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Group 1

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physics

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Question Number : 1 Question Id : 827347301 Question Type : MCQ

A circular rod of length $1m$ and diameter $0.8cm$ is clamped rigidly at one of its end in a vertical position. A couple of magnitude $N\ dynes/cm$ is applied at the open end resulting in deflecting a mirror fixed near this end to deflect the spot of light by $10cm$ on a scale kept at a distance of $1m$. If the modulus of rigidity of the bar is $\eta = 8.0 \times 10^{11}\ dynes/cm^2$, calculate N?

Options :

$1.6 \times 10^6 dynes/cm$

$1.6 \times 10^7 dynes/cm$

$2.56 \times 10^6 dynes/cm$

$2.56 \times 10^7 \, dynes/cm$

Question Number : 2 Question Id : 827347302 Question Type : MCQ

A champion swimmer wants to cross a river spanning 2 km. The velocity of the flow of water in the river is 6 km/hr. The swimmer desires to go exactly to the opposite end. His maximum speed in still water is 10 km/hr. Find the time he would take to cross the river?

Options :

10 min.

15 min.

20 min.

25 min.

Question Number : 3 Question Id : 827347303 Question Type : MCQ

A car of mass M has a simple pendulum suspended from its ceiling. If at any instant the pendulum makes an angle θ with the vertical, the acceleration, a, of the car is given by

Options :

$a = \tan\theta$

$a = \cos\theta$

$a = M\tan\theta$

$a = M\cos\theta$

Question Number : 4 Question Id : 827347304 Question Type : MCQ

Consider a fixed sphere of radius R and a particle of mass M slides on its surface from the topmost point and leaves the contact with the sphere at an angle θ. The angle θ is given by

Options :

$cos^{-1}\left(\frac{1}{3}\right)$

$sin^{-1}\left(\frac{1}{3}\right)$

$cos^{-1}\left(\frac{2}{3}\right)$

$sin^{-1}\left(\frac{2}{3}\right)$

Question Number : 5 Question Id : 827347305 Question Type : MCQ

A central force $\vec{f} = -k\frac{\hat{r}}{r^3}$ acts on a particle of mass M. If the total energy of the particle is E, then its speed V is given by

Options :

$\sqrt{\frac{k}{Mr^2} - \frac{E}{M}}$

$\sqrt{\frac{k}{Mr^2} - \frac{2E}{M}}$

$\sqrt{\frac{k}{2Mr^2} + \frac{2E}{M}}$

$\sqrt{\frac{k}{Mr^2} + \frac{2E}{M}}$

Question Number : 6 Question Id : 827347306 Question Type : MCQ

Liquid drops of water , each of radius r , combines to form a drop of radius R . If T is the surface tension then the rise in temperature of the resulting droplet will be

Options :

$2T\left[\frac{1}{r} - \frac{1}{R}\right]$

$3T\left[\frac{1}{r} - \frac{1}{R}\right]$

$2T\left[\frac{1}{r} + \frac{1}{R}\right]$

$3T\left[\frac{1}{r} + \frac{1}{R}\right]$

Question Number : 7 Question Id : 827347307 Question Type : MCQ

Two masses M_1 and M_2 are connected by a massless spring of force constant k. If at any instant , the displacement of the two masses are respectively x_1 and x_2 , then the Lagrangian L and eigen frequency of small oscillation ω are given by

Options :

$L = \frac{1}{2} M_1 \dot{x_1}^2 + \frac{1}{2} M_2 \dot{x_2}^2 - \frac{1}{2} k(x_2 - x_1)^2 \; ; \omega = \sqrt{\frac{k(M_1+M_2)}{M_1 M_2}}$

$L = \frac{1}{2} M_1 \dot{x_1}^2 + \frac{1}{2} M_2 \dot{x_2}^2 + \frac{1}{2} k(x_2 - x_1)^2 \; ; \omega = \sqrt{\frac{k(M_1-M_2)}{M_1 M_2}}$

$L = \frac{1}{2} M_1 \dot{x_1}^2 - \frac{1}{2} M_2 \dot{x_2}^2 - \frac{1}{2} k(x_2 - x_1)^2 \; ; \omega = \sqrt{\frac{k(M_1+M_2)}{M_1 M_2}}$

$L = \frac{1}{2} M_1 \dot{x_1}^2 - \frac{1}{2} M_2 \dot{x_2}^2 + \frac{1}{2} k(x_2 - x_1)^2 \; ; \omega = \sqrt{\frac{k(M_1-M_2)}{M_1 M_2}}$

Question Number : 8 Question Id : 827347308 Question Type : MCQ

The Hamiltonian for a charge particle of mass m , momentum $\vec{p}$ and carrying a charge q in an electromagnetic field $(\overrightarrow{A}, \varphi)$ with velocity c may be written as:

Options :

$$H = \frac{1}{2}m\left(\frac{\vec{p}}{m} + \frac{q}{mc}\vec{A}\right)^2 + q\varphi$$

$$H = \frac{1}{2}m\left(\frac{\vec{p}}{m} - \frac{q}{mc}\vec{A}\right)^2 - q\varphi$$

$$H = \frac{1}{2}m\left(\frac{\vec{p}}{m} + \frac{q}{mc}\vec{A}\right)^2 - q\varphi$$

$$H = \frac{1}{2}m\left(\frac{\vec{p}}{m} - \frac{q}{mc}\vec{A}\right)^2 + q\varphi$$

