct according to Boolean theorem? |
| Alt1 | A.1 = A |
| Alt2 | A+0 = A |
| Alt3 | A+A = A |
| Alt4 | A+A = 2A |

| | |
|---|---|
| 97 | A β particle traveling at 0.980c has a total energy of:- |
| Alt1 | 2.55 MeV |
| Alt2 | 0.511 MeV |
| Alt3 | 0.245 MeV |
| Alt4 | 0.756 MeV |

| | |
|---|---|
| 98 | The overall gain of a multi-stage amplifier is 140. The 20% of the output voltage is feed back to the input, the gain of the amplifier with the feedback is :- |
| Alt1 | 140 |
| Alt2 | 17.5 |
| Alt3 | 1.75 |
| Alt4 | 175 |

| | |
|---|---|
| 99 | The total gain of a multi-stage amplifier is less than the product of the gains of individual stage due to:- |
| Alt1 | Power loss in coupling device |
| Alt2 | Total gain is never loss than the product of individual stage gain |
| Alt3 | Loading effect of next stage |
| Alt4 | Use of many capacitors |

| | |
|---|---|
| 100 | The nuclear radius of 27Al13 is approximately :- Given a0= 1.5fm |
| Alt1 | 11.2 fm |
| Alt2 | 1.05 fm |
| Alt3 | 4.50 fm |
| Alt4 | 0.350 fm |

Examination: **Ph.D. Physics**

**Section 1 - Section 1**

**Question No.1** 4.00

**Bookmark**

A particle of energy E is incident on a potential step of infinite width and height V0. According to quantum mechanics, if E> $V_0$, then ----------

- The reflectivity and transmittance of the particle will be finite
- The particle will definitely get reflected
- The reflectivity of the particle will be zero
- The particle will definitely get transmitted

**Question No.2** 4.00

**Bookmark**

A simple instruction to clear the lower 4 bits of the accumulator in 8085 assembly language

- XRI OHF
- XRI FOH
- ANI FOH
- ANI OFH

**Question No.3** 4.00

**Bookmark**

The electrostatic potential $V(x, y)$ in free space in a region where the charge density ρ is zero is given by $V(x, y) = 4e^{2x} + f(x) - 3y^2$. Given that the x-component of the electric field $E_x$ and V are zero at the origin, $f(x)$ is

- $3x^2 - 4e^{2x} + 8x$
- $4e^{2x} - 8x$
- $3x^2 - 4e^{2x} + 16x$
- $3x^2 - 4e^{2x}$



**Question No.4** 4.00

**Bookmark**

Raman effect is due to collision of ….

- Electron with photon
- Photon with molecule
- Photon with electron
- Electron with atom

**Question No.5** 4.00

**Bookmark**

A uniform chain of length L and mass M is lying on a smooth table such that one-third of its length is hanging vertically down over the edge of the table. If g is the acceleration due to gravity then the work required to pull the hanging part on the table is---

- $M_gL/3$
- $M_gL$
- $M_gL/9$
- $M_fL/18$

**Question No.6** 4.00

**Bookmark**

A silicon diode is in series with a 1.0 kW resistor and a 5V battery. If the anode is connected to the positive battery terminal, the cathode voltage with respect to the negative battery terminal is---

- 0.3 V
- 5.7 V
- 4.3 V
- 0.7 V

**Question No.7** 4.00

**Bookmark**

Psychologist : Neurosis

- Kids : Pediatrician
- Dermatologist: Sprain
- Oncologist: Measles
- Opthamologist : Catract

**Question No.8** 4.00

**Bookmark**

Eight drops of mercury of equal radii and possessing equal charge combine to form a big drop. The capacitance of the big drop, as compared to each smaller drop, is---

- 2 times
- 4 times
- 16 times
- 8 times

**Question No.9** 4.00

**Bookmark**

Choose the correct meaning of the italicized idiom.
The party in power *came down* on the side of a flexible and early economic policy to help the weaker sections.

