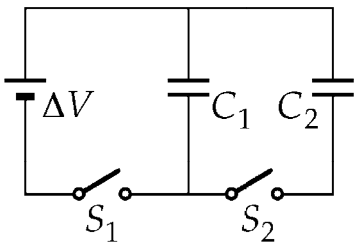
PHYS 232 Lecture supplement 10



26.23: C1= 6 μF, C2= 3 μF, and ΔV= 20 V. Capacitor C1 is charged by closing S1. S1 is then opened and S2 is closed. Calculate the initial charge on C1 and the final charge on each capacitor.

26.40: Two identical parallel-plate capacitors, each with capacitance C, are charged to ΔV and connected in parallel. Then the plate separation in one is doubled. Find;

1. the total energy of the two capacitors before the change
2. the potential difference across each after the change
3. total energy of the system after the change

27.9

The electron beam from a particle accelerator has a circular cross section of radius 1.00 mm.

- If the current is 8 μA, what is the current density in the beam assuming that it is uniform throughout?
- Find the electron density of the beam.

27.9 (a) $J = \frac{I}{A} = \frac{8.00 \times 10^{-6}\ \text{A}}{\pi\left(1.00 \times 10^{-3}\ \text{m}\right)^2} = \boxed{2.55\ \text{A/m}^2}$

(b) From $J = nev_d$, we have $n = \frac{J}{ev_d} = \frac{2.55\ \text{A/m}^2}{\left(1.60 \times 10^{-19}\ \text{C}\right)\left(3.00 \times 10^{8}\ \text{m/s}\right)} = \boxed{5.31 \times 10^{10}\ \text{m}^{-3}}$

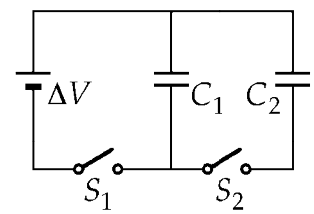
(c) From $I = \Delta Q / \Delta t$, we have $\Delta t = \frac{\Delta Q}{I} = \frac{N_A e}{I} = \frac{\left(6.02 \times 10^{23}\right)\left(1.60 \times 10^{-19}\ \text{C}\right)}{8.00 \times 10^{-6}\ \text{A}} = \boxed{1.20 \times 10^{10}\ \text{s}}$

(This is about 381 years!)

26.23 $C = \dfrac{Q}{\Delta V}$ so $6.00 \infty 10^{-6} = \dfrac{Q}{20.0}$ and

$$Q = \boxed{120\ \mu\text{C}}$$

$Q_1 = 120\ \mu\text{C} - Q_2$ and $\Delta V = \dfrac{Q}{C}$



$\dfrac{120 - Q_2}{C_1} = \dfrac{Q_2}{C_2}$ or $\dfrac{120 - Q_2}{6.00} = \dfrac{Q_2}{3.00}$

$(3.00)(120 - Q_2) = (6.00)Q_2$

$$Q_2 = \frac{360}{9.00} = \boxed{40.0\ \mu\text{C}}$$

$$Q_1 = 120\ \mu\text{C} - 40.0\ \mu\text{C} = \boxed{80.0\ \mu\text{C}}$$