Question Number : 9 Question Id : 827347309 Question Type : MCQ

The mean life of muon in its rest frame is $2 \times 10^{-6}s$. If it is moving with a speed of 0.93 times the speed of light c, then its life in laboratory frame will be

Options :

$2.44 \times 10^{-6}s$

$3.44 \times 10^{-6}s$

$4.44 \times 10^{-6}s$

$5.44 \times 10^{-6}s$

Question Number : 10 Question Id : 827347310 Question Type : MCQ

Calculate the relative velocity of an electron with respect to a photon when the electron is moving with a speed of 0.9 times the velocity of light, c, in a direction opposite to that of a moving photon.

Options :

$0.9c$

c

$c/2$

$c/4$

Question Number : 11 Question Id : 827347311 Question Type : MCQ

A space ship moves with certain velocity V such that the every day corresponds to 4 days on earth's surface. Calculate V?

Options :

$0.9 \times 10^{8}m/s$

$1.9 \times 10^{8}m/s$

$2.9 \times 10^{8}m/s$

$3.9 \times 10^8 m/s$

Question Number : 12 Question Id : 827347312 Question Type : MCQ

If p and T denote the momentum and kinetic energy of a particle, then the rest mass of the particle is given by

Options :

$m_0 = \frac{p^2c^2 - T^2}{2\,T\,c^2}$

$m_0 = \frac{p^2c^2 + T^2}{2\,T\,c^2}$

$m_0 = \frac{p^2c^2 - T^2}{T\,c^2}$

$m_0 = \frac{3p^2c^2 - T^2}{2\,T\,c^2}$

Question Number : 13 Question Id : 827347313 Question Type : MCQ

An infinitely straight wire is charged uniformly . If charge per unit length of the wire is μ and the permittivity of the free space is $\in_0$ then the electric field E at a perpendicular distance R from the wire is given by

Options :

$\frac{1}{4\pi \in_0} \frac{\mu}{r}$

$\frac{1}{2\pi \in_0} \frac{\mu}{r}$

$\frac{1}{2\pi \in_0} ln\frac{\mu}{r}$

$\frac{1}{4\pi \in_0} ln\,\frac{\mu}{r}$

Question Number : 14 Question Id : 827347314 Question Type : MCQ

A solid sphere of radius R has uniformly distributed charge Q. The potential V at any point $r < R$ is given by

Options :

$\frac{1}{4\pi \in_0} \frac{Q}{R}$

$\frac{1}{2\pi \in_0} \frac{Q}{R}$

$\frac{1}{4\pi \in_0} \frac{Q}{R}\left[\frac{3}{2} - \frac{r^2}{R^2}\right]$

$$\frac{1}{4\pi \in_0} \frac{Q}{R} \left[\frac{3}{2} - \frac{r^2}{2R^2}\right]$$

Question Number : 15 Question Id : 827347315 Question Type : MCQ

Find the charge distribution ρ of nucleus for which the Yukawa potential at a point r from the center is $V(r) = \frac{Q}{4\pi\epsilon_0} \frac{e^{-r/a}}{r}$?

Options :

$$\rho = -\frac{Q}{4\pi \in_0} \frac{e^{-r/a}}{r}$$

$$\rho = -\frac{Q}{4\pi a^2} \frac{e^{-r/a}}{r}$$

$$\rho = -\frac{Q}{4\pi a^3} \frac{e^{-r/a}}{r}$$

$$\rho = -\frac{Q}{4\pi} \frac{e^{-r/a}}{r}$$

Question Number : 16 Question Id : 827347316 Question Type : MCQ

Certain space has uniform electric field E and magnetic field B . The scalar and vector potentials at a position vector $\vec{r}$ in such a space is

Options :

$$\phi = \vec{E}.\vec{r}\,;\, \vec{A} = (\vec{B} \times \vec{r})$$

$$\phi = \vec{E}.\vec{r}\,;\, \vec{A} = \frac{1}{2}(\vec{B} \times \vec{r})$$

$$\phi = -\vec{E}.\vec{r}\,;\, \vec{A} = \frac{1}{2}(\vec{B} \times \vec{r})$$

$$\phi = -\vec{E}.\vec{r}\,;\, \vec{A} = \frac{1}{3}(\vec{B} \times \vec{r})$$

Question Number : 17 Question Id : 827347317 Question Type : MCQ

The magnetic field $\vec{B}$, when $\vec{E} = E_0 \sin(\omega t - \alpha z)\widehat{a_y}$, is given by

