9. [11 points] A cube of ice is removed from the freezer and begins to melt. Let $\ell(t)$ be its side length, $V(t)$ its volume, and $S(t)$ its surface area, all dependent upon t, the number of minutes since it was removed from the freezer. The ice cube is melting (its volume is changing) at a rate proportional to its surface area. That is, $\frac{dV}{dt} = kS(t)$, for some number k. Initially the ice cube has a side length of 2 inches.

a. [4 points] Write V and S in terms of ℓ. Calculate the rate of change (with respect to time) of the side length of the ice cube in terms of ℓ and k.

b. [2 points] How fast is the **volume** of the ice cube changing immediately after it is removed from the freezer? Your answer will involve k.

c. [2 points] What is the sign of k? Briefly explain.

d. [3 points] How long will it take the ice cube to melt completely? Your answer may involve k.