December 2010 Paper-II

1. $\vec{A} \times [\vec{B} \times \vec{C}] + \vec{B} \times [\vec{C} \times \vec{A}] + \vec{C} \times [\vec{A} \times \vec{B}]$ Will be:

   (a) $\vec{A} + \vec{B} + \vec{C}$ (b) Zero

   (c) $\vec{A} \times \vec{B} \times \vec{C}$ (d) $\overline{A}.\overline{B} + \overline{B}.\overline{C} + \overline{C}.\overline{A}$

2. If $A = \begin{bmatrix} \text{Cos}\theta & -\text{Sin}\theta \\ \text{Sin}\,\theta & \text{Cos}\,\theta \end{bmatrix}$ then

   (A) $\begin{bmatrix} -\text{Cos}\theta & \text{Sin}\theta \\ -\text{Sin}\,\theta & -\text{Cos}\,\theta \end{bmatrix}$ (b) $\begin{bmatrix} \text{Cos}\theta & \text{Sin}\theta \\ -\text{Sin}\,\theta & \text{Cos}\,\theta \end{bmatrix}$

   (c) $\begin{bmatrix} -\text{Cos}\theta & -\text{Sin}\theta \\ \text{Sin}\,\theta & -\text{Cos}\,\theta \end{bmatrix}$ (d) $\begin{bmatrix} \text{Cos}\theta & \text{Sin}\theta \\ \text{Sin}\,\theta & -\text{Cos}\,\theta \end{bmatrix}$

3. Which of the following Matrices is Skew-Symmetric?

   (a) $\begin{pmatrix} i & 0 \\ 0 & I \end{pmatrix}$ (b) $\begin{pmatrix} -i & 0 \\ 0 & i \end{pmatrix}$

   (c) $\begin{pmatrix} 0 & i \\ i & 0 \end{pmatrix}$ (d) $\begin{pmatrix} 0 & i \\ -i & 0 \end{pmatrix}$

4. If S Denoted a closed surface of a cube of side L Then the surface integral $\oiint \bar{r}.\overline{ds} = \ldots\ldots$

   (a) 0 (b) $3L^3$

   (c) $6L^2$ (d) ∞

5. Number of points of interaction of the Line $3x + 4y = 25$ and the curve $x^2 + y^2 = 25$ is

   (a) 0 (b) 1

   (c) 2 (d) 4

6. Let Z denoted complex number $x + iy$ Then $|z + i| + |z - i| = 16$ represent

   (a) A pair of t Lines (b) A Circle

   (b) An Ellipse (d) A Hyperbola

7. Event A and B are independent event such that $P(A) = 0.3$ and $(A \cup B) = 0.8$. Then $P(B) = \cdots..$

   (a) $\left(\frac{2}{5}\right)$ (b) $\left(\frac{3}{5}\right)$

   (c) $\left(\frac{2}{7}\right)$ (d) $\left(\frac{5}{7}\right)$

8. Range of the function

$$f(x) = \frac{x}{1 + x^2}$$

   is

   (a) $(-2,2)$ (b) $[-2,2]$

   (c) $\left(-\frac{1}{2}, \frac{1}{2}\right)$ (d) $\left[-\frac{1}{2}, \frac{1}{2}\right]$

9. Let $J_n(x)$ denoted Bessel function of the first and then which of the following is not.

   (a) $J_0(0) = 0$ (b) $J_0(0) = 1$

   (c) $J_1(0) = 0$ (d) $J_2(0) = 0$

10. A System of 2-generalised degree of the freedom represented by co ordinated x and y is describe by the Lagrangian $L = \frac{1}{2} m(\dot{x}^2 + \dot{y}^2) - ky$.The following component of generalised momentum is conserved

    (a) $m\dot{x}$ (b) $m\dot{y}$

    (c) $m(\dot{x} + \dot{y})$ (d) $m(\dot{x} - \dot{y})$

11. A ball of mass m is suspended by a string of length l. What is the minimum horizontal velocity to be imparted to the ball to set it in motion along a vertical circle around the point of suspension?

