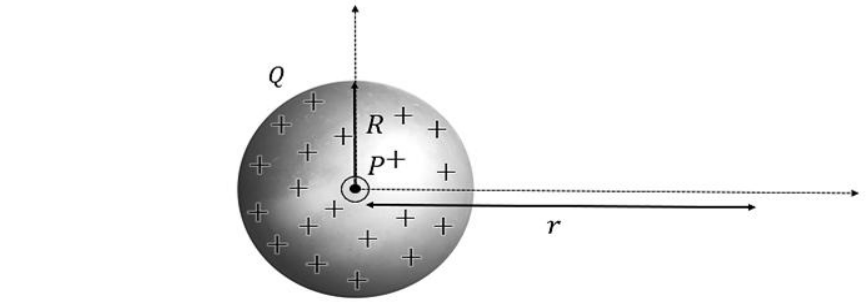
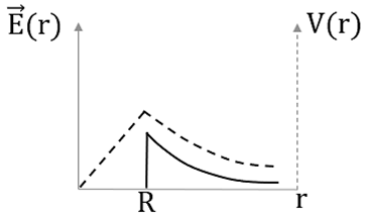
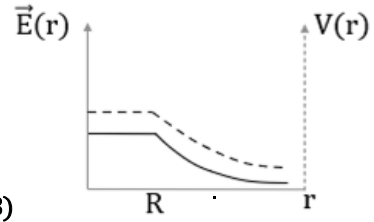
Q.1 Consider a thin spherical shell of radius R with its centre at origin, carrying a uniform positive charge. The variation of electric field $\vec{E}(r)$ and electric potential V(r) with radial distance r from the centre is given by

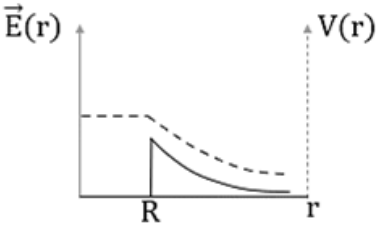




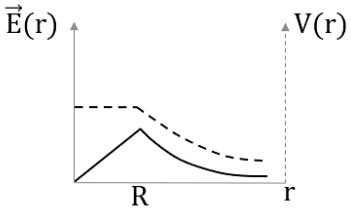
(A)



(B)

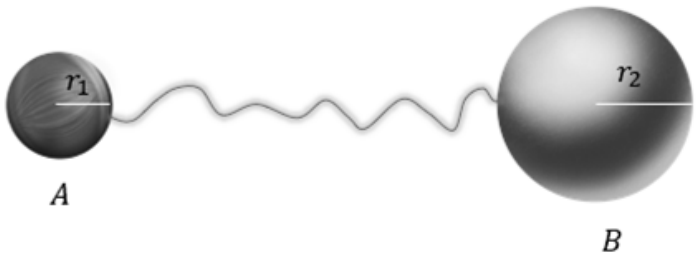


(C)



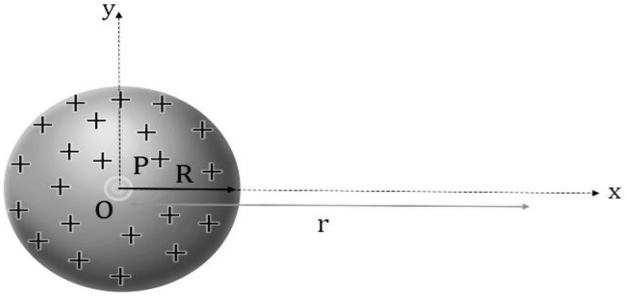
(D)

Q.2 Two metal spheres are very far apart but are connected by a thin wire as shown-If the combined charge of both the sphere is Q, then the common potential will be