- Decide to support
- Decide to speak secretly
- Decide to rebuke severely
- Decide to go to the corner

**Question No.10** 4.00

**Bookmark**

If g is the acceleration due to gravity on the earth's surface, the gain in the potential energy of an object of mass m raised from the surface of the earth to a height equal to the radius R of the earth is---

- ¼ mgR
- ½ mgR
- mgR
- 2mgR

**Question No.11** 4.00

**Bookmark**

_____ she had been lied to, Sally got really angry.

- If Sally discovered
- Having discovered
- Sally when discovered
- Sally discovered

**Question No.12** 4.00

**Bookmark**

Two conductors of the same shape and size, one of copper and the other of aluminium (less conducting), are placed in a uniform electric field. The charge induced in aluminium---

- Will be equal to that to copper
- Will be more than in copper
- Will be zero
- Will be less than in copper

**Question No.13** 4.00

**Bookmark**

If the degree of freedom of a gas is n, then the ratio of $C_p$ and $C_v$ is---

- $1+\frac{2}{n}$
- $\frac{2n}{2n+1}$
- $1+\frac{1}{n}$
- $1+\frac{1}{2n}$

**Question No.14** 4.00

**Bookmark**

**Statement:** Opening a Library in Achupatti will be a wastage.
**Assumptions:**
I. Inhabitants of Achupatti are illiterate.
II. Inhabitants of Achupatti are not interested in reading

- If both I and II are implicit
- If only assumption II is implicit
- If neither I nor II is implicit
- If only assumption I is implicit

**Question No.15** 4.00

**Bookmark**

A reference frame attached to the earth---

- Cannot be an inertial frame because the earth is resolving round the sun
- Is an inertial frame because Newton's law are applicable in this frame
- Is in inertial frame by definition
- Is an inertial frame because the earth is far away from the sun

**Question No.16** 4.00

**Bookmark**

The order and degree of the differential equation are y^''-y'+y^3=0

- 3, 2
- 2, 2
- 3, 3
- 2, 3

**Question No.17** 4.00

**Bookmark**

The Hall co-efficient of a metal is low. It means that ----------

- The Hall field produced in that metal is high
- The charge carrier density in that metal is low
- The charge carrier density in that metal is high
- The conductivity of the metal is zero

**Question No.18** 4.00

**Bookmark**

A moving body is covering distances in proportion to the square of time. The acceleration of the body is----

- Decreasing
- Zero
- Increasing
- Constant

**Question No.19** 4.00

**Bookmark**

A germanium semiconductor is doped with acceptor impurity concentration of 1015 atoms/$cm^3$. For the given hole mobility of 1800 $cm^2$/V-s, the resistivity of the material is

- 3.47 Ω cm
- 0.69 Ω cm
- 0.288 Ω cm
- 6.88 Ω cm

**Question No.20** 4.00

**Bookmark**

The value of p for which the vector field $\vec{V} = (2x + y)\hat{i} + (3x - 2z)\hat{j} + (x + pz)\hat{k}$ is solenoid is ----------

- 0
- 2
- -2
- 1

**Question No.21** 4.00

**Bookmark** ☐

Study the following information carefully and answer the question below it:

P, Q, R, S T went on a picnic. P is son of Q but Q is not the father of P. R is the son of S, who is the brother of P. T is the wife of S.

How many males are present in the group?

- 3
- 4
- 1
- 2

**Question No.22** 4.00

**Bookmark** ☐

The average value of the function $f(x)=4x^3$ in the interval 1 to 3 is

- 15
- 20
- 40
- 80

**Question No.23** 4.00

**Bookmark** ☐

When a bar magnet of magnetic moment M is deflected through an angle q in a uniform magnetic field of induction B, the work done in doing so is---

- $MB\,(1-\cos\theta)$
- $MB\sin\theta$
- $MB$
- $MB\cos\theta$

**Question No.24** 4.00

**Bookmark** ☑

**Statements:** Stories are True, All true incidents are rumours.

**Conclusion:**

I. Stories are rumours.

II. Rumours are stories

- If neither I nor II follows
- If either I or II follows
- If only conclusion II follows
- If only conclusion I follows

**Question No.25** 4.00

**Bookmark** ☐

A proton is moving round in a circular path with a constant speed. From this one can infer that these must be an uniform---

- Magnetic field along the plane of the orbit
- Magnetic field normal to the plane of the orbit
- Electric field normal to the plane of the orbit
- Electric field along the plane of the orbit

**Question No.26** 4.00

**Bookmark** ☐

Unpolarized light can be converted into a partially polarized or plane polarized light by several processes. Which of the following does not do that?

