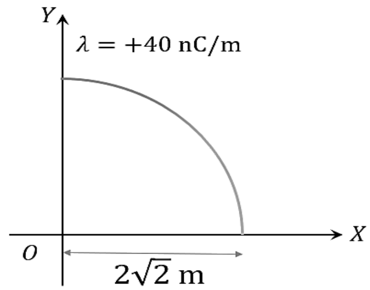
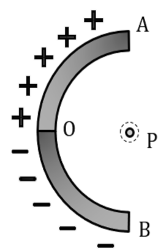
Q.1 For the given uniformly charged quarter ring, net electric field at the center is



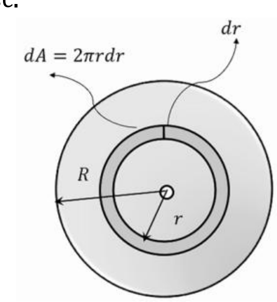
(A) 140 N/C **(B)** 160 N/C **(C)** 180 N/C **(D)** 200 N/C

Q.2 A thin glass rod is bent into a semicircle of radius r. A charge +Q is uniformly distributed along the upper half and a charge −Q is uniformly distributed along the lower half, as shown in figure. Find the electric field E at P.



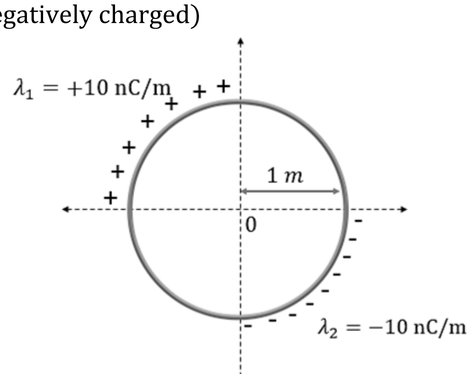
(A) $\frac{Q}{\pi^2\epsilon_0 r^2}$ **(B)** $\frac{2Q}{\pi^2\epsilon_0 r^2}$ **(C)** $\frac{4Q}{\pi^2\epsilon_0 r^2}$ **(D)** $\frac{Q}{4\pi^2\epsilon_0 r^2}$

Q.3 A disc of radius R has surface charge density $\sigma = \sigma_0 r$, where r is the distance from the centre of the disc. Find the total charge on the disc.



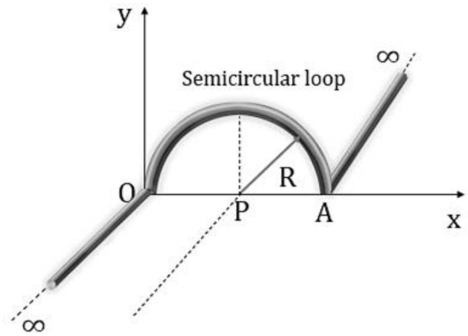
(A) $2\pi\sigma_0 R^3$ **(B)** $\frac{2\pi\sigma_0 R^3}{3}$ **(C)** $\frac{4\pi\sigma_0 R^3}{3}$ **(D)** $\frac{\pi\sigma_0 R^3}{3}$

Q.4 For the given charge distribution on the ring, the net electric field at the centre of non-conducting ring is (Assume the part of ring in first and third quadrant is neutral, second quadrant is positively charged, fourth quadrant is negatively charged)



(A) $180\sqrt{2}$ N/C **(B)** $180\sqrt{3}$ N/C **(C)** $180\sqrt{5}$ N/C **(D)** $180\sqrt{7}$ N/C

Q.5 An infinite wire having linear charge density $+\lambda$ is arranged as shown. A charge particle of mass m and charge q is released from point P. Find the initial acceleration of the particle (at $t = 0$) just after the particle is released. (Assume the straight parts of wire perpendicular to XY plane.)



