1. Two spheres of radii $R$ and $3R$ carry $\frac{q}{2}$ charge each. If they are now connected with a conducting wire and separated from each, so charge on each sphere is ____.__.
   (A) $q$, $q$  (B) $\frac{q}{2}$, $\frac{3q}{4}$  (C) $\frac{q}{4}$, $\frac{3q}{4}$  (D) $\frac{3q}{4}$, $\frac{q}{4}$

2. Four charges each of magnitude $q$ are placed on the vertices $A$, $B$, $C$ and $D$ of a square of side length $a$. The resultant force acting on charge placed at corner $B$ is ____.__.
   (A) $\frac{3q^2}{4\pi\varepsilon_0 a^2}$  (B) $\left[\frac{1+2\sqrt{2}}{2}\right] \frac{q^2}{4\pi\varepsilon_0 a^2}$  (C) $\frac{4q^2}{4\pi\varepsilon_0 a^2}$  (D) $\left(2+\frac{1}{\sqrt{2}}\right) \frac{q^2}{4\pi\varepsilon_0 a^2}$

3. The position vectors of two point charges of $2\mu C$ each are $(2i + 3j - k)$ m and $(3i + 5j + k)$ m respectively. Magnitude of the coulombian force acting between them is ____.__.
   (A) $4 \times 10^{-3}$ N  (B) $4 \times 10^{-9}$ N  (C) $4 \times 10^{-6}$ N  (D) $12 \times 10^{-3}$ N

4. If the charge on capacitor is increased by $5\mu C$, the energy stored in the capacitor increased by 21%, what will be initial charge on the capacitor ?
   (A) $10 \mu C$  (B) $20 \mu C$  (C) $50 \mu C$  (D) $40 \mu C$

5. The capacitance of a parallel plate capacitor having air medium is 9 pF, and the distance between the plates is $d$. Two dielectric substances of dielectric constant $K_1 = 3$ and $K_2 = 6$ are placed between these plates. If the thickness of these plates are $\frac{d}{3}$ and $\frac{d}{2}$ respectively, the capacitance of the capacitor is ____.__.
   (A) $20.25$ pF  (B) $45$ pF  (C) $1.8$ pF  (D) $40.5$ pF

6. Two wires, one of aluminium and the other made of copper are of equal lengths and they also hav equal resistances. $\rho_{Al} = 2.63 \times 10^{-8} \Omega m$. $\rho_{Cu} = 1.72 \times 10^{-8} \Omega m$ density of aluminium is $2.7 \times 10^3$ kg m$^{-3}$ and density of copper is $8.9 \times 10^3$ kg m$^{-3}$. The ratio of mass of copper and aluminium is ____.__.
   (A) $2.15$  (B) $4.6$  (C) $0.46$  (D) $0.21$

7. The maximum power dissipated in an external resistance $R$ when connected to cell emf $E$ and internal resistance $r$ will be
   (A) $\frac{E^2}{4r}$  (B) $\frac{E^2}{2r}$  (C) $\frac{E^2}{3r}$  (D) $\frac{E^2}{r}$
8. A electric current flows through a straight conductor. The line joining a point lying at a distance 10 cm from the wires on the perpendicular bisector of the wires makes an angle 60° with the two ends of wire intensity of magnetic field at this point is _______. T.

(A) $15 \times 10^{-7}$  (B) $20 \times 10^{-8}$  (C) $20 \times 10^{-7}$  (D) $2 \times 10^{-7}$

9. Two particles of masses $M_1$ and $M_2$ having the equal electric charge are accelerated through equal potential difference and then move inside a uniform magnetic field normal to it. If the radii of their circular path are $R_1$ and $R_2$ respectively, the ratio of their masses is _______.

(A) $\frac{R_1}{R_2}$  (B) $\frac{R_2^2}{R_1^2}$  (C) $\frac{R_2}{R_1}$  (D) $\sqrt{\frac{R_1}{R_2}}$

10. 4A current is flowing through the circular coil with radius 5 cm. It is kept in the uniform magnetic field of 0.2 T. Number of turns in the coil is 50. The work required to rotate it by 180° from equilibrium position is _______.

(A) 0.628 J  (B) 2.512 J  (C) 0.2512 J  (D) 25.12 J

11. If an electric current flows in a conducting wire of length $L$. If we bend it in a circular form its magnetic dipole moment would be _______.

(A) $\frac{I^2 L}{4\pi}$  (B) $\frac{I^2 L^2}{4\pi}$  (C) $\frac{I^2 L^2}{4\pi}$  (D) $\frac{IL}{4\pi}$

12. Two converging lenses of power 5D and 4D are placed 5 cm apart. The focal length and power of this combination will be _______.

(A) 12.5 cm, 9D  (B) 12.5 cm, 8D  (C) 15.2 cm, 11D  (D) 12.5 cm, 20D

13. The refractive index of transparent Cylindrical rod is $\frac{2}{\sqrt{3}}$. As shown in the figure the ray is incident at the mid point of its one end.

For which angle of incidence, the ray become parallel to the length of rod.

(A) $\sin^{-1}\left(\frac{1}{2}\right)$  (B) $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$  (C) $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$  (D) $\sin^{-1}\left(\frac{2}{\sqrt{3}}\right)$

14. An electron is accelerated from rest between two points at which potentials are 30 V and 50 V respectively. The De-Broglie wavelength associated with it will be _______.

(A) 2.74 Å  (B) 0.75 Å  (C) 2.75 m  (D) 7.5 Å

15. An electric bulb of 100W converts 3% of electric energy in to light energy. If the wavelength of light emitted is 6625 Å the number of photons emitted in 2s is _______.

(h = 6.625 $\times 10^{-34}$ Js)

(A) $10^{19}$  (B) $4 \times 10^{19}$  (C) $2 \times 10^{19}$  (D) $10^{18}$

16. Two identical spheres carrying equal charge are separated by means of identical insulated strings. When they are immersed in a liquid, the angle between their strings remain the same as it was in air. If the density of material of the sphere and liquid are 1600 kgm$^{-3}$ and 800 kgm$^{-3}$ the dielectric constant of liquid will be _______.

(A) 4  (B) 3  (C) 2  (D) 1
1. Two material have the value of $\alpha_1$ and $\alpha_2$ as $9 \times 10^{-12}$ C$^{-1}$ and $-6 \times 10^{-4}$ C$^{-1}$ respectively. The resistivity of the first material is $\rho_{21} = 3 \times 10^{-8}$ $\Omega$m. A new material is made combining the above two materials. The resistivity of the new material does not change with temperature. What should be the resistivity of second material? Consider the reference temperature 20$^\circ$C. Assume that the resistivity of the new material is equal to the sum of resistivity of its component material.

