國立東華大學
Department of Physics
National Dong Hwa University, 1, Sec. 2,
Da Hsueh Rd., Shou-Feng, Hualien, 97401, Taiwan

General Physics II, Quiz 8
PHYS1000AA, Class year103/2015
2015-04-16, Thursday

Quiz-8 Solution

1. Solution : ***(Similar to problem no.57, chap.23, text book 9th edition)***

(a) The time interval will be the time travelled the distance 5.0 cm . So

$T = \frac{S}{V}$, Where V= velocity , S= 0.05 m

$\therefore T = \frac{0.05\text{ m}}{3\times10^8\text{m/s}} = 1.67\times10^{-10}s = 0.167ns$

(b) Since the particles is in motion , we can calculate the vertical displacement using Newton's Law of motion. The gravitational force is here ignorable due to its very small effect.

$S_y = V_0 t + \frac{1}{2}at^2$, Here $t = T$, V = initial velocity = 0 m/s, a = acceleration

$\therefore S_y = \frac{1}{2}at^2$

Now we know , $a = \frac{Force}{mass} = \frac{QE}{m} = \frac{\text{Particle charge}\times\text{Applied electric field}}{\text{Mass of the particle}}$

$\therefore a = \frac{QE}{m} = \frac{1.6\times10^{-19}C\times9.6\times10^5 N/C}{1.67\times10^{-27}kg} = 9.6\times10^{13}m/s^2$

$So,\ S_y = \frac{1}{2}\left(9.6\times10^{13}m/s^2\right)\left(1.67\times10^{-10}s\right)^2 = 1.3\mu m$

(c) Horizontal component , v_x = the velocity with which it is moving $=3\times10^8 m/s$

& the verticla component will be

$v_y = V_0 + at = 0 + \left(9.6\times10^{13}m/s^2\right)\left(1.67\times10^{-10}s\right) = 1.6\times10^4 m/s$

2. Solution : ***(Similar to problem no.19+15, chap.24+25, text book 9th edition)***

(a)? he number of electric field lines passing through a unit surface area is known as the electric flux. If the electric field is E and the enclosed area of electric field lines A , the electric flux can be defined as $\Phi=\int_s \text{E.dA}$

⊗ The Gauss's law of point charge enclosed by a surface is $\Phi=\int_s \text{E.dA} = \frac{q}{\varepsilon_0}$, Where q= the electron charge , ε_0 = Electric permittivity of vaccum space.

(b) We know the flux $\Phi = \dfrac{\text{Total charge}}{\varepsilon_0}$

Here the total charge = Q-6q

$\therefore$ The total outward flux from the cube, $\Phi = \dfrac{\text{Q-6q}}{\varepsilon_0} = \dfrac{(5\text{-}12)\times 10^{-6} C.N.m^2}{8.85\times 10^{-12} C^2}$

$$\Phi = -0.80\times 10^6 N.m^2/C$$

The flux through each face of the cube, $\Phi = -\dfrac{800}{6}\text{k}N.m^2/C = -133\ \text{k}N.m^2/C$

Since the cube has 6 face symetrical shape

(c) The potential is

$V = \dfrac{1}{4\pi\varepsilon_0}\dfrac{Qq}{r}$,Where, r = Separation distance=$\dfrac{L}{2} = 5.0cm$

Since there are six electron , so for each elctron the potential will be

$$V = \frac{1}{4\pi\varepsilon_0}\frac{Qq}{r} = 8.9\times 10^9 \times \frac{Qq}{r} = \frac{8.9\times 10^9 \times 5\times 10^{-6}\times(-2\times 10^{-6})}{0.05} = -1.78V$$

Then the total potential =$(V_1+V_2+V_3+V_4+V_5+V_6) = 6V = -1.78\times 6 = 10.7V$,

Since $V_1 = V_2 = V_3 = V_4 = V_5 = V_6$

3. Solution: ***(Basic question from text book 9th edition)***

(a) The total charge is Q = CV ,

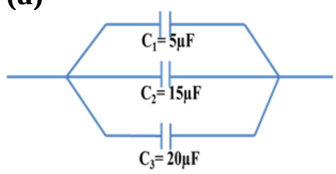
where C = Capacitance of capacitor, V= Applied voltage

If the capacitor is in parallel connection , the total capacitance will be $\text{C}_p = C_1 + C_2 + C_3$

$\therefore \text{C}_p = (5+15+20)\times 10^{-6} F = 40\times 10^{-6} F$

The total charge, Q = CV= $\text{C}_p V\, 40\times 10^{-6}\times 5 = 2\times 10^{-4}\, Coulombs$

(a)



(b) For the case of this connection , $\text{C}_p = C_1 + C_2 = (5+15)\mu F = 20\mu F$

and $\dfrac{1}{C_s} = \dfrac{1}{C_3} + \dfrac{1}{C_p} = \dfrac{1}{20} + \dfrac{1}{20} = \dfrac{1+1}{20} = \dfrac{1}{10}$

$\therefore C_s = 10\mu F$

The voltage you need to supply , V=$\dfrac{Q}{C} = \dfrac{2\times 10^{-4}}{10\times 10^{-6}} = 20V$

(b)