    (a) $\sqrt{gl}$ (b) $\sqrt{3gl}$

    (c) $2\sqrt{gl}$ (d) $\sqrt{5gl}$

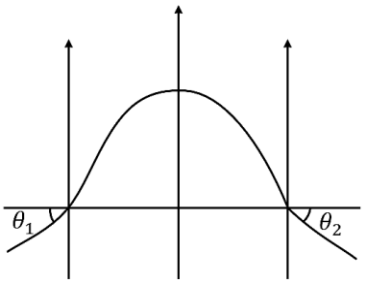
12. A projectile is shot at an angle α to the horizontal. What is the nature of the trajectory of the projectile?

    (a) Elliptical (b) Parabolic

    (c) Hyperbolic (d) Arc of a circle

13. A particle of mass m, charge q is moving with a constant velocity V. It encounters a region of constant magnetic field H perpendicular to V at

an angle θ_1 as shown in figure. The subsequent trajectory of the particle is



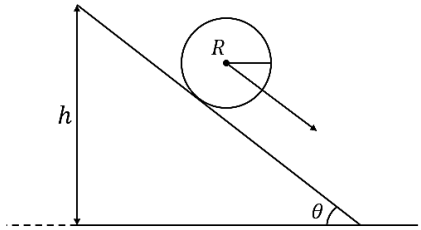
(a) an arc of circle in field region and exit at an angle $\theta_2 = \theta_1$

(b) an are of circle in field region and exiting at an angle $\theta_2 > \theta_1$

(c] an are of circle in field region and exiting at an angle $\theta_2 < \theta_1$

(d) a parabolic arc in the field region and exiting at an angle $\theta_2 = \theta_1$

14. A disk of radius R is rolling down an incline at an angle θ. Each time a switch on the circumference of the disk touches the surface of the inclined a flash of light of width T seconds is emitted. If the disk starts rolling at time $t = 0$ when the first light pulse is emitted, after how much time the emitted light would appear continuous?



(a) $\frac{2\pi R}{Tg \sin\theta}$ (b) $\frac{T}{2\pi}$

(c) $2\pi\sqrt{\frac{R}{g\sin\theta}}$ (d) $\sqrt{\frac{R\sin\theta}{g}}$

15. A classical particle of mass m is moving back and forth in a 1 - d box of length L. If the energy of the particle is doubled, its time period T becomes

(a) 2T (b) $\frac{T}{2}$

(c) $\frac{T}{\sqrt{2}}$ (d) $\sqrt{2}\,T$

16. A mass m is attached to the ceiling with a string of length L. While the pendulum is in motion the mass suddenly breaks and it is halved what happens to the frequency of the pendulum?
(a) it is doubled

(b) it is unchanged

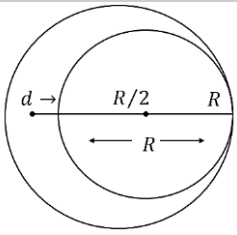
(c) it is halved

(d) The motion becomes erratic.

17. The rest mass of an electron is m_0. When it moves with a velocity $V = 0.6\,c$, then its mass is
(a) m_0 (b) $\frac{5}{4}\,m_0$

(c) $\frac{4}{5}\,m_0$ (d) $2\,m_0$

18. Consider a uniform circular disk of radius R. A circular hole of radius $\frac{R}{2}$ is cut as shown in figure. The centre of mass of the disk then shifts a distance "d" along the line joining the centre's given by



(a) $\frac{R}{3}$ (b) $\frac{R}{2}$

(c) $\frac{R}{4}$ (d) $\frac{R}{5}$

19. A Conducting Spherical shell of Radius R is held at potential V_0. AB is a diameter of the sphere Consider the two cases:

(a) A point charge Q moves from A to B along the Diameter

(b) A point charge Q moves from A to B along a path lying completely outside the shell Then work done is

(a) 0 in both the cases

(b) 0 in first case and QV_0 in second case

(c) QV_0 in both the cases

(d) QV_0 in First case and is any amount depending on the path in second case

20. Consider two spherical shells of radii R and 2R respectively and which are placed far apart. Both of them are charged having same surface charge density σ. If E is the electric field just outside the shell of radius R. then the electric field Just outside the shell of radius 2R is

(a) E (b) 2E

(c) $\frac{E}{2}$ (d) $\frac{E}{4}$

21. The electric field intensity at a Point varies as $\frac{1}{r}$ for

(a) a print charge

(b) an infinite line charge with uniform charge distribution

(c) An infinite plane surface charge with uniform charge.

