Name: Key Period: _____ Date: _____

Electrostatics: 4 – Electric Field in Uniform Electric Fields problems I

Electric Field (Plates)	Electrostatic Force	Electric Potential Energy	Electric Field
$E_{avg} = \frac{-\Delta V}{d}$	$F_E = \frac{kq_1q_2}{r^2} = qE$	$U_E = \frac{Kq_1q_2}{r} = qV$	$E = \frac{F_E}{q}$

I. Answer the following problems. Show all your work to get full credit.

1. Two parallel plates are connected to a 12.0 V battery. If the plates are 9.00x10-2 m apart, what is the electric field strength between them?

$\Delta V = -12V$
$d = 9\times10^{-2}m$
$E_{AVG} = ?$

$E_{AVG} = -\frac{\Delta V}{d} = \frac{-(-12V)}{9\times10^{-2}} = 1.33\times10^{2} N/C$

2. The electric field between two parallel plates is 5.0x103 N/C. If the potential difference between the plates is 2.0x102 V, how far apart are the plates?

$E = 5\times10^{3} N/C$
$\Delta V = -2\times10^{2} V$
$d = ?$

$E_{AVG} = -\frac{\Delta V}{d}$

$d = -\frac{\Delta V}{E_{AVG}} = -\frac{(-2\times10^{2})}{5\times10^{3}} = 4\times10^{-2} m$

3. Two parallel plates are 7.3 cm apart. If the electric field strength between the plates is 2.0x103 V/m, what is the potential difference between the plates?

$d = 0.073m$
$E = 2\times10^{3} N/C$
$\Delta V = ?$

$E_{AVG} = -\frac{\Delta V}{d}$

$\Delta V = -E_{AVG} \times d$
$\Delta V = -(2\times10^{3})(.073)$
$\Delta V = -146V$

4. An alpha particle gains 1.5x10-15 J of kinetic energy. Through what potential difference was it accelerated?

$\Delta K = 1.5\times10^{-15} J$
$q_\alpha = 2(1.6\times10^{-19}) = 3.2\times10^{-19}$

$\Delta K = -\Delta U$
$\Delta K = -q \cdot \Delta V$
$\Delta V = \frac{\Delta K}{-q} = \frac{1.5\times10^{-15}}{-3.2\times10^{-19}} = -4.69\times10^{3} V$

5. A proton is accelerated by a potential difference of 7.20x102 V. What is the change in its kinetic energy?

$q = 1.6\times10^{-19} C$
$\Delta V = -7.2\times10^{2} V$
$\Delta K = ?$

$\Delta K = -\Delta U_E$
$\Delta K = -q \cdot \Delta V$
$\Delta K = -1.6\times10^{-19}(-7.2\times10^{2} V)$
$\Delta K = 1.15\times10^{-16} J$

6. What maximum speed will an alpha particle reach if it moves from rest through a potential difference of -7.50x103 V?

$q_\alpha = 3.2\times10^{-19}\ C$

$\Delta V = 7.5\times10^{3} V$

$m_\alpha = 4(1.67\times10^{-27}) = 6.68\times10^{-27}$

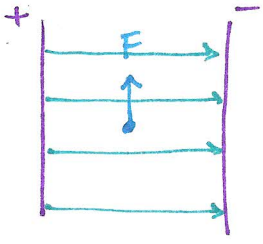
$\Delta K = -\Delta U_E$

$\frac{mv^2}{2} = -q\cdot\Delta V$

$V = \sqrt{\frac{-2q\cdot\Delta V}{m}} = \sqrt{\frac{-2(3.2\times10^{-19})(7.5\times10^{3})}{6.68\times10^{-27}}}$

$V = 8.5\times10^{5}\ m/s$

7. A proton is placed in an electric field between two parallel plates. If the plates are 6.0 cm apart and have a potential difference of 75 V, how much work is done against the electric field when the proton is moved 3.0 cm parallel to the plates?

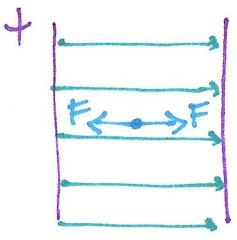


$\Delta V = 75V$

$W = 0J$

WORK is done ONLY if the particle moves in the same direction as the electric field (left or right)

8. In question 7, how much work is done against the electric field in moving the proton 3.0 cm perpendicular to the plates?



$\Delta V = 75V$

STEP 1: Get E

$E_{AVG} = -\frac{\Delta V}{d} = \frac{-(-75)}{.06} = 1250\ N/C$

STEP 2: Get F_E

$F_E = q\cdot E = (1.6\times10^{-19})(1250) = 2\times10^{-16}\ N$

STEP 3: Get W

$W = F\cdot d = (2\times10^{-16}\ N)(.03) = 6\times10^{-18}\ J$