

51. (a) The potential difference V across the plates of a capacitor is related to the charge q on the positive plate by $V = q/C$, where C is capacitance. Since the charge on a discharging capacitor is given by $q = q_0 e^{-t/\tau}$, this means $V = V_0 e^{-t/\tau}$ where V_0 is the initial potential difference. We solve for the time constant τ by dividing by V_0 and taking the natural logarithm:

$$\tau = -\frac{t}{\ln(V/V_0)} = -\frac{10.0 \text{ s}}{\ln[(1.00 \text{ V})/(100 \text{ V})]} = 2.17 \text{ s} .$$

- (b) At $t = 17.0 \text{ s}$, $t/\tau = (17.0 \text{ s})/(2.17 \text{ s}) = 7.83$, so

$$V = V_0 e^{-t/\tau} = (100 \text{ V}) e^{-7.83} = 3.96 \times 10^{-2} \text{ V} .$$