22. The electric field $E = E_0\hat{z}$ is present everywhere in the space. The total electric flux passing through a hemispherical surface

$$z = \sqrt{r^2(x^2 + y^2)}$$

is

(a) 0 (b) $\pi r^2 E_0$

(c) $2\pi r^2 E_0$ (d) $\frac{2\pi r^2 E_0}{3}$

23. Let E_0 & B_0 respectively denoted the magnitudes of electric and magnetic fields associated with the plane electromagnetic radiation in free space. Which of the following is correct?

(a) $E_0 B_0 = c$ (b) $E_0 B_0 = c^2$

(c) $\frac{E_0}{B_0} = c$ (d) $\frac{B_0}{E_0} = c$

24. Magnetic vector potential $\hat{A}$ is released to electrostatics potential V. through the relation

$(a) \nabla . \overline{A} + \epsilon_0 \mu_0 \frac{dV}{dt} = 0$

$(b) \nabla . \overline{A} - \epsilon_0 \mu_0 \frac{dV}{dt} = 0$

$(c) \frac{\partial A}{\partial t} + \epsilon_0 \mu_0 \nabla . V = 0$

(d) $\frac{\partial A}{\partial t} - \epsilon_0 \mu_0 \nabla . V = 0$

25. Two particles X and Y having equal charges, after being accelerated thorough the same potential difference, starting from rest, enter a region of uniform magnetic field and describe circular paths of radii R_1 and R_2 respectively. The ratio of mass of X to that of Y is.

(a) $\sqrt{\frac{R_1}{R_2}}$ (b) $\sqrt{\frac{R_2}{R_1}}$

(c) $\frac{R_1}{R_2}$ (d) $\left(\frac{R_1}{R_2}\right)^2$

26. The power P radiated by an electric dipole is proportional to the frequency w by

(a) $p \propto w$ (b) $p \propto w^2$

(c) $p \propto w^3$ (d) $p \propto w^4$

27. A quantum mechanical particle mass m in one-dimensional box of length L is in its ground state. What will happen to the particle energy when the size of the box is slowly reduced to half its original size i.e made $\frac{L}{2}$?

(a) Energy will not change

(b) Energy will increase to double its Original value

(c) Energy will decrease to half its original value

(c) Energy will increase four-fold.

28. A particle of energy $E < V_0$ is incident on a barrier of height V_0 and width a. The particle will cross the barrier in time proportional to

(a) $\sqrt{V_0 - E}$ (b) $\frac{1}{\sqrt{E - V_0}}$

(c) $\sqrt{\frac{E}{V_0}}$ (d) $a\sqrt{\frac{V_0}{E}}$

29. A charge simple harmonic oscillator is put in an electric field E along its amplitude. What is the change in the ground state energy? (q is the charge of the oscillator and k the spring constant)

(a) $\frac{e^2E^2}{2k}$ (b) Zero

(c) $\frac{e^2E^2}{2m\omega^2}$ (d) $\frac{e^2E^2}{2}\left(\frac{1}{k} + \frac{1}{m\omega^2}\right)$

30. The binding energy of an electron in the ground state of helium atom is 24.6 eV. The energy required to remove both the electrons from the atom is

(a) 49.2 eV (b) 51.8 eV

(c) 38.2 eV (d) 78.8 Ev

31. A 2x2 Hermitian matrix M satisfies $M^2 =$ I , I being the identity matrix. The product of its eigenvalues must be

(a) 0 (b)1

(c)-1 (d) ± 1

32. The ground state of a particle in a 1 - d box of width a is 0.25 eV. What is the energy when it is in its second excited state?

(a) 0.25 eV (b) 1eV

(c) 2.25 eV (d) 79.8 eV

33. A simple harmonic oscillator with energy Spectrum $E = \left(n + \frac{1}{2}\right)\hbar\omega$ is put at the centre of a box of width L. What happens to the energy spectrum?

(a) All energy level shifts by a constant amount of higher energies

(b) Only Ground state energies increase

(c) Each energy level shifts to higher value the

(c) shift being a monotonically increasing function of n

(d) No Change in energy of the Spectrum

34. What are the Eigen values of the operator σ, P where σ is the three Pauli's spin matrices and P is the momentum vector?