(A)$\frac{q\lambda}{2\pi\epsilon_0 mR}\hat{j}$ (B)$\frac{q\lambda}{\pi\epsilon_0 mR}(-\hat{j})$ (C)$\frac{2q\lambda}{\pi\epsilon_0 mR}(\hat{k})$ (D)$\frac{q\lambda}{2\pi\epsilon_0 mR}(-\hat{j})$

Q.6 **Assertion:**A uniformly charged disc has a pin hole at its center. The electric field at the center of the disc is zero.

Reason: Disc can be supposed to be made up of many rings. also, electric field at the center of uniformly charged ring is zero.

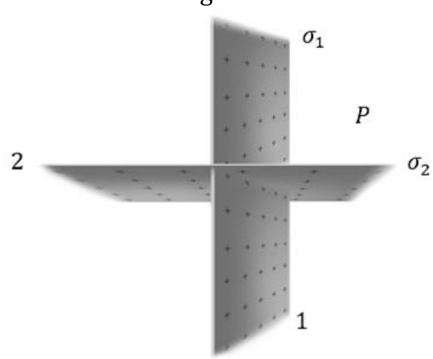
(A) Both Assertion and Reason are correct, and Reason is the correct explanation for Assertion.

(B) Both Assertion and Reason are correct, and but Reason is not the correct explanation for Assertion.

(C) Assertion is true but Reason is false.

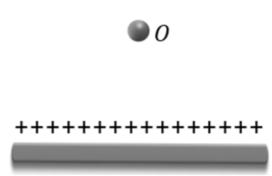
(D) Assertion is false and Reason is true.

Q.7 Two infinite sheets having equal charge densities σ are placed in two perpendicular planes whose two-dimensional view is shown in the figure. The charges are distributed uniformly on sheets in electrostatic equilibrium condition. E_1 and E_2 are electric field at point P due to the sheets 1 and 2 respectively and E is the net electric field. The angle θ is



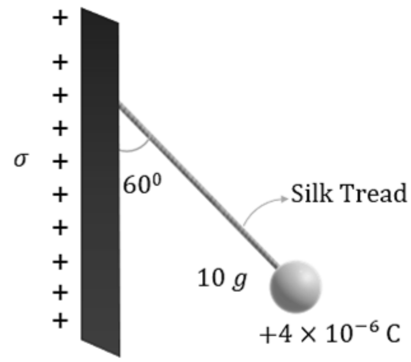
(A)$\sqrt{\frac{\sigma_1^2+\sigma_2^2}{2\epsilon_0}}$ (B)$\frac{\sigma_1^2-\sigma_2^2}{\epsilon_0}$ (C)$\frac{\sigma_1^2+\sigma_2^2}{\epsilon_0}$ (D)Data insufficient

Q.8 A particle of mass 5×10^{-6} g is kept over a large horizontal sheet of charge density $4 \times 10^{-6}\ C/m^2$. What charge should be given to this particle so that if released, it does not fall down?
[Take $\epsilon_0 = 9 \times 10^{-12}\ C^2/Nm^2$]



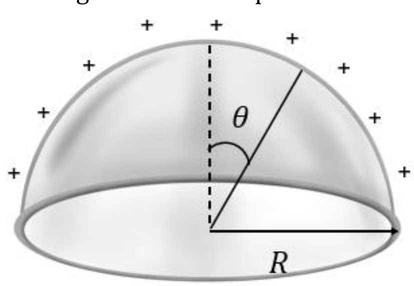
(A) 2.3×10^{-13} C **(B)** 3.3×10^{-13} C **(C)** 4.6×10^{-13} C **(D)** 9.2×10^{-13} C

Q.9 If the shown system is in equilibrium, then the surface charge density on the large sheet is [Take $\epsilon_0 = 9 \times 10^{-12}\ C^2/Nm^2$ and $g = 10\ m/s^2$]



(A) $4.8 \times 10^{-7}\ C/m^2$ **(B)** $5.8 \times 10^{-7}\ C/m^2$ **(C)** $6.8 \times 10^{-7}\ C/m^2$ **(D)** $7.8 \times 10^{-7}\ C/m^2$

Q.10 The surface charge density of a hollow hemisphere varies with θ as $\sigma = \sigma_0 \cos\theta$. The situation is shown in the figure. Find the total charge on the hemisphere.



