# Ch. 18 and 19 Electrostatics Review Practice Questions

1. The leaves move closer together

2. $Q = 5.0\times10^{-6}\,C \times \left(\dfrac{1e^-}{1.60\times10^{-19}C}\right) = \underline{3.1\times10^{13}\text{ electrons}}$

3. $F = \dfrac{kQq}{d^2} = \dfrac{kQ^2}{d^2} \Rightarrow Q = \sqrt{\dfrac{Fd^2}{k}} = 1.054\times10^{-6}C = \underline{1.1\mu C}$

4. a. $E = \dfrac{\Delta V}{d} = \dfrac{60V}{25\times10^{-3}m} = \underline{2400\,N/C \text{ DOWN}}$

b. $\Delta V = Ed$, $d$ from (−) plate to B = 0.010 m

$V_B - \cancel{V_-}^{0} = 2400N/C \times (0.010m = \underline{24V} \approx \underline{20V}$

$\Delta V = Ed$, $d$ from (−) plate to A = 0.020 m

$V_A - \cancel{V_-}^{0} = 2400N/C \times (0.020m) = \underline{48V}$

5. $F = qE = 1.6\times10^{-19}(500.0N/C) = \underline{8.00\times10^{-17}N}$

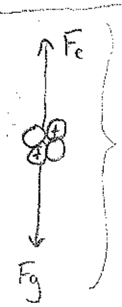
Direction is opposite to $\vec{E}$

6. At point P both fields are in the same direction!

i.e. If $\oplus^{1}$ $P \bullet \rightarrow E_1, \rightarrow E_2$ $\ominus^{2}$ (both fields are right)

If $\ominus^{1}$ $E_1 \leftarrow, E_2 \leftarrow \bullet P$ $\oplus^{2}$ (both fields are left)

$\vec{E} = \vec{E}_1 + \vec{E}_2 = \dfrac{kQ_1}{d_1^2} + \dfrac{kQ_2}{d_2^2} = 2\dfrac{kQ}{d^2} = \underline{1.6\times10^{7}\,N/C}$ away from +, toward −

7. 


$\Sigma\vec{F} = 0$

$F_e = F_g$

$qE = mg$

$E = \dfrac{mg}{q} = \underline{2.0\times10^{-7}N/C \quad \text{UP}}$

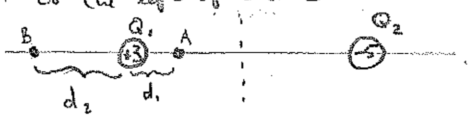
(8) $\Delta V = Ed = 150\,V \simeq \underline{1.50\times10^{2}\,V}$

(9) $\mathcal{E}_{pe} = \dfrac{kQq}{d} = \dfrac{9\times10^{9}\frac{Nm^2}{C^2}(1.6\times10^{-19})(-1.6\times10^{-19})}{7\times10^{-11}} = -3.291\times10^{-18}\,J \simeq \underline{-3\times10^{-18}\,J}$ *

* This is actually the $\mathcal{E}_{pe}$ of BOTH CHARGES TOGETHER!

(10) $V = \dfrac{kQ}{r} = 360000\,V \simeq \underline{400\,000\,V}$

(11) a. For potential to be zero $V_1 + V_2 = 0$; this happens at 2 points, between the 2 charges closer to the ⊕ and to the left of the ⊕.




A: $\dfrac{kQ_1}{d_1} + \dfrac{kQ_2}{1-d_1} = 0$

$\dfrac{3\times10^{-6}C}{d_1} + \dfrac{-5\times10^{-6}}{1-d_1} = 0$

$3(1-d_1) = 5d_1$

$3 = 8d_1$

$d_1 = \frac{3}{8} = 0.375\,m$

B: $\dfrac{kQ_1}{d_2} + \dfrac{kQ_2}{1+d_2} = 0$

$\dfrac{3\times10^{-6}}{d_2} + \dfrac{-5\times10^{-6}}{1+d_2}$

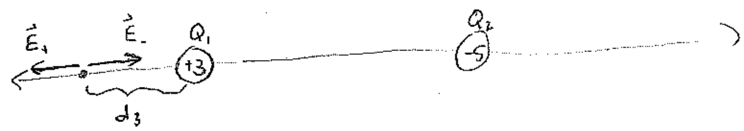
$3(1+d_2) = 5d_2$

$3 = 2d_2$

$d_2 = 1.5\,m$

a. $d_1 = 0.38\,m$ right of the +3 charge, $d_2 = 1.5\,m$ left of the +3 charge

(b) For $\vec{E}$ to be zero $\vec{E}_1 + \vec{E}_2 = 0$; so the fields must be equal magnitude, opposite direction. This happens at only 1 spot, to the left of the (+3) charge




