TEST SERIES CSIR-UGC-NET/JRF Dec. 2016

BOOKLET SERIES D

Paper Code 05 **Test Type: TEST SERIES**

PHYSICAL SCIENCES

Duration: 3:00 Hours **Date: 05-12-2016**

Maximum Marks: 200

Read the following instructions carefully:

* Single Paper Test is divided into three Parts.

Part - A: This part shall carry 20 questions. The candidate shall be required to answer any 15 questions. Each question shall be of **2 marks.**

Part - B: This part shall contain 2**5** questions covering the topics given in the Part 'B' of syllabus. The candidates are required to answer any 20 questions. Each question shall be of **3.5 Marks.**.

Part - C: This part shall contain **30** questions from Part - C of the syllabus. The candidates are required to answer any 20 questions. Each question shall be of **5 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

1. Amar, Akbar and Anthony are three friends, one of whom is a doctor, another is an engineer and the third is a professor. Amar is not an engineer. Akbar is the shortest, the tallest person is a doctor. The engineer's height is the geometric mean of the heights of the other two. Then which of the following is true?

(a) Amar is a doctor and he is the tallest (b) Akbar is a professor and he is the tallest

(c) Anthony is an engineer and he is shortest (d) Anthony is a doctor and he is the tallest

2. Suppose we make N identical smaller spheres from a big sphere. The total surface area of the smaller spheres is X times the total surface area of the big sphere, where X is

(a) $\sqrt{N}$ (b) 1 (c) $N^{1/3}$ (d) N^3

3. How many pairs of positive integers have gcd 20 and lcm 600? (gcd = greatest common divisor, lcm = least common multiple)

(a) 4 (b) 0 (c) 1 (d) 7

4. Choose the largest number

(a) 2^{500} (b) 3^{400} (c) 4^{300} (d) 5^{200}

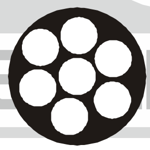
5. What is the arithmetic mean of $\frac{1}{1\times 2}, \frac{1}{2\times 3}, \frac{1}{3\times 4}, \frac{1}{4\times 5}, ..., \frac{1}{100\times 101}$?

(a) 0.01 (b) $\frac{1}{101}$ (c) 0.00111... (d) $\frac{\frac{1}{49\times 50}+\frac{1}{50\times 51}}{2}$

6. One of the four A, B, C and D committed a crime. A said, "I did it," B said, "I didn't." C said, "B did it." D said, "A did it." Who is lying?

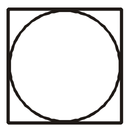
(a) A (b) B (c) C (d) D

7. A circle circumscribes identical, close packed circles of unit diameter as shown in the figure above. What is the total area of the shaded portion?



(a) 2 (b) 2π (c) 1/2 (d) $\pi/2$

8. What does the diagram above establish?



Note: The diagram is a circle inside a square

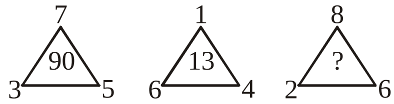
(a) $\pi > 3$ (b) $\pi \geq 2\sqrt{2}$

(c) $\pi < 4$ (d) π is closer to 3 than to 4

9. For real numbers x and y, $x^2 + (y-4)^2 = 0$. Then the value of $x+y$ is

(a) 0 (b) 2 (c) $\sqrt{2}$ (d) 4

10. Find the missing number in the triangle



(a) 16 (b) 96 (c) 50 (d) 80

11. If A×B = 24, B×C = 32, C×D = 48, then A×D

(a) can not be found
(b) is a perfect square
(c) is a perfect cube
(d) is odd

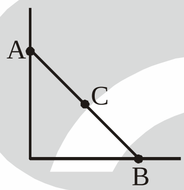
12. If all horses are donkeys, some donkeys are monkeys, and some monkeys are men, then which statement must be true?

(a) All donkeys are men
(b) Some horses may be men
(c) Some horses are men
(d) All horses are also monkeys

13. A person sells two objects at Rs. 1035/- each. On the first object he suffers a loss of 10% while on the second he gains 15%. What is his net loss/gain percentage?

(a) 5% gain
(b) < 1% gain
(c) < 1% loss
(d) no loss, no gain

14. A ladder rests against a wall as shown. The top and the bottom ends of the ladder are marked A and B. The base B slips. The central point C of the ladder falls along



(a) a parabola
(b) the arc of a circle
(c) a straight line
(d) a hyperbola

15. 20% of students of a particular course get jobs within one year of passing. 20% of the remaining students get jobs by the end of second year of passing. If 16 students are still jobless, how many students had passed the course?

