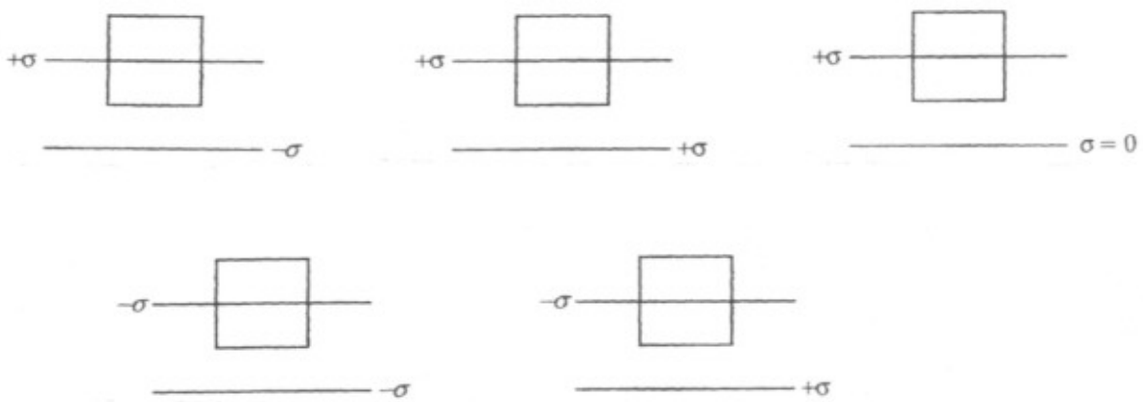
(1) A uniform linear charge density of 4.0 nC/m is distributed along the entire x-axis. Consider a spherical (radius = 5.0 cm) surface centered on the origin. Determine the electric flux in Nm^2/C for this surface. ($\varepsilon_o = 8.85\times10^{-12}\ C^2/Nm^2$)

23 68 62 45 79

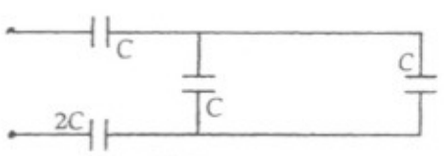
(2) Each of two small spheres is charged positively, the combined charge being 40 μC. Each sphere is repelled from the other by a force of magnitude 2.0 N when the two spheres are 50 cm apart. Determine the charge in μC on the sphere having the smaller charge. ($k_e = 8.99\times10^9\ Nm^2/C^2$)

1.1 1.4 2.0 3.7 17

(3) The electric flux through the sides of a cube is zero. The flux through the top is +20 N/C, while the flux through the bottom is zero. Each plane of charge shown has $\sigma = 17.7\times10^{-11}\ C/m^2$. Which diagram shows the planes of charge which give rise to the flux in this situation?

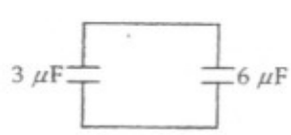


(4) Determine the equivalent capacitance in pF for the network shown when C = 12 pF.



18 59 48 2.4 6.0

(5) The potential difference across a 3 μF capacitor is 12 V. Its plates are then connected to those of an uncharged 6 μF capacitor. When equilibrium is reached, the potential difference between the plates of the 6 μF capacitor is



3V 4V 6V 9V 12V

(6) Two long parallel wires carry unequal currents in the same direction. The ratio of the currents is 3 to 1. The magnitude of the magnetic field at a point in the plane of the wires and 10 cm from each wire is 4.0 μT. What is the larger of the two currents in A? 0.5 3.8 3.0 5 3 4.5

(7) A long straight cylindrical wire of 0.50 cm radius carrying a 2.0 A current is surrounded by a concentric cylindrical shell of 0.50-cm thickness and inner radius 1.00 cm carrying a 4.0 A current in the opposite direction. The magnitude of the magnetic field, in μT, 0.40 m from the center of the cylindrical wire is

1.0 2π 0 4π 2.0

(8) A 30 turn square coil (length of side = 12 cm) with a total resistance of 2.5 Ω is placed in a uniform magnetic field directed perpendicularly to the plane of the coil. The magnitude of the field varies with time according to $B = Ae^{8t}$, where $A = 50$ mT and t is measured in seconds. What is the magnitude in V of the induced *emf* in the coil at $t = 0$?

