4. $v_i = 0$

$v_f = 1.2 \times 10^6$ m/s

$E = 640$ N/C

a) $F = ma$

$a = \frac{F}{m} = \frac{qE}{m} = \frac{(1.602 \times 10^{-19})(640)}{1.673 \times 10^{-27}} = 6.13 \times 10^{10}$ m/s^2

b) $v_f = v_i + at$

$at = v_f - v_i$

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

$= \frac{1.2 \times 10^6}{6.13 \times 10^{10}}$

$= 1.96 \times 10^{-5}$ s

c) $v_f = v_i + 2a\Delta x$

$\Delta x = \frac{v_f - v_i}{2a}$

$\frac{1.2 \times 10^6}{2 \times 6.13 \times 10^{10}}$

$= 9.79 \times 10^{-6}$ m

$\Delta x = ut + \frac{1}{2}at^2$

$= 0 + \frac{1}{2} \times 6.13 \times 10^{10} \times (1.96 \times 10^{-5})^2$

$= 11.77$ m

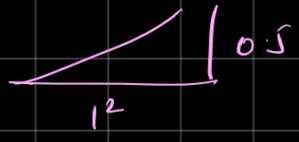
3. $E = \frac{k_e q}{r^2}$

$k_e = 8.9876 \times 10^9$

$q = 2\ \mu C$

$r^2 = 1.25$ m

$E = \frac{k_e q}{r^2}$



$$= \frac{8.9876 \times 10^{9} \times 2 \times 10^{-6}}{1.25}$$

$$= 14380.16 \ N/C$$

$$E = E_x + E_y$$

$$E_x = 0$$

$$E_y = E \sin\theta$$

$$\sin\theta = \frac{0.5}{1.12} = 26.5°$$

$$E_y = 2 \times E \times \sin\theta$$

$$= 2 \times 14380.16 \times \frac{0.5}{1.12}$$

$$= 12839.42$$

$$= 1.28 \times 10^{4} \ N/C$$

b) $F = qE$

$$= -3 \times 10^{-6} \times 1.28 \times 10^{4}$$

$$= -3.84 \times 10^{-2} \ N$$

2. $$F_G = -\frac{k e q_1 q_2}{r^2}$$

$$= -\frac{(8.99 \times 10^{9})(6 \times 10^{-9})(5 \times 10^{-9})}{0.3^2}$$

$$= -3 \times 10^{-6} \ N$$

$$F_3 = \frac{-8.99 \times 10^{9} \times 3 \times 10^{-9} \times 5 \times 10^{-9}}{(0.1)^2}$$

$= -1.35 \times 10^{-5}$ N

a) $F = \sqrt{F_3^2 + F_5^2}$

$= \underline{1.38 \times 10^{-5} \text{ N}}$

b) $\theta = \tan^{-1}\left(\frac{F_3}{F_5}\right)$

$= \tan^{-1}\left(\frac{-1.35 \times 10^{-5}}{-3 \times 10^{-6}}\right)$

$= \underline{77.47^\circ}$

1. $v_i = 3 \times 10^6$ m/s

$v_f = 0$

$E = 1 \times 10^3$ N/C

$F = ma$

$a = \frac{F}{m} = \frac{qE}{m} = \frac{-1.602 \times 10^{-19} \times 10^3}{9.109 \times 10^{-31}}$

$= -1.76 \times 10^{14}$ m/s^2

$v_f^2 = v_i^2 + 2a\Delta x$

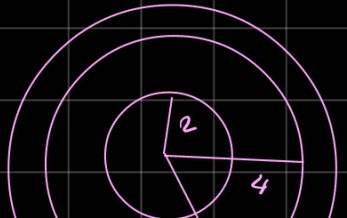
$\Delta x = \frac{-v_i^2}{2a}$

$= \frac{-(3 \times 10^6)^2}{2 \times (-1.76 \times 10^{14})}$

$= 2.56 \times 10^{-2}$ m

6. $r = 2 \times 10^{-2}$ m

$Q = 8 \times 10^{-6}$ C



a) at $r = 1$

$E = 0$

b) $E = \frac{k_e Q}{r^2} = \frac{8.99 \times 10^9 \times 8 \times 10^{-6}}{(3 \times 10^{-2})^2} = 79.9 \times 10^6 \text{ N/C}$

