ST. LAWRENCE HIGH SCHOOL

A JESUIT CHRISTIAN MINORITY INSTITUTION

SOLUTION TO WORK SHEET 10

Subject : PHYSICS

CLASS : XII

Date : 16.5.20

Chapter : Electrostatics

Topic : Capacitance of a spherical capacitor when inner shell is earthed, energy density, Van-de-Graaff generator.

Multiple Choice Question : **1 x 15 = 15**

1. A sphrical capacitor consists of two concentric spherical shells in air, when the inner shell is earthed, then capacitance becomes — (b > a)

   (a) $4\pi\in_0 .K.\frac{b^2}{b-a}$ (b) $4\pi\in_0 .\frac{b^2}{b-a}$ (c) $4\pi\in_0$ (d) 0 Ans : (b) $4\pi\in_0 .\frac{b^2}{b-a}$

2. Outer sphere is given a charge q. Why is charge q divided into q_1 & q_2 ?

   (a) outside and inside of the larger sphere is earthed. (b) as inner sphere is earthed

   (c) outer sphere is not earthed (d) none of these.

   Ans. : (a) outside and inside of the larger sphere is earthed.

3. Potential difference between A & B is [from the fig.]

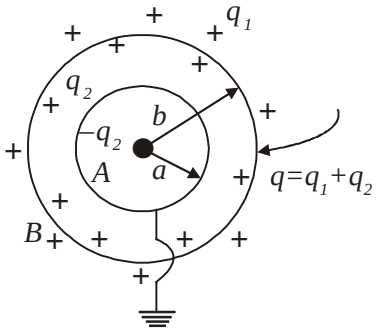
   (a) $V_A - V_B$

   (b) $V_B + V_A$

   (c) V_B

   (d) Zero

   Ans. : (c) V_B



4. If the medium between the two spheres be filled with a dielectric constant K, then its capacitance is

   (a) $4\pi\in_0 .K.\left(\frac{b^2}{b-a}\right)$ (b) $\frac{4\pi\in_0}{K}.\left(\frac{b^2}{b-a}\right)$ (c) $\frac{K}{4\pi\in_0}.ab$ (d) $4\pi\in_0 .K.(b-a)$

   Ans. : (a) $4\pi\in_0 .K.\left(\frac{b^2}{b-a}\right)$

5. Dimension of energy density between two plates in an electric field :

   (a) [M L T^{-2}] (b) [M L^{-1} T^{-2}] (c) [M^2 L^2 T^2] (d) [M^1 L^2 T^3]

   Ans. : (b) [M L^{-1} T^{-2}]

6. Expression for energy density of a parallel plate capacitor in vacuum,

   (a) $\frac{1}{2}\in_0 E^2$ (b) $2\in_0 E^2$ (c) $\in_0 E^2$ (d) $\frac{1}{2}\in_0 E$ Ans. : (a) $\frac{1}{2}\in_0 E^2$

7. Energy density is directly proportional to

   (a) $\in_0$ (b) V (c) E^2 (d) E Ans. : (c) E^2

8. The energy density in the electric field created by a point charge falls off with distance from the point charge as

(a) $\frac{1}{r}$ (b) $\frac{1}{r^2}$ (c) $\frac{1}{r^3}$ (d) $\frac{1}{r^4}$ Ans. : (d) $\frac{1}{r^4}$

9. A charge q_1 is placed at the centre of a spherical conducting shell of radium R. Conducting shell has a total charge q_2. Electrostatic potential energy of the system is

(a) $\frac{q_1^2+2q_1q_2}{8\pi\varepsilon_0 R}$ (b) $\frac{q_2^2+2q_1q_2}{8\pi\varepsilon_0 R}$ (c) $\frac{q_1^2+q_1q_2}{4\pi\varepsilon_0 R}$ (d) $\frac{q_2^2+q_1q_2}{4\pi\varepsilon_0 R}$ Ans. : (b) $\frac{q_2^2+2q_1q_2}{8\pi\varepsilon_0 R}$

10. Let u_a and u_d represent the energy density in air and in a dielectric, respectively, for the same field in both. Let K = dielectric constant. Then,

(a) $u_a = u_d$ (b) $u_a = Ku_d$ (c) $u_d = Ku_a$ (d) $u_a = (K-1)u_d$ Ans. : (c) $u_d = Ku_a$

11. A parallel plate capacitor is connected to a battery. The plates are pulled apart with a uniform speed. If x is the separation between the plates, then the rate of charge of electrostatic energy of the capacitor is proportional to

(a) x (b) x^2 (c) $\frac{1}{x}$ (d) $\frac{1}{x^2}$ Ans. : (d) $\frac{1}{x^2}$

12. A small sphere of radius r_1 having charge q_1 is enclosed by a spherical shell of radius r_2 having charge q_2. Which charge will necessarily flow from the sphere to the shell, when connected

(a) q_1 (b) q_2 (c) Both (a) and (b) (d) May be q_2 Ans. : (a) q_1

13. Van de Graaff generator is used to

(a) store electrical energy (b) build up high voltages of few million volts

(c) decelerate charged particle like electrons (d) Both (a) and (b) are correct

Ans. : (b) build up high voltages of few million volts

14. Which of the following statement(s) is/are true about the principle of Van de Graaff generator?

(a) The action of sharp points

(b) The charge given given to a hollow conductor is transferred to outer surface and is distributed uniformly over it

(c) It is used for accelerating uncharged particle (d) Both (a) and (b) are true

Ans. : (d) Both (a) and (b) are true

15. In a Van de Graaff type generator, a spherical metal shell is to be at a $1.5 \times 10^6 V$. The dielectric strength of the gas surrounding the electrode is $5 \times 10^7\ Vm^{-1}$. What is minimum radius of the spherical shell required?

(a) 0.3 cm (b) 0.03 cm (c) 30 cm (d) 3 m

Ans. : (c) 30 cm

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