Sample MCQ

Engineering Physics: PHY110

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Expression of Heisenberg's uncertainty principle is given as

(a) $\Delta E \cdot \Delta t \geq h/2$
(b) $\Delta E \cdot \Delta x \geq h/2$
(c) $\Delta E \cdot \Delta P \geq h/2$
(d) $\Delta P \cdot \Delta t \geq h/2$

Uncertainty principle was discovered by

(a) de Broglie
(b) Bohr
(c) Schrödinger
(d) Heisenberg

If the uncertainty in the location of a particle is equal to the de Broglie wavelength, the uncertainty in its velocity is

(a) more than the velocity of the particle
(b) less than the velocity of the particle
(c) equal to the velocity of the particle
(d) none of these

An eigenfunction has physical significance if

(a) it is single-valued
(b) it is finite
(c) it is continuous
(d) all of the above

Time-independent Schrödinger wave equation for a free particle in a box is given as

(a) $\nabla^2\psi + \frac{2mE}{\hbar^2}\psi = 0$
(b) $\nabla^2\psi + \frac{2mE}{\hbar^2}\psi = 1$
(c) $\nabla\psi + \frac{2mE}{\hbar}\psi = 0$
(d) $\nabla\psi + \frac{2mE}{\hbar^2}\psi = 1$

Answer
A
D
C
A

If a charged particle of mass (m) is accelerated through a potential difference of V volts de-Broglie wavelength is proportional to

(A) V

(B) $V^{-1/2}$

(C) V^2

(D) $V^{1/2}$

The expression $|\psi(x,y,z)|^2$ stands for

(A) Position

(B) Position probability density

(C) Normalisation

(D) Time probability density

The de-Broglie wavelength of material particles which are in thermal equilibrium at temperature T is

A. $\lambda = \frac{h}{\sqrt{3mkT}}$

B. $\lambda = \frac{\hbar}{\sqrt{2mkT}}$

C. $\lambda = \frac{h}{\sqrt{2kT}}$

D. $\lambda = \frac{\hbar}{\sqrt{mkT}}$

The de-Broglie wavelength for an electron of energy 150 eV is

A. 10^{-8} m

B. 10^{-10} m

C. 10^{-12} m

D. 10^{-14} m

Answer

B

B

A

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~~Calculate the velocity of a neutron having de Broglie wavelength 1Å and mass 1.67×10^{-27} kg.~~

A. 3.96×10^{3} m/s

B. 4.96×10^{4} m/s

C. 5.96×10^{5} m/s

D. 0 m/s

~~An electron is confined to a box of length 2×10^{-9} m/s. Calculate the minimum uncertainty in the measurement of velocity.~~

A. 1.9×10^{4} m/s

B. 0.9×10^{4} m/s

C. 2.9×10^{4} m/s

D. 4.9×10^{4} m/s

Compare the wavelength of a photon and an electron having same momentum

A. $\lambda_e < \lambda_{photon}$

B. $\lambda_e > \lambda_{photon}$

C. $\lambda_e = \lambda_{photon}$

D. None

~~Calculate energy difference between the ground state and first excited state of an electron in a 1D rigid box of length 10^{-8} m.~~

A. 100 eV

B. 129.05 eV

C. 113.04 eV

D. 0 eV

Answer

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The energy of lowest state in a 1D potential box of length (a) is

A. Zero B. $\frac{2h^2}{8ma^2}$

C. $\frac{h^2}{8ma^2}$ D. $\frac{3h^2}{8ma^2}$

Which of the following operator is associated with momentum (p_x)

A. $-\frac{\hbar^2}{2m}\nabla^2$

B. $-i\hbar\frac{\partial}{\partial x}$

B. $-\frac{\hbar}{2m}\nabla^2$

C. $-\frac{\hbar}{i}\nabla$

As the wavelength of the radiation decreases, the intensity of the black body radiations ____________

A. Increases
B. Decreases
C. First increases then decrease
D. First decreases then increase

The wavelength for which energy is maximum is……

a) directly proportional to absolute temperature

b) inversely proportional to absolute temperature

c) unchanged with temperature

d) None

Answer
C
B
C
B

Which of the following operator is associated with energy

A. $-\frac{\hbar^2}{2m}\nabla^2 + V$

B. $-\frac{\hbar}{2m}\nabla^2$

C. $-\frac{\hbar}{i}\nabla$

D. $i\hbar\frac{\partial}{\partial t}$

The relation between phase velocity and group velocity for non-dispersive medium

A. $v_p = v_g$

B. $v_p > v_g$

C. $v_p < v_g$

D. None

Which of the following is the energy state of a particle in infinite potential well of length (l) are allowed

