Pe19- Capacitance Version A

(1) Capacitance $= C = \frac{\varepsilon_0 A}{d}$ $\quad \varepsilon_0 = 8.85E-12 \frac{F}{m}$

$A = 1.05\ m^2$

$d = .63E-3\ m$

$C = \frac{(8.85E-12)(1.05)}{.63E-3} = 1.48E-8$

$= 14.8E-9$ Farads $= \boxed{14.8\ nF = C}$

(2) Given: $C = 14.8E-9$ (cap., Farads) and $V = 2.85E3$ volts

$Q = CV = (14.8E-9)(2.85E3) = 4.2E-5 = \boxed{42\ \mu C}$ (Coulombs)

(3) $Q = CV$ and $E = \frac{V}{d}$ Given: C, Q, d / Find: E = electric field.

$V = \frac{Q}{C} = \frac{1.5}{.8} \rightarrow E = \frac{1.5}{.8}\frac{1}{.7E-3}$ ($.8F$, $1.5C$, $.7E-3\ m$)

$E = \frac{1.5}{(.8)(.7)} \times 10^3 = \boxed{2.7 \frac{kV}{m}}$

(4) $U =$ energy $= \frac{1}{2} QV = \frac{1}{2} CV^2 = \frac{1}{2}\frac{Q^2}{C}$

Given: $Q = 1.5$, $C = .8$, $d = .7E-3$

$\boxed{U = \frac{1}{2}\frac{(1.5)^2}{.8} = 1.406\ J}$

(5) Force $\cdot \Delta X = \Delta U$. ($\Delta X$: change in d) $\quad U = \frac{1}{2}\frac{Q^2}{C} = ?$ Use $C = \frac{\varepsilon_0 A}{d}$

$U = \frac{1}{2}\frac{Q^2 d}{\varepsilon_0 A} \Rightarrow \Delta U = \frac{1}{2}\frac{Q^2}{\varepsilon_0 A}\Delta d$

$F = \frac{\Delta U}{\Delta d} = \frac{1}{2}\frac{Q^2}{\varepsilon_0 A}\cdot\frac{d}{d} = \frac{1}{2}\frac{Q^2 d}{\varepsilon_0 A}\frac{1}{d} = \frac{1}{2}\frac{Q^2}{C}\frac{1}{d} = \frac{U}{d}$

$= \frac{1.406}{.7E-3} = \boxed{2009\ N.}$