TEST SERIES CSIR-NET/JRF Dec. 2017

BOOKLET SERIES A

Paper Code 05

Test Type: TEST SERIES

PHYSICAL SCIENCES

Duration: 02:00 Hours

Date: 22-11-2017

Maximum Marks: 120

Read the following instructions carefully:

* Single Paper Test is divided into **TWO** Parts.

Part - A: This part shall carry **10** questions. Each question shall be of **2 marks.**

Part - B: This part shall contain **50** questions. Each question shall be of **2 marks**.

* Darken the appropriate bubbles with HB pencil/Ball Pen to write your answer.

* There will be negative marking @25% for each wrong answer.

* The candidates shall be allowed to carry the Question Paper Booklet after completion of the exam.

* For rough work, blank sheet is attached at the end of test booklet.

PART-A : GENERAL APTITUDE

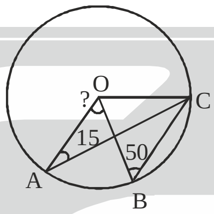
1. A wheel that has 6 cogs is meshed with a larger wheel of 14 cogs. When the smaller wheel has made 21 revolutions, then the number of revolution mode by the larger wheel is.
(a) 4 (b) 9 (c) 12 (d) 49

2. Gold is 19 times as heavy as water and copper is 9 times as heavy as water. In what ratio should these be mixed to get an alloy 15 times as heavy as water?
(a) 1:1 (b) 2:3 (c) 1:2 (d) 3:2

3. By selling an article at $\frac{2}{5}$ of the marked price, there is a loss of 25%. The ratio of the marked price and the cost price of the article is.
(a) 2:5 (b) 5:2 (c) 8:15 (d) 15:8

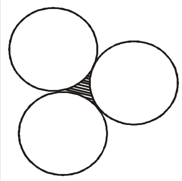
4. 40% of the people read newspaper X, 50% read newspaper Y and 10% read both the papers. What percentage of the people read neither newspaper?
(a) 10% (b) 15% (c) 20 % (d) 25%

5. In the given figure O is the centre $\angle$OBC = 50 and $\angle$ OAC = 15. Then the value of the $\angle$AOB is



(a) 30 (b) 40 (c) 20 (d) 70

6. Three circle of equal radius 'a' cm. touch each other. The area of the shaded region is:



(a) $\left(\frac{\sqrt{3}+\pi}{2}\right)a^2$ sq.cm (b) $\left(\frac{6\sqrt{3}-\pi}{2}\right)a^2$ sq.cm

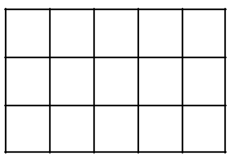
(c) $\left(\sqrt{3}-\pi\right)a^2$ sq.cm (d) $\left(\frac{2\sqrt{3}-\pi}{2}\right)a^2$ sq.cm

7. If the digit 12 of a clock is pointong towards east then in which direction will digit 9 point?
(a) south (b) west (c) north (d) North-east

8. One number is wrong in the series find out the wrong number.
1 4 8 16 31 64 127 156
(a) 31 (b) 16 (c) 8 (d) 6

9. If $28 \div 46 = 4$ and $23 \div 47 = 3$ then $72 \div 48 = ?$
(a) 6 (b) 24 (c) 4 (d) 8

10. How many squares are there in the following figure?



(a) 124 (b) 25 (c) 26 (d) 227

PART-B : ELECTROMAGNETIC THEORY, SOLID STATE & QUANTUM MECHANICS

11. Which of the following represents an elliptically polarized light?

(a) $E_o\left(\hat{x}+i\hat{y}\right)e^{i\left(\vec{k}\cdot\vec{r}-\omega t\right)}$ (b) $E_o\left(\hat{x}-i\hat{y}\right)e^{i\left(\vec{k}\cdot\vec{r}-\omega t\right)}$

(c) $\left(E_1\hat{x}+iE_2\hat{y}\right)e^{i\left(\vec{k}\cdot\vec{r}-\omega t\right)}$ (d) $\left(E_1\hat{x}+E_2\hat{y}\right)e^{i\left(\vec{k}\cdot\vec{r}-\omega t\right)}$

12. A circular loop of radius 'a' and carrying a current 'I' is symmetrically kept inside the hollow cube of side '4a' such that centre of loop coincides with the centre of the cube. Total magnetic flux through the cube is

