N3

2.1 Electric fields. Forces on free charges in electric fields. ~~Class Questions.~~

The strength of an electric field can be defined as the force per unit charge at that point.

$$E = \frac{F}{q}$$

Where: F- force on charge placed in the field in Newtons (N), G- *charge in coulombs (C), E- electric field in newtons per coulomb/NC^{-1}],*

1.A charge of +6.0 μC experiences a force of 1.5x 10^{-3} N east at point P. Calculate the strength of the electric field at P.

$E = \frac{F}{q}$ $E = \frac{1.5\times10^{-3}}{6\times10^{-6}}$ $= 250\ NC^{-1}$

2.A charge of -3.0 μC experiences a force of 4.2 x 10^{-3}? N south at point P. Calculate the strength of the electric field at P.

$E = \frac{F}{q}$ $E = \frac{4.2\times10^{-3}}{3\times10^{-6}} = 1.4\times10^{3}\ NC^{-1}$

3.A charge of +4.0 μC in an electric field of strength 1.5x10^{-3} NC^{-1} north at point P. Calculate the force on the charge.

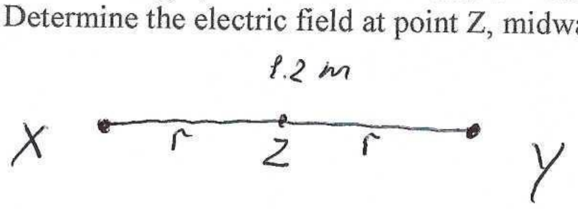
$F = Eq$ $F = 1.5\times10^{-3} \times 4\times10^{-6}$
$= 6\times10^{-9} N$

4. Calculate the strength of electric field 2.5 cm from a charge of -1.5x10^{-10} C in a vacuum.

$E = K\frac{q}{r^2}$ $E = 9\times10^{9} \times \frac{1.5\times10^{-10}}{(0.025)^2} = 2.16\times10^{3}\ NC^{-1}$

5. Two charges, X =+3.6× $10^{-10}$and Y=+7.2× 10^{-10}C are separated by 1.2 m in air. Determine the electric field at point Z, midway between X and Y.

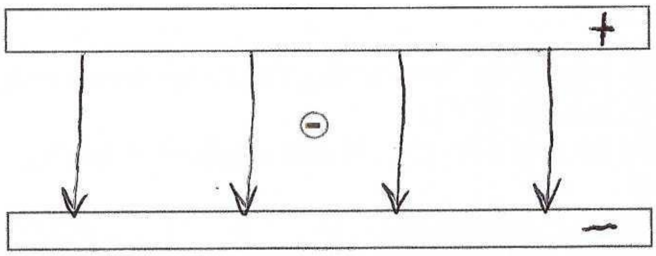
q_2 (X), q_1 (Y)



$E = K\frac{q_1 - q_2}{r^2}$ $E = 9\times10^{9}\ \frac{3.6\times10^{-10}}{0.6^2} = 9.0\ NC^{-1}$

Direction to the left

6. An electron is placed between the two electrically charged plates shown below. The electron accelerates toward the upper plate. The electric field strength between the plates is 4.8 x 10-10 newtons per coulomb:



a. Label the plates with the correct charge.

b. Sketch at least four electric field lines to represent the field between the plates. Ensure that the direction of the field lines is correct!

c. Use the electric field strength given above and the charge on the electron to determine the net force acting on the electron while it is between the plates.

$F_{net} = F_{el} - mg = Eq - mg$ $\quad F_{net} = 4.8\times10^{-10} \times 1.6\times10^{-19} - 9.1\times10^{-31} \times 9.8$

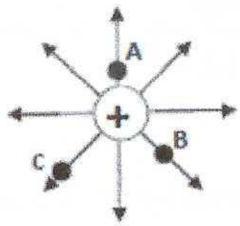
$= 7.68\times10^{-29} - 8.92\times10^{-30}$

$= 6.8\times10^{-29} N$

d. Calculate the acceleration of the electron while it is between the plates.

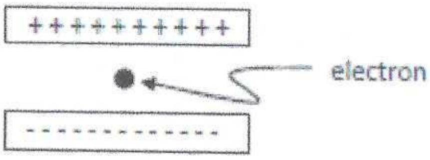
$a = \frac{F}{m}$ $\quad a = \frac{6.8\times10^{-29}}{9.1\times10^{-31}} = 7.5\ ms^{-2}$

7. The diagram below shows some of the lines of electrical force around a positive point charge. Point A is nearest to the charge, point B is farther away, and point C is the farthest.



The electric field strength is
(1) greatest at point A
(2) greatest at point B
(3) greatest at point C
(4) equal at points A, B, and C

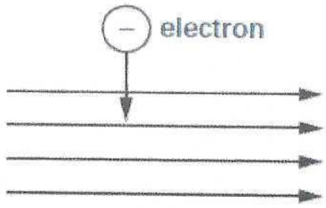
8. As the electron that is placed between the plates below moves toward the positive plate, the force acting on it…



(1) decreases
(2) increases
(3) remains the same

Field uniform

9. A uniform electric field of strength 7.5 N C^{-1} acts to the right as shown below. An electron enters the field as shown.



What is the magnitude and direction of the electrostatic force that acts on the electron once it enters the electric field?

Direction to the left

$F = Eq \quad F = 7.5 \times 1.6 \times 10^{-19}$
$= 1.2 \times 10^{-18}$ N