Q.1 A particle of mass m carrying charge $-q_1$ is moving at a constant angular speed around a fixed charge $+q_2$ at the centre of a circular path of radius r. Find the period of revolution of charge $-q_1$.

(A) $\sqrt{\frac{16\pi^3\epsilon_0 m r^3}{q_1 q_2}}$ **(B)** $\sqrt{\frac{8\pi^3\epsilon_0 m r^3}{q_1 q_2}}$ **(C)** $\sqrt{\frac{q_1 q_2}{16\pi^3\epsilon_0 m r^3}}$ **(D)** Zero

Q.2 A particle A having a charge of 2.0×10^{-6} C and a mass of 100 g is fixed at the bottom of a smooth inclined plane of inclination 30°. Where should another particle B having same charge and mass, be placed on the inclined plane so that B may remain in equilibrium?

(A) 8 cm from the bottom **(B)** 13 cm from the bottom
(C) 21 cm from the bottom **(D)** 27 cm from the bottom

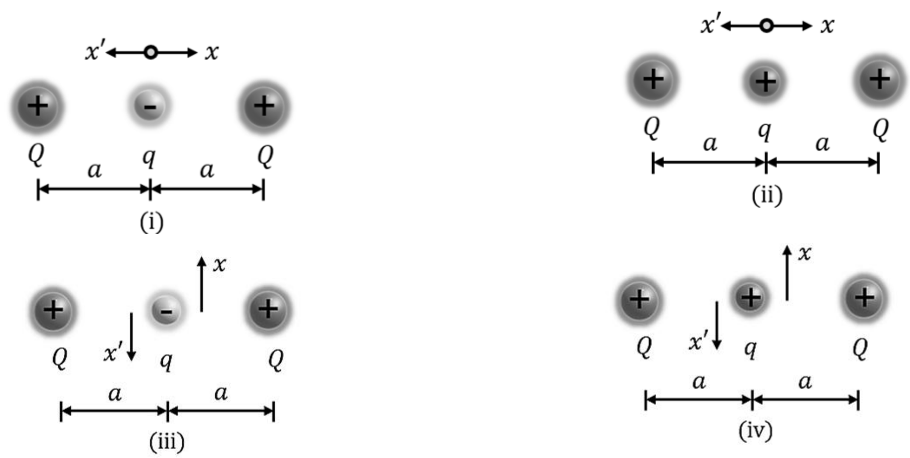
Q.3 Two-point charges $q_1 = +9\ \mu C$ and $q_2 = -1\ \mu C$ are held 10 cm apart. Where should at third charge +Q be placed from q_2 on the line joining them so that charge Q does not experience any net force?

(A) 4 cm **(B)** 5 cm **(C)** 6 cm **(D)** 7 cm

Q.4 Two equal point charges A and B are R distance apart. An equal third charge is placed on the perpendicular bisector at a distance d from the centre will experience maximum electrostatic force when

(A) $d = \frac{R}{2\sqrt{2}}$ **(B)** $d = \frac{R}{\sqrt{2}}$ **(C)** $d = R\sqrt{2}$ **(D)** $d = 2\sqrt{2}R$

Q.5 A charge +q is placed at the centre of the line joining of two exactly equal positive charges Q. Charge q can move only in $x - x'$ direction as shown in figure. Assume +Q charges to be fixed. In which of the above cases charge q is in stable equilibrium?



(A) (I) and (II) **(B)** (II) and (III) **(C)** (III) and (IV) **(D)** (I) and (IV)

Q.6 Three charges of unequal magnitudes can remain in equilibrium if arranged on a [Assume two charges of same nature]

(A) circle **(B)** triangle **(C)** straight line **(D)** None of these

Q.7 Four charges each equal to Q are placed at the four corners of a square and a charge q is placed at the centre of the square. If the system is in equilibrium, then the value of q is

(A) $\frac{Q}{2}(1 + 2\sqrt{2})$ **(B)** $\frac{-Q}{4}(1 + 2\sqrt{2})$ **(C)** $\frac{Q}{4}(1 + 2\sqrt{2})$ **(D)** $\frac{-Q}{2}(1 + 2\sqrt{2})$

Q.8 A solid conducting sphere of radius a has a net positive charge 2Q. A conducting spherical shell of inner radius b and outer radius c is concentric with the solid sphere as shown in the figure and has a net charge −Q. The surface charge density on the inner and outer surfaces of the spherical shell will be

(A) $\frac{-2Q}{4\pi b^2}, \frac{Q}{4\pi c^2}$ **(B)** $\frac{-Q}{4\pi b^2}, \frac{-Q}{4\pi c^2}$ **(C)** $0, \frac{Q}{4\pi c^2}$ **(D)** $\frac{-2Q}{4\pi b^2}, \frac{-Q}{4\pi c^2}$

Q.9 For the given arrangement, a fixed finite line charge is kept in front of a block at equilibrium having -10 nC charge on it. Block and finite line charge are along the same line. If in equilibrium, extension of spring is 10 cm then spring constant (K) is

(A) 3000 N/m **(B)** 3500 N/m **(C)** 3375 N/m **(D)** 2575 N/m

Q.10 Three particles, each of mass $'m'$ and carrying a charge q each, are suspended from a common point by insulating massless strings, each of length $'L'$. If the particles are in equilibrium and are located at the corners of an equilateral triangle of side $'a'$, then calculate the charge q on each particle.

