Electrostatic Potential and Capacitance

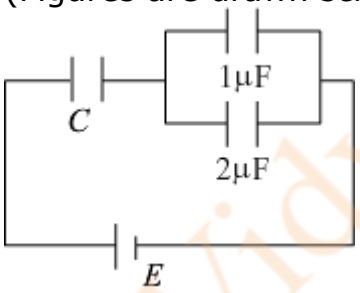
Q.No.1:
Two capacitors C_1 and C_2 are charged to 120 V and 200 V respectively. It is found that by connecting them together, the potential on each one can be made zero. Then:

JEE 2013

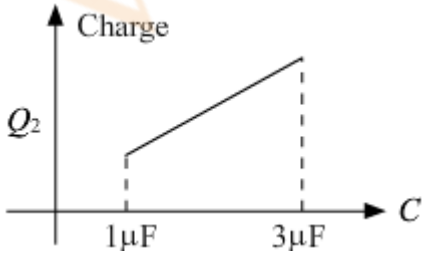
A. $5C_1 = 3C_2$
B. $3C_1 = 5C_2$
C. $3C_1 + 5C_2 = 0$
D. $9C_1 = 4C_2$

Q.No.2: In the given circuit, charge Q_2 on the 2 μF capacitor changes as C is varied from 1 μF to 3 μF. Q_2 as a function of C is represented by
(Figures are drawn schematically and are not to scale.)

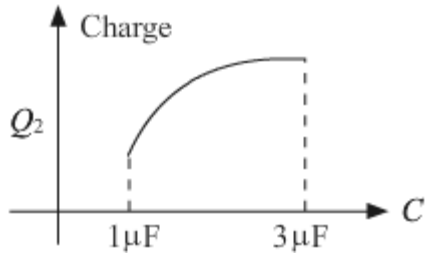
JEE 2015



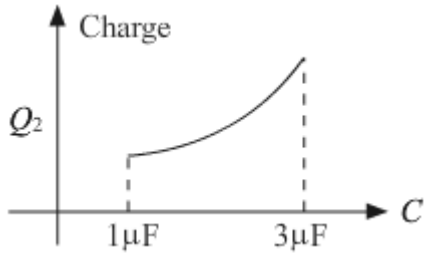
A.



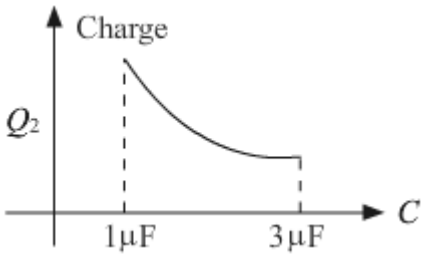
B.



C.



D.



Q.No.3: A capacitance of 2 μF is required in an electrical circuit across a potential difference of 1.0 kV. A large number of 1 μF capacitors are available which can withstand a potential difference of not more than 300 V. The minimum number of capacitors required to achieve this is: **JEE 2017**

A. 32
B. 2
C. 16
D. 24

Q.No.4: A parallel plate capacitor of capacitance 90 pF is connected to a battery of emf 20 V. If a dielectric material of dielectric constant $\mathrm{K} = \frac{5}{3}$ is inserted between the plates, the magnitude of the induced charge will be : **JEE 2018**

A. 2.4 nC
B. 0.9 nC
C. 1.2 nC
D. 0.3 nC

Q.No.5: Three concentric metal shells A, B and C of respective radii a, b and c

(a < b < c) have surface charge densities + σ, – σ and + σ respectively. The potential of shell B is: **JEE 2018**