(A) $4.5 \times 10^{-8}$ $\Omega$m  
(B) $2.4 \times 10^{-8}$ $\Omega$m  
(C) $2.25 \times 10^{-8}$ $\Omega$m  
(D) $3.5 \times 10^{-8}$ $\Omega$m

2. A particle having 2e charges passes through magnetic field $4 \hat{k}$T and some uniform electric field with velocity $25 \hat{j}$ ms$^{-1}$ if the Lorentz force acting on it is $400 \hat{i}$N, the electric field in this region is ______.

(A) $100 \hat{i}$ Vm$^{-1}$  
(B) $100 \hat{k}$ Vm$^{-1}$  
(C) $100 \hat{j}$ Vm$^{-1}$  
(D) $10 \hat{i}$ Vm$^{-1}$

3. An electron is at a distance of 5 m from a charge of 10 c. It's total energy is $21.2 \times 10^{-10}$J. Find its de-Broglie wave length at this point.

$h = 6.625$ Js, $m_e = 9.1 \times 10^{-31}$ kg, $k = 9 \times 10^{10}$ SI

(A) $8.97 \times 10^{-15}$m  
(B) $6.94 \times 10^{-13}$m  
(C) $6.94 \times 10^{-15}$m  
(D) $8.97 \times 10^{-13}$m

4. A thin glass (refractive index 1.5) lens has optical power of $-40$D in air. Its optical power in a liquid medium with refractive index 1.6 will be ______.

(A) $+0.5$D  
(B) $+1.5$D  
(C) $-0.5$D  
(D) $-2.5$D

5. The Electric Field in the region of the space is $\mathbf{E} = (5 \hat{i} + 2 \hat{j} + 3 \hat{k})$Nc$^{-1}$. The electric flux passing through a surface of area 50 m$^2$ placed in X–Y plane inside the electric field is ______.

(A) 250 $\text{Nm}^2\text{c}^{-1}$  
(B) 100 $\text{Nm}^2\text{c}^{-1}$  
(C) 150 $\text{Nm}^2\text{c}^{-1}$  
(D) 200 $\text{Nm}^2\text{c}^{-1}$

6. The dimensional formula Electric Field intensity is ______.

(A) $M^1L^1T^{-2}A^{-1}$  
(B) $M^1L^2T^{-3}A^{-1}$  
(C) $M^1L^3T^{-3}A^{-1}$  
(D) $M^1L^0T^{-3}A^{-1}$
7. Mass of three copper wire are in the ratio 7 : 5 : 3 and their lengths are in the ratio 3 : 5 : 7. The ratio of their electrical resistance are ______.

(A) 1 : 15 : 125  (B) 9 : 5 : 49  (C) \( \frac{9}{7} : \frac{5}{49} \)  (D) 9 : 15 : 49

8. A particle having 2c charges passes through magnetic field 4\( \hat{k} \) T and some uniform electric field with velocity 25\( \hat{j} \) ms\(^{-1}\) if the Lorentz force acting on it is 400\( \hat{I} \) N, the electric field in this region is ______.

(A) 100\( \hat{I} \) Vm\(^{-1}\)  (B) 100\( \hat{k} \) Vm\(^{-1}\)  (C) 100\( \hat{j} \) Vm\(^{-1}\)  (D) 10\( \hat{I} \) Vm\(^{-1}\)

9. A toroidal core with 5000 turns has inner and outer radii of 13 cm and 14 cm respectively. When a current of 0.4 A is passed, the magnetic field produced in the core is 2.5 T. The relative permeability of the core is ______. (\( \mu_0 = 4\pi \times 10^{-7} \) Tm\( \hat{A} \)^{-1})

(A) 843.75  (B) 863.78  (C) 743.82  (D) 685

10. A narrow beam of light is incident on a glass plate of refractive index 1.6. It makes an angle 53° with normal to the interface. Find the lateral shift of the beam at the point of emergence, if thickness of plate is 30 mm.

(A) 9.023 mm  (B) 13.53 mm  (C) 15.52 mm  (D) 13.53 mm

11. An electron is at a distance of 5 m from a charge of 10 c. It's total energy is 21.2 \times 10^{-10}J. Find its de-Broglie wave length at this point.

(h = 6.625 Js, \( m_e = 9.1 \times 10^{-31} \) kg, \( k = 9 \times 10^{10} \) Si]

(A) 8.97 \times 10^{-15} m  (B) 6.94 \times 10^{-13} M  (C) 6.94 \times 10^{-15} M  (D) 8.97 \times 10^{-13} m

12. Two identical thin rings each of radius 2 m are kept on same axis, at distance of 2 m apart. If charges on them are 5c and 3c respectively then the work required to move 1c charge from the centre of one ring to that of other ring is ______.

\( \begin{align*} 
\text{(A)} & \quad \frac{18(\sqrt{2} - 1)}{\sqrt{2}} J \\
\text{(B)} & \quad (9(\sqrt{2} - 1)) \times 10^9 J \\
\text{(C)} & \quad \frac{9(\sqrt{2} - 1)}{\sqrt{2}} \times 10^9 J \\
\text{(D)} & \quad 18(\sqrt{2} - 1) J 
\end{align*} \)

13. Two material have the value of \( \alpha_1 \) and \( \alpha_2 \) as 9 \times 10^{-4} C^{-1} and -6 \times 10^{-4} C^{-1} respectively. The resistivity of the first material is \( \rho_{21} = 3 \times 10^{-8} \) \( \Omega m \). A new material is made combining the above two materials. The resistivity of the new material does not change with temperature. What should be the resistivity of second material? Consider the reference temperature 20°C. Assume that the resistivity of the new material is equal to the sum of resistivity of its component material.

(A) 4.5 \times 10^{-8} \() \Omega m \)  (B) 2.4 \times 10^{-8} \() \Omega M \)  (C) 2.25 \times 10^{-8} \() \Omega m \)  (D) 3.5 \times 10^{-8} \() \Omega m \)

14. A thin glass (refractive index 1.5) lens has optical power of -4 D in air. Its optical power in a liquid medium with refractive index 1.6 will be ______.

(A) + 0.5D  (B) + 1.5D  (C) - 0.5D  (D) - 2.5D

15. The Electric Field in the region of the space is \( \vec{E} = (5\hat{i} + 2\hat{j} + 3\hat{k}) \) Ne\(^{-1}\). The electric flux passing through a surface of area 50 m\(^2\) placed in X-Y plane inside the electric field is ______.