(a) 32 (b) 64 (c) 25 (d) 100

16. Which one of the following numbers will completely divide $(4^{61} + 4^{62} + 4^{63} + 4^{64})$?

(a) 3 (b) 10 (c) 11 (d) 13

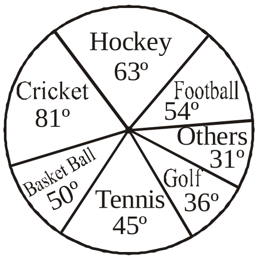
17. A crate of mangoes contains one bruised mango for every 30 mangoes in the crate. If 3 out of every 4 bruised mangoes are considered unsalable, and there are 12 unsalable mangoes in the crate, then how many mangoes are there in the crate?

(a) 150 (b) 180 (c) 240 (d) 480

18. The last day of a century cannot be

(a) Monday (b) Wednesday (c) Tuesday (d) Friday

Directions: (Questions 19 to 20): The circle-graph given here shows the spendings of a country on various sports during a particular year. Study the graph carefully and answer the questions given below it.



19. What percent of the total spendings in spent on Tennis?

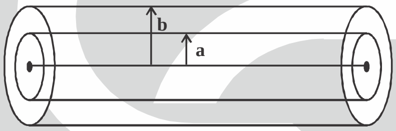
(a) $12\frac{1}{2}\%$ (b) $22\frac{1}{2}\%$ (c) 25% (d) 45%

20. If the total amount spent on sports during the year was Rs. 2 crores, the amount spent on Cricket and Hockey together was

(a) Rs.8,00,000 (b) Rs.80,00,000 (c) Rs.1,20,00,000 (d) Rs.1,60,00,000

PART-B

21. An air-spaced coaxial line has inner and outer conductors with radii a = 2 mm and b = 4 mm, respectively and is shown in the figure below.



If the length 'L' of the line is 1 km, the capacitance of the line is

(a) 80 nF (b) 80 μF (c) 80 pF (d) 40 nF

22. The charge density inside a sphere of radius R is $\rho = k(R-r)$. The electric field at distance 2R from the centre of sphere is

(a) $\frac{kR^2}{12\varepsilon_0}$ (b) $\frac{kR^2}{48\varepsilon_0}$ (c) $\frac{5kR^2}{12\varepsilon_0}$ (d) $\frac{kR^2}{3\varepsilon_0}$

23. A thin conducting rod of length l is rotated with uniform angular velocity ω about a perpendicular axis passing through one of its end. A uniform magnetic field $\vec{B}$ is applied parallel to $\vec{\omega}$. The induced magnitude of electric field inside the rod at a disance r from fixed end is

(a) $\omega B(\ell - r)$ (b) $\frac{\omega B}{\ell}(\ell^2 - r^2)$ (c) ωBr (d) $\frac{\omega Br^2}{\ell}$

24. An electric dipole of dipole moment p_0 is rotated with angular velocity ω. The average power radiated by the dipole is

(a) $\frac{p_0^2\omega^4}{6\pi \in_0 c^3}$ (b) $\frac{p_0^2\omega^4}{12\pi \in_0 c^3}$ (c) $\frac{p_0^2\omega^2}{6\pi \in_0 c^3}$ (d) $\frac{p_0^2\omega^2}{12\pi \in_0 c^3}$

25. The cut-off frequency f_c for the lowest mode of an air-filled rectangular wave guide having cross-section area 1.0×0.75 mm^2 is

(a) $1.5\times10^{11}\ Hz$ (b) $2\times10^{11}\ Hz$ (c) $2\times10^{12}\ Hz$ (d) $2.50\times10^{12}\ Hz$

26. The energy separation in first order perturbation theory in ground state of hydrogen atom in the perturbation $H' = A\vec{S}_p \cdot \vec{S}_e \delta^3(\vec{r})$, A being constant, $\vec{S}_e$ and $\vec{S}_p$ denote the spins of the proton and electron respectively, and $\delta^3(\vec{r})$ is the 3-dimensional Dirac delta function, is

(a) zero (b) $\frac{A}{\pi a_0^3}$ (c) $\frac{2A}{\pi a_0^3}$ (d) $\frac{2A}{2\pi a_0^3}\delta^3(\vec{r})$