A. $\frac{\sigma}{\in_0}\left[\frac{b^2-c^2}{b}+a\right]$

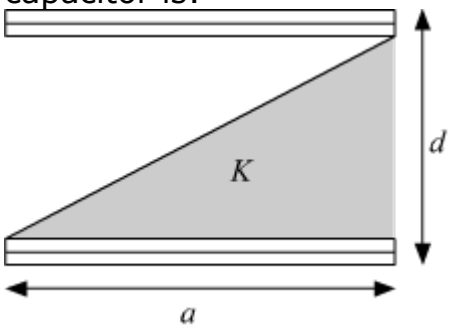
B. $\frac{\sigma}{\in_0}\left[\frac{b^2-c^2}{c}+a\right]$

C. $\frac{\sigma}{\in_0}\left[\frac{a^2-b^2}{a}+c\right]$

D. $\frac{\sigma}{\in_0}\left[\frac{a^2-b^2}{b}+c\right]$

Q.No.6: 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 of dielectric constant K, as shown in the figure. Capacitance of this capacitor is:

JEE 2019



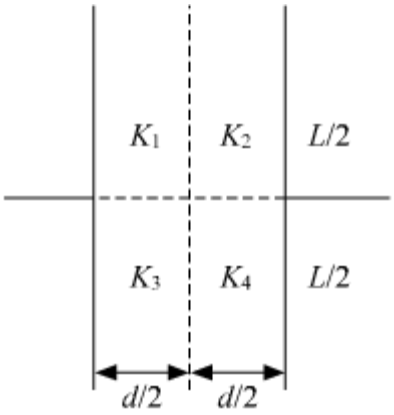
A. $\frac{K\varepsilon_0 a^2}{2d(K+1)}$

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

C. $\frac{K\varepsilon_0 a^2}{d}\ln K$

D. $\frac{1}{2}\frac{K\varepsilon_0 a^2}{d}$

Q.No.7: A parallel plate capacitor with square plates is filled with four dielectrics of dielectric constants K_1, K_2, K_3, K_4 arranged as shown in the figure. The effective dielectric constant K will be:



A. $K = \frac{(K_1+K_3)(K_2+K_4)}{K_1+K_2+K_3+K_4}$

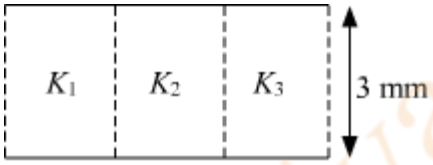
B. $K = \frac{(K_1+K_2)(K_3+K_4)}{2(K_1+K_2+K_3+K_4)}$

C. $K = \frac{(K_1+K_2)(K_3+K_4)}{K_1+K_2+K_3+K_4}$

D. $K = \frac{(K_1+K_4)(K_2+K_3)}{2(K_1+K_2+K_3+K_4)}$

Q.No.8: A parallel plate capacitor is of area 6 cm^2 and a separation 3 mm. The gap is filled with three dielectric materials of equal thickness (see figure) with dielectric constants $K_1 = 10$, $K_2 = 12$ and $K_3 = 14$. The dielectric constant of a material which when fully inserted in above capacitor, gives same capacitance would be:

JEE 2019



A. 4

B. 14

C. 12

D. 36

Q.No.9: Four equal point charges *Q* each are placed in the *xy* plane at (0, 2), (4, 2), (4, –2) and (0, –2). The work required to put a fifth charge *Q* at the origin of the coordinate system will be:

JEE 2019

A. $\frac{Q^2}{4\pi\varepsilon_\circ}\left(1+\frac{1}{\sqrt{3}}\right)$

B. $\frac{Q^2}{4\pi\varepsilon_\circ}\left(1+\frac{1}{\sqrt{5}}\right)$

C. $\frac{Q^2}{2\sqrt{2}\pi\varepsilon_\circ}$

D. $\frac{Q^2}{4\pi\varepsilon_\circ}$

Q.No.10: A parallel plate capacitor having capacitance 12 pF is charged by a battery to a potential difference of 10 V between its plates. The charging battery is now disconnected and a porcelain slab of dielectric constant 6.5 is slipped between the plates. The work done by the capacitor on the slab is:

JEE 2019

A. 692 pJ

B. 508 pJ

C. 560 pJ

D. 600 pJ