(A) 250 Nm\(^2\)c\(^{-1}\)  (B) 100 Nm\(^2\)c\(^{-1}\)  (C) 150 Nm\(^2\)c\(^{-1}\)  (D) 200 Nm\(^2\)c\(^{-1}\)

16. The dimensional formula Electric Field intensity is ______.

(A) M\(^1\)L\(^1\)T\(^{-2}\)A\(^{-1}\)  (B) M\(^1\)L\(^2\)T\(^{-3}\)A\(^{-1}\)  (C) M\(^1\)L\(^1\)T\(^{-3}\)A\(^{-1}\)  (D) M\(^1\)L\(^0\)T\(^{-2}\)A\(^{-1}\)
27. Linear charge density on a straight wire of length \( L \) is \( \lambda(x) = \lambda_0 x^4 \). What is the total charge on the wire? 

- (A) \( \frac{\lambda_0 L}{2} \) 
- (B) \( \frac{\lambda_0 L^5}{5} \) 
- (C) \( \frac{\lambda_0 L^4}{4} \) 
- (D) \( \lambda_0 L \)

28. The Force acting between two point charges in vacuum is \( F \). The force acting at the same distance in the medium of dielectric constant \( K = 4 \) is _____.

- (A) \( 4F \) 
- (B) \( \frac{F}{2} \) 
- (C) \( 2F \) 
- (D) \( \frac{F}{4} \)

29. An electric dipole coincides on \( Z \)-axis and its midpoint is on the origin of the co-ordinate system. The electric field at an axial point at a distance \( Z \) from origin is \( \vec{E}(z) \) and electric field at an equatorial point at a distance \( Y \) from origin is \( \vec{E}(y) \). Here \( Z = Y \geq a \).

\[ \frac{\vec{E}(Y)}{\vec{E}(Z)} = \] 

- (A) 4 
- (B) 2 
- (C) 1 
- (D) 3

30. When two Spheres having \( \theta \) and \( -\theta \) charged are placed at a certain distance the force acting between them is \( F \). Now they are connected by a conducting wire and again separated from each other how much force will act between them if the separation now is same as before the force acting between them will be.

- (A) \( F \) 
- (B) \( \frac{F}{2} \) 
- (C) \( \frac{F}{8} \) 
- (D) \( \frac{F}{4} \)

31. Two charged spheres of radii \( R_1 \) and \( R_2 \) are connected with the help of a conducting wire and then they are separated. The ratio of electric field on their surfaces are \( E_1 \) and \( E_2 \) respectively then

\[ \frac{E_1}{E_2} = \] 

- (A) \( \frac{R_2}{R_1} \) 
- (B) \( \frac{R_2^3}{R_1^3} \) 
- (C) \( \frac{R_1}{R_2} \) 
- (D) \( \frac{R_1^3}{R_2^3} \)

32. Six identical square metallic plates are arranged as shown in figure. Length of each plate is \( l \). The Capacitance of this arrangement would be _____.

- (A) \( \frac{4 \varepsilon_0 l^2}{3d} \) 
- (B) \( \frac{5 \varepsilon_0 l^2}{d} \) 
- (C) \( \frac{5 \varepsilon_0 l^2}{4d} \) 
- (D) \( \frac{3 \varepsilon_0 l^2}{2d} \)

33. On each vertices of a square, of each side equal to length \( a \), +q, +q, -q and -q charges are there, so potential at the centre of the square is _____.

- (A) \( \frac{1}{4\pi \varepsilon_0} \frac{q}{a} \) 
- (B) \( \frac{1}{4\pi \varepsilon_0} \frac{4q}{a} \) 
- (C) \( \frac{1}{4\pi \varepsilon_0} \frac{2q}{a} \) 
- (D) zero
34. 27 small drops of water having same charge and same radius are combined to form one big drop. The ratio of capacitance of one big drop to small drop is _____.
   (A) 2 : 1  (B) 3 : 1  (C) 1 : 3  (D) 1 : 2

35. If the electric potential at point in some region \((x, y, z)\) is \(V(x, y, z) = 5x^2y^3 \times 3y^2z + 2z^2x\). The \(X\) – component of Electric field \((E_x)\) at a point \((1, 2, 0)\) is _____ unit.
   (A) -10  (B) -15  (C) 20  (D) 0

36. Radius of nucleus of an atom of \(z = 50\) is \(9 \times 10^{-15}\) m. Electric potential on the surface of the nucleus is _____.
   (A) \(9 \times 10^6\) V  (B) 9 V  (C) 80 V  (D) \(8 \times 10^6\) V

37. Two plates are 10 cm apart and the potential difference between them is 20 V. The electric field between the plates is _____ V/m.
   (A) 2  (B) 20  (C) 200  (D) 0.5

38. On applying an electric field of \(15 \times 10^{-6}\) Vm\(^{-1}\) across a conductor, current density through it is 3.0 Am\(^{-2}\) the resistivity of the conductor is _____.
   (A) \(45 \times 10^{-6}\) \(\Omega\)m  (B) \(0.5 \times 10^{-6}\) \(\Omega\)m  (C) \(5 \times 10^{-6}\) \(\Omega\)m  (D) \(2 \times 10^{-5}\) \(\Omega\)m

39. The charge flowing the conductor at time \(t\) is \(Q = 4t^2 + 6t + 4\), the current flowing through it at \(t = 2\) s is _____.
   (A) 22 A  (B) 6 A  (C) 16 A  (D) 15 A

40. The drift velocity of free electrons through a conducting wire of radius \(r\) carrying current \(I\) is \(v_d\). If the same current is passed through conductor of radius \(3r\), what will be the drift velocity?
   (A) \(3v_d\)  (B) \(\frac{v_d}{q}\)  (C) \(v_d\)  (D) \(6v_d\)

41. \(L\) is the length and \(D\) is diameter of a conducting wire. For which of the following dimension will the resistance of wire become minimum?
   (A) \(2L, \frac{D}{2}\)  (B) \(\frac{L}{2}, 2D\)  (C) \(L, D\)  (D) \(2L, 2D\)

42. Length of wire and resistance \(R\) \(\Omega\) is increased 5 times, so its resistance become 100\(\Omega\) therefore \(R = \) ___. (The volume of the wire remain same during increase in length).
   (A) 20\(\Omega\)  (B) 40\(\Omega\)  (C) 4\(\Omega\)  (D) 2\(\Omega\)

43. Resistance of a potentiometer wire is \(R\). \(\Omega\) heat \(H\) Cal. is produced in it per second on passing electric current through it. How much is the value of current passing through it _____?
   (A) \(HR\)  (B) \(\frac{JH}{R}\)  (C) \(\sqrt{\frac{JH}{R}}\)  (D) \(\frac{J}{H/R}\)

44. The dimensional formula of resistivity is _____.
   (A) \(M^1L^2T^{-3}A^{-2}\)  (B) \(M^1L^3T^{-3}A^{-2}\)  (C) \(M^1L^3T^{-2}A^{-3}\)  (D) \(M^1L^1T^{-2}A^{-1}\)

45. The magnetic field at the centre of ring carrying electric current is _____ of Area of the ring.
(A) inversely proportional to square root of (B) inversely proportional to square root of
(C) directly proportional (D) directly proportional

An electron performs circular motion of radius \( r \) perpendicular to uniform magnetic field \( B \). The Kinetic energy gained by this electron in half the revolution is _____.