(a) P_x and P_y (b) $P_x \pm P_y$

(c) $\pm |p|$ (d) $\pm[p_x \pm p_y \pm p_z]$

35. Consider a gas of 3 particles with four available quantum states. The probability that there is two in a single state in cases of Boson is

(a) $\frac{36}{64}$ (b) 0

(c) $\frac{12}{20}$ (d) $\frac{4}{20}$

36. Consider a two system of 2 indistinguishable particles, each of which can occupy any of the 3

single quantum state. The number of way in which the 2 particles can be distributed over the 3 states in case the particle Fermions is

(a) 3 (b) 6

(c) 9 (d) 12

37. Consider the Maxwell distribution of speed. The mean speed is given by

(a) $\sqrt{\frac{2kT}{m}}$ (b) $\sqrt{\frac{3kT}{m}}$

(c) 0 (d) $\sqrt{\frac{8\,kT}{m}}$

38. Consider the ideal Fermi gas in three dimensions. The density of energy state is propositional to

(a) $\in^{1/2}$ (b) $\in^{-1/2}$

(c) $\in^{0}$ (d) $\in^{2}$

39. The temperature T of a blackbody enclosure is doubled. Then the total number of photons inside the Enclosure increases by a factor of

(a) 2 (b) 4

(c) 8 (d) 16

40. The volume of a perfect gas is doubled. The number N of atoms and the energy being held constant the change in entropy will be

(a) Nk In V (b) 2 Nk In V

(c)Nk In 2 (d)Nk ln(2V)

41. In a process carried out on an ideal gas (Gas constant 2 cal/mole-K), 70. cal. Of heat is required to raise the temperature from 30°C to 35°C, at constant pressure. The amount of heat required to raise the temperature of the same gas through the same range at constant volume is

(a) 30 Cal (b) 50 Cal

(c) 70 Cal (d) 90 Cal

42. The efficiency of a cannot engine operating between two temperatures T_1 and T_2 $(T_1 > T_2)$ is:

(a) $1+\frac{T_2}{T_1}$ (b) $1+\frac{T_1}{T_2}$

(c) $1-\frac{T_1}{T_2}$ (d) $1-\frac{T_2}{T_1}$

43. The resistance in the range of 10μ Ω to 100 μ Ω can be accurately measured by the method of

(a) ammeter-Voltmeter

(b)Kelvin's double bridge

(a) Potentiometer

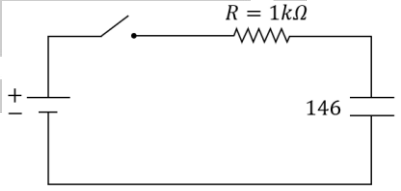
(b) Capacitor discharge

44. A 10 stage photomultiplier tube has a stage gain of 4 secondary Electrons per incident primary electron. The overall amplification of the cube is

(a) 10 (b)10^3

(c) 10^4 (d)10^6

45. In the following diagram Switch S is closed at t = 0. The voltage across the capacitor C after 2 ms will be



(a) 6.3 V (b) 8.6 V

(c) 9.5 V (d)9.8 V

46. For measurement of phase difference between the
two sinusoidal waves using Lissajous figures, the signals are given to oscilloscope's

(a) X-input (b) Y-input

(c) Z-input (d) X-Y input

47. Maximum power is transferred to the load when
(a) Source resistance is double of load resistance

(b) Source resistance is equal to load resistance

(b) Source resistance is half of the load resistance

(d) Source resistance is negligible compared to load resistance

48. The metallic tungsten has a bcc structure X-ray diffraction pattern does not contain Bragg's peak corresponding to
(a) (111) (b) (200)

(c) (110) (d) (222)

49. When the movable mirror of Michelson's interferometer is shifted through 0.0589 nm, a shift of 200 fringes is observed. The wavelength of light used is a
(a) 5885 A^0 (b) 5890A^0

(c) 5895 A^0 (d) 6000 A^0

50. Sensitivity of a pressure gauge is decided by
(a) Lowest pressure it can measured
(b) Highest pressure it can measure
(c) Lowest change in pressure it can measure

(d) Largest change in pressure it can measure.

Answer Key				
1. b	2. b	3. a	4. b	5. c
6. c	7. d	8. c	9. a	10. a
11. b	12. b	13. b	14. a	15. a
16. b	17. b	18. a	19. a	20. d
21. b	22. d	23. c	24.	25. d
26. d	27. d	28.	29. a,c	30. a
31. d	32. b	33. c	34. c	35.
36. a	37. b	38. d	39. d	40. c
41.	42. c	43. a	44.	45. c
46. a	47. b	48. c	49. b	50. a