(a) $8\mu_o Ia$ (b) $4\mu_o Ia$ (c) Zero (d) $2\mu_o Ia$

13. Two semi-infinite grounded conducting planes meet at an angle 60° the number of image charges formed:

(a) 4 (b) 3 (c) 5 (d) 6

14. A beam of unpolarized light is incident on a glass plate at an angle of 60° from normal, the reflected light is completely plane polarized. If angle of incidence is 45°, the angle of refraction is:

(a) $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (b) $\sin^{-1}\left(\frac{1}{\sqrt{6}}\right)$ (c) $\cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (d) $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

15. A light beam from a laser pointer, on normal incidence, create a circular spot of diameter 2×10^{-3} m on a perfectly reflecting surface. If the radiation pressure on the surface due to totally reflected beam is $\left(\frac{2}{3}\right)\times10^{-5}$ N/m^2, the time averaged power of laser beam (in mW) is:

(a) 4π (b) $\frac{\pi}{2}$ (c) 2π (d) π

16. An electromagnetic wave

$$\vec{E}=-20\,e^{i\left(4x+3y-5\times10^8 t\right)}\,\hat{k}\quad \text{V/m}$$

is travelling in isotropic linear non-magnetic dielectric medium. The dielectric constant (ε_r) of the dielectric medium is:

(a) 25 (b) 5 (c) 9 (d) 3

17. A left circularly polarised electromagnetic wave with wavelength $\lambda = 5000\text{Å}$ is incident normally on a calcite crystal. The refractive index for E-wave and O-wave are $n_e = 1.554$ and $n_0 = 1.544$ respectively. The thickness of the crystal so that emergent light is right circularly polarised is:

(a) 2.5μm (b) 12.5 μm (c) 1.25 μm (d) 25 μm

18. An infinite straight wire carries the current , $I(t)=\begin{cases}0, & \text{for } t\le 0\\ I_0, & \text{for } t>0\end{cases}$

The magnetic vector potential of this current at a distance 's' from the wire is given by

$$\vec{A}=\frac{\mu_0 I_0}{2\pi}\,\ell n\left(\frac{ct+\sqrt{(ct)^2-s^2}}{s}\right)\hat{z}$$

The magnetic field $\left(\vec{B}\right)$ at a distance 's' can be represented by:

(a) $\frac{\mu_0 I_0 c}{2\pi\sqrt{(ct)^2 - s^2}}\hat{\phi}$ (b) $\frac{\mu_0 I_0 ct}{2\pi s\sqrt{(ct)^2 - s^2}}\hat{\phi}$ (c) $\frac{\mu_0 I_0 ct}{2\pi s\sqrt{(ct)^2 - s^2}}\hat{s}$ (d) $\frac{\mu_0 I_0 c}{2\pi s\sqrt{(ct)^2 - s^2}}\hat{\phi}$

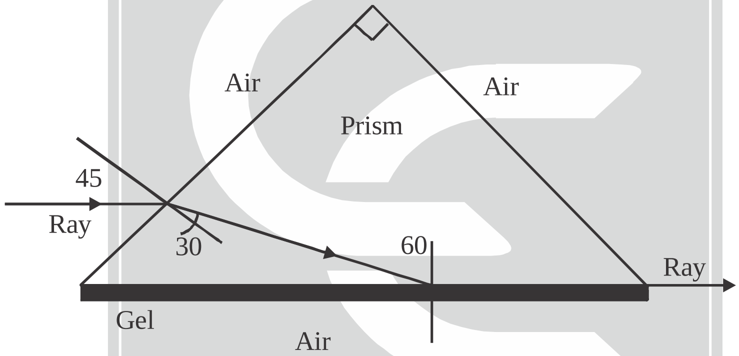
19. A charge particle 'q' is performing simple harmonic motion with amplitude A and angular frequency ω. The average power radiated per cycle by the charge particle is:

(a) $\frac{\mu_0 q^2 A^2 \omega^4}{6\pi c}$ (b) $\frac{\mu_0 q^2 A^2 \omega^4}{12\pi c}$ (c) $\frac{\mu_0 q^2 A^2 \omega^2}{6\pi c}$ (d) $\frac{\mu_0 q^2 A^2 \omega^2}{12\pi c}$