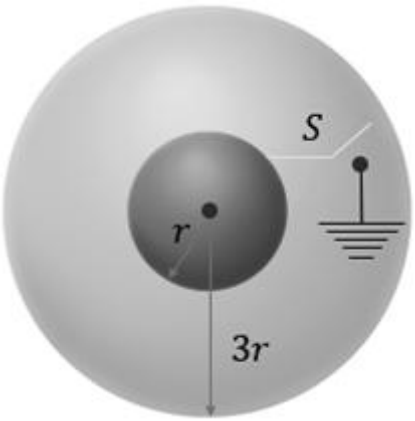
(A) $\frac{kQ}{r_1-r_2}$ (B) $\frac{-kQ}{r_1+r_2}$ (C) $\frac{kQ}{r_1+r_2}$ (D) $\frac{-kQ}{r_1 r_2}$

Q.3 A solid non-conducting sphere of radius R is charged uniformly. At what distance from its surface is the electrostatic potential becomes half of the potential at the centre?



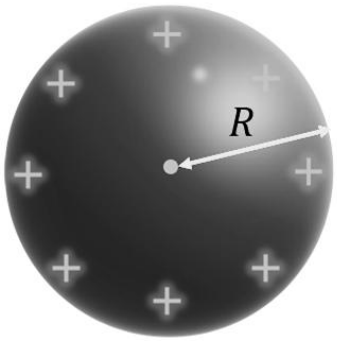
(A) $\frac{4R}{3}$ (B) $\frac{R}{2}$ (C) $\frac{R}{2}$ (D) 2 R

Q.4 Figure shows two conducting thin concentric shells of radii r and $3r$. The outer shell carries a charge q and the inner shell is neutral. The charge that will flow from inner shell to earth after the switch S is closed is



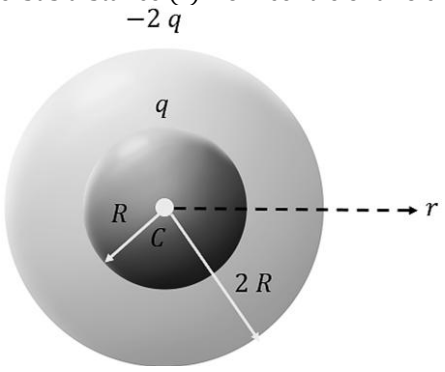
(A) $-\frac{q}{3}$ **(B)** $-\frac{q}{2}$ **(C)** $+\frac{q}{3}$ **(D)** $+\frac{q}{2}$

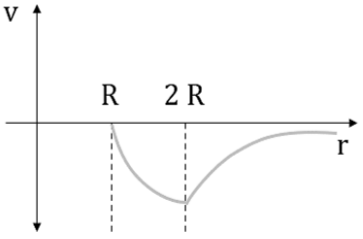
Q.5 A non-conducting sphere of radius 0.5 m carries a total charge of 10×10^{-10} C distributed uniformly which produces an electric field. Then the value of integral $-\int_{\infty}^{0} \vec{E} \cdot d\vec{r}$ will be



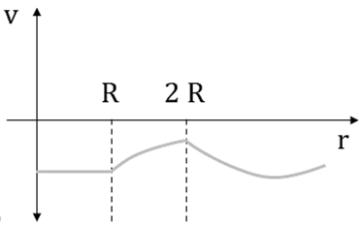
(A) 27 **(B)** –27 **(C)** 0 **(D)** -9

Q.6 Correct curve of potential (V) versus distance (r) from centre of two charged spherical shells is

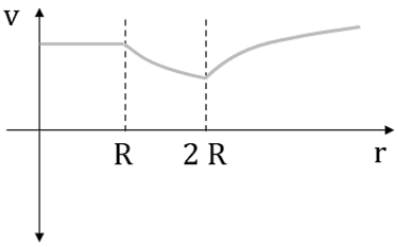




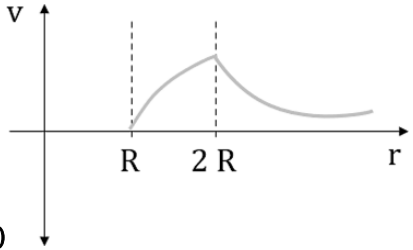
(A)