- Scattering
- Reflection
- Diffraction
- Double refraction

**Question No.27** 4.00

**Bookmark** ☐

The orbital speed of Jupiter is---

- Zero
- Greater than the orbital speed of earth
- Less than the orbital speed of earth
- Equal to the orbital speed of earth

**Question No.28** 4.00

**Bookmark** ☑

A missile is launched with a velocity less than the escape velocity. The sum of its kinetic energy and potential energy is---

- Positive
- Negative
- Zero
- May be positive or negative depending upon its initial velocity.

**Question No.29** 4.00

**Bookmark** ☐


- 1
- 2
- 4
- 3

**Question No.30** 4.00

**Bookmark** ☐

Is Planck's constant 'h', dimensionally

- The product of energy and distance
- The product of linear momentum and distance
- The ratio of energy and time
- The product of force and time

**Question No.31** 4.00

**Bookmark** ☐

When a mass is rotating in a plane about a fixed point, its angular momentum is directed along---

- The radius
- A line perpendicular to the plane of rotation
- The tangent to the orbit
- A line parallel to the plane of rotation

**Question No.32** 4.00

**Bookmark** ☐

Find the odd one out?

- Circle : Arc
- Cover : Page
- Flower : Petal
- Chair : Arm

**Question No.33** 4.00

**Bookmark** ☐

Study the following information carefully and answer the question below it

Lakshman passes through seven lanes to reach his school. He finds that 'Truth lane' is between his house and 'Lie lane'. The third lane from his school is 'Karma lane'. 'Dharma lane' is immediately before the 'Yog lane'. He passes 'Salvation lane' at the end, 'Lie lane' is between 'Truth lane' and 'Dharma lane', the sixth lane from his house is 'Devotion lane'.

How many lanes are there between 'Lie lane' and 'Devotion lane'?

- five
- two
- four
- three

**Question No.34** 4.00

**Bookmark** ☐

In the quantum mechanical operators of two observables of a system do not commutate, then ----------

- It is impossible to know the exact values of observables simultaneously
- Parity of the wave function will be odd
- Total energy of the system must be negative
- Observables must be time dependent

**Question No.35** 4.00

**Bookmark** ☑

There is a force F between two point charge+q and +q distant r apart. If one charge be stationary and the other revolve around it in circle of radius r, then the work done will be---

- F x R
- Zero
- F/2pr
- F x 2pr

**Question No.36** 4.00

**Bookmark** ☐

A spaceship is travelling with a velocity 0.4c, where c is the velocity of light. A person performing an experiment in these spaceship observers a particle moving with a velocity 0.4c in the same direction as that of the motion of the spaceship. A stationary observer on the earth would observe the particle to have the velocity.....

- 0.50c
- 0.69c
- 0.80c
- 0.73c

**Question No.37** 4.00

**Bookmark** ☐

From the following type of matrix, the diagonal elements of which matrix must be pure imaginary numbers or zero.

- Hermitian
- Skew symmetric
- Symmetric
- Skew Hermitian

**Question No.38** 4.00

**Bookmark** ☑

As the diameter of the objective lens of a telescope increases, the resolution of the telescope---

- Decreases
- Remain the same
- Depends on the focal length of the lens
- Increases

**Question No.39** 4.00

**Bookmark** ☐

A spring has force constant k and a mass is suspended from it. The spring is cut in half and the same mass is suspended from one of the halves. If the frequency of oscillation in the first case is α, then the frequency in the second case will be---

- α
- $\alpha\sqrt{2}$
- α/2
- 2α



**Question No.40** 4.00

**Bookmark** ☐

The existence of zero point energy for a linear harmonic oscillator is a consequence of

- Uncertainty principle
- Matter waves
- Special theory of relativity
- Pauli exclusion principle

**Question No.41** 4.00

**Bookmark**

book : _____ : : comb : tooth

- Page
- Cover
- Knowledge
- Title

**Question No.42** 4.00

**Bookmark**

How many atoms per unit cell are in face-centered cubic structure?