20. Two concentric metal spherical shells of radius 'a' and 'b' respectively, are separated by weakly conducting material of conductivity $\sigma = \frac{k}{r^2}$. Where 'r' is the radial distance from the centre. The inner shell is maintained at potential V and outer one is grounded. The amount of current flows from inner to outer shell is:

(a) $\frac{4\pi kV}{(b-a)}$ (b) $\frac{4\pi kabV}{(b-a)}$ (c) $\frac{4\pi kaV}{(b-a)b}$ (d) $\frac{(b-a)V}{4\pi k}$

21. A ray of light is incident on a right-angled prism as shown in the figure below. The lower surface of this prism is coated with a gel. If the incident ray makes angles (marked in degrees) as shown in the figure, the refractive index of the gel must be



(a) 1.40 (b) 1.22 (c) 1.50 (d) 1.52

22. An air filled square wave–guide is operated with a wave of frequency of 3 GHz. The cut off frequency of TE_{11} mode is 2.82 GHz. The dimensions of the wave guide are:

(a) a = 6 cm, b = 6 cm (b) a = 7.5cm, b = 7.5cm
(c) a = 15cm, b = 15cm (d) a = 30cm, b = 30cm

23. The electric field of a plane polarised e.m. wave is given by $\vec{E} = E_0(\hat{x} + e^{i\phi}\hat{y})e^{i(kz-\omega t)}$. The intensity associated with the wave is

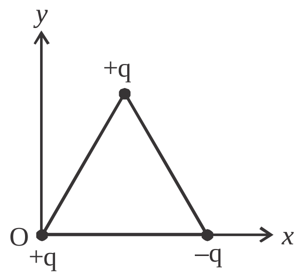
(a) $\frac{\varepsilon_0 E_0^2 c}{2}\sqrt{(1-\cos^2\phi)}$ (b) $\varepsilon_0 E_0^2 c$

(c) $\varepsilon_0 E_0^2 c\sin^2\phi$ (d) $\varepsilon_0 E_0^2 c\cos^2\phi$

24. A light beam emitted by a 5-watt laser has a uniform cross-section of 0.5 mm^2. The amplitude of electric field associated with the beam (in V/m) is:

(a) 8.7×10^4 (b) 8.7×10^5 (c) 6.1×10^4 (d) 6.1×10^5

25. The dipole moment of the system of three charges +q, +q and –q about 'O' placed at the vertices of an equilateral triangle of side 'a' meter is:



(a) $-\frac{qa}{2}\hat{x}+q\frac{\sqrt{3}\,a}{2}\hat{y}$ (b) $\frac{qa}{2}\hat{x}+q\frac{\sqrt{3}\,a}{2}\hat{y}$ (c) $qa\,\hat{x}-q\frac{\sqrt{3}\,a}{2}\hat{y}$ (d) $-qa\,\hat{x}+q\frac{\sqrt{3}\,a}{2}\hat{y}$

26. The transformation equation relating the electric field E and E' of an electro magnetic wave in two frames S and S' moving with velocity $\vec{\upsilon}$ with respect to each other (|| denotes the component of electric field in the direction of $\vec{\upsilon}$)

(a) $E_{\|}^{'}=E_{\|}\left(1-\frac{\upsilon^2}{c^2}\right)^2$ (b) $E_{\|}^{'}=E_{\|}$

(c) $E_{\|}^{'}=E_{\|}\sqrt{\left(1-\frac{\upsilon^2}{c^2}\right)}$ (d) $E_{\|}^{'}=E_{\|}\left(1-\frac{\upsilon^2}{c^2}\right)^{3/2}$

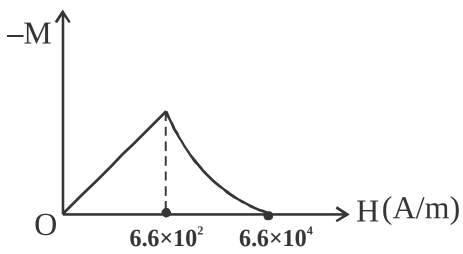
27. The skin depth (δ) in aluminium (Al) with conductivity $\sigma=\left(3.6\times10^{7}\right)\Omega^{-1}m^{-1}$ at 1.6 MHz is

(a) 66.4μm (b) 54.5 μm (c) 74.4 μm (d) 46.9 μm

28. The observed resistivity of copper (Cu) at 4K is $2\times10^{-10}\ \Omega-\text{m}$ and at 300K is $2\times10^{-5}\ \Omega-\text{m}$. Copper has fcc structure with lattie parameter 'a = 3.61 Å' and each copper atom contributes one electron for conduction. The radius (K_F) of Fermi Sphere is:

(a) 0.86Å^{-1} (b) 1.36Å^{-1} (c) 1.26Å^{-1} (d) 1.00Å^{-1}

29. The graph of M vs H is shown for a type-II superconductor.



The coherence length (ξ) for the superconductor is:

(a) 10Å (b) 100Å (c) 1Å (d) 2Å

30. A long thin and flat copper strip of rectangular cross-section (0.1 mm × 1.0 cm) carries a current of 5.0A along its length. If it is placed in a magnetic field of strength 1.0 Tesla perpendicular to the plane of the strip. The Hall voltage generated is: (Given Hall's coefficient of Cu is $R_H = 1.1\times10^{-9}\ m^3/C$)

(a) 1.75 mV (b) 0.93 μV (c) 55 μV (d) 0.55 μV

31. A current 'I' is measured in a copper rod of resistivity 'ρ', length ℓ and radius 'r' by applying the voltage 'V'. If the uncertainties in the measurement of length (ℓ), radius (r) and voltage (V) are 3%, 2% and 5% respectively and no uncertainty in ρ. The uncertainty in the value of current 'I' through the rod is:

(a) 8% (c) 9% (c) 12% (d) 7%

32. In an x-ray diffraction experiment using $\lambda_{Cu} = 1.54Å$, the (011) plane of a fcc lattice gives a diffraction peak at Bragg's angle $\theta_B = 45^o$, with an uncertainity of $\pm 0.9^o$. The lattice parameter (a) of fcc lattice is:

(a) 1.54Å (b) 3.08Å (c) 6.16Å (d) 2.17Å

33. In a cyclotron set up, a klystron radiation 2.4×10^{10} Hz is used for a sample, the resonance absorption occurs at a magnetic field of 9.4×10^{-2} T. The effective mass (m^*) of electron in the sample is

(a) 1×10^{-32} kg (b) 1×10^{-31} kg (c) 3.1×10^{-31} kg (d) 3.1×10^{-32} kg

34. Chromium has bcc structure with lattice constant a = 3Å. The reciprocal lattice of chromium (Cr) is:

(a) sc with cube side $\left(\frac{2\pi}{3}\right)Å^{-1}$ (b) bcc with cube side $\left(\frac{4\pi}{3}\right)Å^{-1}$

(c) fcc with cube side $\left(\frac{4\pi}{3}\right)Å^{-1}$ (d) fcc with cube side $\left(\frac{2\pi}{3}\right)Å^{-1}$

35. Supose you are putting identical hard spheres of diameter σ on a face-centered cubic lattice. In the closest packed configuration of spheres, the lattice constant 'a' of the cubic unit cell in terms of σ is:

(a) $2\sqrt{2}\,\sigma$ (b) $\frac{2}{\sqrt{3}}\sigma$ (c) $\sqrt{2}\,\sigma$ (d) σ

36. A p-type and n-type semiconductor have energy band diagram as shown in the figure. The p-n junction assume to be constructed from these semiconductors.

The built-in voltage of p-n junction is

(a) 0.3 volt (b) 1.5 volt (c) 1.8 volt (d) 1.2 volt

37. The magnetization M of a paramagnetic solid of N atoms per unit volume of magnetic moment μ each at a temperature T is given by $M = N\mu \tanh \frac{\mu H}{k_B T}$, where H is the external magnetic field. In the limit $k_B T >> \mu H$, the magnetization M and the susceptibility χ are

(a) $M = N\mu,\ \chi = 0$ (b) $M = N\mu,\ \chi \propto \frac{1}{T}$

(c) $M = \frac{N\mu^2 H}{k_B T},\quad \chi = \text{constant}$ (d) $M = \frac{N\mu^2 H}{k_B T},\quad \chi = \frac{N\mu^2}{k_B T}$

38. Which of the following statements is INCORRECT regarding a superconducting material?
(a) As per Meissner effect, a pure superconductor expels a magnetic flux completely
(b) Magnitude of the critical magnetic field at which superconductivity is destroyed varies linearly with the temperature.
(c) The specific heat of a superconductor decreases exponentially with decreasing temperature below T_c.
(d) A dc voltage applied across a Josephson junction produces an alternating current.

