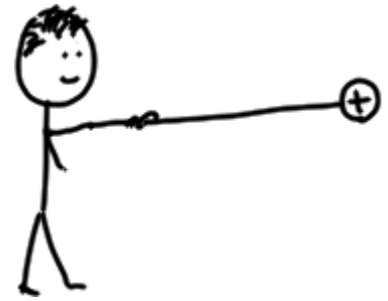


1) HF is a very dangerous gas, forming hydrofluoric acid upon contact with tissue. Chris is (justifiably) afraid of an encounter with HF, so he carries around a 100nC charge at the end of a stick. Chris knows that any polar HF molecules in his vicinity will be attracted to the charge, and thus hopefully avoid his skin.

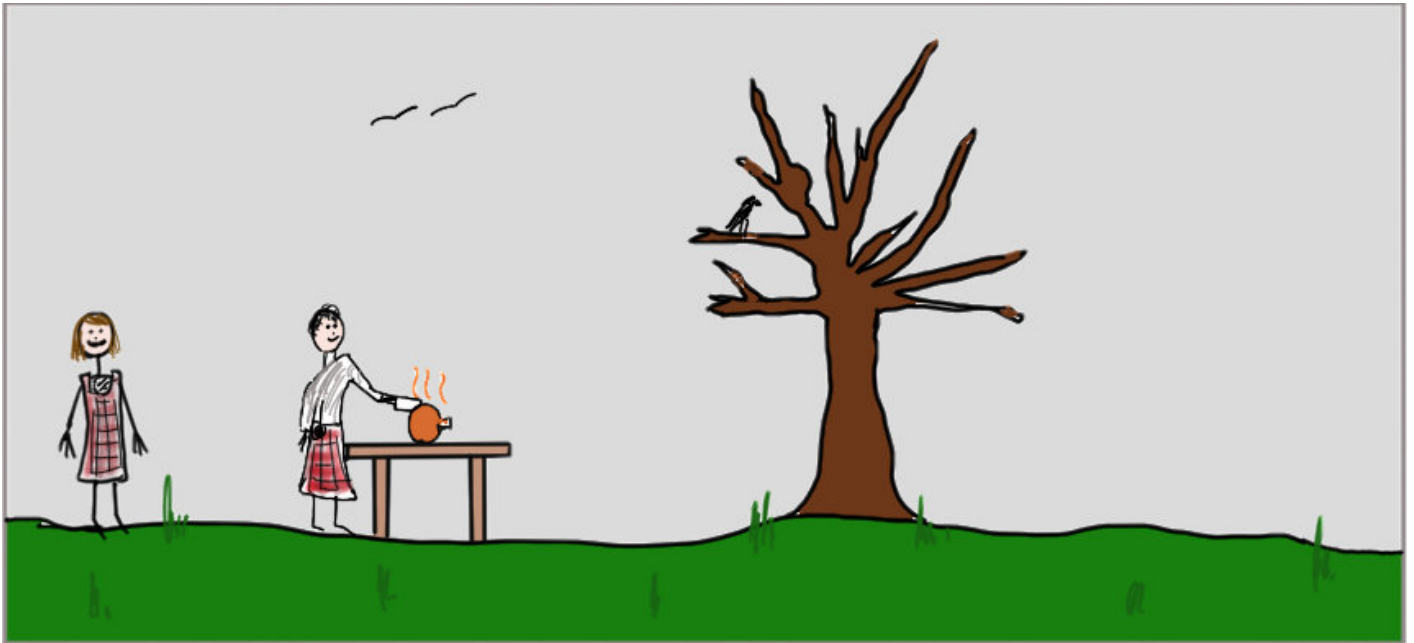


a) The first effect of the charge is to cause the polar HF molecules to re-orient themselves. If we have an HF molecule initially at rest 1m from the charge in the configuration shown below, roughly how long will it be before the molecule is oriented with the fluorine facing the charge? The HF molecule can be modeled as two partial charges separated by 92pm, as shown.



b) If the molecule starts in the configuration with the fluorine facing the charge, also at 1m from the charge, roughly how long will it be before the HF molecule has accelerated to a velocity of 10m/s towards the charge?

Question 2 next page.



2) To celebrate Robbie Burns day ([http://en.wikipedia.org/wiki/Burns supper](http://en.wikipedia.org/wiki/Burns_supper)), Doug McGaffy is about to cut into a freshly boiled haggis (<http://en.wikipedia.org/wiki/Haggis>) for dinner. Unbeknownst to him, his wife Taffy has decided to play a little joke on him. Using her portable van de Graaf generator, she has charged up the inside of the haggis with 0.1mC of charge which we will assume is spread uniformly through the haggis (we'll also assume the Haggis was cooked dry so that it's a good insulator). As his knife penetrates the casing of the Haggis, he is...surprised (to put it mildly) by the ensuing haggisplosion¹. If the Haggis is spherical and weighs 2kg, estimate how high the bits of Haggis will fly during the haggisplosion.

(hint: If you had a ball sitting on a compressed spring, how would you figure out the height to which the ball will fly?)

(extra: what would actually happen if we put this much charge on a haggis?)

¹ **Haggisplosion** (hăg ' ĩs - plō ' shən) *n.* The violent bursting of a Scottish dish consisting of the minced heart, lungs, and liver of a sheep or calf mixed with suet, oatmeal, and seasonings, and boiled in the stomach of the slaughtered animal.
e.g. "Jimmy whacked the piñhaggis² with all his might, causing a haggisplosion that we are not likely to forget."

² **Piñhaggis** (pēn - yăg ' ĩs) *n.* A traditional Scottish dish with organ meats and oatmeal, suspended from a height, intended to be broken by blindfolded players with sticks in a game originating in the Scottish communities of Mexico.