(A) \( \frac{1}{2} mv^2 \)  (B) 0  (C) \( \frac{1}{4} mv^2 \)  (D) \( \pi r Bev \)

47. A strong magnetic field is applied on a stationary electron. Then the electron _____.
(A) begin spin  (B) moves opposite the direction of magnetic field  (C) moves in the direction of the field  (D) remain stationary

48. The resistance of moving coil galvanometer is 99 Ω. What value of shunt is required to pass 10% of main current through the galvanometer?

(A) 11Ω  (B) 10Ω  (C) 9.9Ω  (D) 9Ω

49. The Magnetic field at a point which is at a perpendicular distance \( r \) from a long current carrying wire is 0.5T. The field of induction at a distance \( \frac{r}{2} \) from the same current carrying wire is _____.

(A) 0.25T  (B) 0.75T  (C) 1T  (D) 2T

50. On passing 10A current through the circular coil of radius 5cm, magnetic field produce at the center of coil is \( 3.14 \times 10^{-3} \text{T} \). Number of turns in the coil will be _____.

(A) 250  (B) 50  (C) 25  (D) 100

51. Out of following the resistance of which device is maximum?

(A) Galvanometer  (B) Voltmeter  (C) Ammeter  (D) Millicampmeter

52. The magnetic susceptibilities of a substance is \(-0.925\). Its relative magnetic permeability is _____.

(A) 0.075  (B) \(-0.075\)  (C) 1.925  (D) 1.075

53. The magnet of pole strength \( p \) and magnetic moment \( \mathbf{m} \) is cut into two pieces along its axis. Its pole strength and magnetic moment now become _____.

(A) \( \frac{\mathbf{m}}{2} \)  (B)  \( \frac{p}{2} \cdot \mathbf{m} \)  (C) \( \frac{p}{2}, \frac{\mathbf{m}}{2} \)  (D) \( p, \mathbf{m} \)

54. A proton and an alpha particle enter in a uniform magnetic field perpendicularly with same speed. The periodic time of circular motion of alpha particle will be _____ that of proton.

(A) Four times  (B) Three times  (C) Two times  (D) Equal to

55. A bar magnet is oscillating in earth’s magnetic field with periodic time \( T \). If a similar magnet with the same mass and volume has magnetic dipole moment 9 times that of magnet, then its periodic time will be _____.

(A) \( \frac{T}{3} \)  (B) \( T \)  (C) 3T  (D) 9T
56. A thin convex lens has equal radii of curvature equal to 20 cm. If the refractive index of convex lens is 1.5, its focal length will be ______.
(A) 10 cm  (B) 15 cm  (C) 20 cm  (D) 40 cm

57. The refractive index of water is 4/3. The distance travel by light in water in 3 seconds is ______. \(c = 3 \times 10^8 \text{ ms}^{-1}\)
(A) \(6.75 \times 10^8\) m  (B) \(13.5 \times 10^8\) m  (C) \(4.5 \times 10^8\) m  (D) \(2.25 \times 10^8\) m

58. A person can not see the object beyond 200 cm. The power of lens to correct the vision will be ______.
(A) +0.5D  (B) +5D  (C) -0.5D  (D) -5D

59. A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then its focal length will ______.
(A) zero  (B) infinite  (C) reduce  (D) increase

60. When a ray of light travel from one medium to other then the physical quantity which does not change is ______.
(A) velocity  (B) wave length  (C) frequency  (D) intensity

61. When a piece of sodium or potassium are exposed to sun light ______.
(A) they will become negatively charged  (B) will remain neutral
(C) they will become positively charged  (D) will emit proton

62. The dimensional formula of Plank Constant is ______.
(A) \(M^1L^2T^{-1}\)  (B) \(M^1L^0T^{-2}\)  (C) \(M^1L^2T^{-3}\)  (D) \(M^1L^2T^{-2}\)

63. The linear momentum of a particle is \(1.1 \times 10^4\) kgms\(^{-1}\). The De-Broglie wave length associated with this particle is ______. \(h = 6.6 \times 10^{-34}\) JS.
(A) \(6 \times 10^{-39}\) nm  (B) \(12 \times 10^{-39}\)nm  (C) \(6 \times 10^{-29}\)m  (D) \(3 \times 10^{-29}\)nm

64. If \(\lambda\) is the wave length of incident radiation and \(\phi\) is the work function of metal, under which condition photo-electric effect will not occur?
(A) \(\lambda > \frac{hc}{\phi}\)  (B) \(\lambda < \frac{hc}{\phi}\)  (C) \(\lambda = \frac{hc}{\phi}\)  (D) \(\lambda \leq \frac{hc}{\phi}\)
1. \( \frac{3q}{4} \), \( \frac{3q}{4} \)

In touching method, distribution of charge of sphere's are directly proportional to radius of sphere.

\[ q_1 \propto R_1, \quad q_2 \propto R_2 \]

\[ \frac{q_1}{q_2} = \frac{R_1}{R_2} = \frac{R}{3R} \]

\[ q_2 = 3q_1 \]

Now \( q_1 + q_2 = q \)

\[ q_1 + 3q_1 = q \quad \therefore 4q_1 = q \]

\[ q_1 = \frac{q}{4}, \quad q_2 = \frac{3q}{4} \]

2. \( \frac{1+2\sqrt{2}}{2} \)

\( \frac{q^2}{4\pi \varepsilon_0 a^2} \)

Here \( F_{AC} = \sqrt{F_A^2 + F_C^2} \)

Now \( F_{net} = F_{AC} + F_D = \sqrt{F_A^2 + F_C^2} + F_D \)

\[ F_A = F_B = \frac{kq^2}{a^2}, \quad F_D = \frac{kq^2}{(\sqrt{2}a)^2} = \frac{kq^2}{2a^2} \]

\[ \therefore F_{net} = \sqrt{\left( \frac{kq^2}{a^2} \right)^2 + \left( \frac{kq^2}{a^2} \right)^2 + \frac{kq^2}{2a^2}} \]

\[ = \sqrt{2 \left( \frac{kq^2}{a^2} \right)^2 + \frac{kq^2}{2a^2}} \]

\[ \therefore F_{net} = \frac{\sqrt{2} kq^2}{a^2} + \frac{kq^2}{\sqrt{2}a^2} = \frac{kq^2}{a^2} \left( \sqrt{2} + \frac{1}{2} \right) \]

\[ = \left( 1 + \frac{2\sqrt{2}}{2} \right) \frac{q^2}{4\pi \varepsilon_0 a^2} \]