- 3
- 4
- 1
- 2

**Question No.43** 4.00

**Bookmark**

The packing fraction of diamond cubic crystal structure is ……

- 90%
- 34%
- 56%
- 60%

**Question No.44** 4.00

**Bookmark**

Select the Pair that best respresents the relationship that is given in the question:
Professor : Erudite

- Inventor : Imaginative
- Carpenter : Furniture
- Mason : Architecure
- Entrepreneur : Hardwork

**Question No.45** 4.00

**Bookmark** ☐

Study the following information carefully and answer the question below it

The Director of an MBA college has decided that six guest lectures on the topics of Motivation, Decision Making, Quality Circle, Assessment Centre, Leadership and Group Discussion are to be organised on each day from Monday to Sunday.
(i) One day there will be no lecture (Saturday is not that day), just before that day Group Discussion will be organised.
(ii) Motivation should be organised immediately after Assessment Centre.
(iii) Quality Circle should be organised on Wednesday and should not be followed by Group Discussion
(iv) Decision Making should be organised on Friday and there should be a gap of two days between Leadership and Group Discussion

On which day there is no lecture?

- Wednesday
- Tuesday
- Sunday
- Monday



**Question No.46** 4.00

**Bookmark** ☐

For an anisotropic dielectric media, the relative permittivity is a ….

- Linear quantity
- Tensor quantity
- Scalar quantity
- Vector quantity

**Question No.47** 4.00

**Bookmark** ☐

Which of the following statement is correct for a common emitter amplifier circuit?

- The output is taken from the emitter
- There is no phase shift between input and output voltages
- Both p-n junctions are forward biased
- There is a phase shift between input and output voltages

**Question No.48** 4.00

**Bookmark** ☐

The maximum current which can flow through a 20k ohms resistor, rated 2W is---

- 100 mA
- 10 mA
- 40 mA
- 1 mA

**Question No.49** 4.00

**Bookmark**

For good conductor's skin depth varies inversely with ……power of frequency

- Half
- Two
- Three
- One

**Question No.50** 4.00

**Bookmark**

The coordinates of the three vertices of a triangle are (0, 0, 0), (1, 1, 0) and (-2, 1, 0) then the area of the triangle is

- 1/2
- 3
- 3/2
- 1

**Question No.51** 4.00

**Bookmark**

According to Dirac equation,
Dirac Hamiltonian $(\overline{H})$ is ___.

- $C\bar{\alpha}.\bar{p} + \beta mC^2$
- $-C\bar{\alpha}.\bar{p} - \beta mC^2$
- $C\bar{\alpha}.\bar{p} - i\hbar\beta mC^2$
- $C\bar{\alpha}.\bar{p} - \beta mC^2$



**Question No.52** 4.00

**Bookmark**

Choose the correct meaning of the italicized idiom.
When Peter left he was extremely disappointed. I think he has *gone for good.*

- Permanently
- To a foreign country
- To seek good fortune
- To a good place

**Question No.53** 4.00

**Bookmark**

A signal frequency of 10 kHz is being digitized by an A/D converter. A possible sampling time which can be used is ----------

- 5μs
- 50 μs
- 100 μs
- 150 μs

**Question No.54** 4.00

**Bookmark** ☑

Based on the information given answer the following question.
1. In a family of six persons, there are people from three generations. Each has separate professions and they like different colours. There are two couples.
2. Shyam is an Engineer and his wife is not a doctor and she does not like Red colour.
3. Chartered Accountant likes green colour and his wife is a teacher.
4. Manisha is the mother-in-law of Sunita and she likes orange colour.
5. Vimal is the grand father of Tarun and tarun is the Principal and likes black colour.
6. Nyna is the grand daughter of Manisha and she likes blue colour. Nyna's Mother likes white colour.

