PHYS 1231 / 1221 Answers 2009

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Q1 ⓐ $Q = C_1 \Delta V = 6.00 \times 10^{-6} \times 200$

$= 120\ \mu C$

ⓑ The initial charge on C_1 is now shared between C_1 & C_2

$\therefore\ Q = Q_1 + Q_2$ —

Also, the voltages on C_1 & C_2 are the same

$\therefore\ \frac{Q_1}{C_1} = \frac{Q_2}{C_2}$ —

from eqn ② $Q_1 = \frac{C_1}{C_2} Q_2$

substituting into eqn ①

$$Q = Q_2\left(1 + \frac{C_1}{C_2}\right)$$

$$\therefore\ Q_2 = \frac{120 \times 10^{-6}}{1 + \frac{6.00}{3.00}}$$

$$= \underline{40\ \mu C}$$

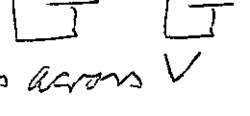
and putting this value back into eqn

$$Q_1 = \frac{6.00}{3.00} \times Q_2$$

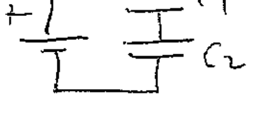
$$= \underline{\underline{80\ \mu C}}$$

ⓒ $V = \frac{Q_1}{C_1} = \frac{80 \times 10^{-6}}{6.00 \times 10^{-6}} = \underline{13.3V}$

PHYS 1231 ONLY ⓓ STEP 1. discharge both capacitors



STEP 2: place them in series across V



The capacitors now have equal charges.

Q2 (a) The magnetic flux through the loop is increasing, out of the paper.

By Lenz's Law, the induced emf will therefore cause a magnetic field into the paper.

By the right hand rule, this requires a clockwise current.

(b) $$\frac{d\phi_B}{dt} = B\frac{dA}{dt} = \underline{Bwv}$$

(c) $$\text{Power} = \frac{\mathcal{E}^2}{R} = \frac{\left(\frac{d\phi_B}{dt}\right)^2}{R} = \frac{B^2w^2v^2}{R}$$

(d) In equilibrium, the input power $= \frac{\Delta PE}{\Delta t}$ since $\Delta KE = 0$

$$\therefore \frac{B^2w^2v^2}{R} = \frac{d(Mgh)}{dt} = Mgv_T$$

$$\therefore \boxed{v_T = \frac{MgR}{B^2w^2}}$$

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(e) $\frac{d\phi_B}{dt}$ is now N times greater

The ~~[illegible]~~ resistance of the loop is now N times greater, as is the mass

$\therefore$ Power $= \frac{\mathcal{E}^2}{R}$ goes up by a factor of N

which exactly compensates for the increase in mass

$\therefore$ the ~~[illegible]~~ value of v_T is unchanged