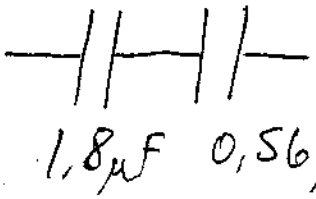
PHYS 230-01

SOLUTIONS - PROB. SET 6

1. (27-1)

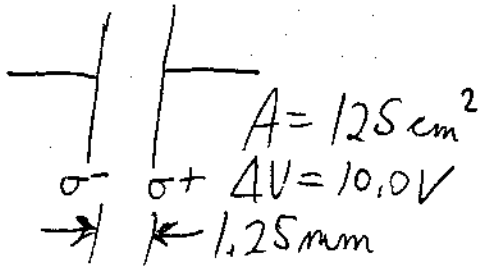
$$Q = C\Delta V = (1.00 \times 10^{-11}\,F)(12\,V)$$
$$= \boxed{1.2 \times 10^{-10}\,C}$$

2. (27-8)



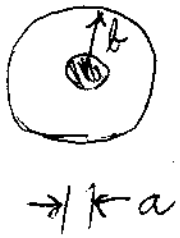
$$\frac{1}{C} = \frac{1}{1.8\mu F} + \frac{1}{0.56\mu F}$$
$$\boxed{C = 0.43\,\mu F}$$

3. (27-17)



$$Q = C\Delta V$$
$$= Q/A = \frac{C\Delta V}{A} = \frac{\varepsilon_0 \cancel{A}\Delta V}{\cancel{A}d}$$
$$= \frac{(8.85 \times 10^{-12}\,F/m)(10.0\,V)}{1.25 \times 10^{-3}\,m}$$
$$= \boxed{7.08 \times 10^{-8}\,C/m^2}$$

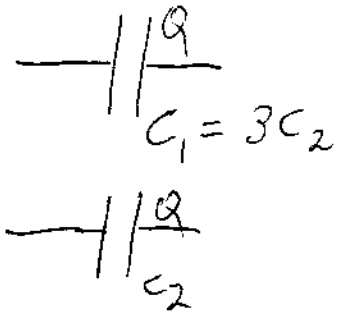
4. (27-18)



For a coaxial capacitor, the capacitance/unit leng is

$$\frac{dC}{dl} = \frac{2\pi\varepsilon_0}{\ln(b/a)} = \frac{2\pi(8.85 \times 10^{-12}\,F/m)}{\ln(3)}$$
$$= \boxed{5.1 \times 10^{-11}\,F/m}$$

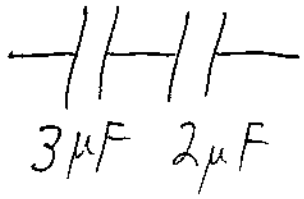
5. (27-23)



$$\frac{\Delta V_1}{\Delta V_2} = \frac{Q/C_1}{Q/C_2} = \frac{C_2}{C_1} = \boxed{\frac{1}{3}}$$

$$\frac{U_1}{U_2} = \frac{Q^2/2C_1}{Q^2/2C_2} = \frac{C_2}{C_1} = \boxed{\frac{1}{3}}$$

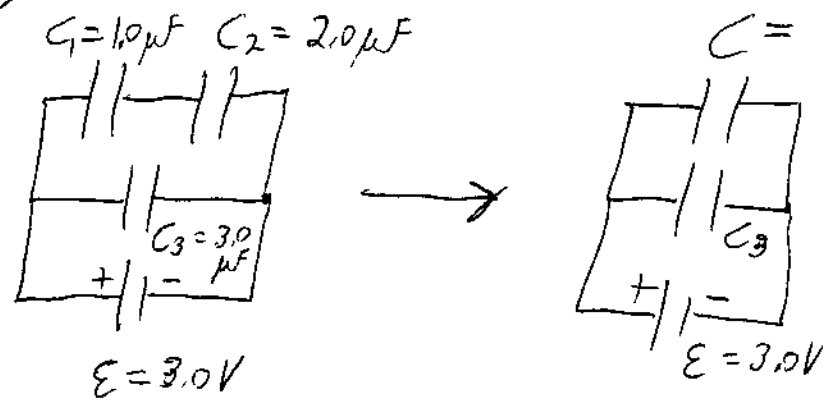
6. (27-26)



$$\frac{1}{C} = \frac{1}{2\mu F} + \frac{1}{3\mu F} = \frac{5}{6\mu F}$$

$$C = \boxed{1.2\ \mu F}$$

7. (27-32)



$$C = \frac{1}{(1/1.0\mu F) + (1/2.0\mu F)} = \frac{2\mu F}{3}$$

$$Q_3 = C_3 \Delta V = (3.0\mu F)(3.0V) = \boxed{9.0\ \mu C}$$

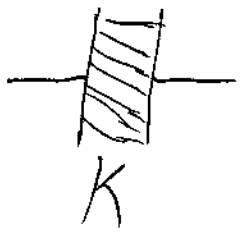
$$Q_1 = Q_2 = C\Delta V = \left(\frac{2\mu F}{3}\right)(3.0V) = \boxed{2.0\ \mu C}$$

$$C_{total} = C + C_3 = 3.66\ \mu F$$

$$U = \frac{1}{2} C_{total} \Delta V^2 = \frac{1}{2}(3.66\ \mu F)(3.0V)^2 = \boxed{1.7 \times 10^{-5} J}$$

PHYS 230-01

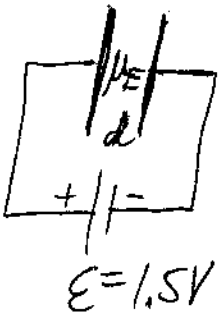
8. (27-9) Capacitor with dielectric



$$C = \frac{K\varepsilon_0 A}{d} = \frac{(2.5)(8.85\times10^{-12}\,F/m)(11\times10^{-4}\,m^2)}{7.4\times10^{-4}\,m}$$

$$= \boxed{3.3\times10^{-11}\,F}$$

9. (27-11)



$$E = \frac{\mathcal{E}}{d} = \frac{1.5V}{2.2\times10^{-3}\,m} = 680\ V/m$$

$$\mu_E = \frac{\varepsilon_0 E^2}{2} = \frac{(8.85\times10^{-12}\,F/m)(680\,V/m)^2}{2}$$

$$= \boxed{2.1\times10^{-6}\,J/m^3}$$