# MT 2

1.

(b) $W = \frac{1}{2}\sum Q_i V_i$

$$V(\vec{r}) = \frac{Q}{4\pi\epsilon_0 r}$$

$$W = \frac{Q^2}{8\pi\epsilon_0}\left[\frac{1}{a} - \frac{1}{b}\right]$$

(a) $V = \frac{Q}{4\pi\epsilon_0 r}$

$$\Delta V = \frac{Q}{4\pi\epsilon_0}\left[\frac{1}{a} - \frac{1}{b}\right]$$

$$C = \frac{Q}{\Delta V} = \frac{4\pi\epsilon_0 ab}{b-a}$$

(c) $E(\vec{r}) = \frac{Q}{4\pi\epsilon_0 r^2}$

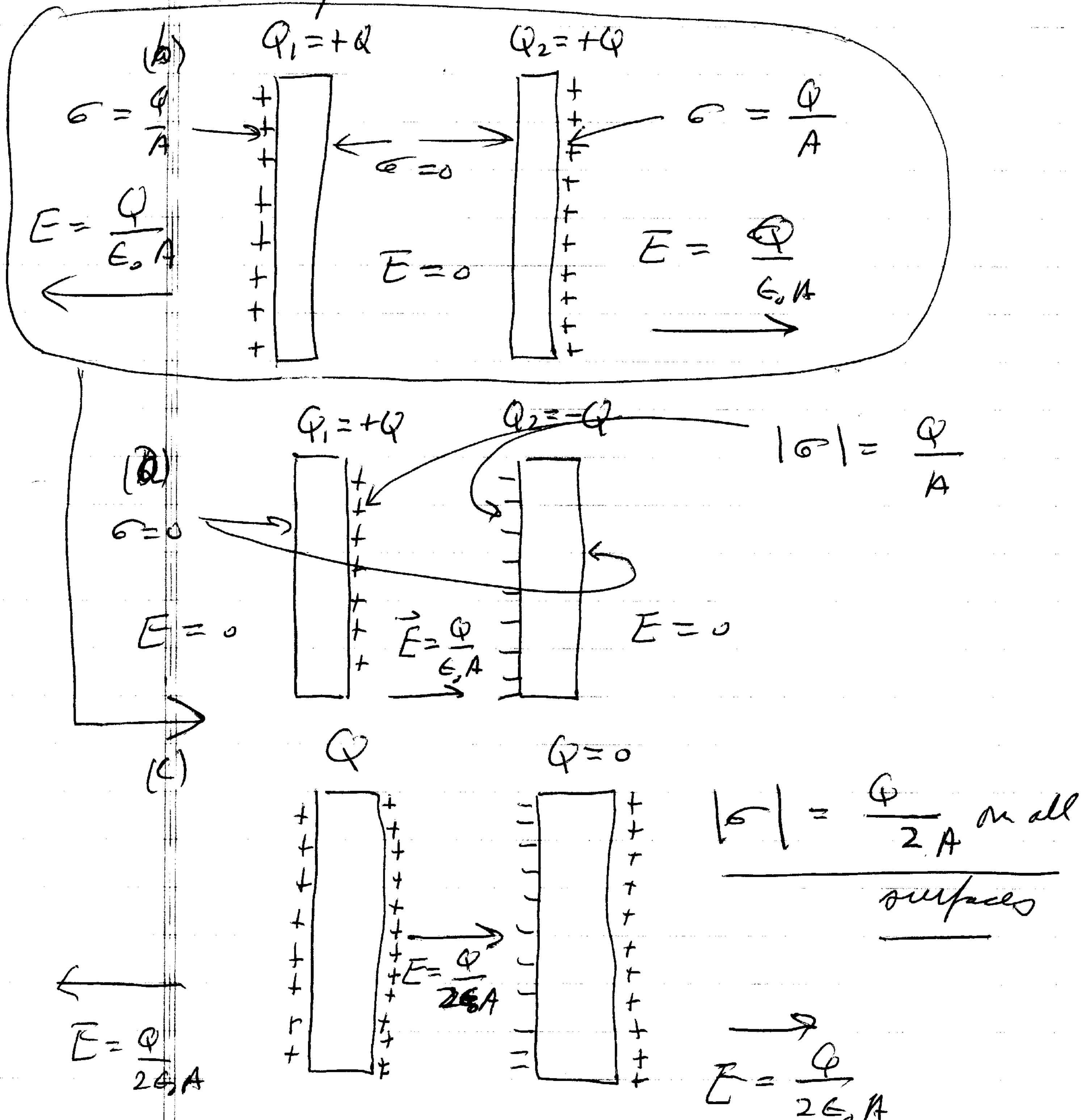
$$W = \frac{\epsilon_0}{2}\int |E|^2 d\tau = \frac{Q^2}{32\pi^2\epsilon_0}\int_a^b \frac{4\pi r^2 dr}{r^4}$$

$$= \frac{Q^2}{8\pi\epsilon_0}\int_a^b \frac{dr}{r^2} = \frac{Q^2}{8\pi\epsilon_0}\left[\frac{1}{a} - \frac{1}{b}\right]$$

answers to (b) + (c) are the same. ✓

# MT 2

2. E = 0 in all conductors. Charge is only on the surfaces.



MT2

3.

(a) line charge $E 2\pi s L = \frac{\lambda L}{\epsilon_0}$

$$E = \frac{\lambda}{2\pi\epsilon_0 s}$$

Image problem image $-\lambda$ at $x = -d$

$F = QE = \lambda L E$

$$\vec{F}/L = \frac{-\lambda^2}{2\pi\epsilon_0 (2d)}\hat{x} = \frac{-\lambda^2 \hat{x}}{4\pi\epsilon_0 d}$$

(b) at conductor $\sigma = \epsilon_0 \vec{E} \cdot \hat{n}$

E is due to both image & original line charge

$$\sigma = \frac{-\lambda}{\pi d}$$

(c) $$W = -\int_d^{2d} F \cdot dx = \frac{\lambda^2}{4\pi\epsilon_0}\int_d^{2d}\frac{dx}{x}$$

$$= \frac{\lambda^2 \ln 2}{4\pi\epsilon_0}$$