(B)

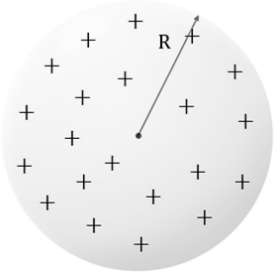


(C)



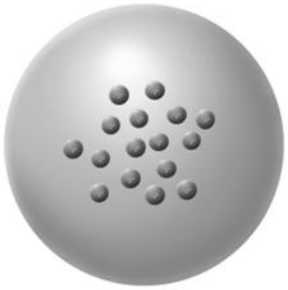
(D)

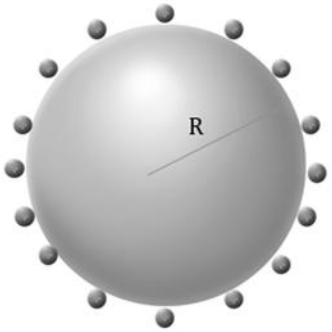
Q.7 A sphere of radius R has a uniform distribution of electric charge in its volume. At a distance x($< R$) from its centre, the electric field is directly proportional to

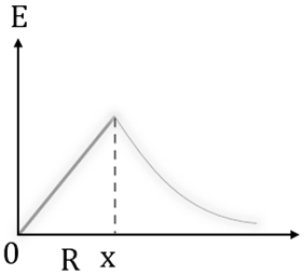


(A) $\frac{1}{x^2}$ (B) $\frac{1}{x}$ (C) x (D) x^2

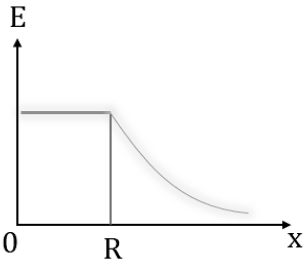
Q.8 An isolated solid metallic sphere of radius R is given an electric charge. Which of the graphs below correctly shows the way in which the electric field E varies with distance x from the centre of the sphere?



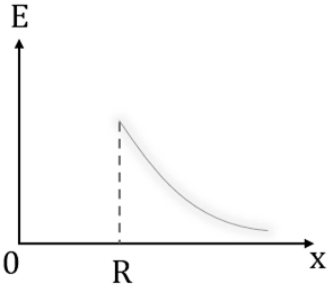




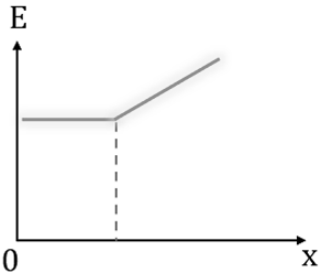
(A)



(B)



(C)

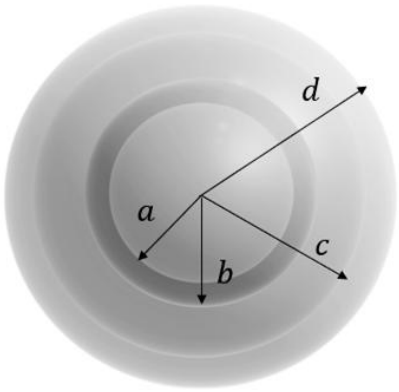


(D)

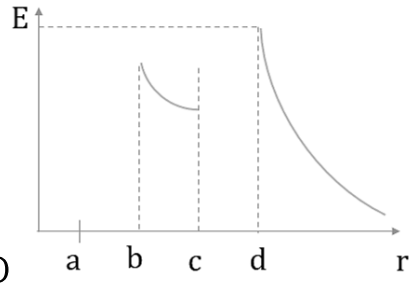
Q.9 A non-conducting ring of radius 0.5 m carries a total charge of 1.11×10^{-10} C distributed non-uniformly on its circumference producing on electric field E everywhere in space. The value of the integral $\int_{l=\infty}^{l=0} -E.\,dl$ (l = 0 being centre of the ring) in volt is