27. Consider the system of three non-interacting electrons in ground state of one-dimensional infinite square well of width L $\left(V(x) = \begin{cases} 0, & \text{if } x < L \\ \infty, & \text{otherwise} \end{cases}\right)$. The sytsem is subjected to a uniform magnetic field $\vec{B}$. The ground state energy of the system is $\left(\mu_B = \frac{e\hbar}{2m} = \text{Bohr magnetron}\right)$

(a) $\frac{3h^2}{8mL^2} \pm \mu_B B$ (b) $\frac{3h^2}{4mL^2} \pm \mu_B B$ (c) $\frac{3h^2}{mL^2} + \mu_B B$ (d) $\frac{3h^2}{4mL^2} - \mu_B B$

28. For a particle of mass *m* moving in the potential $V(x) = \frac{1}{2}m\omega^2 x^2$, a small perturbation only for positive *x*, $H_p = \lambda x$ is applied with $\lambda > 0$ constant. The first order correction to ground state energy is

(a) 0 (b) $\frac{\lambda}{2}\left(\frac{\hbar}{m\omega}\right)^{1/2}$ (c) $\frac{\lambda}{2}\left(\frac{\hbar}{\pi m\omega}\right)^{1/2}$ (d) $\lambda\left(\frac{\hbar}{m\omega}\right)^{1/2}$

29. A linear harmonic oscillator is in a state

$$|\psi\rangle = (a^\dagger + 1)|0\rangle$$

where $|0\rangle$ is the ground state eigen function. Then expectation value of momentum in this state is

(a) 0 (b) $\sqrt{\hbar m\omega}$ (c) $\sqrt{\frac{\hbar m\omega}{2}}$ (d) $\sqrt{\frac{\hbar m\omega}{4}}$

30. A particle which is rotating in *xy*-plane around a fixed point is prepared in the state

$$\psi(\phi) = A\cos^2\phi$$

The uncertainty in *z*-component of its orbital angular momentum is

(a) 0 (b) $\frac{4}{3}\hbar$ (c) $\frac{\hbar}{\sqrt{3}}$ (d) $\frac{2}{\sqrt{3}}\hbar$

31. Consider a system of three classical and non-interacting particle in contact with a thermal reservoir at temperature T. Each particle may occupy any three non-degenerate energies $0, \in$ and $3\in$. The average energy per particle in high temperature limit is

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

32. In a certain process, the entropy increases as i.e. $S \propto T^2$, where T is absolute temperature. The heat capacity at constant volume will vary as

(a) $C =$ constant. (b) $C \propto T$ (c) $C \propto T^2$ (d) $C \propto T^3$

33. The energy of one mole of a particular system is given by $U = AP^2V$, where A is a positive constant of dimensions $[P]^{-1}$. The equation of the adiabats in P-V is

(a) $PV^{5/3} =$ constant (b) $PV^{4/3} =$ constant

(c) $(AP+1)V^{1/3} =$ constant (d) $(AP+1)V^{1/2} =$ constant

34. The entropy S of a system of N particles at temperature T is given by $S = a(NVU)^{1/3}$, where U and V are internal energy and volume of the system respectively and a is cosntant. If temperature changes to $4T$ then internal energy of the system at constant volume becomes

(a) four times (b) two times (c) eight times (d) half

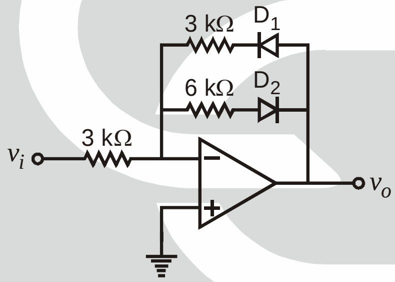
35. The minimum number of NOR gates required to implement $A(A+\overline{B})(A+\overline{B}+C)$ is equal to