A. $\frac{n^2\pi^2\hbar^2}{2ml}$ B. $\frac{n^2\pi^2\hbar^2}{2m\ ^2}$

C. $\frac{n^2\hbar^2}{2ml}$ D. $\frac{\pi^2\hbar^2}{2mln^2}$

The correct relation is

A. $v_g = v_p - \lambda\frac{dv_p}{d\lambda}$

B. $v_p = v_g - \frac{1}{\lambda}\frac{dv_g}{d\lambda}$

C. $v_p = v_g - \lambda\frac{dv_g}{d\lambda}$

D. $v_g = v_p + \lambda\frac{dv_p}{d\lambda}$

Answer

D

A

B

A

Einstein's photoelectric equation is given as

(a) $\frac{1}{2}mv^2 = [W_0 - h\nu]$

(b) $\frac{1}{2}mv^2 = W_0$

(c) $\frac{1}{2}mv^2 = [h\nu - W_0]$

(d) $\frac{1}{2}mv^2 = h\nu$

Planck's radiation law is given as

(a) $E_\lambda d\lambda = \frac{\lambda^5 8\pi hc}{[e^{hc/kT} - 1]} d\lambda$

(b) $E_\lambda d\lambda = \frac{8\pi hc[e^{hc/kT} - 1]}{\lambda^5} d\lambda$

(c) $E_\lambda d\lambda = \frac{8\pi hc}{\lambda^5 [e^{hc/kT} - 1]} d\lambda$

(d) none of these

Stopping potential is given as

(a) $V_0 = \frac{h}{e}[\nu - \nu_0]$

(b) $V_0 = h\nu$

(c) $V_0 = \frac{h}{e}[\nu_0 - \nu]$

(d) $V_0 = \frac{hc}{\lambda}$

Answer
C
C
A

Wave packet comprises a group of waves

(a) of same velocity and wavelength

(b) of slightly different velocity and wavelength

(c) both (a) and (b)

(d) none of these

If ω is the angular frequency and k is the propagation constant, then the phase velocity (υ_p) is given as

(a) $\upsilon_p = \frac{\omega}{k}$

(b) $\upsilon_p = \frac{k}{\omega}$

(c) $\frac{k^2}{\omega}$

(d) $\upsilon_p = \frac{\omega^2}{k}$

Particle and wave nature of electromagnetic waves appear

(a) simultaneously

(b) as either wave or particle nature

(c) both (a) and (b)

(d) none of these

Answer

B

A

B

Which one of following is not the eigenfunction of the operator d^2/dx^2 ?

(a) $\sin x$ (b) $\cos x$

(c) $\sin^2 x$ (d) e^{2x}

Velocity of the matter-wave is

(a) equal to the velocity of light (b) greater than c

(c) less than c (d) none of these

If a particle is moving with kinetic energy K, then the de Broglie wavelength (λ) associated with it is related with K as:

(a) $\lambda \propto K$ (b) $\lambda \propto \sqrt{K}$

(c) $\lambda \propto \frac{1}{K}$ (d) $\lambda \propto \frac{1}{\sqrt{K}}$

Answer

C

B

D

C

If E_1 and E_2 are the energies of a particle in a potential box corresponding to $n = 1$ and $n = 2$, respectively, then the relation between E_1 and E_2 is given as

(a) $E_1 = E_2$ (b) $E_2 = 2E_1$

(c) $E_2 = 4E_1$ (d) $E_2 = 3E_1$

At $T = 0$ K, the energy levels located above E_F (when $E > E_F$) are

(a) partially filled (b) vacant

(c) filled (d) none of these

Fermi–Dirac distribution function is given as

(a) $F(E) = \dfrac{1}{1+e^{(E-E_F)/kT}}$ (b) $F(E) = \dfrac{1}{1-e^{(E-E_F)/kT}}$

(c) $F(E) = 1-\dfrac{1}{1+e^{(E-E_F)/kT}}$ (d) none of these

According to the quantum free electron theory, the expression of conductivity is given as

(a) $\sigma = \dfrac{m^*}{ne^2\lambda}$ (b) $\sigma = \dfrac{ne^2\lambda}{m^*}$ (c) $\sigma = \dfrac{ne^2\lambda}{m^* v}$ (d) $\sigma = \dfrac{m^* v_F}{\lambda\ ne^2}$