(A) $\left[\frac{4\pi\epsilon_0 a^3 mg}{3L}\right]^{\frac{1}{3}}$ **(B)** $\left[\frac{4\pi\epsilon_0 a^3 mg}{3L}\right]^{\frac{1}{2}}$ **(C)** $\left[\frac{2\pi\epsilon_0 a^3 mg}{3L}\right]^{\frac{1}{2}}$ **(D)** None

WORK SHEET

Q.1 The period of a particle in SHM is 8 s. At $t = 0$, it is at the mean position. The ratio of the distance travelled by it in the 1^{st} and the 2^{nd} second is

(A) $\frac{1}{2}$ **(B)** $\frac{1}{\sqrt{2}}$ **(C)** $\sqrt{2}$ **(D)** $\sqrt{2}+1$

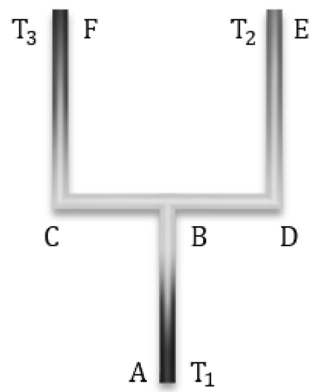
Q.2 Refractive index of a rectangular glass slab is $\mu = \sqrt{3}$. A light ray incident at an angle 60° is displaced laterally through 2.5 cm. Distance travelled by light in the slab is

(A) 4 cm **(B)** 5 cm **(C)** $2.5\sqrt{3}$ cm **(D)** 3 cm

Q.3 The equation of a wave motion is given by, $y = 7\sin(7\pi t - 0.4\pi x + \frac{\pi}{3})$. The ratio of wave velocity to the maximum particle velocity equal is(Assume SI units)

(A) 5: 44 **(B)** 22: 7 **(C)** 44: 7 **(D)** 22: 5

Q.4 Four identical rods AB, CD , CF and DE are connected as shown in figure. The length, cross-sectional area and thermal conductivity of each rod are L, A, K respectively. The ends A, E, F are maintained at temperature T_1, T_2 and T_3 respectively. Assuming no loss of heat to the atmosphere, calculate the temperature at B [CB = BD]. (Consider T_3 as higher temperature)



(A) $\frac{T_1+T_2+T_3}{3}$ **(B)** $\frac{2T_1+3T_2+5T_3}{5}$ **(C)** $\frac{3T_1+2T_2+2T_3}{7}$ **(D)** $\frac{T_1+2T_2+3T_3}{5}$

Q.5 A standing wave set up in a medium is $y = 4\cos(\frac{\pi x}{3})\sin 40\pi t$ where x, y are in cm and t in sec. The velocity of particle at x = 6 cm at $t = \frac{1}{8}$ sec is

(A) 40π cm/s **(B)** -80π cm/s **(C)** 120π cm/s **(D)** -160π cm/s

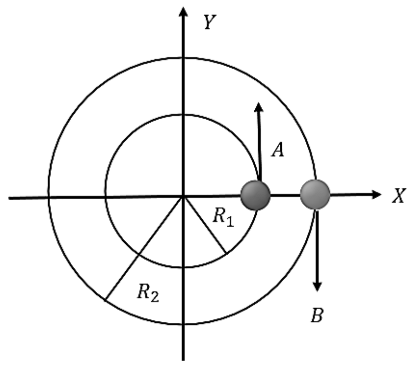
Q.6 For an observer on trolley, direction of projection of particle is shown in the figure, while for observer on ground ball rise vertically. The maximum height reached by ball from trolley is (take $g = 10\ m/s^2$)

(A) 10m **(B)** 15m **(C)** 20m **(D)** 5m

Q.7 Three rods of same length and area of cross-section but of thermal conductivities K, 2K and 3K are connected in series in the same order. Free end of the first rod is at 0° C and free end of third rod is at 55° C. In steady state, temperature difference across the middle rod is

(A) 15° C **(B)** 30° C **(C)** 10° C **(D)** 25° C

Q.8 Two particles A and B are moving on two concentric circles of radii R_1 and R_2 with equal angular speed ω. At $t = 0$, their positions and direction of motion are shown in the figure. The relative velocity $\vec{v_A} - \vec{v_B}$ at $t = \frac{\pi}{2\omega}$ is given by:



(A)$-\omega(R_1 + R_2)\hat{\imath}$ **(B)**$\omega(R_1 + R_2)\hat{\imath}$ **(C)**$\omega(R_1 - R_2)\hat{\imath}$ **(D)**$\omega(R_2 - R_1)\hat{\imath}$