(a) 0 (b) 3 (c) 4 (d) 7

36. If $(211)_x = (152)_8$, then the value of base x is

(a) 6 (b) 5 (c) 7 (d) 9

37. Consider the circuit shown below



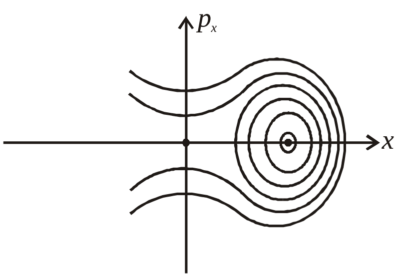
If $v_i = 2$ V, then output v_o is

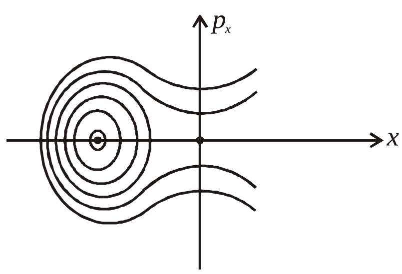
(a) 4 V (b) –4 V (c) 3 V (d) –3 V

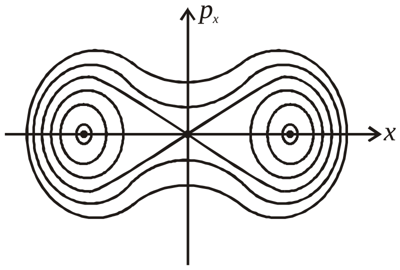
38. A particle of rest mass m_0 is acted upon by a constant force F. Acceleration of particle at the moment its speed $\frac{\sqrt{3}}{2}c$ is

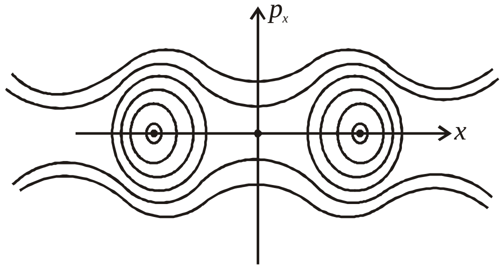
(a) $\frac{F}{m_0}$ (b) $\frac{F}{2m_0}$ (c) $\frac{3F}{4m_0}$ (d) $\frac{F}{8m_0}$

39. A particle is moving under potential $V(x) = (x^2-1)^2$. Phase space trajectory of the particle is

(a) 

(b) 

(c) 

(d) 

40. A particle of unit mass is moving under one dimensional potential energy $V(x)=\frac{-(x^2+1)}{x^4+8}$. If energy of the particle is $-\frac{1}{8}$, its speed at stable equilibrium point will be

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) $\frac{1}{\sqrt{2}}$ (d) 1

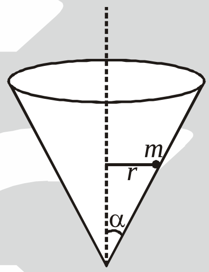
41. A particle of mass m is constrained to move on inside surface of a smooth cone of half angle α. If r represents distance of the particle from axis of cone then equation of motion of the particle is

(a) $\ddot{r}-r\dot{\phi}^2\sin^2\alpha+g\sin\alpha\cos\alpha=0$

(b) $\ddot{r}-r\dot{\phi}^2+g\sin\alpha\cos\alpha=0$

(c) $\ddot{r}-r\dot{\phi}^2+g\cos\alpha=0$

(d) $\ddot{r}-r\dot{\phi}^2\sin^2\alpha+g\cot\alpha=0$



42. Consider an element of a group as: $\begin{bmatrix} a & a \\ a & a \end{bmatrix}$ where a is a non-zero real number. The inverse element of the group is

(a) $\begin{bmatrix} \frac{1}{a} & \frac{1}{a} \\ \frac{1}{a} & \frac{1}{a} \end{bmatrix}$ (b) $\begin{bmatrix} \frac{1}{4a} & \frac{1}{4a} \\ \frac{1}{4a} & \frac{1}{4a} \end{bmatrix}$ (c) $\begin{bmatrix} \frac{1}{2a} & \frac{1}{2a} \\ \frac{1}{2a} & \frac{1}{2a} \end{bmatrix}$ (d) $\begin{bmatrix} \frac{4}{a} & \frac{4}{a} \\ \frac{4}{a} & \frac{4}{a} \end{bmatrix}$

43. The generating function of the Hermite polynomial $H_n(x)$ is given as following:

$$e^{2xt-t^2}=\sum_{n=0}^{\infty}H_n(x)t^n$$

The value of $H_{31}(x=0)$ will be

(a) 256 (b) 512 (c) 1024 (d) 0

44. The value of the following complex integral $\oint_C \frac{1}{z(e^z-1)}dz$ (where C is defined by $|z-2|=3$ traversed in the clockwise direction) is

(a) πi (b) $-\pi i$ (c) $2\pi i$ (d) $-2\pi i$

45. Suppose the Laplace transform of two time varying signals $f_1(t)$ and $f_2(t)$ is given to be $g_1(s)$ and $g_2(s)$ and the convolution theorem is defined as:

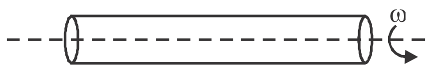
$$L^{-1}\left[g_1(s)g_2(s)\right]=\int_0^p f_1(t)\,f_2(p-t)\,dt$$

The Laplace transform of the integral $\int_0^m e^t \sin(m-t)\,dt$ will be

(a) $\frac{1}{(s-1)(s^2+1)}$ (b) $\frac{1}{(s-1)(s^2-1)}$ (c) $\frac{1}{(s+1)(s^2-1)}$ (d) None of these

PART-C

46. A long thin hollow cylinder of radius R has uniform surface charge density σ. The cylinder is rotated with uniform angular velocity ω about its axis. If B_{in} and B_{out} be magnetic field inside and outside the cylinder (near its middle point), then which of the following option is correct?



(a) $B_{in}=\frac{\mu_0\sigma\omega R}{2}, B_{out}=0$ (b) $B_{in}=\mu_0\sigma\omega R, B_{out}=0$

(c) $B_{in}=\frac{\mu_0\sigma\omega r}{2}, B_{out}=\frac{\mu_0\sigma\omega R^2}{2r}$ (d) $B_{in}=\mu_0\sigma\omega r, B_{out}=\frac{\mu_0\sigma\omega R^2}{r}$

47. A sphere S of radius R has volume charge density $\rho(r)=\beta r^2$, where 'r' is distance from centre and β is a constant. The electric potential on the surface of sphere is

(a) $\frac{\beta R^4}{4\varepsilon_0}$ (b) $\frac{\beta R^3}{4\varepsilon_0}$ (c) $\frac{\beta R^4}{5\varepsilon_0}$ (d) $\frac{\beta R^3}{5\varepsilon_0}$

48. Two electromagnetic waves superpose to give resultant electric field $\vec{E}=E_0\cos kz\sin\omega t\,\hat{i}$. Which of the following statements is **NOT** correct

(a) corresponding magnetic field is $\vec{B}=\frac{E_0 k}{\omega}\sin kz\cos\omega t\,\hat{j}$

(b) two waves are propagating in opposite direction along *z*-axis

(c) average value of energy density is $\frac{1}{2}\varepsilon_0 E_0^2$

(d) average value of Poynting vector $\langle\vec{S}\rangle$ is zero.

49. An alternating sinusoidal current of frquency $\omega=1000\ s^{-1}$ flows in the winding of a straight solenoid whose corss-sectional radius is equal to R = 6.0 cm. The ratio of average values of electric and magnetic energies at surface of solenoid is

(a) 1×10^{-14} (b) 5×10^{-15} (c) 1×10^{-16} (d) 1×10^{-12}

50. The α phase of iron above the Curie temperature has a paramagnetic susceptibility satisfying $\chi = \dfrac{C}{(T - T_C)}$, where C = 2.18 K, and T_C = 1093 K. The spontaneous magnetisation at 0K is 2×10^4 G. The Weiss molecular field in iron at 0K is
(a) 10^5 G (b) 10^6 G (c) 10^7 G (d) 10^8 G

51. Copper has fcc structure with lattice parameter 'a = 3.61 Å' and each copper atom contributes one electron for the conduction. The radius (K_F) of Fermi Sphere is:
(a) 0.86 $Å^{-1}$ (b) 1.00 $Å^{-1}$ (c) 1.26 $Å^{-1}$ (d) 1.36 $Å^{-1}$

52. The dispersion relation for an electron in a solid is

$$\omega\ (k) = \omega_0 \left(3 - \cos k_x a - \cos k_y a - \cos k_z a\right)$$

The effective mass (m*) at BZ boundary is

(a) $\dfrac{\hbar}{\omega_0 a^2}$ (b) $-\dfrac{\hbar}{\omega_0 a^2}$ (c) $\dfrac{2\hbar}{\omega_0 a^2}$ (d) $-\dfrac{2\hbar}{\omega_0 a^2}$

53. The ground state term symbol for Arsenic i.e $^{74}_{33}As$ will be

(a) $^4S_{3/2}$ (b) $^4S_{1/2}$ (c) $^1S_0$ (d) $^4P_{3/2}$

54. Raman-rotational spectrum of a unknown molecule is recorded by using light of wavelength 5000Å. The first Stoke's-Raman line is found at 19700 cm^{-1}. The rotational constant (B) of the molecule is:
(a) 50 cm^{-1} (b) 75 cm^{-1} (c) 150 cm^{-1} (d) 300 cm^{-1}.

