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Physics 12: Electrostatic **Practice Test**

Short Answers: Show all work,

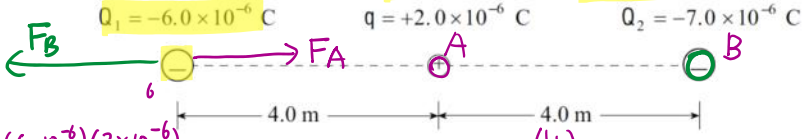
1) Two equal charges of magnitude 1.1×10^{-7}C experience an electrostatic force of 4.2×10^{-4} N. How far apart are the centres of the two charges?

$F_E = \frac{kQ_1Q_2}{r^2}$ $4.2\times10^{-4} = \frac{k(1.1\times10^{-7})(1.1\times10^{-7})}{r^2}$

$r = 0.509$ m

Distance) 0.509 m

2) What are the magnitude and direction of the electric force on the -6.0×10^{-6} C. [3 marks]



$F_A = \frac{k(6\times10^{-6})(2\times10^{-6})}{4^2} = 6.75\times10^{-3}$ N [R]

$F_B = \frac{k(6\times10^{-6})(7\times10^{-6})}{8^2} = 5.906\times10^{-3}$ N [L]

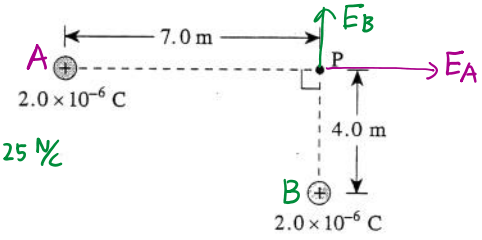
(big)

$F_{net} = F_A - F_B = 8.44\times10^{-4}$ N

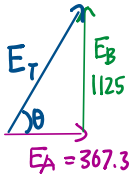
Force) 8.44×10^{-4} N [R]

3) Consider the diagram to the right.

a) Determine the electric field (magnitude and direction) at point P. [4 marks]



$E_A = \frac{kQ}{r^2} = \frac{k(2\times10^{-6})}{7^2} = 367.3$ N/C $E_B = \frac{k(2\times10^{-6})}{4^2} = 1125$ N/C



$E_T^2 = E_B^2 + E_A^2$ $\tan\theta = \frac{1125}{367} = 71.9°$

$E_T = 1183$ N/C

Magnitude) 1183 N/C

Direction) 72° [N of E]

b) Determine the potential (voltage) at point P. [2 marks]

$V_1 = \frac{kQ_1}{r} = \frac{k(2\times10^{-6})}{7} = +2571.4$ V

$V_2 = \frac{kQ_2}{r} = \frac{k(2\times10^{-6})}{4} = +4500$ V

$\rightarrow V_1 + V_2 = 7071.4$

V) 7071 V

4) What potential difference (V) is needed to decelerate an alpha particle from 1.4×10^6 m/s to 6.8×10^5 m/s.

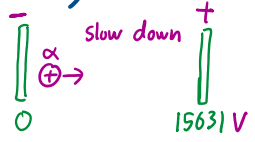
lost → $\Delta E_k = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 = \frac{1}{2}m_\alpha[(6.8\times10^5)^2 - (1.4\times10^6)^2] = -5\times10^{-15}$ J

$m_\alpha = 4\times(1.67\times10^{-27}\text{ kg})$

gain → $\Delta E_p = \Delta V Q_\alpha$

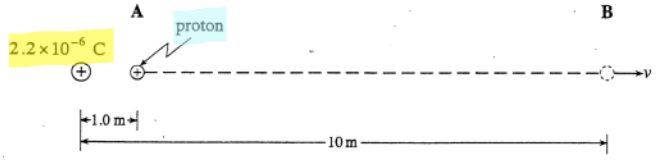
$+5\times10^{-15}\text{ J} = \Delta V(2\times1.6\times10^{-19}\text{ C})$

$\Delta V = +15631$ V



ΔV) 15631 V

5) A proton is located at A, 1.0 m from a fixed $+2.2\ \mu C$ charge



a) what is the change in potential energy of the proton as it moves to B, 10 m from the fixed charge
b) if the proton started from rest at A, what would be it speed at B?