Answer

C

B

A

C

At the condition $T >> \theta_D$, the resistivity of metal according to the quantum free electron theory is given as

(a) $\rho \propto T$ (b) $\rho \propto T^{-1}$ (c) $\rho \propto T^{-2}$ (d) $\rho \propto T^2$

Wiedemann–Franz law is expressed as

(a) $\frac{\sigma_T}{\sigma} = \frac{L}{T}$ (b) $\frac{\sigma_T}{\sigma} = LT$ (c) $\frac{\sigma}{\sigma_T} = LT$ (d) $\frac{\sigma}{\sigma_T} = \frac{L}{T}$

Normalized wave function for the motion of a particle in a box of length a is given as

(a) $\sqrt{\frac{2}{a}} \sin \frac{n\pi x}{a}$ (b) $\sqrt{\frac{a}{2}} \sin \frac{n\pi x}{a}$ (c) $\sqrt{\frac{2}{a}} \sin \frac{n\pi a}{x}$ (d) $\sqrt{\frac{a}{2}} \sin \frac{n\pi a}{x}$

The energy of nth state in a one-dimensional potential box is

(a) zero (b) $\frac{2nh^2}{ma^2}$ (c) $\frac{n^2h^2}{8ma^2}$ (d) $\frac{nh}{8ma^2}$

The temperature dependence of the classical expression for electrical resistivity of a metal is

(a) $\rho \propto \frac{1}{T^2}$ (b) $\rho \propto \frac{1}{T}$ (c) $\rho \propto T^2$ (d) $\rho \propto T^{1/2}$

Answer

A

B

A

C

D

For which one of the following dependencies of drift velocity v_d on the electric field E, is ohm's law true?

(a) $v_d \propto E$ (b) $v_d \propto \frac{1}{E}$ (c) $v_d \propto \sqrt{E}$ (d) $v_d \propto E^2$

The unit of Hall coefficient is

(a) $\Omega\text{-m}^3/\text{Wb}$ (b) $\Omega^{-1}\text{-m}^3/\text{Wb}$
(c) $\Omega\text{-m}^3/\text{Wb}$ (d) $\Omega\text{-m}^2/\text{Wb}^2$

The direction of Hall voltage is

(a) perpendicular to both applied electric field and magnetic field
(b) parallel to applied electric field
(c) perpendicular to applied magnetic field only
(d) perpendicular to applied electric field only

A solar cell is a simple photodiode which is operated at

(a) zero bias voltage (b) constant bias voltage
(c) forward bias voltage (d) reverse bias voltage

If E_H, j_x, and B_z are the Hall field, current density, and magnetic field, respectively, then the Hall constant is given as

(a) $R_H = \frac{E_H j_x}{B_z}$ (b) $R_H = \frac{E_H}{B_z j_x}$ (c) $R_H = \frac{B_z}{E_H j_x}$ (d) $R_H = \frac{j_x B_z}{E_H}$

Answer

A
A
A
A
B

Lorentz field (internal field) for cubic crystal is expressed as

(a) $E_i = E - \frac{P}{3\varepsilon_0}$ (b) $E_i = E + \frac{3P}{\varepsilon_0}$ (c) $E_i = E - \frac{3P}{\varepsilon_0}$ (d) $E_i = E + \frac{P}{3\varepsilon_0}$

Dielectric loss occurs when dielectric is subjected to

(a) dc voltage
(b) ac voltage
(c) both ac and dc voltages
(d) none of these

Piezoelectric effect is the production of electricity by

(a) mechanical stress
(b) temperature
(c) varying field
(d) chemical heat

The electric dipole moment per unit volume is known as

(a) dielectric polarisation
(b) dielectric constant
(c) relative permittivity
(d) total dipole moment

Answer
D
B
A
A

Piezoelectric effect is observed in

(a) nickel
(b) glass
(c) quartz
(d) mica

Electronic polarisation

(a) increases with temperature
(b) decreases with increase in temperature
(c) is independent of temperature
(d) none of these

Ionic polarisation

(a) decreases with increase in temperature
(b) is independent of temperature
(c) increases with temperature
(d) first increases, then decreases with temperature

Orientational polarisation

(a) increases with temperature
(b) is independent of temperature
(c) decreases with increases in temperature
(d) none of these

Polarisation is defined as

(a) dipole moment per unit volume
(b) dipole moment per unit area
(c) surface charge density
(d) none of these