Options :

$$\frac{E_0 \alpha}{\omega} \sin(\omega t - \alpha z)\widehat{a_x}$$

$$-\frac{E_0 \alpha}{\omega} \cos(\omega t + \alpha z)\widehat{a_y}$$

$$-\frac{E_0 \alpha}{\omega} \sin(\omega t - \alpha z)\widehat{a_z}$$

$-\frac{E_0}{\omega}\cos(\omega t + \alpha z)\widehat{a_x}$

Question Number : 18 Question Id : 827347318 Question Type : MCQ

In an isotropic , homogeneous and loss- less medium with $\in_r = 8$ and $\mu_r = 2$, the electric and magnetic fields are respectively $\vec{E} = 60\pi\cos(10^6 t - \alpha x)\widehat{a_y}$ (V/m) and $\vec{H} = P\cos(10^6 t - \alpha x)\widehat{a_z}\ (^A/_m)$. The values of P and α respectively are:

Options :

2 ,0.055

2 ,0.065

1 ,0.042

1 ,0.055

Question Number : 19 Question Id : 827347319 Question Type : MCQ

The Laplace equation satisfied by the potential V at a point outside a cylindrical conductor of radius b is given by $V = -\left(1 - \frac{b^2}{r^2}\right) E_0\, r\, \cos\theta$. Find the surface charge density σ (per unit area) of the conducting surface ?

Options :

$\in_0\ E_0 \cos\theta$

$\in_0\ E_0 \sin\theta$

$2 \in_0\ E_0 \cos\theta$

$2 \in_0\ E_0 \sin\theta$

Question Number : 20 Question Id : 827347320 Question Type : MCQ

Find the amplitude of electric field (E_0) and magnetic field (H_0) of radiation if earth receives 2 $cal.min.^{-1}.cm^{-2}$ of solar radiation ?

Options :

$E_0 = 1027.12(^V/_m)\ ;\ H_0 = 2.72(^A/_m)$

$E_0 = 726.32(^V/_m)\ ;\ H_0 = 1.93(^A/_m)$

$E_0 = 363.16(^V/_m)\ ;\ H_0 = 1.93(^A/_m)$

$E_0 = 726.32(^V/_m)\ ;\ H_0 = 3.86(^A/_m)$

Question Number : 21 Question Id : 827347321 Question Type : MCQ

If the magnetic vector potential is given by $\vec{A} = (y^2\hat{\imath} - x^2\hat{\jmath})$, then the current density $\vec{J}$ may be written as

Options :

$\frac{2}{\mu_0}[\hat{\imath} - \hat{\jmath}]$

$\frac{2}{\mu_0}[\hat{\imath} + \hat{\jmath}]$

$-\frac{2}{\mu_0}[\hat{\imath} - \hat{\jmath}]$

$-\frac{2}{\mu_0}[\hat{\imath} + \hat{\jmath}]$

Question Number : 22 Question Id : 827347322 Question Type : MCQ

If in vacuum the electric and magnetic field respectively are $E = E_0 \sin(kx - \omega t)$ and $B = B_0 \sin(kx - \omega t)$, then

Options :

$E_0 B_0 = \omega k$

$E_0 \omega = B_0 k$

$E_0/\omega = B_0 k$

$E_0 k = B_0 \omega$

Question Number : 23 Question Id : 827347323 Question Type : MCQ

An interference fringe system is observed due to interference of two light beams of intensities I and $9I$. If the phase difference is $\pi/2$ at a point A and π at point B, then the difference of the intensities at A and B is

Options :

$3I$

$4I$

$5I$

$6I$

Question Number : 24 Question Id : 827347324 Question Type : MCQ

A first order diffraction image is observed using a lamp emitting electromagnetic waves of wavelength $6000\ A^0$ and a fabric with 200 threads/cm. Find the angle between the lamp filament and its first diffracted image.

Options :

31.25 min

41.25 min

51.25 min

55.25 min

Question Number : 25 Question Id : 827347325 Question Type : MCQ

The numerical aperture of a step index fibre is *0.15*. If the core diameter and refractive index are $60cm$ and 1.45 respectively, find the normalized frequency for the fibre when light of wavelength of $0.9\mu m$ gets transmitted through it.

Options :

3.14×10^{4}

3.14×10^{5}

3.14×10^{6}

3.14×10^{7}

Question Number : 26 Question Id : 827347326 Question Type : MCQ

In an experiment $1gm$ helium at S.T.P is compressed adiabatically such that its pressure is doubled. If $= 8.3\times 10^{7}ergs/°C/mole$, find the work done in compressing the gas?

Options :

$310.2\times 10^{7}ergs$

$-310.2\times 10^{7}ergs$

$350.2\times 10^{6}ergs$

$-350.2\times 10^{7}ergs$

Question Number : 27 Question Id : 827347327 Question Type : MCQ

What is the difference between $1gm$ of ice at $0°C$ and $1gm$ of steam at $100°C$. Given that latent heat of fusion of ice is $80cals$. And latent heat of steam at $100°C$ is $540cals$.

Options :

$3.12\ cal/°C$

$0.312\ cal/°C$

$0.0312\ cal/°C$

$0.00312\ cal/°C$

Question Number : 28 Question Id : 827347328 Question Type : MCQ

Which of the following relation hold true? All symbols have their usual meaning.

