DPP - 03

Capacitor

Q.1 A parallel plate capacitor with air between the plates has a capacitance of 9pF. The separation between its plates is ' d '. The space between the plates is now filled with two dielectrics. One of the dielectric has dielectric constant $K_1 = 3$ and thickness $\frac{d}{3}$ while the other one has dielectric constant $K_2 = 6$ and thickness $\frac{2d}{3}$. Capacitance of the capacitor is now

(A) 1.8pF (B) 45pF (C) 40.5pF (D) 20.25pF

Q.2 Half of the space between parallel plate capacitor is filled with a medium of dielectric constant K parallel to the plates. If initially the capacity is C, then the new capacity will be :-

(A) $\frac{2KC}{1+K}$ (B) $\frac{C(K+1)}{2}$ (C) $\frac{CK}{(1+K)}$ (D) KC

Q.3 The radii of a spherical capacitor are 0.5 m and 0.6 m. If the empty space is completely filled by a medium of dielectric constant 6 , then the capacity of the capacitor will be :-

(A) 3.3×10^{-10} F (B) 2×10^{-9} F (C) 2 F (D) 18 F

Q.4 Capacitance of an isolated conducting sphere of radius R_1 becomes n times when it is enclosed by. a concentric conducting sphere of radius R_2 connected to earth. The ratio of their radii $\left(\frac{R_2}{R_1}\right)$ is

(A) $\frac{n}{n-1}$ (B) $\frac{2n}{2n+1}$ (C) $\frac{n+1}{n}$ (D) $\frac{2n+1}{n}$

Q.5 A slab of dielectric constant K has the same crosssectional area as the plates of a parallel capacitor and thickness $\frac{3}{4}$d, where d is the separation of the plates. The capacitance of the capacitor when the slab is inserted between the plates will be (Given C_0 = capacitance of capacitor with air as medium between plates.)

(A) $\frac{4KC_0}{3+K}$ (B) $\frac{3KC_0}{3+K}$ (C) $\frac{3+K}{4KC_0}$ (D) $\frac{K}{4+K}$

Q.6 Two identical thin metal plates has charge q_1 and q_2 respectively such that $q_1 > q_2$. The plates were brought close to each other to form a parallel plate capacitor of capacitance C. The potential difference between them is

(A) $\frac{(q_1+q_2)}{C}$ (B) $\frac{(q_1-q_2)}{C}$ (C) $\frac{(q_1-q_2)}{2C}$ (D) $\frac{2(q_1-q_2)}{C}$

Q.7 Two metallic plates form a parallel plate capacitor. The distance between the plates is ' d. A metal sheet of thickness $\frac{d}{2}$ and of area equal to area of each plate is introduced between the plates. What will be the ratio of the new capacitance to the original capacitance of the capacitor?

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

Q.8 A parallel plate capacitor with plate area ' A ' and distance of separation ' d ' is filled with a dielectric, What is the capacity of the capacitor when permittivity of the dielectric varies as

$\varepsilon(x) = \varepsilon_0 + kx$, for $\left(0 < x \le \frac{d}{2}\right)$

$\varepsilon(x) = \varepsilon_0 + k(d - x)$, for $\left(\frac{d}{2} \le x \le d\right)$

(A) $\frac{kA}{2}\ln\left(\frac{2\varepsilon_0}{2\varepsilon_0 - kd}\right)$

(B) $\left(\varepsilon_0 + \frac{kd}{2}\right)^{2/kA}$

(C) $\frac{kA}{2\ln\left(\frac{2\varepsilon_0 + kd}{2\varepsilon_0}\right)}$

(D) 0

Q.9 If q_f is the free charge on the capacitor plates and q_b is the bound charge on the dielectric slab of dielectric constant k placed between the capacitor plates, then bound charge q_b can be expressed as

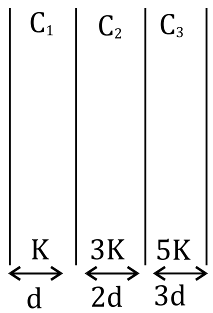
(A) $q_b = q_f\left(1 - \frac{1}{k}\right)$