$\dfrac{\cancel{k}Q_1}{d_3^2} = \dfrac{\cancel{k}Q_2}{(1+d_3)^2}$

$\sqrt{(1+d_3)^2 Q_2} = \sqrt{d_3^2\, Q_2}$

$(1+d_3)\sqrt{3} = d_3\sqrt{5}$

$\sqrt{3} = \sqrt{5}\,d_3 - \sqrt{3}\,d_3$

$d_3 =$

$d_3 = 3.4\,m$ left of $+3\,\mu C$ charge

(12) $W_{nc} = 0\,J$

$\Delta\mathcal{E}_k = -\Delta\mathcal{E}_p$

$\mathcal{E}_k - \cancel{\mathcal{E}_{k0}}^{\,0} = -q\Delta V$

$\frac{1}{2}mv^2 = -q\Delta V$

$v = \sqrt{\dfrac{-2q\Delta V}{m}}$

$v = \sqrt{\dfrac{-2(1.6\times10^{-19}C)(-50.0V)}{1.67\times10^{-27}kg}} = \underline{9.8\times10^{4}\,m/s}$

$\boxed{OR}$

$E = \dfrac{\Delta V}{d} = \dfrac{50}{0.025} = 2000\,N/C$

$a = \dfrac{\Sigma F}{m} = \dfrac{qE}{m} = 1.916167665\times10^{11}\,m/s^2$

$v^2 = v_0^2 + 2ad$

$v = \sqrt{2ad}$

$v = \underline{9.8\times10^{4}\,m/s}$

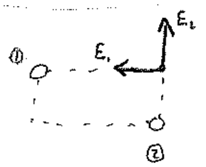
(13) $\sum \vec{F} = m\vec{a}$

$qE = ma$

$q\frac{\Delta V}{d} = ma$

$\Delta V = \frac{mad}{q} = \frac{9.11\times10^{-31}\,kg\,(1.0\times10^{12}\,m/s^2)(6.0\times10^{-2}\,m)}{1.6\times10^{-19}\,C}$

$\Delta V = \underline{0.34\,V}$

(14) 

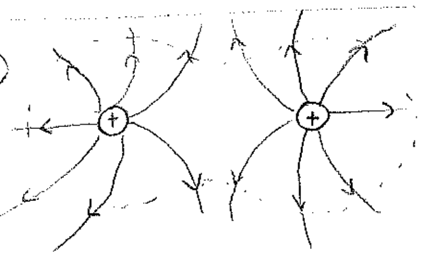
(a) $\vec{E}_1 = \frac{kQ}{d^2} = 6.\bar{6}\times10^{4}\,N/C$ left

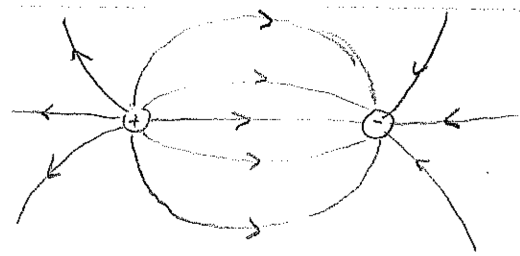
$\vec{E}_2 = \frac{kQ}{d^2} = 1.44\times10^{5}\,N/C$ up

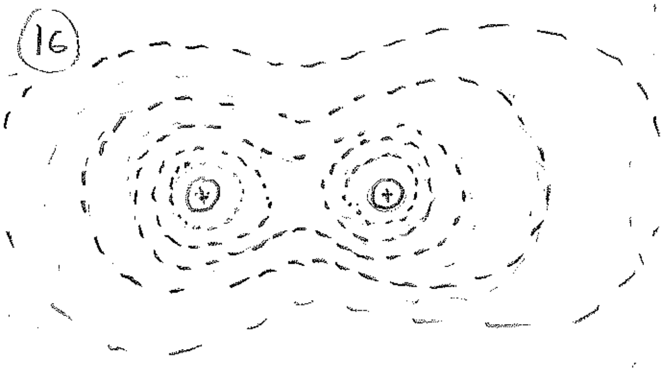
$\underline{\vec{E} = 1.59\times10^5\,N/C}$ @ 65.2° above $-x$ (N of W)

