3. (a) When charge $q$ moves through a potential difference $\Delta V$, its potential energy changes by $\Delta U = q\,\Delta V$. In this case, $\Delta U = (30\,\mathrm{C})(1.0 \times 10^9\,\mathrm{V}) = 3.0 \times 10^{10}\,\mathrm{J}$.

(b) We equate the final kinetic energy $\frac{1}{2}mv^2$ of the automobile to the energy released by the lightning, denoted by $U_{\text{lightning}}$.

$$v = \sqrt{\frac{2\,U_{\text{lightning}}}{m}} = \sqrt{\frac{2(3.0 \times 10^{10}\,\mathrm{J})}{1000\,\mathrm{kg}}} = 7.7 \times 10^3\ \mathrm{m/s}\ .$$

(c) We equate the energy required to melt mass $m$ of ice to the energy released by the lightning: $\Delta U = mL_F$, where $L_F$ is the heat of fusion for ice. Thus,

$$m = \frac{\Delta U}{L_F} = \frac{3.0 \times 10^{10}\,\mathrm{J}}{3.33 \times 10^5\,\mathrm{J/kg}} = 9.0 \times 10^4\ \mathrm{kg}\ .$$