3. \( 12 \times 10^{-3} \) N

\[ q_1 = q_2 = 2\mu \text{C} = 2 \times 10^{-6} \text{ C} \]

\( \vec{r}_1 = (2, 3, -1) \text{m}, \quad \vec{r}_2 = (3, 5, 1) \text{m} \)

\[ \vec{F}_{12} = \frac{kq_1q_2}{\left| \vec{r}_1 - \vec{r}_2 \right|^2} \left( \vec{r}_1 - \vec{r}_2 \right) \quad \text{...(1)} \]

\[ \left| \vec{r}_1 - \vec{r}_2 \right| = \sqrt{1^2 + 2^2 + 2^2} = \sqrt{1 + 4 + 4} = 3 \text{m} \]

So equation (1) becomes,

\[ \vec{F}_{12} = \frac{9 \times 10^9 \times 2 \times 10^{-6} \times 2 \times 10^{-6}}{(3)^3} \cdot (-1, -2, -2) = 4 \times 10^{-3} \cdot (-1, -2, -2) \]

\[ |\vec{F}_{12}| = 4 \times 10^{-3} \sqrt{1^2 + 4^2 + 4^2} = 4 \times 10^{-3} \sqrt{1 + 16 + 16} = 4 \times 3 \times 10^{-3} = 12 \times 10^{-3} \text{ N} \]

4. \( 20 \text{ C} \)

\[ U = \frac{Q^2}{2C} \]

\[ \therefore U + \frac{21}{100} U = \frac{(Q + 2)^2}{2C} \]

\[ \frac{1.21U}{U} = \left( \frac{Q + 2}{Q} \right)^2 \]

\[ \therefore 1.21 = \left( \frac{Q + 2}{Q} \right) \]

\[ \frac{Q + 2}{Q} = \sqrt{1.21} \]

\[ \therefore Q + 2 = 1.1Q \]

\[ \therefore Q = 20 \text{ C} \]
5. \( \frac{D}{40.5 \text{ pF}} \)

\[ k_1 = 3 \quad k_2 = 6 \]

\[ C_1 \quad C_2 \]

\[ \frac{d}{3} \quad \frac{2d}{3} \]

In air \( C = \frac{Ae_0}{d} = 9 \text{ pF} \)

\[ C_1 = \frac{k_1Ae_0}{d/3} = \frac{3Ae_0}{d/3} = \frac{9Ae_0}{d} = 81 \text{ pF} \]

\[ C_2 = \frac{k_2Ae_0}{2d/3} = \frac{6Ae_0}{2d/3} = \frac{9Ae_0}{d} = 81 \text{ pF} \]

Both are in series so,

\[ \frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{81} + \frac{1}{81} = \frac{2}{81} = \frac{1}{40.5} \]

\[ \therefore \ C = 40.5 \text{ pF} \]

6. (A) 2.15

For aluminum \( R_1 = \rho_1 \frac{l_1}{A_1} \)

Similarly for copper \( R_2 = \rho_2 \frac{l_2}{A_2} \)

But \( R_1 = R_2 \) and \( l_1 = l_2 \)

\( \frac{\rho_1}{A_1} = \frac{\rho_2}{A_2} \Rightarrow \frac{A_2}{\rho_2} = \frac{A_1}{\rho_1} \)

Multiplying both sides by the respective densities

\[ \frac{d_2A_2}{d_1A_1} = \frac{d_2\rho_2}{d_1\rho_1} = \frac{8.9 \times 10^3 \times 1.72 \times 10^{-8}}{2.7 \times 10^3 \times 2.63 \times 10^{-8}} \]

\[ \frac{d_2A_2}{d_1A_1} = \frac{m_2}{m_1} = 2.15 \]

\( m_1 \) being less then \( m_2 \), the aluminum wire is lighter.

7. (A) \( \frac{E^2}{4r} \) V

When \( R = r \) power is maximum

\[ i.e. \ P = \frac{e^2 \cdot R}{(R + r)^2} = \frac{e^2 \cdot r}{(r + r)^2} = \frac{e^2}{4r} \]

8. (C) \( 20 \times 10^{-7} \text{ T} \)

\[ B = \frac{\mu_0 I}{4\pi y} (\sin \theta_1 + \sin \theta_2) \]

\[ = \frac{4\pi \times 10^{-7} \times 2}{4\pi \times 10 \times 10^{-2}} (\sin 30^\circ + \sin 30^\circ) \]

\[ = 2 \times 10^{-6} \left( \frac{1}{2} + \frac{1}{2} \right) \]

\[ = 2 \times 10^{-6} = 20 \times 10^{-7} \text{ T} \]

9. (B) \( \frac{R_1^2}{R_2^2} \)

Here both equal electric charges are accelerated through same p.d. for 1st charge,

\[ V_q = \frac{1}{2} M_1 v_1^2 \] \( \ldots (1) \)

For 2nd charge \( V_q = \frac{1}{2} M_2 v_2^2 \) \( \ldots (2) \)

From (1) and (2),

\[ \frac{1}{2} M_1 v_1^2 = \frac{1}{2} M_2 v_2^2 \]

\[ \therefore M_1 v_1^2 = M_2 v_2^2 \] \( \ldots (3) \)

Also both charges are move under same magnetic field then

\[ \frac{M_1 v_1^2}{R_1} = qB v_1 \quad \therefore qB = \frac{M_1 v_1}{R_1} \]

and \[ \frac{M_1 v_2^2}{R_2} = qB v_2 \quad \therefore qB = \frac{M_2 v_2}{R_2} \]

So, \[ \frac{M_1 v_1}{R_1} = \frac{M_2 v_2}{R_2} \]

\[ \therefore \frac{M_1}{M_2} = \left( \frac{R_1}{R_2} \right)^2 \]
10. (A) 0.628 J
\[ W = mB (\cos \theta_1 - \cos \theta_2) \]
\[ = N \pi B (\cos 0^\circ - \cos 180^\circ) \]
\[ N \pi r^2 B(1 + 1) = 2N \pi r^2 - B \]
\[ = 2 \times 50 \times 3.14 \times (5 \times 10^{-2})^2 \times 0.2 \times 4 \]
\[ = 0.628 \text{ J} \]