(A) $\frac{\sigma_0 \pi R^2}{2}$ **(B)** $2\sigma_0 \pi R$ **(C)** $\sigma_0 \pi R^2$ **(D)** $\sigma_0 \pi R^3$

WORK SHEET

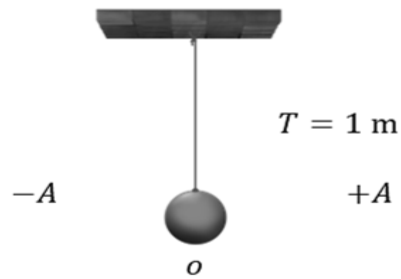
Relative Motion

Q.1 Rain pouring down at an angle α with the vertical has a speed of $5\ \text{ms}^{-1}$. A girl runs against the rain with a speed of $3\ \text{ms}^{-1}$ and sees that rain makes an angle β with the vertical, then the relation between α and β is

(A)$\tan\alpha = \tan\beta$ **(B)**$\tan\alpha = \cot\beta$ **(C)**$\tan\alpha = \frac{3+5\sin\beta}{5\cos\beta}$ **(D)**$\tan\beta = \frac{3+5\sin\alpha}{5\cos\alpha}$

Buoyant Force

Q.2 A simple pendulum oscillating in air has a period of 1 minute. The bob of the pendulum is completely immersed in a non-viscous liquid. If the density of the liquid is $\left(\frac{3}{4}\right)^{th}$ of the density of the material of the body and the bob is inside the liquid at all time, its period of oscillation in the liquid will be



(A)$60s$ **(B)**100s **(C)**120s **(D)**140s

Terminal Velocity

Q.3 If a ball of steel (density $\rho_s = 7.8\ \text{g/cm}^3$) attains a terminal velocity of 10 cm/s when falling in a tank of water (coefficient of viscosity, $\eta_w = 8.5 \times 10^{-4}$ Pa − s). Then, its terminal velocity in glycerine ($\rho_g = 1.2\ \text{g/cm}^3, \eta_g = 13.2$ Pa − s) would be nearly:

(A)1.6×10^{-5} cm/s **(B)**1.5×10^{-5} cm/s **(C)**6.45×10^{-4} cm/s **(D)**6.25×10^{-4} cm/s

Calorimetry

Q.4 600 g of ice at 253 K is mixed with 0.08 kg of steam at 100 °C. Latent heat of vaporization of steam = 540 cal/g. Latent heat of fusion of ice = 80 cal/g. Specific heat of ice = 0.5 cal/g/°C. The resultant temperature of the mixture is

(A)273 K **(B)**300 K **(C)**330 K **(D)**373 K

String Fixed at Both Ends

Q.5 A string, fixed at both ends, vibrates in a resonant mode with a separation of 2.0 *cm* between the consecutive nodes. For the next higher resonant frequency, this separation is reduced to 1.6 *cm*. Find the length of the string.

(A)6 cm **(B)**8 cm **(C)**10 cm **(D)**12 cm

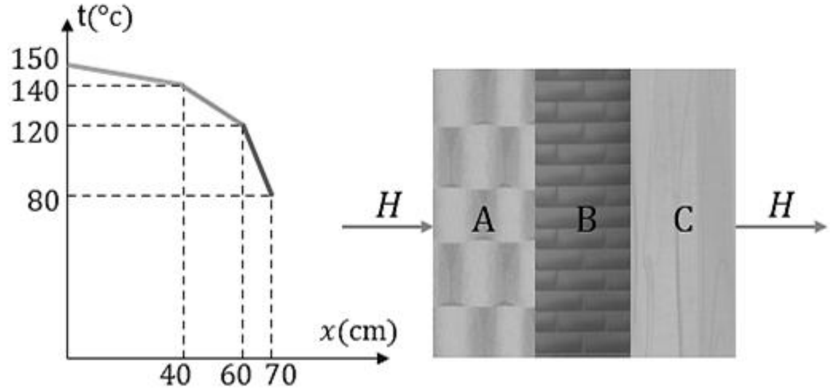
Intensity of Sound Waves

Q.6 Sound from 2 identical sources S_1 and S_2 reach a point P. When both sounds reach in the same phase, the intensity at P due to each source is I_0. The power of S_1 is now reduced by 64

