57. (a) The four tires act as resistors in parallel, with an equivalent value given by

$$\frac{1}{R_{\rm eq}} = \sum_{n=1}^{4} \frac{1}{R_{\rm tire}} = \frac{4}{R_{\rm tire}} \quad \Longrightarrow \quad R_{\rm eq} = \frac{R_{\rm tire}}{4} \ .$$

Using the stated values ($C = 5.0 \times 10^{-10}\,$F and $10^8\,\Omega < R_{\rm tire} < 10^{11}\,\Omega$) we find the capacitive time constant $\tau = R_{\rm eq}C$ in the range $0.012\,{\rm s} < \tau < 13\,{\rm s}$.

(b) Eq. 26-22 leads to

$$U_0 = \frac{1}{2}CV^2 = \frac{1}{2}\left(5.00 \times 10^{-10}\,{\rm F}\right)\left(30.0 \times 10^3\,{\rm V}\right)^2 = 0.225 \text{ J} \ .$$

(c) As demonstrated in Sample Problem 28-5, the energy "decays" exponentially according to

$$U = U_0 e^{-2t/\tau} \ .$$

Solving for the time which gives $U = 0.050$ J, we find

$$t = \frac{\tau}{2}\,\ln\!\left(\frac{U_0}{U}\right) = \frac{\tau}{2}\,\ln\!\left(\frac{0.225}{0.050}\right)$$

which yields, for the range of time constants found in part (a), values of t in the range $0.094\,{\rm s} < t < 9.4\,{\rm s}$. To obtain these particular values, we used 3-figure versions of the part (a) results ($0.0125\,{\rm s} < \tau < 12.5\,{\rm s}$).

(d) The lower range of resistance leads to the smaller times to discharge, which is the more desirable situation. Based on this criterion, low resistance tires are favored.

(e) There are a variety of ways to safely and quickly ground a large charged object. A large metal cable connected to, say, the (metal) building frame and held at the end of, say, a long lucite rod might be used (to touch a part of the car that does not have much paint or grease on it) to make the car safe to handle.