11. (B) \[ \frac{L^2}{4\pi} \]
\[ L = 2\pi \]
\[ r = \frac{L}{2\pi} \text{ also } m = IA = \pi^2 \cdot 1 \]
\[ m = \pi \frac{L^2}{4\pi^2} = \frac{IL^2}{4\pi} \]

12. (B) 12.5 cm, 8D

Focal length of first lens,
\[ f_2 = \frac{1}{5} = 0.2 \text{ m} = 20 \text{ cm} \]
Focal length of second lens,
\[ f_2 = \frac{1}{4} = 0.25 \text{ m} = 25 \text{ cm} \]
Distance between two lenses, \( d = 5 \text{ cm} \)

Now, equivalent focal length of this combination is
\[ \frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2} \]
\[ f = \frac{f_1 f_2}{f_1 + f_2 - d} = \frac{20 \times 25}{(20 + 25) - 5} \]
\[ = 12.5 \text{ cm} \]

And equivalent power is given by,
\[ P = (P_1 + P_2) - dP_1 P_2 \]
\[ = (5 + 4) - (0.05) \times (5)(4) \]
(d is written in meter)

\[ P = 8 \text{ D or } P = \frac{1}{f} = \frac{1}{0.125} \]
\[ = 12.5 \text{ cm} = 8\text{D} \]

13. (D) \( \sin^{-1} \left( \frac{2}{\sqrt{3}} \right) \)

\[ n_1 \sin \theta_1 = n_2 \sin \theta_2 \]
\[ \therefore (1) \sin \theta = \frac{2}{\sqrt{3}} \sin 90^\circ \]
\[ \therefore \sin \theta = \frac{2}{\sqrt{3}} \therefore \theta = \sin^{-1} \frac{2}{\sqrt{3}} \]

14. (A) 2.74 Å

Here \( V \) change in p.d. = 50 - 30 = 20V

15. (A) 10^19

Here, \( \lambda = 6625 \times 10^{-10} \text{ m} \),
\[ c = 3 \times 10^8 \text{ m/s}, n = ? \]
\[ nhf = 3 \text{ joule/sec} \]
\[ \therefore \frac{n}{hc} = 3 \]
\[ n = \frac{3\lambda}{hc} = \frac{3 \times 6625 \times 10^{-10}}{6.625 \times 10^{-34} \times 3 \times 10^8} \]
\[ \therefore n = 10^{19} \text{ per second.} \]

16. (C) 2

\[ \rho' = \frac{\rho k}{k - 1} \]
\[ = 1600 = \frac{800k}{k - 1} \]
\[ \therefore 2(k - 1) = k \]
\[ 2k - 2 = k \]
\[ k = 2 \]

17. (C) \( \frac{9}{7} : 5 : \frac{49}{3} \)

\[ m_1 : m_2 : m_3 = 7 : 5 : 3 \]
\[ l_1 : l_2 : l_3 = 3 : 5 : 7 \]
\[ R = \frac{\rho l}{V} = \frac{\rho l^2}{m} \therefore R \propto \frac{l^2}{m} \]
\[ R_1 : R_2 : R_3 = \frac{l_1^2}{m_1} = \frac{l_2^2}{m_2} = \frac{l_3^2}{m_3} \]
\[ = \frac{9}{7} : \frac{25}{5} : \frac{49}{3} = \frac{9}{7} : \frac{5}{3} : \frac{49}{3} \]

18. (A) 100 \text{ \textdegree} \text{ V m}^{-1}

\[ \vec{F} = q(\vec{E} + \vec{v} \times \vec{B}) \]
Here, \( q = 2 \) C, \( \vec{V} = 25 \hat{j} \) ms\(^{-1}\),
\[ \vec{B} = 4\hat{k}T, \vec{F} = 400\hat{i} \]
\[ \therefore 400\vec{F} = 2[\vec{E} + (25)(4) (\hat{j} \times \hat{k})] \]
\[ = 2\vec{E} + 200\hat{i} \]
\[ \therefore 2\vec{E} = 200\hat{i} \]
\[ \therefore \vec{E} = 100\hat{i} \)Vm\(^{-1}\)

19. (A) 843.75

\[ N = 5000 \]

Average radius \( r = \frac{13+14}{2} = 13.5 \text{ cm} \)
\[ = 13.5 \times 10^{-2} \text{ m} \]
\[ n = \frac{N}{f} = \frac{N}{2\pi r}, \quad I_f = 0.4 \text{ A}, \quad B = 2.5 \text{ T}, \]
\[ k_m = \frac{\mu}{\mu_0} = (?) \]
\[ B = \mu N = \mu n I_f \]
\[ \therefore \frac{B}{\mu_0} = \frac{\mu}{\mu_0} I_f = k_m n I_f \]
\[ \therefore k_m = \frac{B}{\mu_0 n I_f} = \frac{B2\pi r}{\mu_0 n I_f} \]
\[ = \frac{2.5 \times 2\pi \times 13.5 \times 10^{-2}}{4 \pi \times 10^{-7} \times 5000 \times 0.4} \]
\[ = 0.0084375 \times 10^5 \]
\[ h_0 = 843.75 \text{ m} \]

20. (B) 13.53 mm

\[ \therefore \] From Snell's law \( n_1 \sin \theta_1 = n_2 \sin \theta_2 \]
\[ \therefore (1) \sin 53^\circ = 1.6 \sin \theta_2 \]
\[ \therefore \sin \theta_2 = \frac{0.8}{1.6} = \frac{1}{2} = \sin 30^\circ \]
\[ \therefore \theta_2 = 30^\circ \]

Now, \( x = \frac{\tan(\theta_1 - \theta_2)}{\cos \theta_2} \]
\[ = 30 \tan(53^\circ - 30^\circ) \]
\[ = \frac{30 \sin 23^\circ \times 30 \times 0.3907 \times 2}{\cos 30^\circ \sqrt{3}} \]
\[ = 13.53 \text{ mm} \]

21. (C) \( 6.94 \times 10^{-15} \text{ M} \)

\[ \therefore \text{P.E. of electron} \]

22. (C) \( \frac{9(\sqrt{2} - 1)}{\sqrt{2}} \times 10^9 \text{ J} \)

\[ \therefore W = \frac{q(Q_1 - Q_2)}{4\pi \varepsilon_0 R} \left( \frac{\sqrt{2} - 1}{\sqrt{2}} \right) \]
\[ = \frac{kq(Q_1 - Q_2)}{R} \left( \frac{\sqrt{2} - 1}{2} \right) \]
\[ = 9 \times 10^9 \times (5 - 3) \left( \frac{\sqrt{2} - 1}{\sqrt{2}} \right) \text{ J} \]

