Name: Key Period: ______ Date: ________

Electrostatics: Electric Potential, Electric Potential & Electric potential Difference

electric potential energy
$U_E = \frac{K q_1 q_2}{r} = qV$

electric Potential
$V = K \sum_i \frac{q_i}{r_i}$

electric force
$F_E = \frac{K q_1 q_2}{r^2}$

electric Potential difference
$V_{AB} = V_B - V_A$

I. Answer the following problems.

1) What is the potential at a distance of 6.0 cm from a 2.5 µC charge? $3.8 \times 10^5 V$

$V = \frac{(9\times10^9)(2.5\times10^{-6})}{.06} = 3.8\times10^5 V$

2) What is the potential at a distance of 25 cm from a -2.5 µC charge? $-9\times10^4 V$

$V = \frac{(9\times10^9)(-2.5\times10^{-6})}{.25}$

3) How much work is done against the electric field produced by a 5.0 µC charged object when a 0.030 µC charge is moved from a distance of 45 cm to 15 cm. 0.006

$W = \Delta U_E = U_{E15} - U_{E45}$

$W = 0.009 - 0.003$

$W = .006 J$

$U_{E45} = \frac{(9\times10^9)(5\times10^{-6})(.03\times10^{-6})}{.45} = 0.003$

$U_{E15} = \frac{(9\times10^9)(5\times10^{-6})(.03\times10^{-6})}{.15} = 0.009$

4) A proton is released 2.0x10-11 m from the centre of a 6.4x10-18 C fixed charge. What is the speed of the proton when it is 0.50 m from the charge? $7.4\times10^5 m/s$

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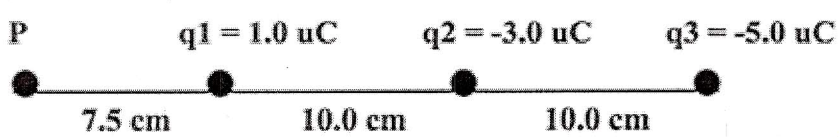
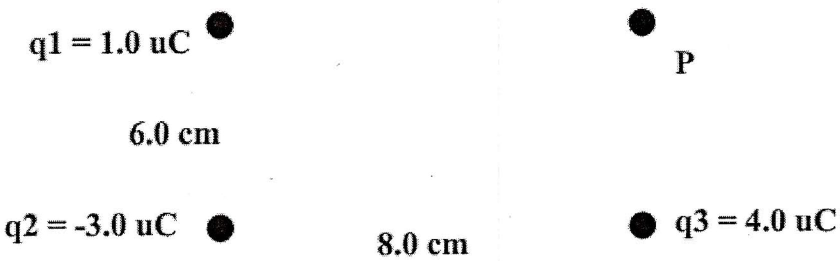
5) Three charges are located in a line as shown. Find the potential at point P. $-1.98\times10^5 V$



$V = 9\times10^9 \left[\frac{1\times10^{-6}}{.075} - \frac{3\times10^{-6}}{.175} - \frac{5\times10^{-6}}{.275}\right] = -1.98\times10^5 V$

6) Three charges are located at the corners of a rectangle as shown below. Find the potential at point P. $\underline{4.43\times10^{5}\,V}$



$$V = 9\times10^{9}\left[\frac{1\times10^{-6}}{.08} + \frac{-3\times10^{-6}}{.1} + \frac{4\times10^{-6}}{.06}\right] = 4.43\times10^{5}\,V$$

7) The centers of two alpha particles are held 2.5x10-12 m apart, when they are released. Calculate the speed of each alpha particle when they are 0.75 m apart. $\underline{V = 3.32\times10^{5}\,m/s}$

$$\Delta K = -\Delta U$$

$$\frac{mv^2}{2} - \frac{mv_0^2}{2} = -\left[1.22\times10^{-27} - 3.68\times10^{-16}\right]$$

$$V = 3.32\times10^{5}\,m/s$$

$$U_0 = \frac{(9\times10^{9})\left[2(1.6\times10^{-19})\right]^2}{2.5\times10^{-12}} = 3.68\times10^{-16}$$

$$U_f = \frac{(9\times10^{9})\left[2(1.6\times10^{-19})\right]^2}{.75} = 1.22\times10^{-27}$$

8) 4.4x10-5 J of work is done moving a 3.00 uC charge at a constant speed from point A to point B. If A and B are 2.4 cm apart, what is the potential difference between A and B? $\underline{\Delta V = 14.66\,V}$

$$\Delta U = W = 4.4\times10^{-5}\,J$$

$q_1 = 3\times10^{-6}$

$r = 2.4$

$$U_E = qV$$

$$\Delta U_E = q\cdot\Delta V$$

$$\Delta V = \frac{\Delta U_E}{q} = \frac{4.4\times10^{-5}\,J}{3\times10^{-6}}$$

$$\Delta V = 14.66\,V$$

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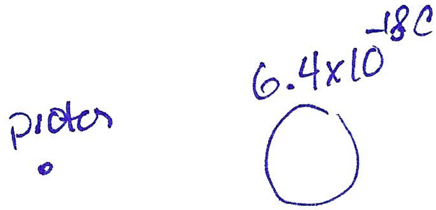

$$\Delta K = -\Delta U$$

$$\frac{mv^2}{2} = U_F - U_0$$

$$V = \sqrt{\frac{-2(U_F - U_0)}{m}}$$

$$V = \sqrt{\frac{-2(1.8 \times 10^{-26} - 4.6 \times 10^{-16})}{1.67 \times 10^{-27}}}$$

$$V = \underline{\underline{7.4 \times 10^5 \, m/s}}$$

$$U_0 = \frac{K q_1 q_2}{r} = \frac{9 \times 10^9 (6.4 \times 10^{-18})(1.6 \times 10^{-19})}{2 \times 10^{-11}}$$

$$U_0 = 4.6 \times 10^{-16}$$

$$U_F = \frac{K q_1 q_2}{r} = \frac{(9 \times 10^9)(6.4 \times 10^{-18})(1.6 \times 10^{-19})}{.5}$$

$$U_F = 1.8 \times 10^{-26}$$