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1a) Charging by induction:
Electric charges ~~by both~~ can be obtained to an object without touching it by a process called electrostatic induction A positively charged rod brought near a neutral (uncharged) conducting sphere that is insulated so that there is no conducting path to ground. The repulsive force between the protons of the rod causes ~~the~~ a redistribution of charges on sphere so that the rod can maintain

Finally when the rubber rod is removed from the vicinity of the sphere the induced negatively charge remains on the ungrounded sphere and becomes uniformly distributed over the surface of a sphere

1b) $Q_1 + Q_2 = 5 \times 10^{-5} C$

$F = 1N$

$d = 2m$

Calculate the charge on each sphere

$K = 9 \times 10^9$

$$F = \frac{K Q_1 Q_2}{r^2}$$

$$1 = \frac{9 \times 10^9 (Q_1 Q_2 \times 5 \times 10^{-5})}{2^2}$$

$$4 = 9 \times 10^9 \times 5 \times 10^{-5} Q_1 + 9 \times 10^9 Q_2$$

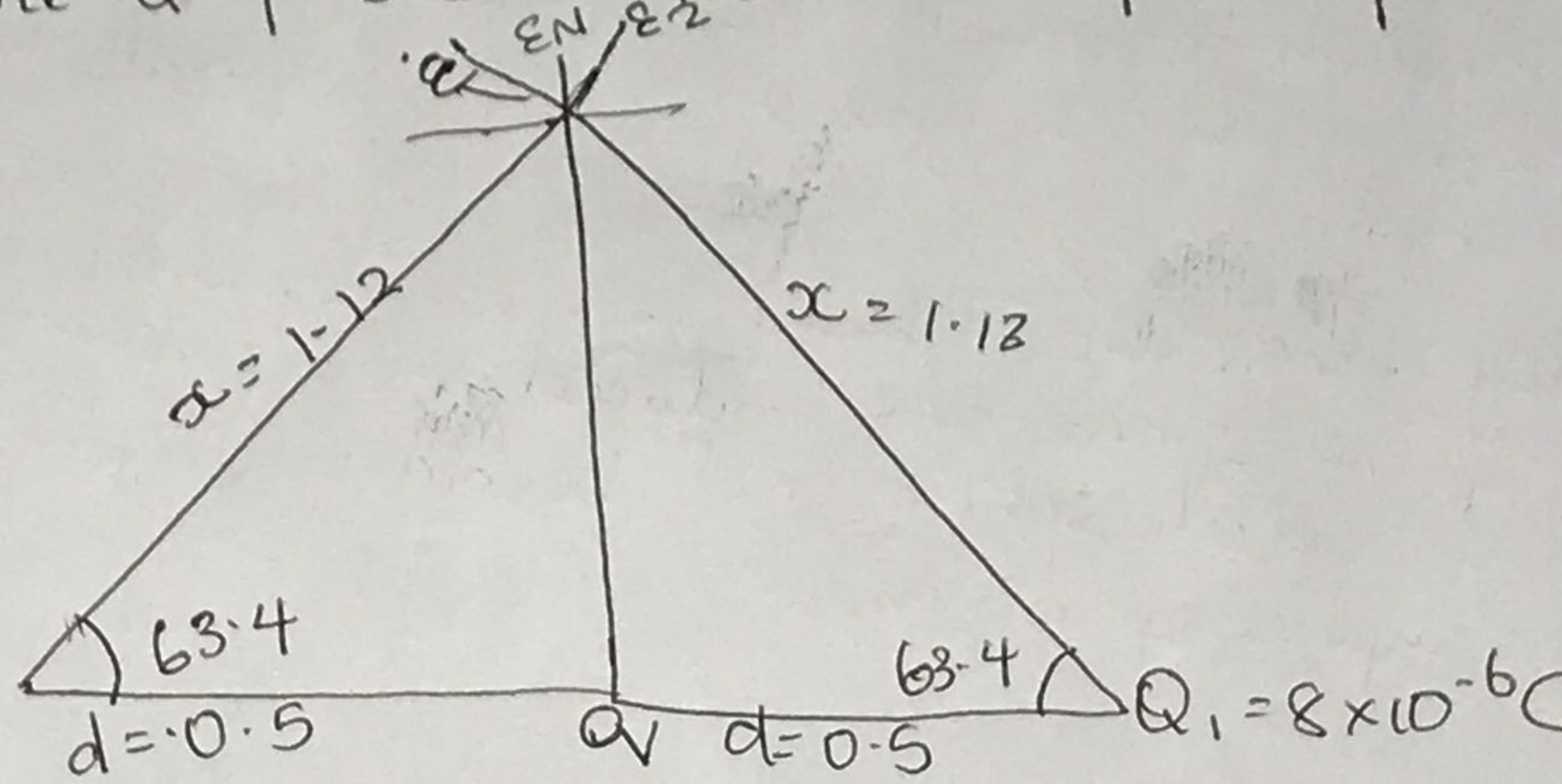
$$4 = 4.5 \times 10^5 Q_1 + 9 \times 10^9 Q_2$$

quadratic equation

$$9 \times 10^9 Q_2 - 4.5 \times 10^5 Q_1 + 4 = 0$$

$Q_1 = 0.0000111C$
$Q_2 = 0.000038C$
$Q_1 = 1.11 \times 10^{-5} C$
$Q_2 = 3.8 \times 10^{-5} C$