Options :

$TdS = C_V dT + T\left(\frac{\partial p}{\partial T}\right)_V dV$

$TdS = C_V dT + T\left(\frac{\partial S}{\partial T}\right)_V dV$

$TdS = C_V dT - T\left(\frac{\partial p}{\partial T}\right)_V dV$

$TdS = C_V dT - T\left(\frac{\partial S}{\partial T}\right)_V dV$

Question Number : 29 Question Id : 827347329 Question Type : MCQ

The Gibb's function , G , in thermodynamics is given by $G = H - TS$, where H, T and S respectively refers to enthalpy, temperature and entropy. For an isothermal , isobaric reversible process G

Options :

varies nonlinearly with P

is less than zero

remains constant

varies nonlinearly with volume

Question Number : 30 Question Id : 827347330 Question Type : MCQ

Thermodynamical relation that express the change in temperature with change in volume at constant entropy is given by

Options :

$\left(\frac{\partial T}{\partial V}\right)_s = \left(\frac{\partial p}{\partial Q}\right)_V$

$\left(\frac{\partial T}{\partial V}\right)_s = T\left(\frac{\partial p}{\partial Q}\right)_V$

$\left(\frac{\partial T}{\partial V}\right)_s = -T\left(\frac{\partial p}{\partial Q}\right)_V$

$\left(\frac{\partial T}{\partial V}\right)_s = -V\left(\frac{\partial p}{\partial Q}\right)_V$

Question Number : 31 Question Id : 827347331 Question Type : MCQ

The value of the integral $\oint \frac{dQ}{T}$ for a reversible cycle is

Options :

zero

greater than zero

less than zero

T, the temperature

Question Number : 32 Question Id : 827347332 Question Type : MCQ

For non-interacting particles of spin $^1/_2$, the total number of accessible states is

Options :

$2N$

N

2^N

N^2

Question Number : 33 Question Id : 827347333 Question Type : MCQ

For a single particle , the number of coordinates in phase space equals

Options :

6

4

3

2

Question Number : 34 Question Id : 827347334 Question Type : MCQ

The thermodynamic probability for a system in equilibrium is

Options :

zero

one

maximum

minimum

Question Number : 35 Question Id : 827347335 Question Type : MCQ

The translational partition function , Z, for a gas molecule is

Options :

proportional to $T^{1/2}$

proportional to $T^{1/3}$

proportional to $T^{3/2}$

proportional to $T^{2/3}$

Question Number : 36 Question Id : 827347336 Question Type : MCQ

If E_F is the Fermi energy and $f(E)$ is the fermi distribution at temperature T , then $f(E_F)$ is

Options :

equal to $\frac{1}{2}$

a step function

$E < E_F$

$E > E_F$

Question Number : 37 Question Id : 827347337 Question Type : MCQ

The average value of v_x for a system of particle obeying Maxwellian distribution is

Options :

$1/k_BT$

$\frac{1}{2}k_BT$

$\sqrt{\frac{k_B T}{m}}$

zero

Question Number : 38 Question Id : 827347338 Question Type : MCQ

Find the most probable position of the particle if the wave function is

$$\psi(x) = \frac{1 + i\,x}{1 + i\,x^2}$$

Options :

$x = \pm\sqrt{\sqrt{2} - 1}$

$x = \pm\sqrt{2 + 1}$

$x = \pm\sqrt{\sqrt{3} - 1}$

$x = \pm\sqrt{\sqrt{3} + 1}$

Question Number : 39 Question Id : 827347339 Question Type : MCQ

If $\psi(r) = \sqrt{\frac{1}{\pi a^3}}\, e^{-r/a}$ corresponds to the ground state wave function of hydrogen atom, the average value $< r >$ is

Options :

zero

$a/2$

$3a/2$

$5a/2$

Question Number : 40 Question Id : 827347340 Question Type : MCQ

The quantum mechanical operator representing the momentum of a particle is given by

Options :

$-i\hbar\,\partial/\partial x$

$-i\hbar\,\partial/\partial t$

$i\hbar\frac{d^2}{dx^2}$

$-i\hbar\frac{d^2}{dx^2}$

Question Number : 41 Question Id : 827347341 Question Type : MCQ

The de-Broglie wavelength, λ, for a charge Q accelerated through a potential V volts is given by

Options :

$\lambda = {hm}/{\sqrt{QV}}$

$\lambda = {h}/{\sqrt{2mQV}}$

$\lambda = {h}/{\sqrt{mQV}}$

$\lambda = {h}/{mQV}$

Question Number : 42 Question Id : 827347342 Question Type : MCQ

The Schrodinger time independent equation can be written as

Options :

$H\psi = (E - V)\psi$

$H\psi + E\psi = 0$

$H\psi = (E + V)\psi$

$H\psi = E\psi$

Question Number : 43 Question Id : 827347343 Question Type : MCQ

The uncertainty in the velocity of an electron when they are located within a distance of $2A^{\circ}$ is

Options :

$5.83 \times 10^{5} m/s$

$5.83 \times 10^{7} m/s$

$5.83 \times 10^{9} m/s$

$5.83 \times 10^{8} m/s$

Question Number : 44 Question Id : 827347344 Question Type : MCQ

The average momentum in the ground state of a particle of mass m moving in a one-dimensional box of length L is given by

Options :

${h}/{L}$

${h}/{2\pi L}$

${h}/{2L}$

${2h}/{L}$

Question Number : 45 Question Id : 827347345 Question Type : MCQ

If $L_{\pm} = L_x \pm i\, L_y$, find the value of L^2 ?

