PHYSICS III
Dr. Joenathan – Winter 2000

HOMEWORK VI
Chapter 24; 5, 17, 26, 36, 39

24-5.
(a)

$$U_{123} = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1 q_2}{r_{12}} + \frac{q_1 q_3}{r_{13}} + \frac{q_2 q_3}{r_{23}}\right)$$

$$= \frac{1}{4\pi\varepsilon_0}\left[\frac{(6.00\times10^{-6}C)\,(4.00\times10^{-6}C)}{1.50m} + \frac{(6.00\times10^{-6}C)\,(-3.00\times10^{-6}C)}{5.00m} + \frac{(4.00\times10^{-6}C)\,(-3.00\times10^{-6}C)}{3.50m}\right]$$

$$= 8.06\times10^{-2}\,J$$

(b)

$$U_{23} = \frac{1}{4\pi\varepsilon_0}\frac{q_2 q_3}{r_{23}} = \left(8.99\times10^{9}\ \frac{N\cdot m^2}{C^2}\right)\frac{(4.00\times10^{-6}C)(-3.00\times10^{-6}C)}{3.50m}$$

$$= -3.08\times10^{-2}\,J$$

$$\Delta U = U_{23} - U_{123} = -3.08\times10^{-2}\,J - 8.06\times10^{-2}\,J = -0.111J$$

$$\Delta K + \Delta U = 0$$

$$\Delta K = K_1 = -\Delta U = +0.111J$$

(c)

$$U_{13} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_3}{r_{13}} = \left(8.99\times10^{9}\ \frac{N\cdot m^2}{C^2}\right)\frac{(6.00\times10^{-6}C)(-3.00\times10^{-6}C)}{5.00m}$$

$$= -3.24\times10^{-2}\,J$$

$$\Delta U = U_{13} - U_{123} = -3.24\times10^{-2}\,J - 8.06\times10^{-2}\,J = -0.113J$$

$$\Delta K = K_2 = -\Delta U = +0.113J$$

24-17.

(a)

$$\Delta V = -\int_0^f E \cdot ds = -E \cdot \Delta s_{AB} - E \cdot \Delta s_{BC}$$

$$= -(600.\,V/m\ \hat{i} + 800.V/m\ \hat{j}) \cdot (3.00m)\,\hat{i} - (600.\,V/m\ \hat{i} + 800.V/m\ \hat{j}) \cdot (4.00m)\,\hat{j}$$

$$= -5.00 \times 10^3 V$$

(b)

$$\Delta V = -E \cdot \Delta s_{AD} - E \cdot \Delta s_{DC}$$

$$= -(600.\,V/m\ \hat{i} + 800.\,V/m\ \hat{j}) \cdot (4.00m)\,\hat{j} - (600.\,V/m\ \hat{i} + 800.\,V/m\ \hat{j}) \cdot (3.00m)\,\hat{i}$$

$$= -5.00 \times 10^3 V$$

(c)

$$\Delta V = -E \cdot \Delta s_{AC} = -\left(600.\frac{V}{m}\hat{i} + 800.\frac{V}{m}\hat{j}\right) \cdot (3.00m\ \hat{i} + 4.00m\ \hat{j})$$

$$= -5.00 \times 10^3 V$$

24-26.
(a)

$$\Delta V_{AB} = V_B - V_A$$

$$V_A = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1}{a_1} + \frac{q_2}{a_2}\right)$$

$$= \frac{1}{4\pi\varepsilon_0}\left(\frac{24.0\times10^{-6}C}{0.080m} + \frac{-36.0\times10^{-6}C}{\sqrt{(0.120m)^2 + (0.080m)^2}}\right)$$

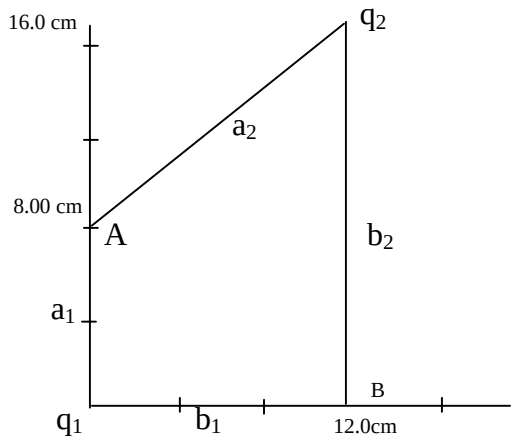
$$= +4.53\times10^5 V$$

$$V_B = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1}{b_1} + \frac{q_2}{b_2}\right)$$

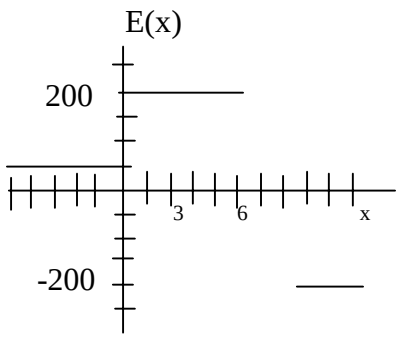
$$= \frac{1}{4\pi\varepsilon_0}\left(\frac{24.0\times10^{-6}C}{0.120m} + \frac{-36.0\times10^{-6}C}{0.160m}\right)$$

$$= -2.25\times10^5 V$$

$$= \Delta V_{AB} = -2.25\times10^5 V - 4.53\times10^5 V = -6.78\times10^5 V$$



24-36. (b) Between x = 3 and x = 6 m



24-39.

(a)

$$V_B = \frac{1}{4\pi\varepsilon_0}\left[\frac{2Q}{y} - \frac{2Q}{\sqrt{a^2 + y^2}}\right]$$

$$= \frac{Q}{2\pi\varepsilon_0}\left[\frac{1}{y} - \frac{1}{\sqrt{a^2 + y^2}}\right]$$

(b)

$$E_B = -\frac{\partial V_B}{\partial y} = \frac{Q}{2\pi\varepsilon_0}\left[\frac{1}{y^2} - \frac{y}{(a^2 + y^2)^{3/2}}\right]$$