(A)8: 1 **(B)**12: 1 **(C)**16: 1 **(D)**20: 1

Conduction Law

Q.7 The graph shown gives the temperature along x −axis that extends directly throught a wall consisting of three layers A, B and C. The air temperature on one side of the wall differs from that on the other side. Thermal conduction through the wall is steady. Out of the three layers A, B and C thermal conductivity is greatest for layer



(A)A (B)B (C)C (D)Same for all

Apparent Depth

Q.8 A vessel of depth $2h$ is half filled with a liquid of refractive index $2\sqrt{2}$ and the upper half with another liquid of refractive index 2. The liquids are immiscible. The apparent depth of an object which has a height $\frac{h}{2}$ from the bottom of the vessel inside the liquid as seen from the top of the vessel is

(A)$\frac{3h}{4\sqrt{2}}$ (B)$\frac{5h}{4\sqrt{2}}$ (C)$\frac{4h}{4\sqrt{2}}$ (D)$\frac{9h}{4\sqrt{2}}$

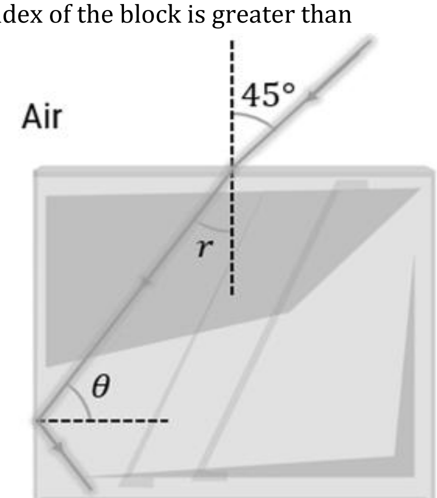
Stefan-Boltzmann's Law

Q.9 Two metallic spheres S_1 and S_2 are made of the same material and have got identical surface finish. The mass of S_1 is thrice that of S_2. Both the spheres are heated to the same high temperature and placed in the same room having lower temperature but are thermally insulated from each other. The ratio of the initial rate of cooling of S_1 to that S_2 is

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

TIR

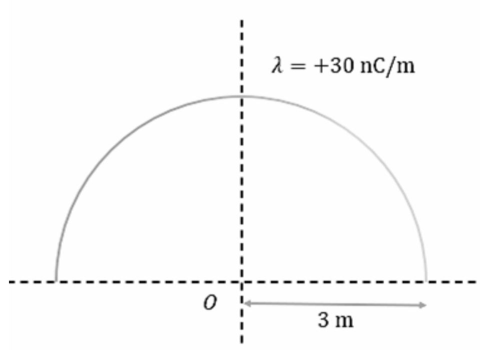
Q.10 For the given incident ray as shown in the figure, the condition for total internal reflection will be satisfied if the refractive index of the block is greater than



(A)$\frac{\sqrt{3}+1}{2}$ (B)$\sqrt{\frac{5}{2}}$ (C)$\sqrt{\frac{3}{2}}$ (D)$\sqrt{\frac{7}{2}}$

Electric Field Due to an Arc at the Centre

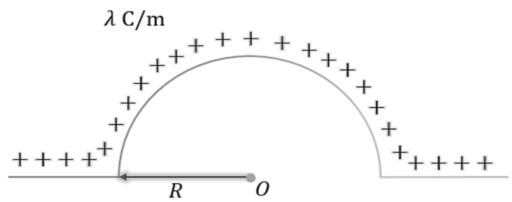
Q.11 For the given uniformly charged semi-circular ring, electric field at the centre is



(A) 150 N/C (B) 160 N/C (C) 170 N/C (D) 180 N/C

Electric Field Due to an Arc at the Centre

Q.12 The electric field intensity due to a thin infinitely long wire of uniform linear charge density λ at O as shown in the figure is