Options :

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

$\frac{1}{2}(L_+L_- + L_-L_+){L_z}^2$

$(2L_+L_- + L_-L_+)$

$\frac{1}{2}(2L_+L_- + L_-L_+){L_z}^2$

Question Number : 46 Question Id : 827347346 Question Type : MCQ

If $\vec{L} = L_x\hat{\imath} + L_y\hat{\jmath} + L_z\hat{k}$, the value of commutator $[L_x, L_y, L_z]$ is

Options :

$i\hbar[L_x + L_y]$

$i\hbar[{L_x}^2 + {L_y}^2]$

$i\hbar[{L_x}^2 - {L_y}^2]$

$i\hbar[L_x - L_y]$

Question Number : 47 Question Id : 827347347 Question Type : MCQ

What is the probability that a particle has $L_z = 0$, if its state is given by

$$\frac{1}{\sqrt{14}}\begin{pmatrix}3\\2\\1\end{pmatrix}$$

Options :

$2/5$

$2/7$

$3/5$

$3/7$

Question Number : 48 Question Id : 827347348 Question Type : MCQ

The wave function of hydrogen atom is given by

$$\psi(r,\theta,\phi) = \frac{1}{\sqrt{2}}\left(\frac{1}{a_0}\right)^{3/2}\left[1 - \frac{r}{2a_0}\right]e^{-r/2a_0}\cos\theta$$

where a_0 is a constant. The quantum number of the state are

Options :

$n = 1, l = 0, m = 0$

$n = 2, l = 1, m = 0$

$n = 2, l = 1, m = 1$

$n = 1, l = 2, m = 1$

Question Number : 49 Question Id : 827347349 Question Type : MCQ

The state $S_z = \hbar/2$ refers to a spin half particle. The expectation value for $S_y{}^2$ is

Options :

$\hbar/2$

$\hbar^2/4$

$\hbar^2/3$

$\hbar/3$

Question Number : 50 Question Id : 827347350 Question Type : MCQ

If

$$V(\vec{r}) = \begin{cases} V_0 & if\ r \leq a \\ 0 & if\ r > a \end{cases}$$

then the low energy scattering cross-section $\sigma(\theta)$ is

Options :

$\left(\frac{2mV_0a^3}{3\hbar^2}\right)^2$

$\left(\frac{2mV_0a^3}{3\hbar^2}\right)^3$

$\left(\frac{2mV_0a^3}{\hbar^2}\right)^2$

$\left(\frac{2mV_0a^3}{5\hbar^2}\right)^3$

Question Number : 51 Question Id : 827347351 Question Type : MCQ

A transistor is put in a common base configuration such that the emitter current is $2mA$. If the collector current in open emitter circuit is $50\mu A$, what is the total collector current for $\alpha = 0.90$ is

Options :

$1.80mA$

$1.70mA$

$1.75mA$

$1.85mA$

Question Number : 52 Question Id : 827347352 Question Type : MCQ

When electromagnetic radiation shorter than $3000nm$ is incident on a semiconductor, its conductivity increases. Find the band gap of the semiconductor

Options :

$0.415eV$

$1.415eV$

$0.750eV$

$0.315eV$

Question Number : 53 Question Id : 827347353 Question Type : MCQ

If the band gap of pure silicon is $1.1eV$, then by doping with

Options :

$n-$type impurities , the band gap is less than $1.1eV$

$p-$ or $n-$type impurities , the band gap is always $1.1eV$

$p-$type impurities , the band gap becomes $1.25eV$

$p-$type impurities , the band gap more than $1.1eV$

Question Number : 54 Question Id : 827347354 Question Type : MCQ

The maximum resistance R that can be used in series with a zener diode $(V_Z = 5V,\ I_Z = 10mA)$ when a $20V$ supply is connected across the combination is

Options :

$10k\Omega$

$1.0k\Omega$

$1.5k\Omega$

$15k\Omega$

Question Number : 55 Question Id : 827347355 Question Type : MCQ

In an $n-p-n$ transistor circuit if $I_c = 2mA$ and $\alpha = 0.98$ then the base current I_b is

Options :

$0.041mA$

$4.10mA$

$0.41mA$

$0.0041mA$

Question Number : 56 Question Id : 827347356 Question Type : MCQ

A transistor amplifier has current gain 50 . When connected with the input signal

$$V_i = V_1 \sin\left(2\pi ft + {}^{\pi}/_{2}\right)$$

the output signal is found to be

$$V_o = V_2 \sin\left(2\pi ft + {}^{3\pi}/_{2}\right).$$

The transistor is connected as

Options :

a common base amplifier

a common collector amplifier

a common emitter amplifier

a push- pull amplifier

Question Number : 57 Question Id : 827347357 Question Type : MCQ

An operational amplifier has bias currents of $40\mu A$ and $39.5\mu A$. The input offset current is

Options :

$250nA$

$500nA$

$750nA$

$150nA$

Question Number : 58 Question Id : 827347358 Question Type : MCQ

An op-amp has 3 terminal amplifier stages with the following gains and critical frequencies