$= 79.9 \text{ MN/C}$

c) at $r = 4.5$

$E = 0$

d) at $r = 7$

$E = \frac{kQ}{r} = \frac{8.99 \times 10^9 \times 4 \times 10^{-6}}{(7 \times 10^{-2})^2} = 7.34 \times 10^6 \text{ N/C}$

$= 7.34 \text{ MN/C}$

5. $s = 0.5 \text{ m}$

$E = 80 \times 10^3 \text{ N/C}$

$E = \frac{\sigma}{\varepsilon_0}$

$\sigma = E\varepsilon_0$

$= 80 \times 10^3 \times 8.85 \times 10^{-12}$

$= 7.08 \times 10^{-7} \text{ C/m}^2$

$= 708 \text{ nC/m}^2$

$\sigma = \frac{Q}{A}$

$Q = \sigma \cdot A$

$= 708 \times 10^{-9} \times 0.5 \times 0.5$

$= 177 \text{ nC}$

4. $r = 5 \times 10^{-2} \text{ m}$

$\lambda = 30 \times 10^{-9} \text{ N/C}$

a) $E = 0$

b) $E = 2 k_e \lambda$

$$= \frac{2 \times 8.99 \times 10^9 \times 30 \times 10^{-9}}{10}$$

$$= 53.94 \text{ N/C}$$

$\frac{1}{2} = k_e$

c) $$E = \frac{2 \times 8.99 \times 10^9 \times 30 \times 10^{-9}}{100}$$

$$= 5.394 \text{ N/C}$$

3. a) $E = 0$

b) $$E = \frac{k_e Q}{a^2} \times 2 = \frac{8.99 \times 10^9 \times 26 \times 10^{-6}}{(0.4)^2} \times 10$$

$$= 365 \text{ kN/C}$$

c) $$E = \frac{k_e Q}{r^2} = \frac{8.99 \times 10^9 \times 26 \times 10^{-6}}{(0.4)^2}$$

$$= 1.46 \text{ MN/C}$$

d) $$E = \frac{kQ}{r^2} = \frac{8.99 \times 10^9 \times 26 \times 10^{-6}}{(0.6)^2}$$

