

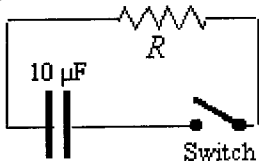
1. Three parallel plate capacitors, each having a capacitance of  $1.0 \mu\text{F}$  are connected in parallel. The potential difference across the combination is  $100 \text{ V}$ . What is the equivalent capacitance of this combination?

- A)  $0.3 \mu\text{F}$   
 B)  $1 \mu\text{F}$   
 C)  $3 \mu\text{F}$   
 D)  $6 \mu\text{F}$   
 E)  $30 \mu\text{F}$

*In parallel, capacitance adds.*

$$C_p = C_1 + C_2 + C_3 = 1\mu\text{F} + 1\mu\text{F} + 1\mu\text{F} = 3\mu\text{F}$$

The figure shows a simple RC circuit consisting of a  $10.0\text{-}\mu\text{F}$  capacitor in series with a resistor. Initially, the switch is open as suggested in the figure. The capacitor has been charged. The potential difference between its plates is  $100.0 \text{ V}$ . At  $t = 0 \text{ s}$ , the switch is closed. The capacitor discharges exponentially so that  $2.0 \text{ s}$  after the switch is closed, the potential difference between the capacitor plates is  $37 \text{ V}$ . In other words, after  $2.0 \text{ s}$  the potential difference between the capacitor plates is reduced to  $37\%$  of its original value.



2. Calculate the charge  $Q$  stored in the capacitor before the switch is closed.

- A)  $1000 \text{ C}$   
 B)  $0.1 \text{ C}$   
 C)  $1 \times 10^7 \text{ C}$   
 D)  $1 \text{ mC}$   
 E)  $1 \text{ C}$

$$Q = CV = (10 \times 10^{-6} \text{ F})(100 \text{ V}) = 1 \times 10^{-3} \text{ C} = 1 \text{ mC}$$

3. Determine the potential drop (i.e. voltage) across the resistor  $R$  at  $t = 2.0 \text{ s}$  (i.e., two seconds after the switch is closed).

- A) zero volts  
 B)  $37 \text{ V}$   
 C)  $63 \text{ V}$   
 D)  $87 \text{ V}$   
 E)  $100 \text{ V}$

*The R & C are in parallel, so they have the same voltage.*

*"Potential Drop" means voltage.*

4. Determine the numerical value of the resistance  $R$ . (Hint: find the time constant from the way the voltage changes.)

- A)  $1.0 \times 10^5 \Omega$   
 B)  $2.0 \times 10^5 \Omega$   
 C)  $5.0 \times 10^5 \Omega$   
 D)  $1.0 \times 10^6 \Omega$   
 E)  $2.5 \times 10^6 \Omega$

$$V = V_0 e^{-t/\tau}$$

$$37 \text{ V} = 100 \text{ V} e^{-t/\tau}$$

$$0.37 = e^{-t/\tau}$$

$$\ln 0.37 = -t/\tau$$

$$RC = \tau$$

$$R = \frac{\tau}{C} = \frac{2}{10 \times 10^{-6}} = 2 \times 10^5 \Omega$$

$$\tau = \frac{-t}{\ln(0.37)} = \frac{-2}{-1} = 2 \text{ s}$$