Stage-1: $A_{v_1} = 40dB, f_{c_1} = 4kHz$; Stage-2: $A_{v_2} = 20dB, f_{c_2} = 40kHz$; Stage-1: $A_3 = 10dB, f_3 = 160kHz$

The open-loop midrange gain and total phase lag between $f = f_{c_1}$ respectively is

Options :

$70dB, -52.14°$

$30dB, -52.14°$

$50dB, +52.14°$

$70dB, +52.14°$

Question Number : 59 Question Id : 827347359 Question Type : MCQ

Using half adders and OR-gates a full adder can be implemented. Therefore a 4-bit parallel full adder without any initial carry needs

Options :

7 half adders and 4-OR gates

7 half adders and 3-OR gates

8 half adders and 2-OR gates

8 half adders and 4-OR gates

Question Number : 60 Question Id : 827347360 Question Type : MCQ

The clock frequency, required for having a delay of $32\mu S$ in 8 bit serial register , is

Options :

$275kHz$

$250kHz$
$300kHz$
$375kHz$

Question Number : 61 Question Id : 827347361 Question Type : MCQ

If A and B are inputs to a logic gate and its output is X, then for $A = 1$, $B = 0$ it is observed that $X = 1$. What type of gate it could be ?

Options :

OR gate or NAND gate

AND gate or NOR gate

AND gate only

NOT gate or NOR gate

Question Number : 62 Question Id : 827347362 Question Type : MCQ

The JKFF , initially cleared and then clocked for 5 pulses. The output sequence Q will be

Options :

010000

010101

011001

010010

Question Number : 63 Question Id : 827347363 Question Type : MCQ

The characteristic table of an X-Y flip-flop is given below.

X	Y	Q_{n+1}
0	0	1
0	1	Q_n
1	0	$\overline{Q_n}$
1	1	0

It is needed to be implemented using J-K flip flop by making

Options :

$J = X, K = \bar{Y}$

$J = Y, K = \bar{X}$

$J = \bar{Y}, K = X$

$J = \bar{X}, K = Y$

Question Number : 64 Question Id : 827347364 Question Type : MCQ

If the radius of the n -th orbit of an electron in hydrogen atom is r_n , then its total energy is given by

Options :

$e^2/2\pi \in_0 r_n{}^2$

$-e^2/4\pi \in_0 r_n$

$e^2/8\pi \in_0 r_n{}^2$

$-e^2/8\pi \in_0 r_n$

Question Number : 65 Question Id : 827347365 Question Type : MCQ

In hydrogen atom , the n -th energy level is given by

$$E_n = -\frac{1}{(4\pi \in_0)^2}\frac{me^4}{2n^2h^2}.$$

The n -th energy levels $E_n{}^p$ of the positronium (it is a hydrogen like bound state of a positron and an electron) is

Options :

$2\,E_n$

$4E_n$

$E_n/2$

$E_n/4$

Question Number : 66 Question Id : 827347366 Question Type : MCQ

What is the ratio of frequencies of first line of Balmer series to that in Lyman series

Options :

$5/27$

$27/5$

$5/9$

$9/27$

Question Number : 67 Question Id : 827347367 Question Type : MCQ

If the wave function of hydrogen atom has φ - dependent part as $e^{i2\varphi}$, then the minimum principal quantum number n and angular momentum quantum number l are respectively

Options :

3 and 1

2 and 2

3 and 2
2 and 3

Question Number : 68 Question Id : 827347368 Question Type : MCQ

The possible values of total angular momentum **J,** in accordance with L-S coupling for a system of two electrons with $l_1 = 2$ and $l_2 = 1$, is

Options :

4,3,2
4,2,1
3,2,1,0
4,3,2,1,0

Question Number : 69 Question Id : 827347369 Question Type : MCQ

If the ionization energy for hydrogen atom is $13.6eV$. Using Bohr's model , the ionization energy of Li^{2+} ion is

Options :

$27.2eV$
$122.4\ eV$
$40.8\ eV$
$4.5\ eV$

Question Number : 70 Question Id : 827347370 Question Type : MCQ

An atom kept in a weak magnetic field shows Zeeman components for the transition $^2D_{5/2} \rightarrow {}^2P_{3/2}$. How many components are observed?

Options :

14
12
10
8

Question Number : 71 Question Id : 827347371 Question Type : MCQ

Find the bond length of the CO molecule in which the first line of rotational spectra is $3.8423cm^{-1}$. Given that $M_C = 19.921 \times 10^{-27}kg$; $M_O = 26.561 \times 10^{-27}kg$.