55. The absorption spectrum of O_2 shows a vibrational structure that becomes continuum at 56875 cm^{-1}. At the continuum, it dissociates into one ground state atom (O_g) and one excited state atom (O_e). The energy difference between O_e and O_g is 15125 cm^{-1}. The dissociation energy (in cm^{-1}) of ground state of O_2 is:

(a) $\dfrac{56875}{15125}$ (b) $\dfrac{15125}{56875}$ (c) 72000 (d) 41750

56. The matrices for the unperturbed hamiltonian (H_0) and perturbed hamiltonian (H') are given by

$$H_0 = \begin{pmatrix} E_0 + \in & 0 \\ 0 & E_0 - \in \end{pmatrix} \quad H' = \begin{pmatrix} 0 & A \\ A & 0 \end{pmatrix}$$

where $\in$ and A are positive and real constants. Let $|\phi_1\rangle$ and $|\phi_2\rangle$ be orthonormal eigenfunctions of unperturbed hamiltonian corresponding to eigenvalues ground state and first excited states respectively. The wave function of first excited state corrected to first order is

(a) $|\phi_1\rangle \pm \dfrac{A}{2\in}|\phi_2\rangle$ (b) $|\phi_2\rangle - \dfrac{A}{2\in}|\phi_1\rangle$ (c) $|\phi_1\rangle + \dfrac{A}{2\in}|\phi_2\rangle$ (d) $|\phi_2\rangle + \dfrac{A}{2\in}|\phi_1\rangle$

57. For a particle of mass m moving in the potential

$$V(x) = \begin{cases} k\,x, & \text{if } x > 0 \\ \infty, & \text{if } x < 0 \end{cases}$$

where k is a positive and real constant. The ground state energy of the particle if Variational principle is used to estimate it with trial wave function

$$\psi(x)=\begin{cases}A\cos\left(\frac{\pi x}{a}\right), \text{ if } 0<x<a \\ 0, \quad \text{otherwise}\end{cases}$$, with $a>0$ as variational parameter, is

(a) $\frac{(1+\sqrt{2})}{2^{5/3}}\left(\frac{k^2\pi^2\hbar^2}{m}\right)^{1/3}$ (b) $\frac{5}{2}\left(\frac{k\pi\hbar}{2\sqrt{m}}\right)^{2/3}$ (c) $\frac{3}{2}\left(\frac{k^2\pi^2\hbar^2}{2m}\right)^{1/3}$ (d) $\frac{3}{2}\left(\frac{k\pi\hbar}{\sqrt{m}}\right)^{2/3}$

58. The scattering amplitude in the first Born approximation in the scattering amplitude of a particle of mass m and energy $E=\frac{\hbar^2k^2}{2m}$ and $b=2k\sin(\theta/2)$ from square well potential $V(x)=\begin{cases}-V_0 & \text{for } r\le a \\ 0 & \text{for } r>a\end{cases}$, if the geometrical radius of the scatterer is much less than the wavelength associated the incident particle, is

(a) $\frac{2mV_0a^3}{3\hbar^2}$ (b) $\frac{mV_0a^3}{3\hbar^2}$ (c) $\frac{2mV_0a^3}{\hbar^2}$ (d) $\frac{mV_0a^3}{2\hbar^2}$

59. 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) $i\vec{\sigma}\cdot(\vec{\sigma}\times\hat{n})-i\vec{\sigma}$

60. Consider a system of N distinguishable and non interacting particles. The single particle energy spectrum is $\varepsilon_n=n\varepsilon$, with $n=0,1,2,\ \ldots,+\infty$ and degeneracy $g_n=n+1$ ($\in\ >0$ is a constant). The system is in thermal equilibrium at temperature T, the partition function of the system is given by,

(a) $Q_N(V,T)=\left(\frac{n+1}{\left(1-e^{-\varepsilon/kT}\right)}\right)^N$ (b) $Q_N(V,T)=\left(\frac{n+1}{\left(1-e^{-\varepsilon/kT}\right)^2}\right)^N$

(c) $Q_N(V,T)=\left(\frac{1}{\left(1-e^{-\varepsilon/kT}\right)^2}\right)^N$ (d) $Q_N(V,T)=\left(\frac{1}{\left(1-e^{-\varepsilon/kT}\right)}\right)^N$

61. A system is characterized by N distinguishable and non interacting atoms in thermal equilibrium with a reservoir at temperature T. Each atom can occupy the energy levels $E_n=(n+1)\varepsilon$, $(\varepsilon>0,\ n=0,1,2,\ldots\ldots+\infty)$, and the degeneracy of n^{th} level is equal to $g_n=\lambda^n$ with $\lambda>1$. The average energy of the system is

