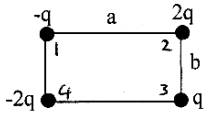
PHYS102.10
Quiz # 8-Chapter 24

Name: Key Id#:

How much work is required to assemble the system of charges shown in the figure bringing each charge from infinity? Take a = 20 cm and b = 10 cm and q = 10 μC.



$W = U$

$$U = k\left[\frac{q_1q_2}{r_{12}} + \frac{q_1q_3}{r_{13}} + \frac{q_1q_4}{r_{14}} + \frac{q_2q_3}{r_{23}} + \frac{q_2q_4}{r_{24}} + \frac{q_3q_4}{r_{34}}\right]$$

$$= k\left[-\frac{2q^2}{a} - \frac{q^2}{\sqrt{a^2+b^2}} + \frac{2q^2}{b} + \frac{2q^2}{b} - \frac{4q^2}{\sqrt{a^2+b^2}} - \frac{2q^2}{a}\right]$$

$$= 9\times10^9\left[-\cancel{1\times10^{-9}} - 4.76\times10^{-10} + \cancel{2\times10^{-9}} + 2\times10^{-9} - 1.9\times10^{-9} - \cancel{1\times10^{-9}}\right]$$

$$W = 9\times10^9 \times (-0.376\times10^{-9}) = -3.38\ \text{J}$$

The electric field does the work.

PHYS102.11
Quiz # 8 – Chapter 24

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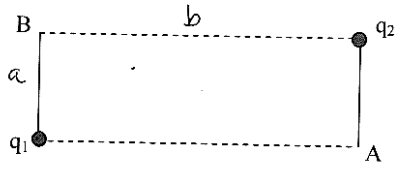
Consider the arrangement of charges $q_1 = 20\ \mu C$ and $q_2 = -10\ \mu C$, a = 10 cm and b = 20 cm.

(a) Calculate the potential difference $V_B - V_A$.
(b) How much work is required to move a charge $q_3 = 100\ \mu C$ from point A to point B?



a) $V_B = \frac{kq_1}{a} + \frac{kq_2}{b} = 9\times10^9\left(\frac{20\times10^{-6}}{0.1} - \frac{10\times10^{-6}}{0.2}\right)$

$= 135\times10^4\ V$

$V_A = \frac{kq_1}{b} + \frac{kq_2}{a} = 9\times10^9\left(\frac{20\times10^{-6}}{0.2} - \frac{10\times10^{-6}}{0.1}\right) = 0$

$\boxed{V_B - V_A = 135\times10^4\ V}$

b) $W = q_3\,\Delta V = q_3(V_B - V_A)$

$= 100\times10^{-6}\times 135\times10^4 = \boxed{135\ J}$

PHYS102.12
Quiz # 8 – Chapter 24

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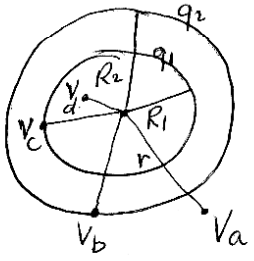
Consider two concentric spherical shells. The first shell has a radius $R_1 = 5$ cm and charge $q_1 = 20\ \mu C$. The second shell has a radius $R_2 = 10$ cm and charge $q_2 = -10\ \mu C$. Find the net electric potential at

(a) r = 15 cm
(b) r = 10 cm = R_2
(c) r = 5 cm = R_1
(d) r = 2 cm from the center of the sphere



a) $V_a = \frac{kq_1}{r} + \frac{kq_2}{r}$

$= 9\times10^9\left(\frac{20\times10^{-6}}{0.15} - \frac{10\times10^{-6}}{0.15}\right)$

$= 6\times10^5\ V$

b) $V_b = \frac{kq_1}{R_2} + \frac{kq_2}{R_2}$

$= 9\times10^9\left(\frac{20\times10^{-6}}{0.1} - \frac{10\times10^{-6}}{0.1}\right) = 9\times10^5\ V$

c) $V_c = \frac{kq_1}{R_1} + \frac{kq_2}{R_2}$

$= 9\times10^9\left(\frac{20\times10^{-6}}{0.05} - \frac{10\times10^{-6}}{0.1}\right) = 27\times10^5\ V$

d) $V_d = \frac{kq_1}{R_1} + \frac{kq_2}{R_2} = 27\times10^5\ V$