Example: Electric Field

a. Determine the electric field 0.10*m* from a point charge Q which carries a charge of 0.20μC.

$$E = \frac{kQ}{r^2} = \frac{(9\times10^9)(0.20\times10^{-6})}{(.1)^2}$$

$$E = 180\,000\ \frac{N}{C} = 1.8\times10^5\ \frac{N}{C}$$

b. Determine the magnitude and direction of the electric force exerted on a second charge q = 0.
which is placed 0.10*m* from Q.

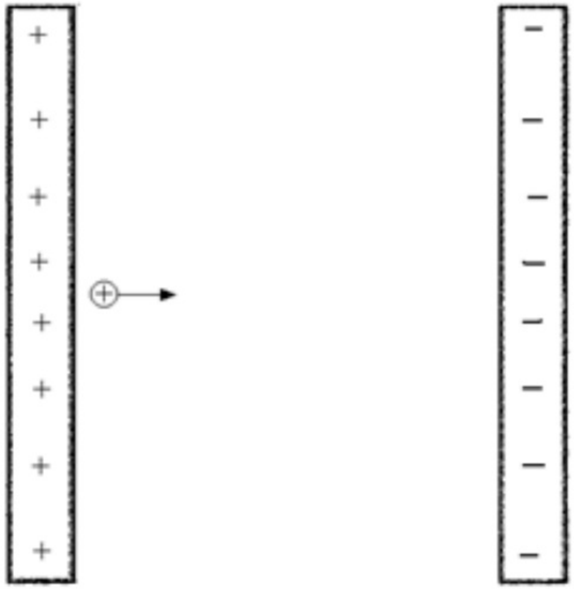
$$E = \frac{F}{q} \therefore F = qE = (0.8\times10^{-6})(1.8\times10^5$$

$$F = 0.144\ N$$

Example: Charged Plates

A particle of mass 1.0 x 10^{-3} kg has an excess charge of +1.0μC. The particle is located in a region between two oppositely charged parallel plates where the electric field is uniform and has a magnitude of 1000 N/C. Determine

a. The magnitude of the force acting on the particle
b. Rate of acceleration of the particle
c. If the distance between the plates is 0.010m and the particle is initially at rest at a point close to the positive plate, determine the velocity of the particle just before it strikes the negative plate.



a) $F = qE = (1\times10^{-6})(1000) = 1\times10^{-3}\ N$

b) $F = ma \quad a = \frac{F}{m} = \frac{1\times10^{-3}}{1\times10^{-3}} = 1\ m/s^2$

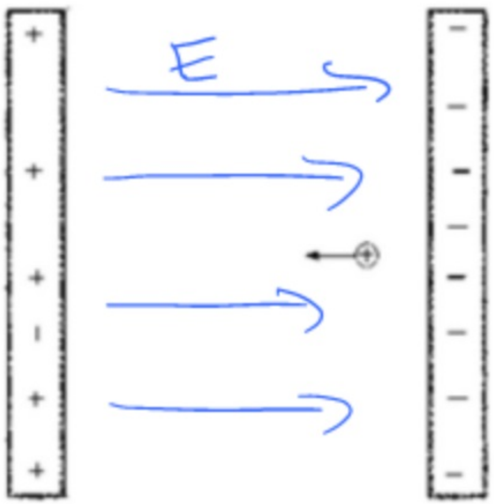
c) $v_f^2 = v_i^2 + 2as$

$v_f = \sqrt{0^2 + 2(1)(.01)} = 0.14\ m/s$

Example: Slowing a proton

A proton traveling at 3.0 x 10^6 m/s enters a region where the electric field has a magnitude of 3.0 x 10^5 N/C. The electric
field is uniform and retards the proton's motion. Determine

a. the distance the proton will travel before coming to a momentary halt
b. time required for the proton to travel this distance



a) $F = ma = qE \quad \therefore a = \frac{qE}{m}$

$m = 1.67 \times 10^{-27}$ kg

$a = \frac{(1.60 \times 10^{-19})(3 \times 10^{5})}{(1.67 \times 10^{-27})} = -2.87 \times 10^{13} \frac{m}{s^2}$