23. (A) \( 4.5 \times 10^{-8} \text{ } \Omega \text{m} \)

\[ \therefore \text{We have } \left( \rho_{20} \right)_2 = \frac{\left( \rho_{20} \right)_1}{\alpha_2} \]
\[ = \frac{3 \times 10^{-8} \times 9 \times 10^{-6}}{6 \times 10^{-4}} \]
\[ = 4.5 \times 10^{-8} \Omega \cdot \text{m} \]

24. (C) \( -0.5 \text{ D} \)

\[ \therefore P = \frac{1}{f} = \left( \frac{n_g}{n_a} - 1 \right) \left( \frac{1}{R_1} - \frac{1}{R_2} \right) \]
\[ = \left( \frac{n_f}{n_c} - 1 \right) \left( \frac{1}{R_1} - \frac{1}{R_2} \right) \]
\[
\begin{align*}
\cdot \quad & P' = \left( \frac{n_{e}}{n_{c}} - 1 \right) = \left( \frac{1.5}{1.6} - 1 \right) = \frac{-0.1}{1.6} = 0.5 \\
\cdot \quad & P = \frac{-1 \times 2}{16 \times 1} = \frac{-1}{8} \\
& = \frac{-1}{8} \times 4 = \frac{-1}{2} = -0.5 \text{D}
\end{align*}
\]

25. (C) 150 Nm\(^2\)C\(^{-1}\)

\(\mathbf{E} = 5\hat{i} + 2\hat{j} + 3\hat{k} \text{ N/C}\),

\(A = 50 \text{m}^2\) in XY plane

\(\therefore \mathbf{A} = 50\hat{k} \text{ m}^2\)

\(\phi = \mathbf{E} \cdot \mathbf{A}\)

\[=(5\hat{i} + 2\hat{j} + 3\hat{k}) \cdot (50\hat{k})\]

\[= 150 \text{ Nm}^2 \text{C}^{-1}\]

26. (C) \(M^1L^1T^{-3}A^{-1}\)

\(\mathbf{E} = \frac{\mathbf{F}}{q} = \frac{N}{C} = \frac{M^1L^1T^{-2}}{A^1T^1} = M^1L^1T^{-3}A^{-1}\)

\(\therefore \frac{-\lambda_0 L^5}{5}\)

\(\therefore Q = \int_0^L \lambda(x) \, dx = \lambda_0 \int_0^L x^4 \, dx\)

\[= \lambda_0 \left[ \frac{x^5}{5} \right]_0^L = \frac{\lambda_0 L^5}{5}\]

27. (B) \(\frac{F}{4}\)

\(\therefore F' = \frac{F}{k} = \frac{F}{4}\)

29. (B) 2

\(\therefore |E(z)| = \frac{2kp}{z^3}, |E(y)| = \frac{kp}{y^3}\)

at \(z = y \gg a\), \(\left| \frac{E(z)}{E(y)} \right| = 2\)

30. (C) \(\frac{F}{8}\)

\(\therefore F = \frac{k(2Q)(Q)}{r^2} = \frac{2kQ^2}{r^2} \quad \ldots(1)\)

After separation, \(\frac{Q}{2}\)\(\frac{A}{r}\)

\(\therefore F_1 = \frac{kQ^2}{r^2} \quad \ldots(2)\)

\(\therefore \frac{F}{F_1} = \frac{2kQ^2}{r^2} \times \frac{4r^2}{kQ^2} = 8\)

\(\therefore F_1 = \frac{F}{8}\)

31. (C) \(\frac{R_1}{R_2}\)

\(\therefore\) Electric field on the surface a charged sphere is,

\(E = \frac{kQ}{R^2} = \left( \frac{kQ}{R} \right) \frac{R}{R} = \frac{V}{R}\)

After bringing in contact, electric potential on the surface of both spheres become equal.

\(\therefore E \propto \frac{1}{R}\)

\(\therefore \frac{E_1}{E_2} = \frac{R_2}{R_1}\)

32. (A) \(\frac{4\varepsilon_0 l^2}{3d}\)

\(\therefore\) Area of each plate = \(A = \ell^2\). Capacitance formed by plates 1 and 2 is \(C_1 = \frac{\varepsilon_0 A}{d}\)

Capacitance formed by plates 3 and 4 is zero because effective parallel area between two plates = 0.

Capacitance formed by plates 5 and 6 is \(C_{3} = \frac{\varepsilon_0 A}{3d}\).

Now \(C_1\) and \(C_3\) are in parallel,

\(\therefore C = C_1 + C_3 = \frac{\varepsilon_0 A}{d} + \frac{\varepsilon_0 A}{3d}\)

\[= \frac{4\varepsilon_0 A}{3d} = \frac{4\varepsilon_0 l^2}{3d}\]
Distance between vertices and centre of square is \( r = \frac{a}{\sqrt{2}} \)

Total electrical potential at the centre \( V = V_1 + V_2 + V_3 + V_4 \)
\[
= \frac{kq}{a} + \frac{kq}{a} - \frac{kq}{a} - \frac{kq}{a} = 0
\]
34. (B) 3 : 1

Volume of big drop = 27
(volume of small drops)
\[
\frac{4}{3}\pi R^3 = 27 \left( \frac{4}{3}\pi r^3 \right)
\]
\[
\therefore \ R = 3r
\]
Now \( C = 4\pi\varepsilon_0 R = \frac{C_R}{C_r} \)
\[
\frac{R}{r} = \frac{3r}{r} = 3
\]
\[
\therefore \ C_R : C_r = 3 : 1
\]
35. (C) 20 unit

Ex = \( -\frac{dv}{dx} = -10xy + 0 + 2z^2 \)
\[
=-10xy + 2z^2
\]
Substitute \( x = 1, y = 2, z = 0 \)
\( Ex = -10(1)(2) + 2(0)^2 = -20 \)
\[
\therefore \ |Ex| = 20 \text{ unit}
\]
36. (D) \( 8 \times 10^6 \) V

\[
V = \frac{kQ}{r} = \frac{k(ne)}{r}
\]
\[
= \frac{9 \times 10^9 \times 50 \times 1.6 \times 10^{-19}}{9 \times 10^{-15}}
\]
\[
= 80 \times 10^5 = 8 \times 10^6 \text{ V}
\]
37. (C) 200 V/m

\[
d = 10 \text{ cm} = 10 \times 10^{-2} \text{ m}, \ V = 20V
\]
\[
E = \frac{V}{d} = \frac{20}{10^{-1}} = 200 \text{ V/m}
\]
38. (D) \( 2 \times 10^2 \Omega \)m