(B) $q_b = q_f\left(1 + \frac{1}{k}\right)$

(C) $q_b = q_f\left(1 - \frac{1}{\sqrt{k}}\right)$

(D) $q_b = q_f\left(1 + \frac{1}{\sqrt{k}}\right)$

Q.10 In the reported figure, a capacitor is formed by placing a compound dielectric between the plates of parallel plate capacitor. The expression for the capacity of the said capacitor will be (Given, area of plate = A)



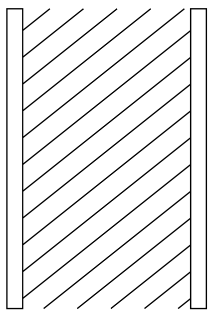
(A) $\frac{9}{6}\frac{K\varepsilon_0 A}{d}$

(B) $\frac{15}{6}\frac{K\varepsilon_0 A}{d}$

(C) $\frac{25}{6}\frac{K\varepsilon_0 A}{d}$

(D) $\frac{15}{34}\frac{KE_0 A}{d}$

Q.11 A parallel plate capacitor has plates of area A separated by distance ' d ' between them. It is filled with a dielectric which has a dielectric constant that varies as $k(x) = K(1 + \alpha x)$ where ' x ' is the distance measured from one of the plates. If $(\alpha d) << 1$, the total capacitance of the system is best given by the expression



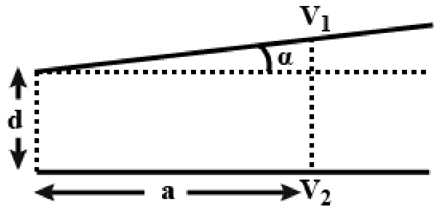
(A) $\frac{A\varepsilon_0 K}{d}\left(1 + \left(\frac{\alpha d}{2}\right)^2\right)$

(B) $\frac{AK\varepsilon_0}{d}\left(1 + \frac{\alpha d}{2}\right)$

(C) $\frac{A\varepsilon_0 K}{d}\left(1 + \frac{\alpha^2 d^2}{2}\right)$

(D) $\frac{AK\varepsilon_0}{d}(1 + \alpha d)$

Q.12 A capacitor is made of two square plates each of side ' a ' making a very small angle α between them, as shown in figure. The capacitance will be close to



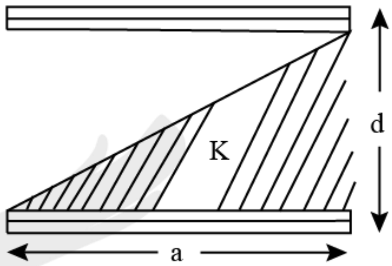
(A) $\frac{\varepsilon_0 a^2}{d}\left(1-\frac{\alpha a}{4d}\right)$

(B) $\frac{\varepsilon_0 a^2}{d}\left(1+\frac{\alpha a}{d}\right)$

(C) $\frac{\varepsilon_0 a^2}{d}\left(1-\frac{\alpha a}{2d}\right)$

(D) $\frac{\varepsilon_0 a^2}{d}\left(1-\frac{3\alpha a}{2d}\right)$

Q.13 A parallel plate capacitor is made of two square plates of side a, separated by a distance $d(d < a)$. The lower triangular portion is filled with a dielectric constant K, as shown in the figure. Capacitance of this capacitor is



(A) $\frac{1}{2}\frac{K\varepsilon_0 a^2}{d}$

(B) $\frac{K\varepsilon_0 a^2}{d(K-1)}\ln K$

(C) $\frac{K\varepsilon_0 a^2}{2d(K+1)}$

(D) $\frac{K\varepsilon_0 a^2}{d}\ln K$

ANSWER KEY

1.	(C)	**2.**	(A)	**3.**	(B)	**4.**	(A)	**5.**	(A)	**6.**	(C)	**7.**	(A)
8.	(C)	**9.**	(A)	**10.**	(D)	**11.**	(B)	**12.**	(C)	**13.**	(B)		