1c) $Q_1 = Q_2 = 8\mu C$
$d = 0.5m$
determine Q if electric field at a point p is zero




$E_1 = \frac{KQ_1}{r_1^2} = \frac{9 \times 10^9 \times 8 \times 10^{-6}}{(1.12)^2} = 5739.795918$

$E_2 = \frac{KQ_1}{r^2} = \frac{9 \times 10^9 \times 8 \times 10^{-6}}{1.12^2} = 5739.79518$

$E_Q = \frac{KQ}{r^2} = \frac{9 \times 10^9 \times Q}{1} = 9 \times 10^9 Q$

| Vector | angle | x-comp | y-comp |
|---|---|---|---|
| $E_1 = 5739.795918$ | $63.4°$ | $E_1 \times \cos\theta = 2570.045785$ | $5132.262839$ |
| $E_2 = 5739.795918$ | $63.4°$ | $2570.045785$ | $5132.262830$ |
| $E_Q = 9 \times 10^9 Q$ | $90°$ | $E_Q \cos\theta = 0$ <br> $\Sigma x = 0$ | $9 \times 10^9 Q$ <br> $\Sigma y = 10264.52568$ |

magnitude $= \sqrt{(\Sigma x)^2 + (\Sigma y)^2}$

6C $E_{q} = \sqrt{(0)^2 + (10264.52568)^2}$

Since $E_0 = 0$

$0 = 9\times10^9 q + 10264.52568$

turning q to the SOF

$q = \frac{-10264.52568}{9\times10^9}$

$q = 1.140502853\times10^{-6}$

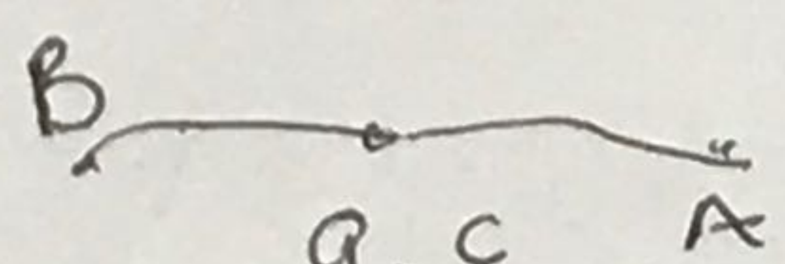
$\simeq q = 11.4\mu C$

3a.) Volume Charge density

ii.) Surface charge density

iii) Linear charge density

3b) Electric potential difference: The electric potential difference between two points in an electric field is the work done per unit charge. It is a scaler quantity




From the diagram above, suppose a test charge is move from a point to an abitrary path. The electric field exerts a force at constant velocity which must act on a charge ~~Therefore the~~ elemental wo

Section B

4a) Magnetic flux is defined as the strength of the magnetic field, it is given as $\Phi$. mathematically, $\Phi = B.d = A$

4b) $m = 9\times10^{-31}kg$

$r = 1.4\times10^{-7}m$

$B = 3.5\times10^{-1}$ weber/meter$^2$

cyclotron frequency = angular speed

$\omega = \frac{V}{r} = \frac{qVB}{m}$

$\omega = \frac{qVB}{m} = \frac{1.6 \times 10^{-19} \times 3.5 \times 10^{-1}}{9 \times 10^{-31}}$

$\omega = 62222222222.2222 T^{-1}$

4c. mass of electron = $9.11 \times 10^{-31}$ kg

ii) A radius of $1.4 \times 10^{-7}$ m

iii) Magnetic field of $3.5 \times 10^{-1}$ weber/meter square

5a) Biot-Savart law states that the magnetic field is directly proportional to the product of the permeability of free space ($\mu$) the current (A), the change in length, the radius and inversely proportional to square of radius ($r^2$). ~~It can~~

5b) Magnetic Field of a straight current carrying conductor

Recall

Using special integrals:

~~It~~ When the length of a conductor is very great in comparison to its distance from point P, we consider it infinitely long. That is, when is much larger than, we have axial symmetry in a physical situation, we have axial symmetry about the y-axis. Thus, at all points in a circle of radius around the conductor, magnitude ~~B~~ of B is Equation defines the magnitude of the magnitude field of flux density B near a ~~strong~~ long, straight current carrying conductor.