Name: ____________________________ Period: ______ Date: ________

6/4

Electrostatics: Electric Potential, Electric Potential & Electric potential Difference

Problems 2

Electric Potential Energy	Electric Potential	Electric Potential Difference
$U_E = \frac{kq_1q_2}{r} = qV$	$V = k\sum_i \frac{q_i}{r_i}$	$V_{AB} = V_B - V_A$

I. Answer the following problems.

1. A positive charge q1=+2x10^{-6}C is held stationary, while a negative charge, q_2=-1x10^{-8}C is released from rest at a distance of 10cm from q_1. Find the kinetic energy of charge q_2 when it's 1cm from q_1. ______________

gain Kinetic energy → loss of Potential

$U = K\frac{q_1}{r}$

$U_E = K\frac{q_1q_2}{r} = \frac{(9\times10^9)(2\times10^{-6})(-1\times10^{-8})}{.10}$

$U_E = -1.8\times10^{-3}$

$U_E = \frac{(9\times10^9)(2\times10^{-6})(-1\times10^{-8})}{.01}$

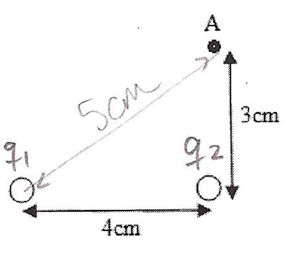
$U_E = -1.8\times10^{-2}$

$\Delta U = -1.8\times10^{-2} - (-1.8\times10^{-3}) =$

$\Delta U = -1.62\times10^{-2}$ J $= \Delta K$

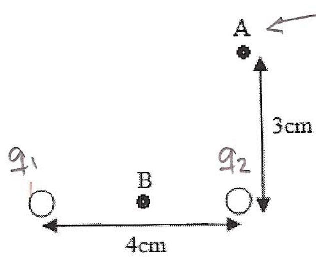
2. If charges q_1=4x10^{-9}C and q_2=-6x10^{-9}C are stationary, Calculate the potential at point A in the figure below. ______________

$V = K\left[\frac{q_1}{r_1} + \frac{q_2}{r_2}\right] = 9\times10^9\left[\frac{4\times10^{-9}}{.05} + \frac{-6\times10^{-9}}{.03}\right]$



$V = -1080V$

3. How much work would it take to move a charge 1=+1x10^{-2}C from point A to point B (midway point between q_1 and q_2)? ______________



$V_A = -1080V$

(S1) Find V_B

$V_B = K\left[\frac{q_1}{r_1} + \frac{q_2}{r_2}\right] = 9\times10^9\left[\frac{4\times10^{-9}}{.02} + \frac{-6\times10^{-9}}{.02}\right]$

$V_B = -900V$

$W = U_E = qV$ $\quad W = \Delta U_E = q\cdot\Delta V$

(S2) Change in electric potential from A→B

$\Delta V_{A\to B} = V_B - V_A = -900 - (-1080) = +180V$

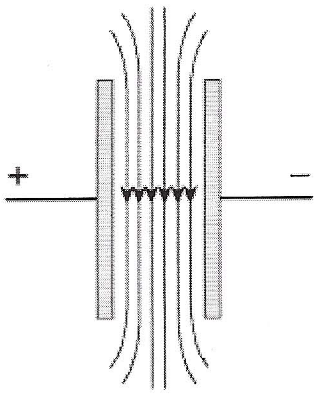
(S3) $U_E = q\cdot\Delta V = 1\times10^{-2}(180V) = 1.8J = W$

II. Answer the following multiple choice questions.

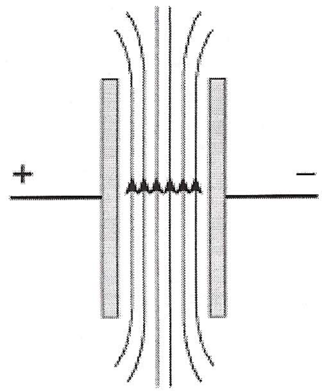
1.

Which of the following best illustrates the electric field between parallel plates with opposite electric charges?

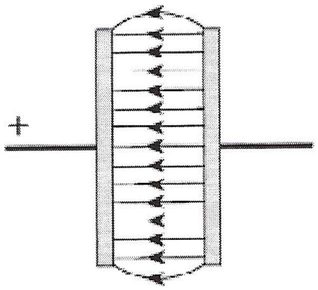
A.



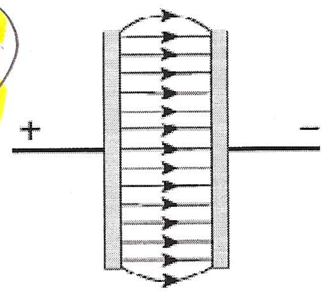
B.



C.



D.



2.

$92(1.6\times10^{-19}) = 1.47\times10^{-17}$

The atomic nucleus of uranium contains 92 protons. What is the direction and magnitude of the electric field 2.5×10^{-10} m from this nucleus?