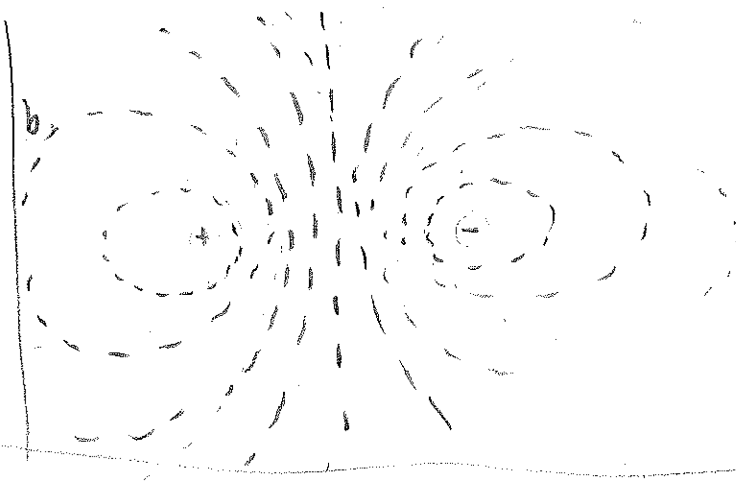
(b) $V = V_1 + V_2 = \frac{kQ_1}{0.9} + \frac{kQ_2}{0.5} = 12\,000\,V = \underline{1.20\times10^4\,V}$

(c) $W = \Delta E = q\Delta V = q(V - \cancel{V_0}^{\,0}) = \underline{0.0360\,J}$

(15) 

b. 

(16) 

b. 

17. Same as 12

18. a. 

b. top 2500.0V bottom 0V

c. $E = \frac{\Delta V}{d} = 1.25\times10^6\,N/C$

d. $F = qE = 2.0\times10^{-13}\,N$ down

e. $a = \frac{\sum F}{m} = 1.20\times10^{14}\,m/s^2$ down

f. $1.8\times10^6\,m/s$

g. $t = \frac{d_x}{v_x} = 3.89\times10^{-9}\,s$

h. $\vec{v}_y = \cancel{\vec{v}_{0y}}^{\,0} + \vec{a}_y t = 4.66\times10^5\,m/s$

i. $\vec{d}_y = \cancel{\vec{v}_{0y}t}^{\,0} + \frac{1}{2}\vec{a}_y t^2 = 9.06\times10^{-4}\,m$

j. $1.86\times10^6\,m/s$ @ 14.5° below horizontal

(19) Use the steps from 18!

$E = \frac{V}{d_y}$ ; $F = qE = \frac{qV}{d_y}$ ; $a_y = \frac{F}{m} = \frac{qV}{md_y} = 1.117764471 \times 10^{14} m/s^2$

$t = \frac{d_x}{v_x}$

$\vec{v}_y = \vec{v}_{oy} + \vec{a}_y t = 3.72588157 \times 10^5 m/s$

$\vec{v} = 2.4... \times 10^6 m/s$ @ 8.8° above horizontal

(20.)


$\hat{y}$:

$\vec{a}_y = \frac{\Delta \vec{v}_y}{t}$

$\vec{v}_y = 2.20... \times 10^5 m/s$
$\vec{v}_{oy} = 0$

$\vec{a}_y = 1.764... \times 10^{13} m/s$

$\hat{x}$:

$t = \frac{d_x}{v_x}$

$v_y = \sqrt{v^2 - v_x^2}$

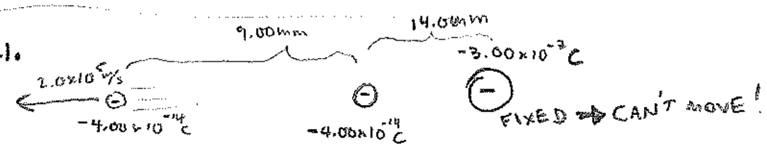
$v_y = 2.205107707 \times 10^5 m/s$

$\vec{a}_y = \frac{\Sigma \vec{F}_y}{m} = \frac{qE}{m} = \frac{q \Delta V}{d_y m}$

$\Delta V = 920.63 ... V$

$\Delta V = 920 V$

21.




b. left.

$W_{nc}^{\,0} = \Delta U_k + \Delta U_E$

$\Delta U_k = -\Delta U_E$

$U_k = -\left(\frac{kQq}{0.023} - \frac{kQq}{0.014}\right)$

$U_k = kQq\left(\frac{1}{0.014} - \frac{1}{0.023}\right)$

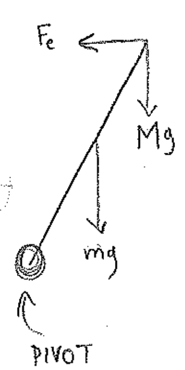
$U_k = 3.01863354 \times 10^{-9}$

$\frac{1}{2}mv^2 = U_k$

$m = \frac{2U_k}{v^2}$

$m = 1.5 \times 10^{-19} kg$

22.




$\sum \vec{\tau} = 0$

$\tau_{cw} = \tau_{ccw}$

$\tau_m + \tau_M = \tau_e$

$mg\cos 74°(0.55) + Mg\cos 74°(1.1) = \frac{kQq}{d^2}\sin 74(1.1)$

$0.440276164\ Nm = \frac{kQq}{d^2}\sin 74°(1.1)$

$q = 1.03037 \times 10^{-6}$

$q = 1.0\ \mu C$ positive