Answer

C
C
B
C
A

The electric field which a dipole experiences in a medium is

(a) known as the local field
(b) equal to the external field
(c) known as the internal field
(d) both (a) and (c)

The Clausius–Mossotti relation is

(a) $\frac{\epsilon_r - 1}{\epsilon_r + 1} = \frac{N\alpha}{3\epsilon_0}$ (b) $\frac{\epsilon_r + 1}{\epsilon_r - 2} = \frac{N\alpha}{3\epsilon_0}$ (c) $\frac{\epsilon_r + 1}{\epsilon_r - 1} = \frac{N\alpha}{3\epsilon_0}$ (d) $\frac{\epsilon_r - 1}{\epsilon_r + 2} = \frac{N\alpha}{3\epsilon_0}$

Dielectric materials have

(a) free charges
(b) no free charge
(c) free electrons
(d) none of these

The relation between dielectric constant (ϵ_r) and electric susceptibility χ is

(a) $\chi_e = \epsilon_0 (\epsilon_r - 1)$
(b) $\chi_e = \epsilon_r \epsilon_0$
(c) $\chi_e = \frac{\epsilon_r}{\epsilon_0}$
(d) $\chi_e = \epsilon_0 (\epsilon_r - 1) E$

The correct relation for dielectric medium is

(a) $\vec{E} = \epsilon \vec{D}$
(b) $\vec{D} = \epsilon_0 \vec{P}$
(c) $\vec{D} = \epsilon_0 \vec{E} + \vec{P}$
(d) $\vec{D} = \epsilon_0 (\epsilon_r - 1) \vec{E}$

Answer

D

D

B

A

C

Ferromagnetic substances have

(a) high permeability and low susceptibility
(b) low permeability and high susceptibility
(c) low permeability and low susceptibility
(d) high permeability and high susceptibility

The relation between B, H, and M is

(a) $B = \mu_0 (H + M)$
(b) $M = \mu_0 (B + H)$
(c) $H = M\mu_0 (B + M)$
(d) $M = 1/\mu_0 (B + H)$

The susceptibility of a paramagnetic substance is

(a) negative
(b) positive
(c) zero
(d) none of these

For a paramagnetic material, the dependence of magnetic susceptibility (χ) on the absolute temperature (T) is given by

(a) $\chi \propto T^{-1}$
(b) $\chi \propto T$
(c) $\chi =$ Constant
(d) none of these

Diamagnetic substances when placed in a magnetic field are

(a) strongly attracted
(b) repelled
(c) weakly attracted
(d) neither attracted nor repelled

Answer

A

A

B

A

B

The magnetic susceptibility of a paramagnetic substance is

(a) small and positive
(b) small and negative
(c) large and positive
(d) large and negative

The unit of intensity of magnetisation is

(a) ampere/metre
(b) ampere × metre^2
(c) ampere × metre
(d) Weber/metre

The variation of magnetic susceptibility (χ) of a diamagnetic material with absolute temperature T is given by

(a) $\chi \propto T^0$
(b) $\chi \propto T$
(c) $\chi \propto T^{-1}$
(d) $\chi \propto T^{3/2}$

The Curie law, $\chi \propto 1/T$, is observed by

(a) diamagnetic substances only
(b) paramagnetic substances only
(c) ferromagnetic substances only
(d) none of these

Perfect diamagnetism is expressed by the equation

(a) $\mu_r = 0$
(b) $B = 0$
(c) div $\vec{B} = 0$
(d) curl $\vec{B} = 0$

Answer

A

A

A

B

A

Meissner effect is shown by the equation

(a) $B = 0$ at $T > T_c$

(b) $B = 0$ at $T \leq T_c$

(c) $B \neq 0$ at $T \geq T_c$

(d) div $\vec{B} = 0$ at $T = T_c$

Meissner effect is strictly followed by

(a) diamagnetic material

(b) ferromagnetic material

(c) superconducting material

(d) paramagnetic material

The critical temperature is that temperature where

(a) resistivity of a superconducting metal drops to zero

(b) current flowing through a superconductor is minimum

(c) magnetic field inside a superconductor becomes constant

(d) none of these

A normal conductor and a superconductor are classified on the basis of

(a) availability of conducting electrons at low temperature.

(b) availability of conducting electrons in pairs at low temperature

(c) nonzero resistance at low temperature (above T_c)

(d) zero resistance at critical temperature

Answer

B

A

A

D