(A) +2 **(B)** –1 **(C)** –2 **(D)** zero

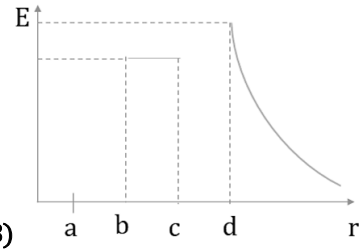
Q.10 A small conducting spherical shell with inner radius a and outer radius b is concentric with a larger conducting spherical shell with inner radius c and outer radius d as shown in the figure. The inner shell has total charge +2q and outer shell has charge +4q. The graph of radial component of electric field (E) as a function of distance (r) from centre of shell will be:



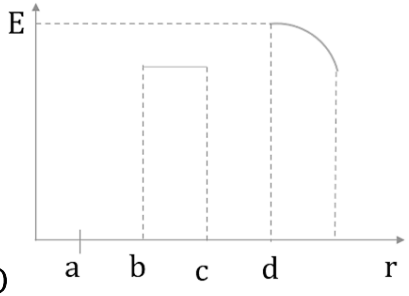
(A)



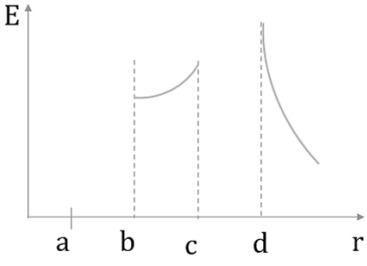
(B)



(C)



(D)

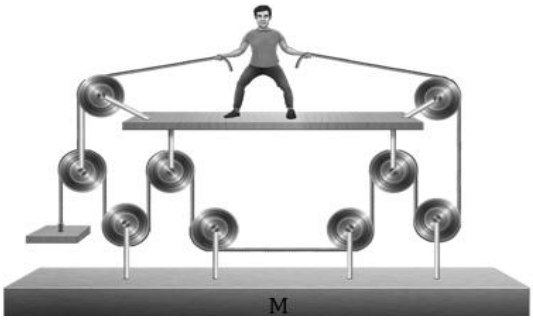


WORK SHEET

Q.1 A police jeep travelling at a speed of 45 km/h is chasing a thief's car moving at a speed of 153 km/h. If police fire a bullet with a muzzle velocity of 180 m/s, the velocity with which it strikes the thief's car is

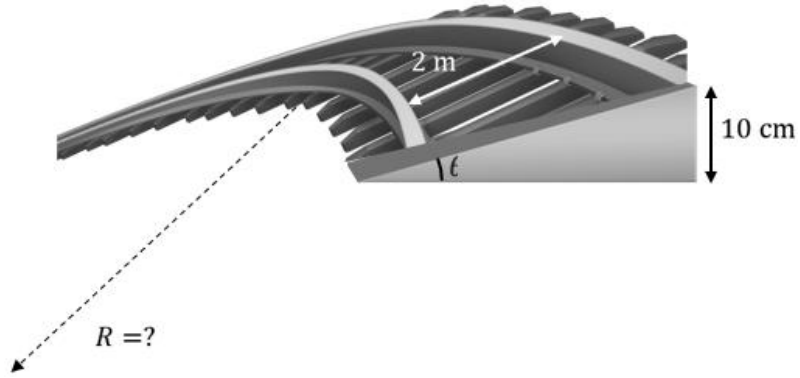
(A) 54 m/s **(B)**150 m/s **(C)**450 m/s **(D)**250 m/s

Q.2 System is shown in the figure and man is pulling the rope from both sides with constant speed 'u'. Then what will be the velocity of the block, if the rope is inextensible?