39. The energy (E) of an electron in terms of its wave vector $\left(\vec{k}\right)$ is given by $E = E_0 - A\left[\cos k_x a + \cos k_y a + \cos k_z a\right]$. Where E_0 and A are constants. If effective mass (m*) of electron at the top of the band is $\left(\frac{m_0}{2}\right)$ and a = 3Å. Where m_0 is free electron mass. The value of A (in eV) is:

(a) 2.5 (b) 0.57 (c) 1.70 (d) 0.85

40. At normal incidence, a beam of light propagating in vacuum reflects at an interface with a medium of refractive index n = 3.0. The fraction of energy reflected R is given by $R = \left(\frac{n-1}{n+1}\right)^2$. If the percentage error in the value of n is 1%, the percentage error in the estimation of R is:

(a) 4 % (b) 3% (c) 7 % (d) 5%

41. A LED (Light Emitting diode) made up of GaP seminconductor, that has band gap of 2.26 eV. The wavelength of emitted light is?
(a) 5000 Å (b) 6000Å (c) 5200 Å (d) 5500Å

42. An intrinsic sample of silicon is doped with P and Al with doping densities of $1.5\times10^{16}/cm^3$ and $2.5\times10^{16}/cm^3$ respectively. If intrinsic carrier concentration of Si is $1.5\times10^{10}/cm^3$. The electron and hole densities per cm^3 are, respectively.
(a) $2.25\times10^4, 1\times10^{16}$ (b) $1.5\times10^4, 2.5\times10^{16}$
(c) $1\times10^{16}, 2.25\times10^4$ (d) $1.5\times10^{16}, 1\times10^4$

43. Electrons moves with relativistic speeds on graphene sheet and assumed to follow the dispersion relation $\varepsilon(k) = vk$ (where v is constant) over the entire k-space, then the dependence of Fermi wave vector (K_F) on electron density (n) is

(a) $K_F \propto n^{1/2}$ (b) $K_F \propto n$ (c) $K_F \propto n^{2/3}$ (d) $K_F \propto n^{1/3}$

44. $\bar{L}$ is the total angular momentum of particle, then which of the following is true
(a) $\bar{L}\times\bar{L} = 0$ (b) $\bar{L}\times\bar{L} = i\hbar\bar{L}$ (c) $\bar{L}\times\bar{L} = -i\hbar\bar{L}$ (d) $\bar{L}\times\bar{L} = i\hbar L^2$

45. A set of N vectors $X_1, X_2, ...X_n$ satisfy the eigenvalue equation for an operator A with scalar eigenvalues $\lambda_1, \lambda_2...............\lambda_n$ (i.e. $AX_k = \lambda_K X_K$). The linear combination vector $X = \sum_{k=1}^{N} C_k X_K$ where C_k's are non-zero scalar coefficient.

(a) X is not an eigenvector of A

(b) X is an eigenvector of A only if λ_k's are all distinct

(c) X is an eigenvector of A only if the λ_k's are equal

(d) X is an eigenvector of A if C_k's are equal

46. A particle of mass of m is confined to a one-dimensional region $0 \le x \le a$ at $t = 0$, its normalized wave function is

$$\psi(x, t=0) = \sqrt{\frac{8}{5a}}\left[1+\cos\left(\frac{\pi x}{a}\right)\right]\sin\left(\frac{\pi x}{a}\right)$$

The energy uncertainty in the given state of the particle will be

(a) $\frac{3\pi^2\hbar^2}{5ma^2}$ (b) $\frac{3\pi^2\hbar^2}{2ma^2}$ (c) $\frac{12\pi^2\hbar^2}{ma^2}$ (d) $\frac{4\pi^2\hbar^2}{5ma^2}$

47. A particle of mass m moves non-relativistically in one-dimension in a potential given by $V(x) = -a\delta(x)$, where $\delta(x)$ is the usual Dirac delta function. The particle is bound. The value of x_0 for that the probability of finding the particle with $|x| < x_0$ is exactly equal to 1/2 is

(a) $\frac{\hbar^2}{ma}\ln 2$ (b) $\frac{\hbar^2}{2ma}\ln 2$ (c) $\frac{\hbar}{2ma}\ln 2$ (d) $\frac{\hbar}{ma}\ln 2$

