3. Sucking

1) Let x be the horizontal axes, and y — the vertical axes. At the liquid surface, the potential energy of a unit volume is constant (so that the liquid will not flow towards the lower potential energy). So, the formula for the height $\chi(x)$ of the liquid surface is given by $\Pi_{vp} = \rho_m g\chi - \frac{1}{4\pi\varepsilon_0}\frac{\rho_e q}{r} = 0$, where $r = \sqrt{x^2 + (\chi - H)^2}$ is the distance of the given point from the charge. Let us designate $\chi_0 \equiv \chi(0)$. From the previous formula we obtain (bearing in mind that for $x = 0$ we have $r = H - \chi_0$) the result

$$\chi_0(\chi_0 - H) + \frac{1}{4\pi\varepsilon_0}\frac{\rho_e q}{\rho_m g} = 0.$$

Using the designation $\frac{1}{4\pi\varepsilon_0}\frac{\rho_e q}{\rho_m g} = A$, the result can be written as

$$\chi_0 = \frac{1}{2}\left(H - \sqrt{H^2 - 4A}\right).$$

2) It is clear that flowing starts at the point $x = 0$, where the fluid surface is the highest. When the flowing starts, this surface point [with coordinates $(0, \chi_0)$] realizes the potential energy maximum, when moving along the y-axes towards the charge. So, the function

$$\Pi(y) = \rho_m g y - \frac{1}{4\pi\varepsilon_0}\frac{\rho_e q}{h - y}$$

has a maximum at $y = H_0$. This gives us two equations:

$$\rho_m g\chi_0 - \frac{1}{4\pi\varepsilon_0}\frac{\rho_e q}{h - \chi_0} = 0,$$

$$\rho_m g - \frac{1}{4\pi\varepsilon_0}\frac{\rho_e q}{(h - \chi_0)^2} = 0.$$

Comparing these, we find $h = 2\chi_0$ and $\chi_0^2 = \frac{1}{4\pi\varepsilon_0}\frac{\rho_e q}{\rho_m g}$, hence

$$h = \sqrt{\frac{\rho_e q}{\pi\varepsilon_0\rho_m g}}.$$