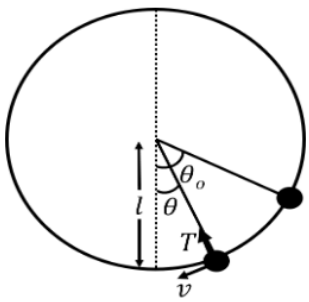
(A) $\frac{3u}{4}$ **(B)** $\frac{u}{2}$ **(C)** $\frac{u}{4}$ **(D)** u

Q.3 A railway track is banked by making the outer rail 10 cm higher than the inner rail. The distance between the rails is 2 m. If the speed limit for trains on this track is 72 km/h, what will be the radius of curvature of the turn 2 for safe travelling? Take $g = 10\ m/s^2$.



(A)80 m **(B)**500 m **(C)**800 m **(D)**1000 m

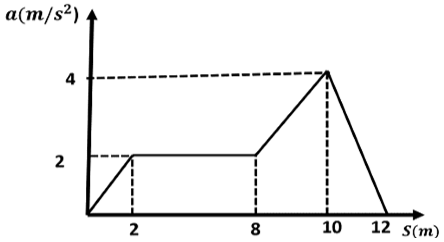
Q.4 A 40 kg mass at the end of a rope of length 1, oscillates in a vertical plane with angular amplitude θ_0 What is the tension T in the rope when it makes an angle & with the vertical? If the breaking strength of the rope is 80 kgf, what is the maximum angular amplitude θ_{max} with which the mass can oscillate without the rope breaking?



(A)$T = mg(2\cos\theta - 3\cos\theta_0), \theta_{max} = 30°$ **(B)**$T = mg(3\cos\theta - 2\cos\theta_0), \theta_{max} = 60°$

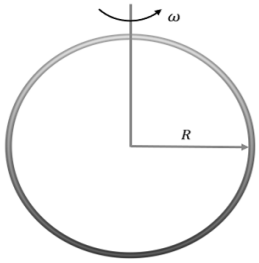
(C)$T = mg(2\cos\theta - 3\cos\theta_0), \theta_{max} = 60°$ **(D)**$T = mg(3\cos\theta - 2\cos\theta_0), \theta_{max} = 30°$

Q.5 The acceleration-displacement graph of a particle moving in a straight line is shown in the figure. Initial velocity of the particle is zero. Find the velocity of the particle when displacement of the particle is 12 m.



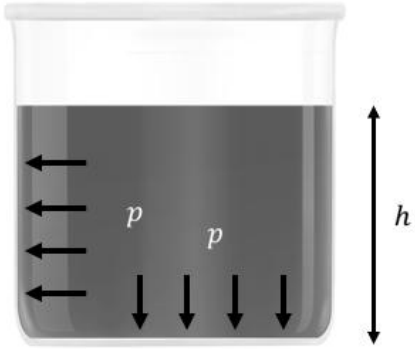
(A) $3\sqrt{2}$ m/s **(B)** 2/5 m/s **(C)** 4 m/s **(D)** $4\sqrt{3}$ m/s

Q.6 A ring of mass m and radius R rotates about an axis passing through its centre and perpendicular to its plane with angular velocity w. Find the velocity of transverse pulse in the ring.



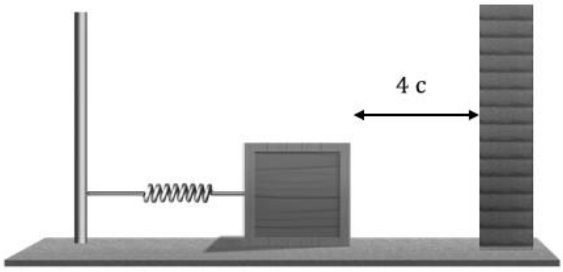
(A) $\frac{R\omega}{2}$ **(B)** $2R\omega$ **(C)** $\frac{3}{2}R\omega$ **(D)** $R\omega$

Q.7 A cylinder has a radius of 10 cm. What height should it be filled with water so that the thrust at its walls is equal to that on its bottom?



(A) 10 cm **(B)** 0.2 cm **(C)** 2.5 cm **(D)** 20 cm

Q.8 A block of mass 200 gram attached to a spring of stiffness 50 N/m is lying on a frictionless floor as shown in figure. The block is moved to compress the spring by 8 cm and released. If collision with the wall is elastic, find the time period of oscillations.

