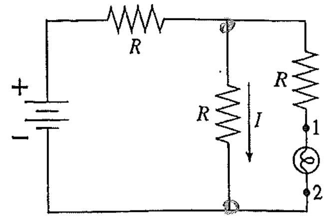
26. Initially the lightbulb is glowing. It is then removed from its socket.



a. What happens to the current I when the bulb is removed? Does it increase, stay the same, or decrease? Explain.

Increases. Assume bulb has Resistance R.

$R_{eq,\ initial} = R + \frac{1}{\frac{1}{R} + \frac{1}{2R}} = \frac{5}{3}R$

$\frac{2}{3}$ of total current $= I = \frac{2}{3} \cdot \frac{V}{R_{eq}} = \frac{2}{3} \cdot \frac{3V}{5R} = \frac{2}{5}\frac{V}{R}$.

If bulb removed, $R_{eq} = 2R$, all total current $= I = \frac{V}{2R}$ $\quad \frac{1}{2} > \frac{2}{5}$

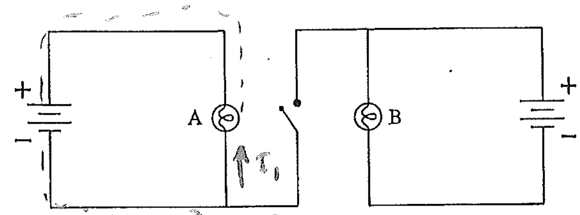
b. What happens to the potential difference ΔV_{12} between points 1 and 2? Does it increase, stay the same, decrease, or become zero? Explain.

Before $\Delta V = IR = \frac{1}{5}\frac{V}{R} \cdot R = \frac{V}{5}$.

After $\Delta V = \frac{V}{2}$. (No ΔV across resistor above)

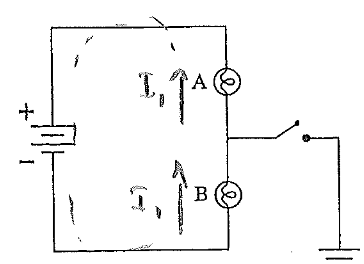
so $|\Delta V_{12}| \uparrow$.

27. Bulbs A and B are identical and initially both are glowing. Then the switch is closed. What happens to each bulb? Does its brightness increase, stay the same, decrease, or go out? Explain.



SAME.
No current flows through switch. $\vec{I}_1 = 0$.
Use Junction law.

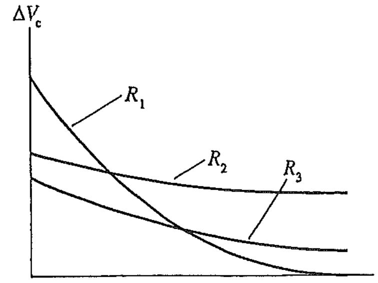
28. Bulbs A and B are identical and initially both are glowing. Then the switch is closed. What happens to each bulb? Does its brightness increase, stay the same, decrease, or go out? Explain.



SAME.
No current flows through switch
Use Junction law

32.9 *RC* Circuits

29. The graph shows the voltage as a function of time on a capacitor as it is discharged (separately) through three different resistors. Rank in order, from largest to smallest, the values of the resistances R_1 to R_3.



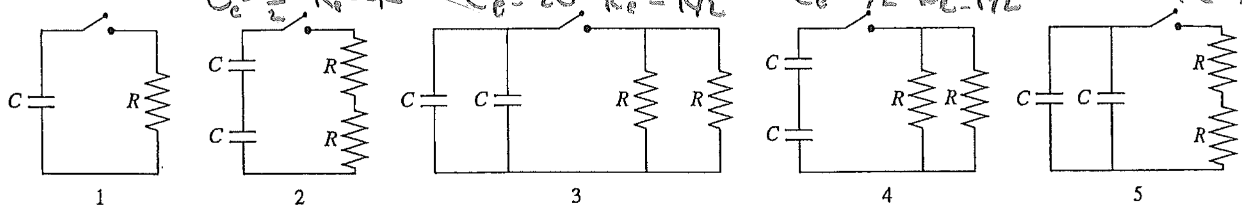
Order: R_2, R_3, R_1

Explanation:

$\tau = RC$, slowest decay → largest R

30. The capacitors in each circuit are discharged when the switch closes at $t = 0$ s. Rank in order, from largest to smallest, the time constants τ_1 to τ_5 with which each circuit will discharge.

$C_e = \frac{C}{2}$, $R_e = 2R$ — $C_e = 2C$, $R_e = R/2$ — $C_e = C/2$, $R_e = R/2$ — $C_e = 2C$, $R_e = 2R$

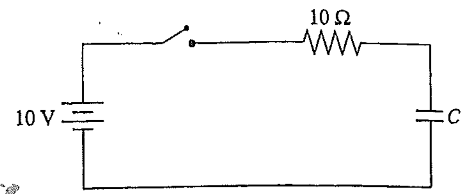


Order: $\tau_5 > \tau_1 = \tau_2 = \tau_3 > \tau_4$

Explanation:

$4RC > RC > \frac{RC}{4}$.

31. The charge on the capacitor is zero when the switch closes at $t = 0$ s.



a. What will be the current in the circuit after the switch has been closed for a long time? Explain.

0 A. Long time = steady state

$\Rightarrow Q = \text{const.}$

$\Rightarrow \frac{dQ}{dt} = I = 0$

b. Immediately after the switch closes, before the capacitor has had time to charge, the potential difference across the capacitor is zero. What must be the potential difference across the resistor in order to satisfy Kirchhoff's loop law? Explain.

10V.

c. Based on your answer to part b, what is the current in the circuit immediately after the switch closes?

$IR = V \qquad I = \frac{10V}{10\Omega} = 1\,A.$

d. Sketch a graph of current versus time, starting from just before $t = 0$ s and continuing until the switch has been closed a long time. There are no numerical values for the horizontal axis, so you should think about the *shape* of the graph.