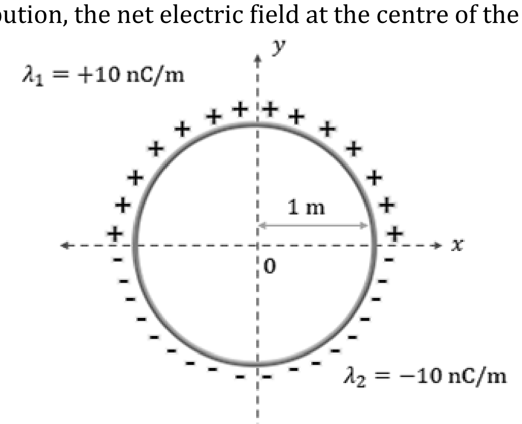


(A) $\frac{\lambda}{2\pi\epsilon_0 R}$ (B) $\frac{\sqrt{2}\lambda}{2\pi\epsilon_0 R}$ (C) $\frac{\lambda\sqrt{5}}{2\pi\epsilon_0 R}$ (D) 0

Q.13 A uniformly charged ring with radius 0.5 m has 0.002π m gap. If the ring carries a charge of +1 C, the electric field at the centre is

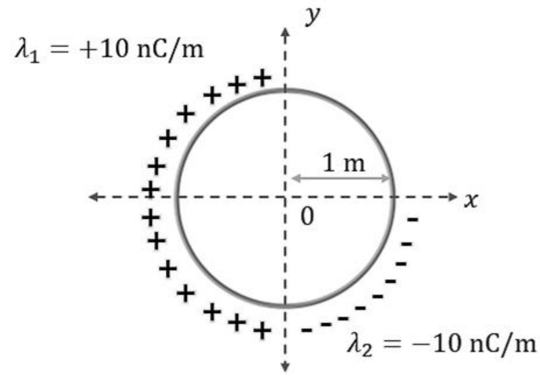
(A) $7.5 \times 10^{7}\ \mathrm{NC^{-1}}$ (B) $7.2 \times 10^{7}\ \mathrm{NC^{-1}}$ (C) $6.2 \times 10^{7}\ \mathrm{NC^{-1}}$ (D) $6.5 \times 10^{7}\ \mathrm{NC^{-1}}$

Q.14 For the given charge distribution, the net electric field at the centre of the non-conducting ring is



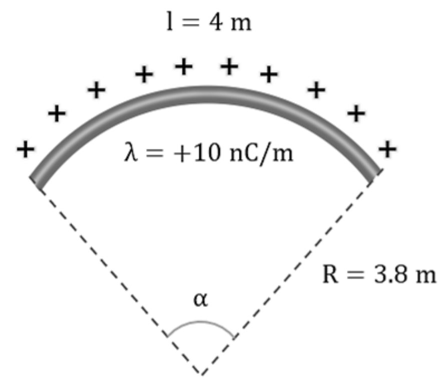
(A) 180 N/C (B) 220 N/C (C) 320 N/C (D) 360 N/C

Q.15 For the given charge distribution, net electric field at the centre of non-conducting ring is (Assume that charge on first quadrant is neutral, second and third quadrant is positively charged, fourth quadrant is negatively charged)



(A) 185 N/C **(B)** 285 N/C **(C)** 384 N/C **(D)** 484 N/C

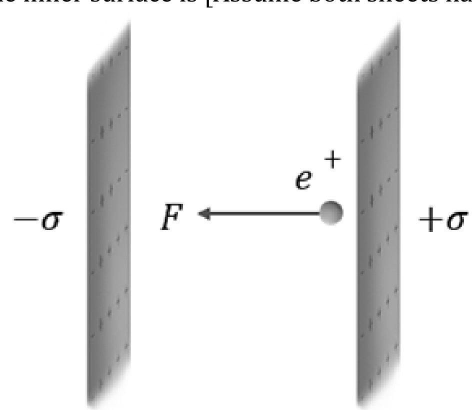
Q.16 For the given uniformly charged ring sector, the net electric field at the point P is (Take $\frac{20}{19}\ rad = 60°$)