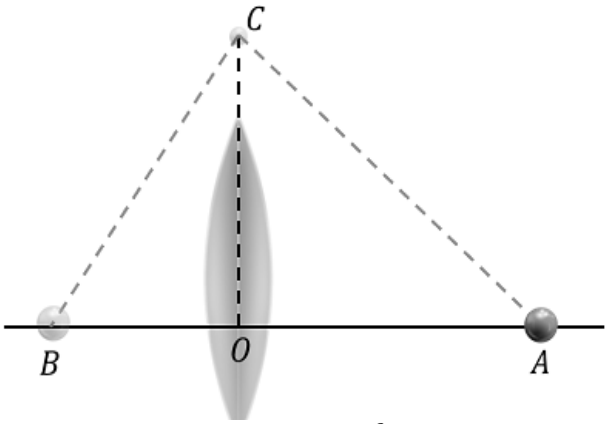


(A) 0.451 sec **(B)** 0.5 sec **(C)** 0.265 sec **(D)** 1 sec

Q.9 Refraction takes place at a concave spherical boundary (of radius of curvature R) separating glass - air medium. For the image to be real, the object which is placed inglass at a distance u $\left(\mu_{\text{glas:}} = \frac{3}{2}\right)$.

(A) $u > 3R$ **(B)** $u < 3R$ **(C)** $u > 2R$ **(D)** $u < R$

Q.10 If an object is placed at A (OA > f); where f is the local length of the lens, the image is formed at B. A perpendicular is erected at O and C is chosen on it such that the ∠BCA is a right angle. Then the value of f will be:



(A) $\frac{AB}{OC^2}$ **(B)** $\frac{(AC)(BC)}{OC}$ **(C)** $\frac{OC^2}{AB}$ **(D)** $\frac{(OC)(AB)}{AC+BC}$

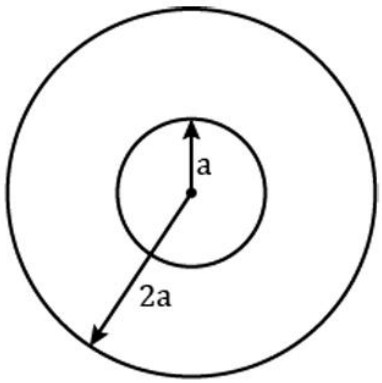
Q.11 A charge of 10 uc is distributed uniformly over the circumference of a ring of radius 3 m placed on the x - y plane with the axis at origin. Find electric potential at point P (0, 0, 4m)

(A) 18×10^3 V **(B)** 18×10^4 V **(C)** 1.8×10^2 V **(D)** 1.8×10^4 V

Q.12 Statement (1): For a non-uniformly charged thin circular ring with net charge zero, the electric potential at each point on the axis of the ring is zero.
Statement (2): For a non-uniformly charged thin circular ring with net charges as zero, electric field at any point on the axis of the ring is zero.

(A) (1) is true, (2) is false. **(B)** (1) is False, (2) is false.
(C) Both statements are true. **(D)** Both statements are false.

Q.13 If the electric potential of the inner shell is 10 V and that of the outer shell is 5 V, then the potential at the centre will be

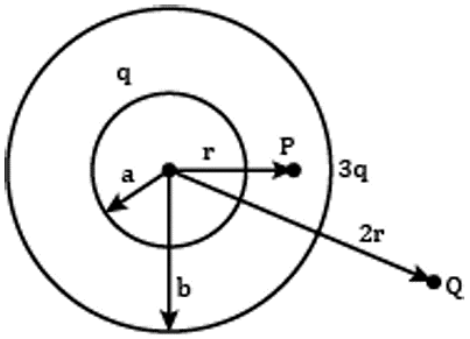


(A) 10 V **(B)** 5 V **(C)** 15 V **(D)** Zero

Q.14 If the atmospheric electric field is approximately 150 V/m and the radius of the earth is 6400 km, then the total charge of the earth is:

