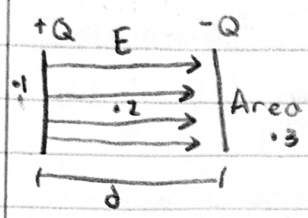
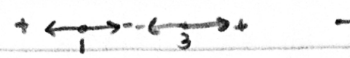
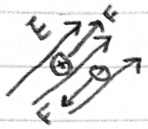
Capacitors

PH 112





$E_1 = 0 \quad E_3 = 0 \quad E_2 = \frac{\sigma}{\varepsilon_0} = Q/A\varepsilon_0$



$F_{el} = q\vec{E} = m\vec{a} \quad \vec{a} = \frac{q}{m}\vec{E}$

Example #1

$\phi = 6\,cm = .06\,m$

$d = 5mm \times 10^{-3} m$

$N_e = 10^{11} e^-$

$t = ? \quad v = ?$

$F = \frac{eQ}{\pi \varepsilon_0 r^2}$

$Q = eN_e = 1.6\times10^{-19}(10^{11}) = 1.6\times10^{-8} C$

$\varepsilon_0 = \frac{1}{4\pi 9\times10^9} \quad r = \frac{\phi}{2} = 0.03m$

$a = \frac{F}{m_e} \quad m_e = 9.1\times10^{-31} kg \quad a = 1.12\times10^{17}\ m/s^2$

$t = \sqrt{2d/a} \quad v = at \quad t = 0.3s \quad v = 3.3\times10^7\ m/s$

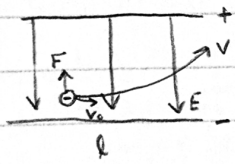
Example #2

$v_{ox} = 3.34\times10^7\ m/s$

$l = 2\,cm = .02\,m$

$E = 5\times10^4\ N/C$

$\theta = ?$



$\tan\theta = \frac{v_y}{v_x} \quad F_{el} = ma \quad eE = m_e a$

$v_y = at \quad v_x = v_{ox} \quad a_y = \frac{e}{m_e}E = \frac{1.6\times10^{-19}}{9.1\times10^{-31}}(5\times10^4)$

$l = v_{ox}t \quad t = l/v_{ox} = \frac{0.02}{3.34\times10^7} \quad = 8.79\times10^{15}\ m/s^2$

$= 0.6\,ns \quad v_y = 8.79\times10^{15}(.6\times10^{-9}) = 5.3\times10^6\ m/s$

$\theta = \tan^{-1}\left(\frac{5.3\times10^6}{3.34\times10^7}\right) = \boxed{8.95°}$