Options :

$0.0113\ A^{\circ}$
$0.113\ A^{\circ}$
$1.13A^{\circ}$
$1.31A^{\circ}$

Question Number : 72 Question Id : 827347372 Question Type : MCQ

The short wavelength cut-off of the continuous X-ray spectrum for a certain target is 0.1250nm. The potential applied to the X-ray tube is

Options :

$9.930kV$

$4.965kV$

$19.860kV$

$2.482kV$

Question Number : 73 Question Id : 827347373 Question Type : MCQ

In an experiment on Raman scattering , laser of certain frequency ν gets scattered by diatomic molecules of moment of inertia I . The Raman shifted frequency is proportional to

Options :

ν

I

I^{-1}

I^2

Question Number : 74 Question Id : 827347374 Question Type : MCQ

A material at a certain temperature T has two energy levels with a separation of wavelength of $0.1\mu m$. If the upper level is 1.75 as densely populated as the lower level, then T is

Options :

$2.572 \times 10^4 K$

$2.572 \times 10^3 K$

$2.572 \times 10^2 K$

$2.572 \times 10^5 K$

Question Number : 75 Question Id : 827347375 Question Type : MCQ

In Compton scattering experiment X-rays of wave length $3A^{\circ}$ is scattered by a substance such that the scattered photons are observed at an angle $\varphi = 90^{\circ}$. What is the energy of the recoil electron? Given that $h = 6.62 \times 10^{-34} Js$, and the rest mass of electron $m_0 = 9.1 \times 10^{-31} kg$.

Options :

1.2540e-018 Joules

3.2540e-018 Joules

4.2540e-018 Joules

5.2540e-018 Joules

Question Number : 76 Question Id : 827347376 Question Type : MCQ

In diamond, the angular distance between tetrahedral bonds are same as between the body diagonal of a cube. The value of the angle is given by

Options :

$\theta = cos^{-1}(1/3)$

$\theta = cos^{-1}\left(1/\sqrt{3}\right)$

$\theta = cos^{-1}\left(1/\sqrt{2}\right)$

$\theta = tan^{-1}(1/3)$

Question Number : 77 Question Id : 827347377 Question Type : MCQ

If V is the volume of a unit cell in Bravais lattice, the volume of a unit cell in reciprocal lattice is

Options :

$2\pi/V$

$(\pi)^2/V$

$(2\pi)^3/V$

π^3/V

Question Number : 78 Question Id : 827347378 Question Type : MCQ

What is the density of electrons in **Na** crystal , if the nearest neighbor distance in it is $1.82A^{\circ}$?

Options :

$0.215\, m^{-1}$

$0.107\, m^{-1}$

$3.640\, m^{-1}$

$1.820\, m^{-1}$

Question Number : 79 Question Id : 827347379 Question Type : MCQ

The cell edge in $NaCl$ crystal is $a = 0.563nm$. If Bragg's reflection has to occur at the smallest angle, the set of plane must correspond to the indices

Options :

011

100

110

111

Question Number : 80 Question Id : 827347380 Question Type : MCQ

In case of elastic vibration of crystal, if m -is the mass of any atom , a -the distance between nearest atoms and β is the force constant then the longitudinal vibration frequency is maximum if the wave number k is

Options :

π

$\pm {}^{\pi}/_{a}$

$\pm {}^{a}/_{\pi}$

${}^{\pi}/_{2}$

Question Number : 81 Question Id : 827347381 Question Type : MCQ

In the measurement of specific heat C_V in the low temperature limit $T \to 0$, the electronic contribution to it is proportional to

Options :

T^{-1}

constant

T^{-2}

T^{-3}

Question Number : 82 Question Id : 827347382 Question Type : MCQ

In free electron gas model, the relation between Fermi energy E_F and the number density of electron n is given by

Options :

$E_F = \left(\frac{\hbar^2}{2m}\right)(\pi^2 n)^{3/2}$

$E_F = \left(\frac{\hbar^2}{2m}\right)(3\pi^2 n)^{3/2}$

$E_F = \left(\frac{\hbar^2}{2m}\right)(3\pi^2 n)^{2/3}$

$E_F = \left(\frac{\hbar^2}{2m}\right)(3\pi^2 n)^{-3/2}$

Question Number : 83 Question Id : 827347383 Question Type : MCQ

The Curie temperature of a ferromagnetic substance is $125K$. Then

Options :

The plot of inverse susceptibility χ versus temperature T is linear with slope T_C , the Curie temperature.

The susceptibility χ gets doubled when the substance is cooled from $325K$ to $225K$.

χ^{-1} value is doubled when the substance is cooled from $325K$ to $225K$.

All the magnetic dipoles gets oriented in the direction of 60°.

Question Number : 84 Question Id : 827347384 Question Type : MCQ

The mobility of electron $\mu_e = 0.39m^2V^{-1}s^{-1}$ and that of hole $\mu_p = 0.19m^2V^{-1}s^{-1}$ in an intrinsic semiconductor (Germanium) at $300K$. If $n_i = 2.4 \times 10^{19}m^{-3}$, then the conductivity of the semiconductor is

Options :

$2.23\ mho/m$

$1.23\ mho/m$

$12.3\ mho/m$

$0.123\ mho/m$

Question Number : 85 Question Id : 827347385 Question Type : MCQ

What is the Fermi level with respect to E_i in Germanium at $300K$, if $n = 10^{17}cm^{-3}$? Given that $n_i = 2.4 \times 10^{13}cm^{-3}, E_{Ge} = 0.7eV$.