\[
\therefore \ \rho = \frac{J}{E} = \frac{3}{15 \times 10^{-6}} = \frac{1}{5 \times 10^{-6}}
\]
\[
= 0.2 \times 10^{+6} = 2 \times 10^5 \Omega \text{m}
\]
39. (A) 22A

\[
Q = 4t^2 + 6t + 4, \ \frac{dQ}{dt} = 8t + 6
\]
\( I \) (at \( t = 2 \) sec) = \( (8(2) + 6) = 22A \)
40. (B) \( \frac{V_d}{q} \)

\[
I = Av_dne \quad \therefore \ v_d \propto \frac{1}{A} \quad \therefore \ v_d \propto \frac{1}{r^2}
\]
So,
\[
\frac{v_d'}{v_d} = \left( \frac{r'}{r} \right)^2 = \left( \frac{r}{3r} \right)^2 = \frac{1}{9}
\]
\[
\therefore \ v_d' = \frac{v_d}{9}
\]
41. (B) \( \frac{L}{2}, \ 2D \)

\[
R = \frac{\rho l}{A} = \frac{\rho l^2}{A \cdot l} = \frac{\rho l^2}{V} = \frac{4 \pi}{3} \pi D^2
\]
\[
\therefore \ R \propto \frac{l^2}{D^2}
\]
Resistance should be minimum for smaller value of length and higher value of diameter.
\[
i.e. \ l' = \frac{L}{2}, \ d' = 2D
\]
42. (C) 4Ω

\[
R \propto l^2
\]
So,
\[
\frac{R_2}{R_1} = \left( \frac{l_2}{l_1} \right)^2 = \left( \frac{5l}{l} \right)^2 = 25
\]
\[
\therefore \ R_1 = \frac{R_2}{25} = \frac{100}{25} = 4\Omega
\]
43. (C) \( \sqrt{\frac{JH}{R}} \)

\[
H = \frac{l^2Rt}{J}; \ \text{at} \ t = 1, \ H = \frac{l^2R}{J}
\]
\[
l^2 = \frac{HJ}{R}; \ I = \sqrt{\frac{HJ}{R}}
\]
44. (B) \( M^1L^3T^{-3}A^{-2} \)

\[
R = \frac{\rho l}{A}; \ \rho = \frac{RA}{e} = \Omega \text{m}
\]
\[
[\rho] = M^1L^2T^{-3}L^1 = M^1L^3T^{-3}A^{-2}
\]
(B) inversely proportional

\[ B \propto \frac{1}{r} \]

46. (B) 0

\[ \Delta K \cdot E = 0 \]

\[ \therefore W = DK \cdot E = 0 \]

47. (D) remain stationary

\[ \text{Here velocity of electron = 0. } \]

So \( F = qvB \sin \theta = 0 \)

48. (A) 11 Ω

\[ S = \frac{4I_4}{1-1_4} = \frac{99 \times 0.11}{1 - 0.11} = 11 \ A \]

49. (C) 1T

\[ B \propto \frac{1}{y} \]

\[ \therefore \frac{B'}{B} = \frac{y}{y'} = \frac{r}{r/2} = 2 \]

\[ \therefore B' = 2B = 2(0.5) = 1.0 \ T \]

50. (C) 25

\[ B = \frac{\mu_0 NI}{2r} \]

\[ N = \frac{2Br}{\mu_0 I} = \frac{2 \times 3.14 \times 10^{-3} \times 5 \times 10^{-2}}{4\pi \times 10^{-7} \times 10} \]

\[ = 0.25 \times 10^2 = 25 \]

51. (B) Voltmeter

52. (A) 0.075

\[ \mu_r = 1 + XXX \]

\[ \mu_r = 1 - 0.925 = 0.075 \]

53. (C) \( \frac{p}{2} \), \( \frac{m}{2} \)

\[ \text{When magnetic is cut in to two pieces along its axi then its magnetic moment and pole strength, both are half.} \]

54. (C) Two times

\[ T = \frac{2\pi m}{qB} \]

For \( \alpha \)-particle \( T_\alpha = \frac{2\pi m_\alpha}{q_\alpha B} \) and for.

proton \( T_p = \frac{2\pi m_p}{q_p B} \)

\[ \therefore \frac{T_\alpha}{T_p} = \frac{m_\alpha}{q_\alpha} \times \frac{q_p}{m_p} = \frac{(4m_p)}{(2e)} \times \frac{e}{m_p} = 2 \]

\[ \therefore T_\alpha = 2 T_p \]

55. (A) \( \frac{T}{3} \)

\[ m_1 = m, \ m_2 = 9m \]

\[ T = 2\pi \sqrt{\frac{l}{mb}} \Rightarrow \frac{T_2}{T_1} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{m}{9m}} = \frac{1}{3} \]

\[ \therefore T_2 = \frac{T_1}{3} = \frac{T}{3} \]

56. (C) 20 cm

\[ n = 1.5, \ R_1 = 200m, \ R_2 = -20 \ cm \]

\[ \frac{1}{f} = (n-1) \left( \frac{1}{R_1} - \frac{1}{R_2} \right) \]

\[ = (1.5-1) \left( \frac{1}{20} + \frac{1}{20} \right) = (0.5) \left( \frac{2}{20} \right) \]

\[ \therefore f = 20 \ cm \]

57. (D) \( 2.25 \times 10^8 \) m

\[ t = \frac{d}{V} \text{ but } n = \frac{C}{V} \text{ : } V = \frac{C}{n} \]

\[ \therefore t = \frac{n \cdot d}{c} \]

\[ \therefore d = \frac{t \cdot C}{n} = \frac{3 \times 3 \times 3 \times 10^8}{4} \]

\[ = 2.25 \times 10^8 \ m \]

58. (A) +0.5D

\[ f = 200 \ cm = 200 \times 10^{-2} \ m \]

\[ \therefore P = \frac{1}{f} = \frac{1}{200 \times 10^{-2}} = \frac{100}{200} = 0.5D \]
59. (B) infinite

\[ \frac{1}{f} = \left( \frac{n_2 - n_1}{n_1} \right) \left( \frac{1}{R_1} - \frac{1}{R_2} \right) \] here \( n_1 = n_2 \)

So, \( \frac{1}{f} = 0 \Rightarrow f = \frac{1}{0} = \text{infinite} \)

60. (C) frequency

Frequency is characteristic of source, not medium.

61. (C) they will become positively charged

62. (A) \( M^1 L^2 T^{-1} \)

\( [h] = \text{Joule-sec.} = M^1 L^2 T^{-2} T = M^1 L^2 T^{-1} \)

63. (A) \( 6 \times 10^{-29} \) nm

64. (A) \( \frac{\lambda}{\phi} \)

For photoelectric effect to be observed, energy of each photon should be at least equal to or more than work function of metal.