Who is the Chartered Accountant?

- Manisha
- Nyna
- None of the above
- Vimal

**Question No.55** 4.00

**Bookmark** ☐

Eigen value of the particle exchange operator is/are ----------

- 1
- iħ
- ±1
- ± iħ

**Question No.56** 4.00

**Bookmark** ☐

In a JFET the change in drain current is due to the applied----

- Magnetic field between G and S
- Electric field between S and D
- Magnetic field between S and D
- Electric field between G and S

**Question No.57** 4.00

**Bookmark** ☐

A particle describes a circular orbit gives by r = 2a cosθ under the influence of an attractive central force directed towards a point on the circle. The force inversely proportional to

- $r^3$
- $r^5$
- $r^4$
- $r^2$

**Question No.58** 4.00

**Bookmark** ☐

Out of the following quantities, pick out one that is invariant under a Galilean transformation.....

- Force
- Momentum
- Velocity
- Displacement

**Question No.59** 4.00

**Bookmark**

A planet is revolving around a star in an elliptic orbit. The ratio of the farthest distance to the closest distance of the planet from the star is 4. The ratio of kinetic energies of the planet at the farthest to the closest position is.....

- 16:01
- 4:01
- 1:16
- 1:04

**Question No.60** 4.00

**Bookmark**

For repulsive inverse square forces, the shape of orbit will be.....

- Hyperbolic
- Elliptic
- Circular
- Parabolic

**Question No.61** 4.00

**Bookmark**

Vector C is the sum of two vectors A and B and vector D is the cross product of vectors A and B. What is the angle between vectors C and D?

- $60^o$
- zero
- $30^o$
- $90^o$

**Question No.62** 4.00

**Bookmark**

A spherically symmetric potential leads to the atomic states which are ----------

- Degenerate with degeneracy (2l+1) where l is the angular momentum
- Non-degenerate except for the ground state
- All non-degenerate in general
- Degenerate or non-degenerate depending on the principal quantum number

**Question No.63** 4.00

**Bookmark**

A calcite crystal is placed over a dot on a place of paper and rotated. On seeing through the calcite, one will see---

- Two rotating dots
- Two stationary dots
- One dot rotating about the other
- One dot only

**Question No.64** 4.00

**Bookmark**

If magnetic monopole existed, then which of the following Maxwell's equation will be modified?

- $div\bar{D} = \rho$
- $div\bar{B} = 0$
- $curl\ \bar{H} = J + \frac{\partial \bar{D}}{\partial t}$
- $curl\ \bar{E} = -\frac{\partial B}{\partial t}$

**Question No.65** 4.00

**Bookmark**

The rank of the matrix

$$\begin{bmatrix} 2 & -2 & 0 & 6 \\ 4 & 2 & 0 & 2 \\ 1 & -1 & 0 & 3 \\ 1 & -2 & 1 & 2 \end{bmatrix}$$

- 1
- 5
- 4
- 3

**Question No.66** 4.00

**Bookmark**

It is important to realize that the ties that bind us together in common activity are so _____ that they can disappear at any moment.

- tenacious
- tenuous
- restrictive
- tentative

**Question No.67** 4.00

**Bookmark**

A plane-polarized monochromatic electro-magnetic wave incident on a plane interface at the Brewster angle gives rise to a reflected wave which is

- Unpolarised
- Partially polarized
- Polarized parallel to the interface
- Polarized perpendicular to the interface

**Question No.68** 4.00

**Bookmark**

Digital circuit can be made by repetitive use of …..

- AND gates
- NOT gates
- NAND gates
- OR gates

**Question No.69** 4.00

**Bookmark**

Choose the antonym of the italicized word.
The habit of *squandering* money should not be encouraged.