(a) $\frac{\varepsilon}{e^{\varepsilon/kT}-\lambda}$ (b) $\frac{N\varepsilon}{e^{\varepsilon/kT}-\lambda}$ (c) $\frac{N\varepsilon e^{\varepsilon/kT}}{1-\lambda e^{-\varepsilon/kT}}$ (d) $\frac{N\varepsilon}{1-\lambda e^{-\varepsilon/kT}}$

62. Consider an ideal Fermi gas is confined in one dimensional region of length L at $T=0$. If the density of gas increases to two times of its initial value, then its Fermi energy

(a) increases to eight times of its initial value (b) increases to $2\sqrt{2}$ times of its initial value
(c) increases to four times of its initial value (d) remains unchanged

63. For the ${}_8O^{17}$ nucleus (A = 17, Z = 8), the effective magnetic moment is given by

(a) $+1.9131\,\mu_N$ (b) $4.793\,\mu_N$ (c) $3.793\,\mu_N$ (d) $-1.9131\,\mu_N$

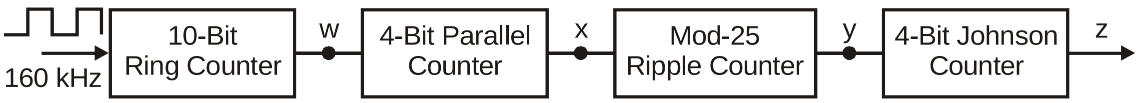
64. The nuclear spin and parity of ${}_{12}Mg^{25}$ nucleus, according to the nuclear shell model (including spin-orbit coupling), is

(a) $\frac{1^-}{2}$ (b) $\frac{5^+}{2}$ (c) $\frac{5^-}{2}$ (d) $\frac{1^+}{2}$

65. Choose the INCORRECT statement from the following :

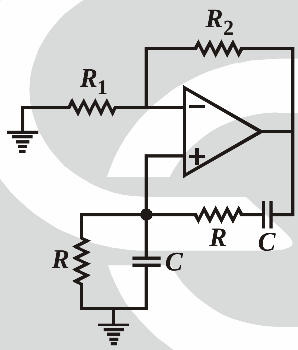
(a) The quark content of Σ^+ is $uu\bar{s}$
(b) The quark content of π^- is $d\bar{u}$
(c) The quark content of K^- is $\bar{u}s$
(d) The quark content of neutron is udd

66. The frequency of the pulse at z in the network shown in figure below is



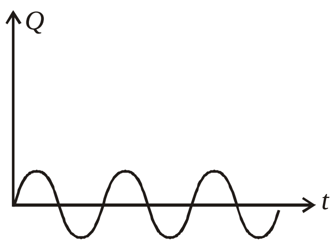
(a) 10 Hz (b) 160 Hz (c) 40 Hz (d) 5 Hz

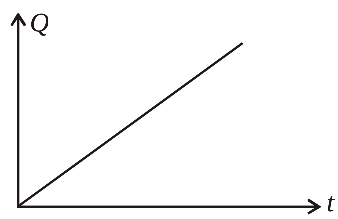
67. In the following circuit minimum required value of R_2/R_1 to sustain oscillation is

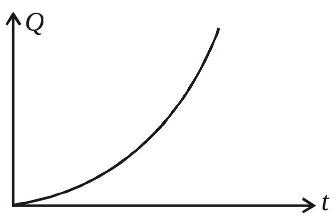


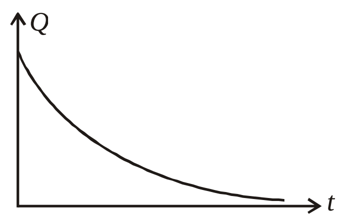
(a) 1.5 (b) 1 (c) 2 (d) 4

68. Lagrangian of a system is $L = \frac{1}{2}\alpha q^2\dot{q}^2 - \frac{\beta}{4}q^4$. If a canonical transformation $(q, p \to Q, P)$ is made through generating function $F(q, P) = q^2P$ then Q versus t graph will be

(a)


(b)


(c)


(d)


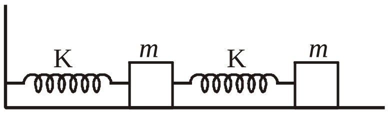
69. A particle moves in circular orbit under central potential $V(r)=Kr^{3n-6}$. For orbit to be stable, minimum integer value of n is