	DIRECTION OF ELECTRIC FIELD	MAGNITUDE OF ELECTRIC FIELD
A.	towards nucleus	5.3×10^{2} N/C
B.	away from nucleus	5.3×10^{2} N/C
C.	towards nucleus	2.1×10^{12} N/C
D.	away from nucleus	2.1×10^{12} N/C

$E = \frac{F}{q} = \frac{kq}{r^2}$

$E = \frac{(9\times10^{9})(1.47\times10^{-17})}{2.5\times10^{-10}}$

$E = 2.1\times10^{12}$ AWAY

3.

A 0.16 C charge is moved in an electric field from a point with a potential of 25 V to another point with a potential of 95 V. How much work was done to move this charge?

A. 4.0 J
B. 11 J
C. 15 J
D. 19 J

$q = 0.16\,C$ $V = 25V$ $V = 95$

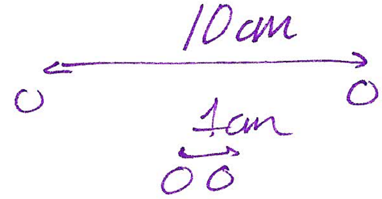
$W = \Delta U_e = q\Delta V$

$W = 0.16(95-25)$

$W = 11.2$

① Gain = Loss

$\Delta K = \Delta U_E$

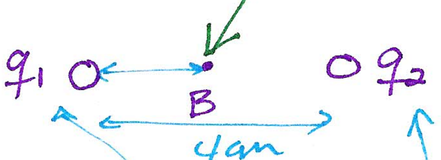


$\Delta U_E = U - U_0$

$U_E = \frac{K q_1 q_2}{r}$

③ $1\times10^{-2}C$ $V_A = K\left[\frac{q_1}{r_1} + \frac{q_2}{r_2}\right] = \_\_\_\_ V$

W



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

$= q(V_B - V_A)$

STEP 1: Get V_B

$V_B = K\left[\frac{q_1}{r_1} + \frac{q_2}{r_2}\right]$

STEP 2: Get ΔV

$\Delta V_{A\to B} = V_B - V_A$

STEP 3: Get ΔU_E

$\Delta U_E = q \cdot \Delta V_{A\to B}$

Multiple Choice

②
92 protons

$r = 2.5\times10^{-10} m$

$E = ?$

$q = 92(q_p)$

$E = \frac{F_E}{q} = \frac{Kq}{r^2}$

③ $q = .16C$

$V_A = 25V$

$V_B = 95V$

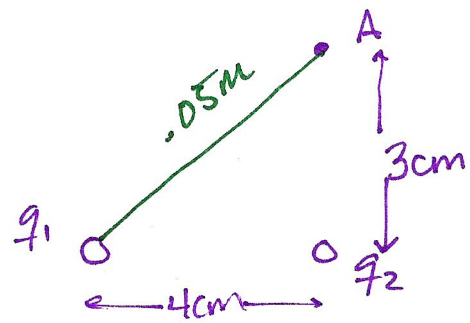
$W \to \Delta U_E$

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

(2)

$q_1 = 4\times10^{-9}\,C$

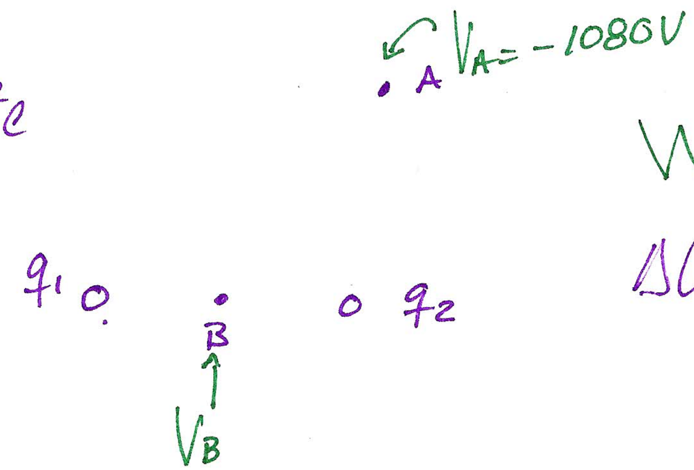
$q_2 = -6\times10^{-9}\,C$



$$V_A = K\left[\frac{4\times10^{-9}}{.05} + \frac{-6\times10^{-9}}{.03}\right] = \underline{\underline{-1080\,V}}$$

(3)

$q = 1\times10^{-2}\,C$



$W = \Delta U_E$

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

$\uparrow$ $V_B - V_A$

STEP 1: Find V_B

$$V_B = K\left[\frac{4\times10^{-9}}{.02} + \frac{-6\times10^{-9}}{.02}\right]$$

STEP 2: Find the electric potential

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

STEP 3: Find the change in electric potential

$$\Delta U_E = q\cdot\Delta V_{AB}$$