48. Consider a spinless particle represented by the wave function $\psi = k(x+y+2z)e^{-\alpha r}$,

where $r = \sqrt{x^2+y^2+z^2}$ and k and α are real constant. The total angular momentum of the particle is [you may use the following expression for the first few spherical harmonic

$Y_0^0 = \sqrt{\frac{1}{4\pi}}$; $Y_1^{\pm 1} = \pm\sqrt{\frac{3}{6\pi}}\sin\theta\, e^{\pm i\phi}$; $Y_1^0 = \sqrt{\frac{3}{4\pi}}\cos\theta$; $Y_2^{\pm 1} = \mp\sqrt{\frac{15}{8\pi}}\sin\theta\cos\theta\, e^{\pm i\phi}$]

(a) $\sqrt{2}\,\hbar$ (b) $\sqrt{6}\,\hbar$ (c) 0 (d) $\sqrt{12}\,\hbar$

49. A system of three (non-identical) spin one-half particles, whose spin operator are s_1, s_2 and s_3, is governed by the Hamiltonian

$$H = \frac{A}{\hbar^2} s_1 \cdot s_2 + \frac{B}{\hbar^2}(s_1+s_2)\cdot s_3$$

The number of degeneracy of a energy level $E = \left(\frac{A}{4} - B\right)$ is

(a) 2 (b) 3 (c) 4 (d) 5

50. An infinitely deep one-dimensional square well has wall at $x = 0$ and $x = L$. Two small perturbing potentials of width 'a' and height 'V' are located at $x = \frac{L}{4}, x = \frac{3}{4}L$, where '$a$' is very small $\left(a \ll \frac{L}{100}\right)$. The difference in the first order energy shift between the $n = 4$ and $n = 6$ energy levels due to this perturbation is

(a) $\frac{Va}{L}$ (b) $\frac{3Va}{L}$ (c) $\frac{4Va}{L}$ (d) $\frac{3Va}{2L}$

51. Consider the one-dimensional motion of an electron confined to the potential well $V(x) = \frac{1}{2}kx^2$ and also subjected to a perturbing electric field $\vec{E} = F\hat{x}$. The dipole moment of this system in the presence of the electric field is given by

(a) $\frac{e^2F}{k}$ (b) $-\frac{e^2F}{k}$ (c) $\frac{eF}{k}$ (d) $-\frac{eF}{k}$

52. Consider that a two level system with energies E_1 and E_2 ($E_2 > E_1$) is perturbed by a time dependent perturbation $H_P(t) = \hat{U}\delta(t)$, with operator $\hat{U} = \begin{pmatrix} 0 & \gamma \\ \gamma & 0 \end{pmatrix}$, where γ is a constant. The probability of transition of the system from ground state to first excited state is

(a) $\frac{2\pi t}{\hbar^2}U^2\delta(t)$ (b) $\frac{2\pi}{\hbar}U\delta(t)$ (c) $\frac{\gamma^2}{\hbar^2}$ (d) 0

53. Suppose the ground stationary state of a harmonic oscillator with force constant 200 and mass is 4m is given by

$$\psi_0 = \left(\frac{c}{\pi}\right)^{1/4} e^{-cx^2/2}$$

Then c should depend on

(a) $c = \frac{20\sqrt{2m}}{\hbar}$ (b) $c = \frac{10\sqrt{2m}}{\hbar}$ (c) $c = \frac{\hbar}{20\sqrt{2m}}$ (d) $c = \frac{\hbar}{10\sqrt{4m}}$

54. The unperturbed energy levels of a system are $\varepsilon_0 = 0$, $\varepsilon_1 = 3$ and $\varepsilon_2 = 5$. The second order correction to energy for the ground state in the presence of the perturbation V for which $V_{10} = 4$, $V_{20} = 3$ and $V_{12} = 8$ has been found to be

(a) –7.1 (b) 0 (c) +5.1 (d) –8

55. A quantum system with two orthonormal states $|1\rangle$ and $|2\rangle$ is described by following Hamiltonian

$$\hat{H} = |1\rangle\langle 2| + |2\rangle\langle 1|$$

the sum of energy eigenvalues is

(a) 3 (b) ± 1 (c) 0 (d) 2

56. Consider a quantum particle of mass m is moving under the following potential:

$$V(x, y) = \frac{1}{2}m\omega^2\left(x^2 + y^2\right)$$

It is known that the particle is in an energy eigenstate with energy eigenvalue $4\hbar\omega$. Which one of the following cannot be the wave function of the particle? (Given: $H_n(x)$ is Hermite polynomial of order n)

