Chapter End Test

Max. Mark : 25	Electrostatic Potential and Capacitance	CLASS
Time : 45 Min.		XII

1. Inside a charged hollow spherical conductor, the potential:

(a) is constant.

(b) varies directly as the distance from the centre.

(c) varies inversely as the distance from the centre.

(d) varies inversely as the square of the distance from the centre

2. The electric potential at the surface of an atomic nucleus (Z = 50) of radius 9.0×10^{-15} m is:

(a) 80 volt (b) 8×10^6 volt

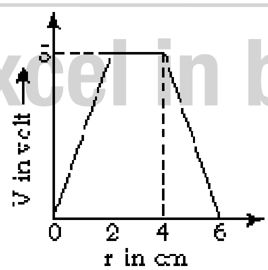
(c) 9 volt (d) 9×10^5 volt

3. A hollow spherical conductor of radius R is given a charge Q. Work done in moving a charge q from its centre to surface is:

(a) $\frac{Qq}{4\pi\varepsilon_0 R}$ (b) $\frac{Qq}{2\pi\varepsilon_0 R}$

(c) $\frac{Qq}{\pi\varepsilon_0 R}$ (d) Zero

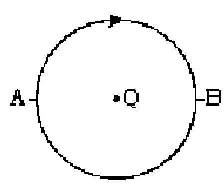
4. The variation of potential with distance r from a fixed point is shown in Fig. The electric field at r = 5 cm, is:



(a) (2.5) V/cm (b) (–2.5) V/cm

(c) (–2/5) V/cm (d) (2/5) V/cm

5. A charge Q is placed at the centre of a circle of radius R. The work done in moving a charge q from A to B so as to complete a semicircle is:



(a) Zero (b) $\frac{Qq}{4\varepsilon_0 R}$

(c) $\frac{Qq}{2\varepsilon_0 R}$ (d) $\frac{Qq}{4\varepsilon_0 R^2}$

6. The energy which an electron acquires when accelerated through a P.D. of 1 volt is called:

(a) 1 joule (b) 1 electron volt

(c) 1 erg (d) 1 watt

7. The capacity of a parallel plate capacitor depends on:

(a) The metal used to make the plates. (b) The thickness of the plates.

(c) The potential applied across the plates. (d) The separation between across the plates.

8. Increasing the charge on the plates of a capacitor means:

(a) Increasing the capacitance.

(b) Increasing the potential difference between the plates.

(c) Decreasing the potential difference between the plates.

(d) No change in the field between the plates.

9. The capacity of a parallel plate capacitor is C. Its capacity when the separation between the plates is halved, will be:

(a) 4C (b) 2C

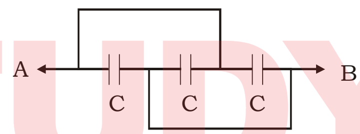
(c) C/2 (d) C/4

10. The energy stored in a capacitor of capacity C which is raised to a potential V is given by:

(a) CV (b) ½CV

(c) $\frac{1}{2}CV^2$ (d) $\frac{1}{2}C^2V$

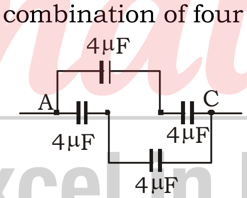
11. Three capacitors are connected as shown in Fig. The equivalent capacity between A and B is:



(a) C (b) 3C

(c) 1/3C (d) 2/3C

12. Equivalent capacitance of the given combination of four capacitors between A and C.



(a) 8 μF (b) 10 μF

(c) 4 μF (d) 124 μF

13. A and B are two thin concentric hollow conductors having radii a and b and charges Q_1 and Q_2 respectively. Given that a > b and P is a point between the two spheres and distance of P from the common centre is r(b < r < a). The potential at P is proportional to

(a) $\frac{Q_1+Q_2}{r}$ (b) $\frac{Q_1}{a}+\frac{Q_2}{r}$

(c) $\frac{Q_1}{a}+\frac{Q_2}{b}$ (d) $\frac{Q_1}{b}+\frac{Q_2}{a}$

14. The electric Potential V at any Point o (x, y, z all in metres) in space is given by $V = 4x^2$ volt. The electric field at the point (1 m, 0.2m) in volt/metre is

(a) 8, along negative x - axis (b) 8, along positives x - axis

(c) 16, along negative x - axis (d) 16, along positives x - axis

15. Three charges 2q, -q, -q are located at the vertices of an equilateral triangle. At the centre of the triangle.

(a) The Field is Zero but Potential is non – zero

(b) The Field is non - Zero but Potential is zero

(c) Both field and Potential are Zero

(d) Both field and Potential are non- Zero

16. A dielectric slab is inserted between the plates of an isolated capacitor. The force between the plates will (Thickness of slab is less than separation between plates)

(a) increase (b) decrease

(c) remain unchanged (d) become zero

17. Two equal charges q are placed at a distance of 2a and a third charge -2q is placed at the midpoint. The potential energy of the system is ....

(a) $\frac{9q^2}{8\pi \epsilon_0 a}$ (b) $\frac{q^2}{8\pi \epsilon_0 a}$

(c) $-\frac{7q^2}{8\pi \epsilon_0 a}$ (d) $\frac{6q^2}{8\pi \epsilon_0 a}$

18. N identical drops of mercury are charged simultaneously to 10 volt, when combined to form one large drop, the potential is found to be 40 volt, the value of N is

(a) 4 (b) 6

(c) 8 (d) 10

19. Two spherical conductors of radii r_1 and r_2 are at potentials V_1 and V_2 respectively, then what will be the common potential when the conductors are brought in contact?