- hoarding
- saving
- collecting
- discarding

**Question No.70** 4.00

**Bookmark**

The rest mass of the electron is m0 when it moves with a velocity v = 0.6 c, then its mass is.....

- 4/5 $m_0$
- $m_0$
- $2m_0$
- 5/4 $m_0$

**Question No.71** 4.00

**Bookmark**

Imagine a light planet revolving around a very massive star in a circular orbit of radius R with a period of revolution T. If the gravitational force of attraction between the planet and the star is proportional to $R^{-5/2}$ then---

- $T^2$ is proportional to $R^{3/2}$
- $T^2$ is proportional to $R^{3.76}$
- $T^2$ is proportional to $R^3$
- $T^2$ is proportional to $R^{7/2}$

**Question No.72** 4.00

**Bookmark**

A body is moved along a straight line by a machine delivering constant power. The distance moved by the body in time t is proportional to---

- $t^{1/2}$
- $t^{3/2}$
- $t^{3/4}$
- $t^2$

**Question No.73** 4.00

**Bookmark**

The polarizing angle and the refractive index (m) are related to each other by the relation---

- $\mu = \sin\theta$
- $\mu = \tan\theta$
- $\mu = \cot\theta$
- $\mu = \cos\theta$

**Question No.74** 4.00

**Bookmark**

When there are no external forces, the shape of a small liquid drop is determined by---

- Density of liquid
- Viscosity of liquid
- Surface tension
- Temperature of air only

**Question No.75** 4.00

**Bookmark**

A ROM is a ……

- Read/write memory
- Non-volatile memory
- Volatile memory
- Byte – organised memory

**Question No.76** 4.00

**Bookmark**

If the electric and magnetic fields are unchanged when the potential $\vec{A}$ changes (in suitable units) according to $\vec{A} \rightarrow \vec{A} + \hat{r}$ , where $\vec{r} = r(t)\hat{r}$, then the scalar potential $\Phi$ must simultaneously changes to -----

- $\Phi + \frac{\partial r}{\partial t}$
- $\Phi + r$
- $\Phi - \frac{\partial r}{\partial t}$
- $\Phi - r$

**Question No.77** 4.00

**Bookmark**

The gravitational and electrical forces between two electrons 10 cm apart are $F_g$ and $F_e$ respectively. The ratio $F_g/F_e$ is of the order---

- 10
- Oct-36
- Oct-43
- 1036

**Question No.78** 4.00

**Bookmark**

Intensity of light scattered by molecules of air in the atmosphere is proportional to---

- $\lambda^2$
- $1/\lambda^4$
- $\lambda$
- $1/\lambda^2$

**Question No.79** 4.00

**Bookmark**

Dad often comes home late these days, _____?

- is it?
- doesn't he?
- isn't it?
- does he?

**Question No.80** 4.00

**Bookmark**

If two soap bubbles of different radii are in contact then---

- Sizes of the bubbles remain the same
- Air rushes from smaller bubble to bigger bubble which continuous to grow at the cost of the smaller bubble
- Air rushes from the bigger bubble into the smaller bubble until the size of smaller bubble becomes equal to that of bigger and vice-versa.
- Air rushes from the bigger bubble to smaller bubble until the sizes of the two become same

**Question No.81** 4.00

**Bookmark**

What is the rest mass energy of an electron?

- 1 MeV
- 931 MeV
- 913 MeV
- 0.51 MeV

**Question No.82** 4.00

**Bookmark**

An electron of mass M kg and charge e coulomb travels from rest through a potential difference of V volts. The final energy is---

- $\mathrm{MeV}\,j$
- $\frac{eV}{M}j$
- $\frac{e}{V}j$
- $\mathrm{eV}\,j$

**Question No.83** 4.00

**Bookmark**

The escape velocity of a particle depends upon its mass m, being proportional to---

- $m^0$
- $m^2$
- $m^{1/2}$
- $m$

**Question No.84** 4.00

**Bookmark**

Choose the best synonym of the italicized word.
Nobody knew that Sunil had a *sinister* design in marrying her.