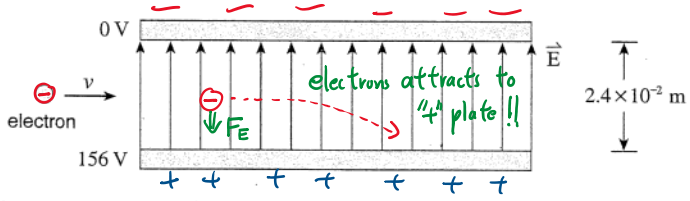
a) $\Delta E_p = E_{P_B} - E_{P_A} = kQ_1Q_2\left[\frac{1}{r_f} - \frac{1}{r_i}\right] = k\,(2.2\times10^{-6})(1.6\times10^{-19})\cdot\left[\frac{1}{10\,m} - \frac{1}{1\,m}\right] = -2.85\times10^{-15}\ J$ (Q_{proton})

b) lose E_p → gain E_k ∴ $E_{k\,gain} = +2.85\times10^{-15}\ J$ ($E_{k\,final}$) from rest $E_{k_i} = \emptyset$

$2.85\times10^{-15} = \frac{1}{2} m_p V^2$ ($m_p = 1.67\times10^{-27}$ kg) $V = 1.848\times10^{6}$ m/s

a) -2.85×10^{-15} J
b) 1.85×10^{6} m/s

5) An electron with speed of $3.3\times10^{7}\ m/s$ is directed between charged parallel plates as shown.



Determine the **magnitude and direction of the acceleration** of the electron as it passes between the plates. It would probably be a good idea to determine the electrostatic force first. [5 marks]

$F_E = \frac{\Delta V|Q|}{d} = \frac{156\,V\,(1.6\times10^{-19})}{0.024\ m} = 1.04\times10^{-15}\ N$ (e^-)

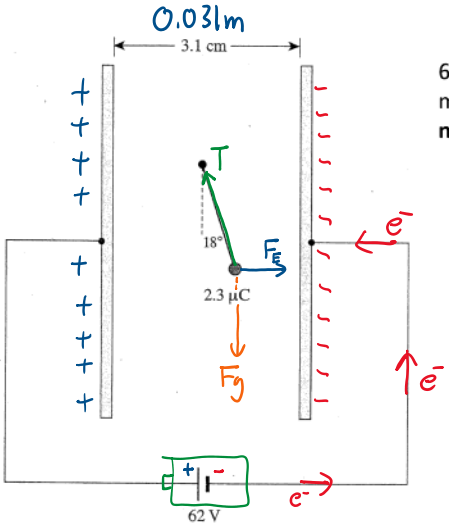
$F_{net} = m_e a \quad 1.04\times10^{-15} = (9.11\times10^{-31})\,a$

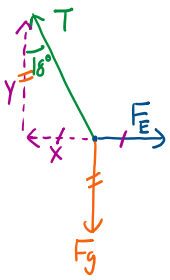
$a = 1.142\times10^{15}\ m/s^2$

Acceleration) 1.142×10^{15} m/s² [Down] to "+" plate.

Direction)_____

6) Consider the setup shown to the right. Note that the hanging charge makes an angle of 18° and has a positive charge of 2.3 μC. Determine the **mass** of the hanging sphere. [2 marks]





(X) $T_x = F_E = \frac{\Delta V Q}{d} = \frac{62V\,(2.3\times10^{-6}C)}{0.031m} = 4.6\times10^{-3}N$

$\tan 18° = \frac{T_x}{T_y}$

$\therefore T_y = 0.014157\ N$

(Y) $F_g = T_y$

Ans)_____ $1.44\times10^{-3}\ kg$

$mg = 0.014157$

$m = 1.44\times10^{-3}\ kg.$