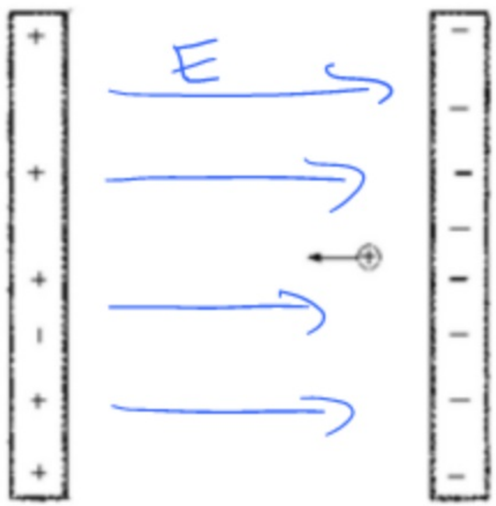
$v_f^2 = v_i^2 + 2as \quad \Big| \quad s = \frac{v_f^2 - v_i^2}{2a} = \frac{0^2 - (3 \times 10^6)^2}{2(-2.87 \times 10^{13})}$

$s = 0.157\,m$

Example: Slowing a proton

A proton traveling at 3.0×10^6 m/s enters a region where the electric field has a magnitude of
3.0×10^5 N/C. The electric
field is uniform and retards the proton's motion. Determine

a. the distance the proton will travel before coming to a momentary halt
b. time required for the proton to travel this distance



b) $v_f = v_i + at$

$$t = \frac{v_f - v_i}{a}$$

$$t = \frac{0 - 3\times10^{6}}{-2{,}87\times10^{13}} = 1.05\times10^{-7}\,s$$

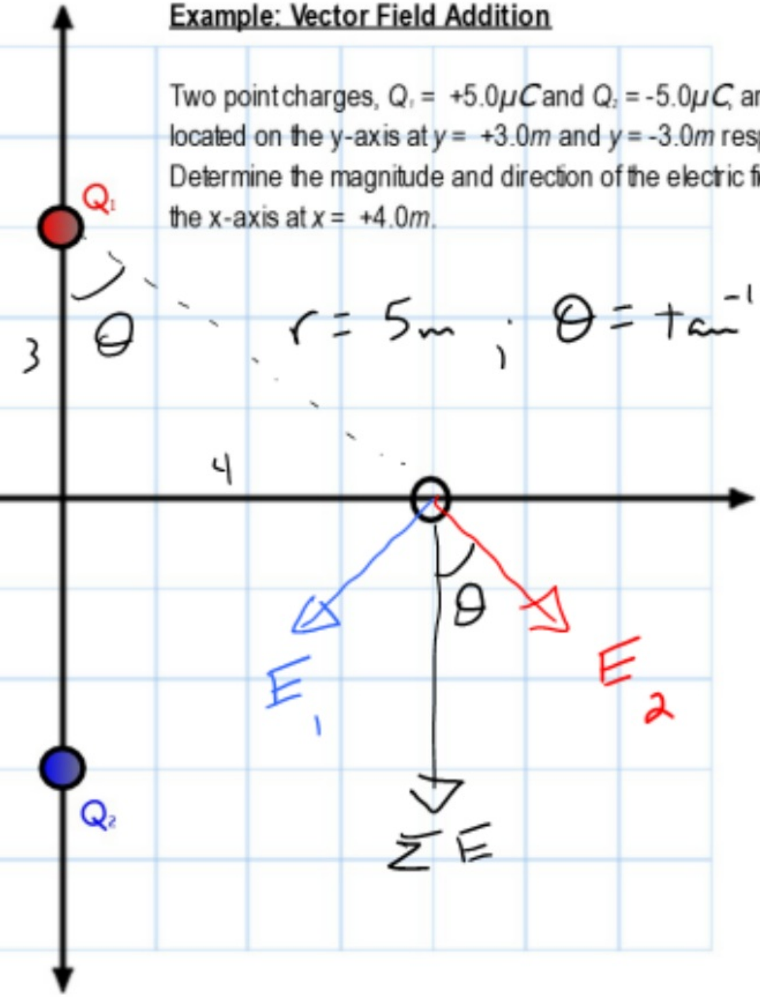
Example: Vector Field Addition

Two point charges, $Q_1 = +5.0\mu C$ and $Q_2 = -5.0\mu C$, are located on the y-axis at $y = +3.0m$ and $y = -3.0m$ respectively. Determine the magnitude and direction of the electric field on the x-axis at $x = +4.0m$.

$$E_1 = E_2 = \frac{kQ}{r^2} = 1800\,\frac{N}{C}$$

$$\Sigma E = E_{1y} + E_{2y}$$

$$r = 5m\ ; \quad \theta = \tan^{-1}\frac{4}{5} = 38.7^0$$



$$E_y = E\cos\theta = 1405\,\frac{N}{C}$$

$$\Sigma E = 2810\,\frac{N}{C}\ \text{down}$$