- selfish
- sinful
- murderous
- evil

**Question No.85** 4.00

**Bookmark**

X-rays are electromagnetic radiations. They can, therefore, be deflected by---

- Neither electric nor magnetic fields
- Electric and magnetic fields together
- Electric fields only
- Magnetic fields only

**Question No.86** 4.00

**Bookmark**

Which of the following phenomena is responsible for the production of shadow?

- Polarisation
- Diffraction
- Rectilinear propagation of light
- Interference

**Question No.87** 4.00

**Bookmark** ☐

For an op-amp with negative feedback, the output is

- Fed back to the inverting input
- Equal to the input
- Increased
- Fed back to the non- inverting input

**Question No.88** 4.00

**Bookmark** ☐

One day, Ravi walked a distance of 75 metres towards the north. Then he turned left and walked for about 25 metres, he turned left again and walked 80 metres. Finally, he turned to the right at an angle of $45^{o}$. In which direction was he moving finally?

- South-east
- North-east
- South-west
- North-west

**Question No.89** 4.00

**Bookmark** ☐

Choose the correct meaning of the italicized idiom.
Raju has a very nice manner, but you would better take what he says *with a grain of salt.*

- To complement
- To criticize
- To talk sensibly
- To listen to something with considerable doubt

**Question No.90** 4.00

**Bookmark** ☐

An electron and a proton are situated in a uniform electric field. The ratio of their acceleration will be equal to---

- Ratio of the masses of proton and electron
- Unity
- Zero
- Ratio of the masses of electron and proton

**Question No.91** 4.00

**Bookmark** ☑

Newton-Raphson method is applicable to the solution of

- Both algebraic and transcendental equations
- Both algebraic and transcendental and also used when the roots are complex
- Transcendental equations only
- Algebraic equations only

**Question No.92** 4.00

**Bookmark** ☐

The absolute temperature of a gas is increased 3 times. The root mean square velocity of the molecules will be---

- 9 times
- $\sqrt{3}$ times
- 3 times
- 1/3 times

**Question No.93** 4.00

**Bookmark**

Which of the following series in the spectrum of the hydrogen atom lies in the visible region of the electromagnetic spectrum?

- Brackett series
- Lymen series
- Paschen series
- Balmer series

**Question No.94** 4.00

**Bookmark**

The path of a charged particle in crossed electric and magnetic field is ----------

- A cycloid
- Hyperbolic
- Circular
- Parabolic

**Question No.95** 4.00

**Bookmark**

The line on the earth's surface joining the points, where the field is horizontal, is called----

- Magnetic line
- Magnetic axis
- Magnetic meridian
- Magnetic equator

**Question No.96** 4.00

**Bookmark**

Apparent weight of a body in a lift will be double of its real weight when---

- Lift comes down with acceleration g
- Lift goes down with velocity of 9.8 m/sec
- Lift goes up with velocity of 9-8m/sec
- Lift goes up with acceleration g

**Question No.97** 4.00

**Bookmark**

A player tossed two coins. If two head show he wins Rs. 4. If one head shows he wins Rs.2, but if two tails show he payRs. 3 as penalty. Calculate the expected value of Rupees he wins in the game.

- Rs.9
- Rs. 2.15
- Rs. 0.25
- Rs. 1.25

**Question No.98** 4.00

**Bookmark**

Which one of the following is not a point defect?

- Vacancy
- Compositional defect
- Screw dislocation
- Interstitial

**Question No.99** 4.00

**Bookmark**

A diffraction pattern is obtained using a beam of red light. What happens if the red light is replaced by blue light?

- No change
- Diffraction bands become narrower and crowded together
- Diffraction bands becomes broader and farther apart
- Bands disappear

**Question No.100** 4.00

**Bookmark**

An alpha particle of energy 5 MeV is scattered through $180^{o}$ by a fixed uranium nucleus. The distance of closest approach is of the order of ---

- $10^{-15}$ cm
- 1 Å
- $10^{-10}$ cm
- $10^{-12}$ cm