(a) -1 (b) -2 (c) 1 (d) 2

70. A planet (mass m) revolves around the Sun (mass M) in an elliptical orbit of major and minor axes a and b. If T be time of revolution then

(a) $T=2\pi\sqrt{\dfrac{a^3}{G(m+M)}}$ (b) $T=2\pi\sqrt{\dfrac{a^3}{Gm}}$ (c) $T=2\pi\sqrt{\dfrac{a^3}{GM}}$ (d) $T=4\pi\sqrt{\dfrac{a^3}{GM}}$

71. Frequencies of normal modes of system shown in the figure are



(a) $\sqrt{\dfrac{3\pm\sqrt{2}}{2}\cdot\dfrac{K}{m}}$ (b) $\sqrt{\dfrac{3\pm\sqrt{5}}{2}\cdot\dfrac{K}{m}}$

(c) $\sqrt{\dfrac{2\pm\sqrt{3}}{2}\cdot\dfrac{K}{m}}$ (d) $\sqrt{\dfrac{2\pm\sqrt{2}}{2}\cdot\dfrac{K}{m}}$

72. Suppose $y=f(x)$ be a twice continuously differentiable function on $(0,\infty)$ satisfying the following conditions:

$$f(1)=1 \text{ and } f'(x)=\frac{1}{2}f\left(\frac{1}{x}\right) \quad (x>0)$$

The differential equation that will be satisfied by $y=f(x)$ will be

(a) $4x^2\dfrac{d^2y}{dx^2}-y=0$ (b) $4x^2\dfrac{d^2y}{dx^2}+y=0$

(c) $4x^2\dfrac{d^2y}{dx^2}+x\dfrac{dy}{dx}+y=0$ (d) $4x^2\dfrac{d^2y}{dx^2}-x\dfrac{dy}{dx}+y=0$

73. The Laurrent series expansion of a complex function $f(z)$ about $z=2$ is given as following:

$$f(z)=\frac{1}{2(z-2)^3}-\frac{1}{4(z-2)^2}+\frac{1}{8(z-2)}-\frac{1}{16}+\frac{(z-2)}{32}-........$$

The order of the pole and residue of the function $f(z)$ at $z=2$ are respectively

(a) 3, 1/2 (b) 3, 1/8 (c) 1, 1/8 (d) 2, -1/4

74. The real part of a complex analytic function $f(z)$ is given as following:

$$u(x,y)=y^3-3x^2y+x^2-y^2$$

The complex function $f(z)$ will be of the form

(a) $f(z)=z^2-iz^3$ (b) $f(z)=z^2+iz^3$ (c) $f(z)=z^3+iz^2$ (d) $f(z)=z^3-iz^2$

75. Consider the following vector field:

$$\vec{A}=-\frac{y}{x^2+y^2}\hat{i}+\frac{x}{x^2+y^2}\hat{j}$$

The value of the integral $\iint_S(\vec{\nabla}\times\vec{A}).d\vec{S}$ will be

(where S is surface of the hemisphere $x^2+y^2+z^2=1,\ z>0$)

(a) 0 (b) π (c) 2π (d) 4π

Space for rough work

PHYSICAL SCIENCES
TEST SERIES-IV

Date : 05-12-2016

PART-A

1. (a)	2. (c)	3. (a)	4. (b)	5. (b)	6. (c)	7. (d)
8. (c)	9. (d)	10. (d)	11. (b)	12. (b)	13. (b)	14. (b)
15. (c)	16. (b)	17. (d)	18. (c)	19. (a)	20. (b)	

PART-B

21. (a)	22. (b)	23. (c)	24. (b)	25. (a)	26. (b)	27. (d)
28. (c)	29. (c)	30. (d)	31. (b)	32. (c)	33. (c)	34. (c)
35. (a)	36. (c)	37. (b)	38. (d)	39. (c)	40. (a)	41. (a)
42. (b)	43. (d)	44. (a)	45. (a)			

PART-C

46. (b)	47. (c)	48. (c)	49. (a)	50. (c)	51. (d)	52. (b)
53. (a)	54. (a)	55. (d)	56. (d)	57. (b)	58. (a)	59. (c)
60. (c)	61. (d)	62. (c)	63. (d)	64. (b)	65. (a)	66. (a)
67. (c)	68. (a)	69. (d)	70. (c)	71. (b)	72. (b)	73. (b)
74. (b)	75. (c)					