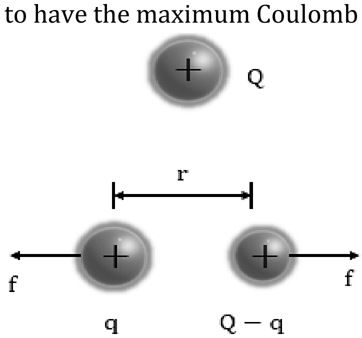
Q.9 A boy of mass 45 kg, whose leg bones have a cross-sectional area of 5 cm^2 and length 50 cm, falls through a height of 2 m without breaking his leg bones. If the bones can withstand a stress of $0.9 \times 10^8\ Nm^{-2}$, calculate the Young's modulus for the material of the bone. Use, $g = 10\ ms^{-2}$

(A)$9 \times 10^9\ Nm^{-2}$ **(B)**$4.5 \times 10^9\ Nm^{-2}$ **(C)**$2.25 \times 10^9\ Nm^{-2}$ **(D)**$1.2 \times 10^9\ Nm^{-2}$

Q.10 You are a student of grade 12. One day in your school, your teacher catches you doing gossip at the back bench. He asks you to either hang the balloon at the wall without using any equipment or go outside the class. How will you come out of this dilemma?

(A) Using the concept of charging by induction **(B)**Using the concept of charging by conduction
(C) Using the concept of charging by friction **(D)**Either of the option a or b

Q.11 A certain charge Q is to be divided into two parts q and Q − q. The relationship between Q and q placed at a certain distance apart to have the maximum Coulomb repulsion is



(A)$q = \frac{Q}{2}$ **(B)**$q = \frac{Q}{3}$ **(C)**$q = \frac{2Q}{2}$ **(D)**$q = \frac{Q}{4}$

Q.12 A small metallic sphere is hung by an insulating thread between two plates A and B with uniform distribution of point charges on their surface. A neutral sphere is hung at the mid point between plates. The net force on the sphere is:

(A)zero **(B)**towards plate A **(C)**towards plate B **(D)**vertically upwards

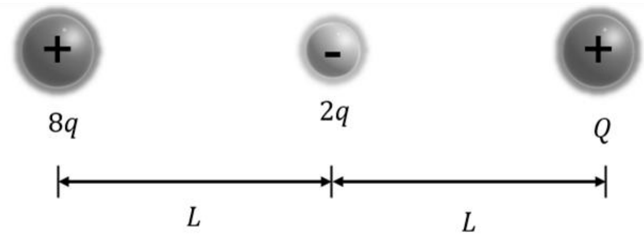
Q.13 A charge Q is placed at each of the two opposite corners of a square. A charge q is placed at each of the other two corners. If the resultant force on each charge q is zero, then

(A) $q = \sqrt{2}Q$ **(B)**$q = -\sqrt{2}Q$ **(C)**$q = 2\sqrt{2}Q$ **(D)**$q = -2\sqrt{2}Q$

Q.14 Four charges are placed at the circumference of a dial clock as shown in the figure. If the clock has only hour hand, then the resultant force on a charge $+q_0$ placed at the centre, points in the direction which shows the time as

(A)1:30 **(B)**7: 30 **(C)**4: 30 **(D)**10: 30

Q.15 A charge Q is placed at a distance L from the charge $-2q$ as shown in figure. The system of three charges will be in equilibrium, if Q is equal to



(A) $-4q$ **(B)** $+4q$ **(C)** $+8q$ **(D)** $-8q$

Q.16 For the given arrangement of charges, charges 1 and 2 are fixed. A third charge at mid of line joining charges 1 and 2 is kept. Net force on third charge is directed toward original position if it is displaced along

(A)axial line **(B)**equatorial line **(C)**BothA and B **(D)** None of these

Q.17 Three charges (two of same nature) are arranged on a straight line are in equilibrium. This nature of equilibrium is

(A) stable **(B)** unstable **(C)** neutral **(D)** Any of the above

Q.18 Four-point charges are placed at the vertices of a square of side $\sqrt{2}\ m$ as shown in figure.
What will be the magnitude of force experienced by a charge $+q$ placed at the centre of the square? Here $k = \frac{1}{4\pi\epsilon_0}$

(A)4kQq **(B)** 2kQq **(C)**$2\sqrt{2}$kQq **(D)**4kQq

Q.19 A charged wire of length 3 m lies along x − axis in such a way that its linear charge density is given by $\lambda = 2x^2$ C/m. The total charge on the wire is

(A)15 C **(B)**18 C **(C)**17 C **(D)**16 C

Q.20 Electrostatic force F on a charge $\frac{Q}{2}$ at an axial point due to a finite line charge varies as $F = \frac{18000}{x^2+4x}$, where x is in metres and is the distance along axial line from one of the ends. The total charge on the line is

(A)2 C **(B)** 0.02 C **(C)**0.002 C **(D)**0.004 C

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

ANSWER KEY

Sol.	(A)	(A)	(D)	(B)	(C)	(B)	(B)	(C)	(B)	(C)