Options :

$2.15\ eV$

$4.30eV$

$0.430eV$

$0.215eV$

Question Number : 86 Question Id : 827347386 Question Type : MCQ

A sample of silicon of thickness $150\mu m$ and doped with 10^{23} phosphorous atoms / m^3 is kept in a magnetic field of $0.25Wb/m^2$. The Hall voltage produced across the sample ,if a current of $1mA$ is passed, will be

Options :

$1.0416\mu V$

$10.416\mu V$

$104.16\mu V$

$1041.6\mu V$

Question Number : 87 Question Id : 827347387 Question Type : MCQ

If the critical magnetic fields for a superconducting specimen are $1.35 \times 10^5 A/m$ and $3.95 \times 10^5 A/m$ at $15K$ and $13K$ respectively. What is the critical field at $0K$?

Options :

$1.179 \times 10^5 A/m$

$11.79 \times 10^5 A/m$

$5.79 \times 10^5 A/m$

$8.79 \times 10^5 A/m$

Question Number : 88 Question Id : 827347388 Question Type : MCQ

The ratio of nuclear sizes of ^{27}Al and ^{64}Cu is approximately

Options :

7.5

0.75

0.075

0.0075

Question Number : 89 Question Id : 827347389 Question Type : MCQ

The nuclear spin of the $_3Li^7$ and $_6C^{14}$ nuclei are respectively

Options :

half integer and zero

integer and half integer

integer and zero

half integer and half integer

Question Number : 90 Question Id : 827347390 Question Type : MCQ

The original three quarks proposed by Gell -Mann and Zweig were labeled u (for 'up') , d (for 'down') and s (for 'strange') . Which one of the following represents a proton?

Options :

uuu

uud

$u\bar{u}d$

uds

Question Number : 91 Question Id : 827347391 Question Type : MCQ

$_{88}Ra^{226}$ decays by emitting an α -particle . What is the kinetic energy of the released α -particle?

Options :

$0.4871MeV$

$4.871MeV$

$48.71eV$

$4.871eV$

Question Number : 92 Question Id : 827347392 Question Type : MCQ

In free space neutron decays as:

$$_0n^1 \rightarrow {}_1H^1 + {}_{-1}e^0 + [\,]$$

The parenthesis represents a

Options :

Graviton

Photon
Neutrino
Antineutrino

Question Number : 93 Question Id : 827347393 Question Type : MCQ

If 5β - and 3α - particles are emitted by a radioactive nucleus , then the ratio of number of proton to neutrons will be

Options :

$\frac{Z-1}{A-Z}$

$\frac{Z-6}{A-Z-5}$

$\frac{Z-1}{A-Z-11}$

$\frac{Z}{A-Z-13}$

Question Number : 94 Question Id : 827347394 Question Type : MCQ

The mean life of a radioactive substance is T. Calculate the number of decays between time 0 and time t , if the number decays per unit time at $t = 0$ is n?

Options :

$ne^{-t/T}$

ne^{-tT}

$nT[1 - e^{tT}]$

$n[1 - e^{t/T}]$

Question Number : 95 Question Id : 827347395 Question Type : MCQ

Atomic masses of hydrogen and helium are 1.00778 amu and 4.00216 amu respectively. What is the wavelength of radiation produced when 4 atoms of hydrogen are condensed to form an atom of helium?

Options :

$4.6 \times 10^{-14} m$

$4.6 \times 10^{-13} m$

$4.6 \times 10^{-12} m$

$4.6 \times 10^{-11} m$

Question Number : 96 Question Id : 827347396 Question Type : MCQ

If radioactive substances A and B have half lives 1hour and 2 hour respectively, then the ratio of disintegration of B to that of A after a lapse of 2hour is given by

Options :

2:1

1:3
3:1
1:2

Question Number : 97 Question Id : 827347397 Question Type : MCQ

An ionization chamber is charged to a potential of $800V$. If its capacity is $40pF$, then in passing an α - particle producing 2×10^5 ion pairs, the percentage reduction in charge would be

Options :

$8.0 \times 10^{-5}\%$

$10.0 \times 10^{-5}\%$

$3.2 \times 10^{-4}\%$

$6.4 \times 10^{-4}\%$

Question Number : 98 Question Id : 827347398 Question Type : MCQ

The 'dead time' of a GM counter is $300\mu s$. If the counting rate is 1000 per minute, find the true counting rate ?

Options :

$1006.7/min$

$1005/min$

$905/min$

$1205/min$

Question Number : 99 Question Id : 827347399 Question Type : MCQ

A pion decays from rest to give a muon of $4MeV$ energy. What is the energy of the accompanying neutrino ?

Options :

$29.66MeV$

$2.966MeV$

$296.6MeV$

$0.51MeV$

Question Number : 100 Question Id : 827347400 Question Type : MCQ

What is the threshold energy for the nuclear reaction $^{14}\mathrm{N}\,(n,\alpha)\,^{11}\mathrm{B}$ in MeV ? Given that mass of $^{14}\mathrm{N}$ = 14.007550 amu ; mass of neutron = 1.0087987 amu ; mass of α - particle = 4.003879 amu ; mass of $^{11}\mathrm{B}$= 11.012811 amu.

Options :

$1.52MeV$

$15.2MeV$

$0.152MeV$

$0.0152MeV$