(A) 12 N/C **(B)** 16 N/C **(C)** 20 N/C **(D)** 24 N/C

Two Infinite Sheets

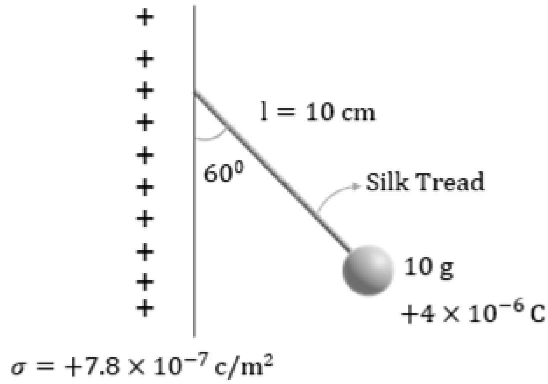
Q.17 Two large conducting sheet are placed parallel to each other with a separation of 2 cm between them. An electron starting from rest near one of the sheets reaches the other plate in 2 μs. The surface charge density on the inner surface is [Assume both sheets have same charge density]



(A) 3.1×10^{-13} C/m^2 **(B)** 4.1×10^{-13} C/m^2 **(C)** 5.1×10^{-13} C/m^2 **(D)** 6.1×10^{-13} C/m^2

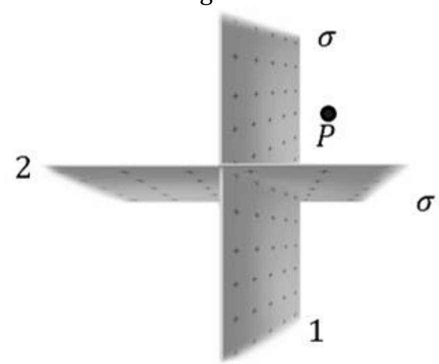
Electric Field Due to Disk and Infinitely Large Sheet

Q.18 The shown system is in equilibrium. Suppose the ball is slightly pushed and released. The time period of small oscillations performed by the ball is



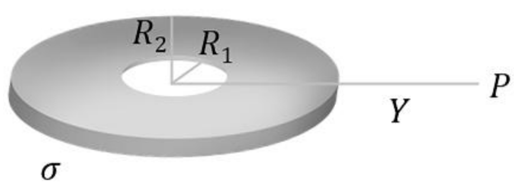
(A)0.44 s **(B)**0.55 s **(C)**0.66 s **(D)**0.77 s

Q.19 Two infinite sheets having equal charge densities σ are placed in two perpendicular planes whose two-dimensional view is shown in the figure. The charges are distributed uniformly on sheets in electrostatic equilibrium condition. E_1 and E_2 are electric field at point P due to the sheets 1 and 2 respectively and E is the net electric field. The angle θ is



(A)30° **(B)**45° **(C)**60° **(D)**15°

Q.20 An annular disc has inner and outer radius R_1 and R_2 respectively. Charge is uniformly distributed. Surface charge density is σ. Find the electric field at any point distant y along the axis of the disc.



(A)$\frac{\sigma y}{2\epsilon_0}\left[\frac{1}{\sqrt{R_1^2+y^2}} - \frac{1}{\sqrt{R_2^2+y^2}}\right]$ **(B)**$\frac{\sigma}{2\epsilon_0}$

(C)$\frac{\sigma y}{2\epsilon_0(R_2-R_1)}$ **(D)**$\frac{\sigma}{2\epsilon_0}\log\frac{R_2+y}{R_1+y}$

ANSWER KEY

Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(C)	(A)	(B)	(A)	(D)	(A)	(A)	(A)	(D)	(C)

WORK SHEET

Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(D)	(C)	(D)	(A)	(A)	(C)	(A)	(B)	(D)	(C)
Q.	11	12	13	14	15	16	17	18	19	20
Sol.	(D)	(A)	(B)	(D)	(B)	(D)	(C)	(B)	(B)	(A)