(a) $\frac{r_1 v_1 + r_2 v_2}{r_1 + r_2}$ (b) $\frac{r_1 v_1 + r_2 v_2}{r_1 - r_2}$

(c) $\frac{r_1 v_1 - r_2 v_2}{r_1 + r_2}$ (d) None of these

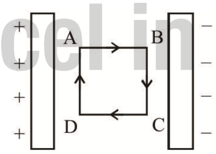
20. Capacitance of a parallel plate capacitor becomes $\frac{4}{3}$ times its original value if a dielectric slab of thickness t = d/2 is inserted between the plates (d is the separation between the plates). The dielectric constant of the slab is

(a) 8 (b) 4

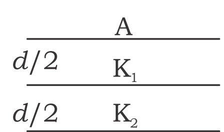
(c) 6 (d) 2

21. What is the work done in moving a test charge q through a distance of 1 cm along the equatorial axis of an electric dipole? **[1]**

22. A uniform electric field E exists between two charged plates as shown in the figure. What would be the workdone in moving a charge 'q' along the closed rectangular path ABCDA? Give reason. **[1]**



23. A parallel plate capacitor is filled with two dielectric as shown in figure. What is its capacitance? **[2]**

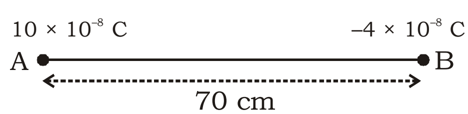


24. A parallel plate capacitor with air between its plates having plate area of 6×10^{-3} m^2 and separation between them 3 mm is connected to a 100 V supply. Explain what would happen when a 3 mm thick mica sheet of dielectric constant 6 is inserted between the plates

(a) while voltage supply remains constant and

(b) while voltage supply is disconnected. **[3]**

25. Two point charges 10×10^{-8} C and -4×10^{-8} C are separated by a distance of 70 cm in air as shown in figure.



(i) Find at what distance from point A would the electric potential be zero.

(ii) Also calculate the electrostatic potential energy of the system. **[3]**

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Hints/Solutions to Chapter End Test

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1. (a)	**2.** (b)	**3.** (d)	**4.** (a)	**5.** (a)
6. (b)	**7.** (d)	**8.** (b)	**9.** (b)	**10.** (c)
11. (b)	**12.** (c)	**13.** (b)	**14.** (a)	**15.** (b)
16. (c)	**17.** (c)	**18.** (c)	**19.** (a)	**20.** (d)

21. Zero

22. Zero because electrostatic field is a conservative field and the work done in a closed path is zero.

23. $C_1 = K_1 \frac{\varepsilon_0 A}{d/2} = \frac{2K_1\varepsilon_0 A}{d}$ $\quad C_2 = K_2 \frac{\varepsilon_0 A}{d/2} = \frac{2K_2\varepsilon_0 A}{d}$

Since, they are in series.

$$\frac{1}{C} = \frac{1}{C_1} = \frac{1}{C_2} = \frac{d}{2K_1\varepsilon_0 A} + \frac{d}{2K_2\varepsilon_0 A}$$

$$\frac{1}{C} = \frac{d}{2\varepsilon_0 A}\left(\frac{1}{K_1} + \frac{1}{K_2}\right)$$

$$C = \frac{2\varepsilon_0 A K_1 K_2}{d(K_1 + K_2)}$$

24. (a) New capacitance (C') = KC

$$= K\frac{\varepsilon_0 A}{d}$$

$$= 6 \times \frac{8.85 \times 10^{-12} \times 6 \times 10^{-3}}{3 \times 10^{-3}}$$

$$= 1.06 \times 10^{-10} \text{ F}$$

Voltage after inserting mica = Voltage before inserting mica

Since, E = $\frac{V}{d}$

Electric field after inserting mica = Electric field before inserting mica

Potential Energy = $\frac{1}{2}C'V'^2 = \frac{1}{2}(KC)V^2$

$= K\left(\frac{1}{2}CV^2\right)$ ...(∴ Six times)

Q' = C'V' = KCV = KQ ...(∴ Six times)

(b) Electric field reduces by a factor K,

$E' = \frac{E}{6}$ ...(Electric field reduces by six times)

Since, $V = Ed$

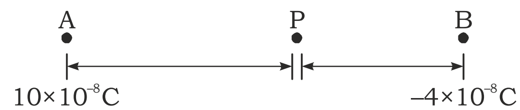
$V' = \frac{V}{6}$ ...(Potential difference reduces by six times)

Energy = $\frac{1}{2}C'V' = \frac{1}{2}(KC)\left(\frac{V}{K}\right)^2$

$= \frac{\frac{1}{2}C'V'}{K}$ ...(Energy reduces by a factor of six)

Charge Q' = C'V' = $KC\frac{V}{K} = Q$ ...(Charge remain the same)

25. (i) $V_P = V_A + V_B$



$O = \frac{K(10\times10^{-8})}{(70-x)\times10^{-2}} + \frac{K(-4\times10^{-8})}{x\times10^{-2}}$

$\frac{10}{70-x} = \frac{4}{x}$

$10x = 280 - 4x$

$14x = 280$

$x = 20$ cm

(ii) $U = \frac{Kq_1q_2}{r} = \frac{9\times10^9\times(10\times10^{-8})(-4\times10^{-8})}{0.7}$

$U = -5.14 \times 10^{-5}$ J