(a) $H_1\left(\sqrt{\frac{m\omega}{\hbar}}x\right)H_2\left(\sqrt{\frac{m\omega}{\hbar}}y\right)\exp\left[-\frac{m\omega}{\hbar}\left(x^2 + y^2\right)\right]$

(b) $H_2\left(\sqrt{\frac{m\omega}{\hbar}}x\right)H_1\left(\sqrt{\frac{m\omega}{\hbar}}y\right)\exp\left[-\frac{m\omega}{\hbar}\left(x^2 + y^2\right)\right]$ (c) $H_3\left(\sqrt{\frac{m\omega}{\hbar}}x\right)\exp\left[-\frac{m\omega}{\hbar}\left(x^2 + y^2\right)\right]$

(d) $H_2\left(\sqrt{\frac{m\omega}{\hbar}}x\right)H_2\left(\sqrt{\frac{m\omega}{\hbar}}y\right)\exp\left[-\frac{m\omega}{\hbar}\left(x^2 + y^2\right)\right]$

57. Let, k be the wave number of the incident plane wave in a scattering experiment. If the scattering is a mixture of s-wave and p-wave with phase shifts $\frac{\pi}{6}$ and $\frac{\pi}{3}$ respectively, then the total scattering cross-section will be

(a) $\frac{2\pi}{k^2}$ (b) $\frac{4\pi}{k^2}$ (c) $\frac{6\pi}{k^2}$ (d) $\frac{10\pi}{k^2}$

58. If $\vec{\sigma}$ is Pauli's spin operator for a spin-½ particle and $\hat{n}$ is unit vector, then the commutator $[\vec{\sigma}\cdot\hat{n}, \vec{\sigma}]$ is

(a) $2i\vec{\sigma}\cdot(\vec{\sigma}\times\hat{n})$ (b) $i(2\hat{n}(\vec{\sigma}\cdot\hat{n})-\vec{\sigma})$ (c) $2i(\vec{\sigma}\times\hat{n})$ (d) $i\vec{\sigma}\cdot(\vec{\sigma}\times\hat{n})-i\vec{\sigma}$

59. Two electrons at fixed positions on the z-axis have a magnetic dipole interaction energy $E = A\,(\vec{S}_1\cdot\vec{S}_2 - 3S_{1z}\,S_{2z})$, where $S_i = \frac{1}{2}\sigma_i$, σ_i being the Pauli's spin matrix, A = constant. The eigenvalues of E/A in state $|1,+1\rangle$ is

(a) 0 (b) $-\frac{1}{2}$ (c) -1 (d) $+1$

60. A particle of mass 'm' is moving in a one dimensional box defined by the potential $V = 0,\ 0 \le x \le a$ and $V = \infty$ otherwise. The ground state energy corresponding to the trail function

$$\psi(x) = A\,x(a-x)$$

is

(a) $\frac{20\hbar^2}{ma^2}$ (b) $\frac{5\hbar^2}{ma^2}$ (c) $\frac{10\hbar^2}{ma^2}$ (d) $\frac{15\hbar^2}{2ma^2}$

Space for rough work

CAREER ENDEAVOUR
Best Institute for IIT-JAM, NET & GATE

CSIR-UGC-NET/JRF | GATE PHYSICS

PHYSICAL SCIENCES
TEST SERIES-A

Date : 22-11-2017

ANSWER KEY

PART-A

1. (b)	2. (d)	3. (d)	4. (c)	5. (d)	6. (d)	7. (c)
8. (c)	9. (a)	10. (c)				

PART-B

11. (c)	12. (c)	13. (c)	14. (b)	15. (d)	16. (c)	17. (d)
18. (b)	19. (b)	20. (a)	21. (b)	22. (b)	23. (b)	24. (a)
25. (a)	26. (b)	27. (a)	28. (b)	29. (c)	30. (c)	31. (d)
32. (b)	33. (d)	34. (c)	35. (c)	36. (d)	37. (d)	38. (b)
39. (c)	40. (b)	41. (d)	42. (a)	43. (a)	44. (b)	45. (c)
46. (a)	47. (b)	48. (a)	49. (a)	50. (c)	51. (a)	52. (c)
53. (b)	54. (a)	55. (c)	56. (d)	57. (d)	58. (c)	59. (b)
60. (b)						