(A) 6.8×10^5 C **(B)** 6.8×10^6 C **(C)** 6.8×10^8 C **(D)** 6.8×10^9 C

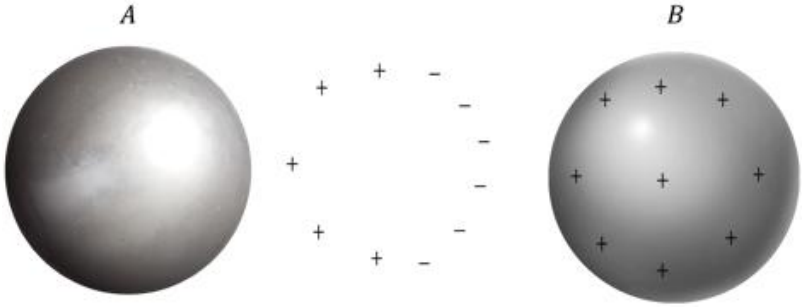
Q.15 The electric field intensity at points P and Q in the shown arrangement, are in the ratio



Hollow concentric shell

(A) 1: 2 **(B)** 2: 1 **(C)** 1: 1 **(D)** 4: 3

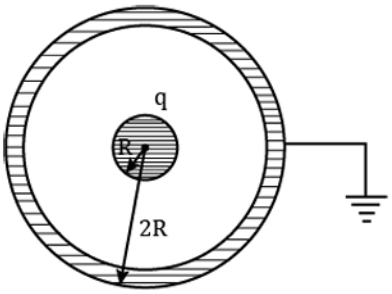
Q.16 An unchanged conductor A is brought near a positively charged conductor B, then



(A) the charge on B will increase but potential of B will not change.
(B) the charge on B will not change but the potential of B will decrease.
(C) the charge on B will decrease but potential of B will not change.
(D) the charge on B will not change but the potential of B will increase.

Q.17 A spherical metal shell of radius R_A and a solid metal sphere of radius $R_B (< R_A)$ are kept far apart and each is given a charge $+Q$. Then they are connected by a thin wire. Choose the correct option.
(A) The electric field inside the shell is zero.
(B) Charge on metal shells is greater than charge on solid metal.
(C) $\frac{\text{Surface charge density of shell}}{\text{Surface charge density of solid sphere}} = \frac{R_B}{R_A}$
(D) All of the above

Q.18 A charge q is distributed uniformly on the surface of a solid sphere of radius R. It is covered by a thick concentric hollow conducting sphere of radius 2R. The charge on outer surface of hollow sphere if it is grounded is

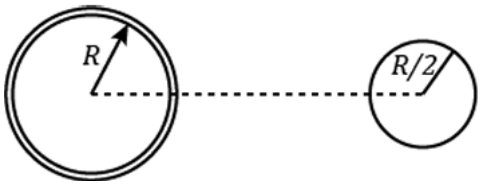


(A) q **(B)** −q **(C)** 0 **(D)** 2q

Q.19 Two concentric conducting spheres of radii R and 2R are carrying charges Q and $-2Q$ respectively. If the charge on inner sphere is doubled, the potential difference between the two spheres will

(A) become two times **(B)**become four times **(C)**be halved **(D)**remain same

Q.20 A ring of radius R having a linear charge density λ moves towards a solid imaginary sphere of radius$\frac{R}{2}$, so that the centre of the ring passes through the centre of sphere. The axis of the ring is perpendicular to the line joining the centres of the ring and the sphere. The maximum flux through the sphere in this process is



(A) $\frac{\lambda R}{\varepsilon_0}$ **(B)**$\frac{\lambda R}{2\varepsilon_0}$ **(C)**$\frac{\lambda \pi R}{4\varepsilon_0}$ **(D)**$\frac{\lambda \pi R}{3\varepsilon_0}$

ANSWER KEY

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