0.20 0.17 0.31 0.38 0.20

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CT

① $\Phi_E = \frac{Q_{in}}{\epsilon_0}$

$Q_{in} = 2r \cdot \lambda$

$\Rightarrow \Phi_E = \frac{2r \cdot \lambda}{\epsilon_0} =$

$= \frac{2 \cdot 0{,}05 \cdot 4{,}0 \cdot 10^{-9}}{8{,}85 \cdot 10^{-12}}$ Nm²/C =

$= \underline{45 \text{ Nm}^2/\text{C}}$

② $Q_1 + Q_2 = 40\,\mu C$

$-\bar{F}$ Q_1 r Q_2 $\bar{F}$

$F = k_e \frac{Q_1 Q_2}{r^2} \Rightarrow Q_1 \cdot Q_2 = \frac{r^2 F}{k_e}$

$\Rightarrow Q_1 (40 \cdot 10^{-6} - Q_1) = \frac{r^2 F}{k_e}$

$\Rightarrow Q_1^2 - 40 \cdot 10^{-6} Q_1 + \frac{r^2 F}{k_e} = 0$

$\Rightarrow Q_1 = 20 \cdot 10^{-6} \pm \sqrt{400 \cdot 10^{-12} - \frac{0{,}5^2 \cdot 2}{8{,}99 \cdot 10^9}} =$

$= 20 \cdot 10^{-6} \pm 18{,}6 \cdot 10^{-6}$ $Q = 38{,}6\,\mu C$ el. $\underline{1{,}4 \cdot 10\,\mu C}$

③ $+\sigma$ $+\sigma$

④ C, 2C, C, C ⇔ C, 2C, 2C ⇔

C C_1 ⇔ $\frac{1}{C_1} = \frac{1}{2C} + \frac{1}{2C} \Rightarrow C_1 = C$

C_2 ⇔ $\frac{1}{C_2} = \frac{1}{C} + \frac{1}{C_1} \Rightarrow C_2 = \frac{C}{2}$

$\frac{C}{2} = \frac{1}{2} \cdot 12\,\mu F = \underline{6\,\mu F}$

⑤ ΔV_1 Q C_1 $\quad C_1 = \frac{Q}{\Delta V_1} \Rightarrow Q = C_1 \Delta V_1$

C_1 C_2 ⇔ ΔV_2 Q $C_1 + C_2$

$\Delta V_2 = \frac{Q}{C_1 + C_2} = \frac{C_1 \Delta V_1}{C_1 + C_2} =$

$= \frac{3 \cdot 12}{3+6} = \frac{1}{3} \cdot 12 = \underline{4\,V}$

⑥ I, r, r, B_{3I}, B_I, 3I

Allm: $B = \frac{\mu_0 I}{2\pi r} =$

$= 2 \cdot 10^{-7} \frac{I}{r}$

motriktade B:n

netto: $B_{3I} - B_I = \frac{\mu_0}{2\pi r}(3I - I) =$

$= 2 \cdot 10^{-7} \frac{2I}{0{,}1} = 4 \cdot 10^{-6}$ T

$\Rightarrow I = 1$ A $\Rightarrow 3I = \underline{3\,A}$

⑦ I_1 I_2 r

Ampere's lag:

$B \cdot 2\pi r = \mu_0 (I_1 - I_2)$

$\Rightarrow B = \frac{\mu_0}{2\pi} \frac{I_1 - I_2}{r} =$

$= 2 \cdot 10^{-7} (4{,}0 - 2{,}0) \frac{1}{0{,}40}$ T =

$= 1{,}0 \cdot 10^{-6}$ T = $\underline{1{,}0\,\mu T}$

⑧ B, N varv, Y

$Y = 0{,}12^2\ m^2$

$N = 30$

$B = A e^{8t}$

$\Phi_B = Y \cdot B$, $Y = \text{konst}$ $\Rightarrow \frac{d\Phi_B}{dt} = Y \frac{dB}{dt} =$

$= Y \frac{d}{dt}(A e^{8t}) = 8AY e^{8t} =$

$= [t = 0] = 8 \cdot 50 \cdot 10^{-3} \cdot 0{,}12^2$

$\mathcal{E} = N \cdot \frac{d\Phi_B}{dt} = 30 \cdot 8 \cdot 50 \cdot 10^{-3} \cdot 0{,}12^2 = \underline{0{,}17\,V}$