$$= 649.28 \text{ kN/C}$$

2. $E = 0$

$$E = \frac{kQ}{r^2} = \frac{8.99 \times 32}{0.2} = 7192 \text{ N/C}$$

1. $A = 3.2 \text{ m}^2$

$E = 6.2 \times 10^5 \text{ N/C}$

a) $\Phi_E = EA \cos\theta$

$= 6.2 \times 10^5 \times 3.2$

$= 1.984 \ \frac{Nm^2}{C}$

b) $\Phi_E = EA \cos 90$

$= \underline{0}$

6. $r = 14 \times 10^{-2} \ m$

$Q = 26 \times 10^{-6} \ C$

a) $V = \frac{kQ}{r} = 1.67 \ MV$

$E = 0$

b) $V = \frac{kQ}{r} = 1.17 \ MV$

$E = \frac{kQ}{r^2} = 5.84 \ MN/C$

c) $V = 1.67 \ MV$

$E = 11.93 \ MN/C$

5. $V = 7.5 \times 10^3 \ V$

$r = 0.3 \ m$

$V = \frac{kQ}{r}$

$Q = \frac{Vr}{k}$

$= \frac{7.5 \times 10^3 \times 0.3}{8.99 \times 10^9}$

$= 2.50 \times 10^{-7}\ C$

$Q = ne$

$n = \frac{Q}{e} = \frac{2.50 \times 10^{-7}}{1.602 \times 10^{-19}}$

$= 1.56 \times 10^{12}$ elections

4. $E = 500\ V/m$

$V = -3 \times 10^3\ V$

$V = \frac{kQ}{r}$

$E = \frac{kQ}{r^2}$

$\frac{V}{E} = \frac{kQ}{r} \times \frac{r^2}{kQ}$

$= r$

$r = \frac{-3 \times 10^3\ V\ m}{500\ V}$

$= 6\ m$

$V = \frac{kQ}{r}$

$Q = \frac{Vr}{k} = \frac{-3 \times 10^3 \times 6}{8.99 \times 10^9}$

$= \frac{18 \times 10^{-6}}{8.99}$

$= -2\ \mu C$

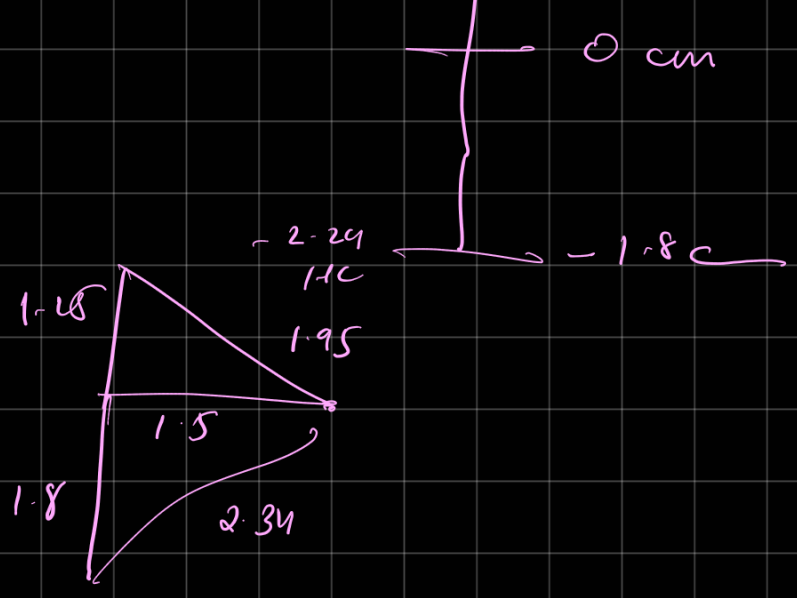
3.a) $V = k_e \left[\frac{q_1}{r} + \frac{q_2}{r} \right]$

$4.5\ \mu C$ — $1.25\ cm$

$= 2.12 \text{ MV}$

b) $V = k_e \left[\frac{q_1}{r_1} + \frac{q_2}{r_2} \right]$

$= \underline{1.21 \text{ V}}$



2. $E = 250 \text{ V/m}$

$U_E = -qEs$

$= (12 \times 10^{-6})(250)(0.2)$

$= -6 \times 10^{-4} \text{ J}$

$U = qV$

$V = \frac{U}{q} = \frac{-6 \times 10^{-4} \text{ J}}{12 \times 10^{-6}} = -50 \text{ V}$

1. a) $E = \frac{V}{r} = \frac{600}{5.33 \times 10^{-3}} = 112.57 \text{ kN/C}$

b) $F = qE = 1.602 \times 10^{-19} \times 1.1257 \times 10^{5}$

$= 1.80 \times 10^{-14} \text{ N}$

c) $\Delta V = -qE \cdot \vec{s}$

$= 1.602 \times 10^{-19} \times 1.1257 \times 10^{5} \times 2.43 \times 10^{-3}$

$= 4.38 \times 10^{-17} \text{ J}$

1. $2a = (-1.2\hat{i} + 1.1\hat{j}) - (1.4\hat{i} - 1.3\hat{j})$

$= -2.6\hat{i} + 2.4\hat{j}$ mm

$= (-2.6\hat{i} + 2.4\hat{j}) \times 10^{-3}$ m

$p = 2aq$

$= (-9.1\hat{i} + 8.4\hat{j}) \times 10^{-12}$ mC

$\vec{\tau} = \vec{p} \times \vec{E}$

$[(-9.1 + 8.4\hat{j}) \times 10^{-12}] \times [(7.8\hat{i} - 4.9\hat{j}) \times 10^{3}]$

$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -9.1 & 8.4 & 0 \\ 7.8 & -4.9 & 0 \end{vmatrix} = -20.93\,\hat{k} \times 10^{-9}$ Nm

6. $Q = C\Delta V$

$\Delta V = E_{max}\, d$

$Q = C E_{max}\, d$