Sub :

Day

Time :

Date : / /

Name : Md Raiharul Islam Bhuiyan

Id : 20101239

Section : 16

Assignment : 3

Bux id : Raihan Rifat

gsuit : raiharul.islam.bhuiyan@g.bracu.ac.bd

Sub :

Day

Time : Date : / /

Ans to the Q; N; 3.1

(a)

$$K V_d = mg$$

$$\therefore K = \frac{mg}{V_d} \quad \text{(Ans:)}$$

(b)

$$Eq = mg + K V_u$$

$$\Rightarrow Eq = mg + \frac{mg}{V_d} \cdot V_u$$

$$\Rightarrow \frac{V}{d} \cdot q = mg\left(1 + \frac{V_u}{V_d}\right)$$

$$\Rightarrow d = \frac{mgd(V_d + V_u)}{V V_d}$$

(Ans:)

Sub :

Day

Time : Date : / /

(c)

mass of droplet, $m = \frac{4}{3} \pi \times \rho \pi a^3$

$= \frac{4}{3} \times 3.1416 \times 825 \times (0.5 \times 10^{-6})^3$ kg

$= 4.3156 \times 10^{-16}$ kg

(d)

$m = 4.315 \times 10^{-16}$ kg

$d = 2.04$ mm $= 2.04 \times 10^{-3}$ m

$V = 11.06$ V

$$q = \frac{mgd\,(V_d + V_u)}{V\,V_d}$$

$V_d + V_u \simeq V_d$

$$\therefore \quad q = \frac{mgd \cdot V_d}{V\,V_d}$$

Sub :

Day

Time : Date : / /

$$\therefore q = \frac{mgd}{V}$$

$$= \frac{4.315\times10^{-16} \times 9.8 \times 2.04\times10^{-3}}{11.06}$$

$$= 7.799\times10^{-19}\ C$$

(e)

$$e = 1.602\times10^{-19}$$

$\therefore$ Multiple of electron $= \frac{q}{e}$

$$= \frac{7.799\times10^{-19}}{1.6\times10^{-19}}$$

$$= 4.874$$

$$\approx 5$$

Sub :

Day

Time : Date : / /

Ans to the Q: N: 3.2

(a)

Using Gauss's law,

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

$$= \frac{8.987 \times 10^9 \times 20 \times 10^{-6}}{(1)^2}$$

$= 179750$ N/C

(b)

$a = 0.5$ m

$b = 2.0$ m

We know,

$$\oint\!\!\oint \bar{E} \cdot d\bar{s} = \frac{q_{enc}}{\epsilon_0}$$

Sub: Day Time: Date: / /

But there is no electric field between them, $\oint E = 0$

$$\therefore 0 = \frac{q_{enc}}{\epsilon_0}$$

$$\therefore q_{enc} = 0\,C$$

(c)

$c = 3\,m$

$d = 5\,m$

$r_2 = 2.5\,m$

We know,

$$\oint E \cdot \vec{dA} = \frac{Q_{enc}}{\epsilon_0}$$

$$\Rightarrow 0 = \frac{q + Q_{in}}{\epsilon_0}$$

$$\therefore q + Q_{in} = 0$$

$$\therefore Q_{in} = -q$$

Sub:

Day

Time: Date: / /

$\therefore Q_{total} = Q_{in} + Q_{outer}$

$\therefore Q_{total} = -q + Q_{outer}$

$\therefore Q_{outer} = Q_{total} + q$

$= 0 + 20\times10^{-6}$

$= 20\times10^{-6}$ (Ans:)

Gaussian radius $r_2 = 2.5$ m

$\therefore \vec{E} = \frac{kq}{r_2^2}$

$= \frac{8.987\times10^{9} \times 20\times10^{-6}}{(2.5)^2}$

$= 28758.5\ NC^{-1}$ (Ans)

Sub :

Day

Time : Date : / /

(d)

$Q = 20\times10^{-6}$

$\therefore \oint \vec{E}\,d\vec{s} = \frac{Q}{\epsilon_0}$

$= \frac{20\times10^{-6}}{8.855\times10^{-12}}\ Nm^2C^{-1}$

$= 2.26\times10^{6}\ Nm^2C^{-1}$

(e)

$d = 5m$

$q = 20\times10^{-6}$

$V_d = \frac{kq}{d}$

$= \frac{8.987\times10^{9}\times20\times10^{-6}}{5}$

$= 35948\,V$ (Ans:)

Sub:

Day

Time:

Date: / /

Now,

$V_c = V_d = 35948 \ V$ (Ans.)

Now,

$V_{\left(\frac{c+d}{2}\right)} = V_d = 35948 \ V$ (Ans.)

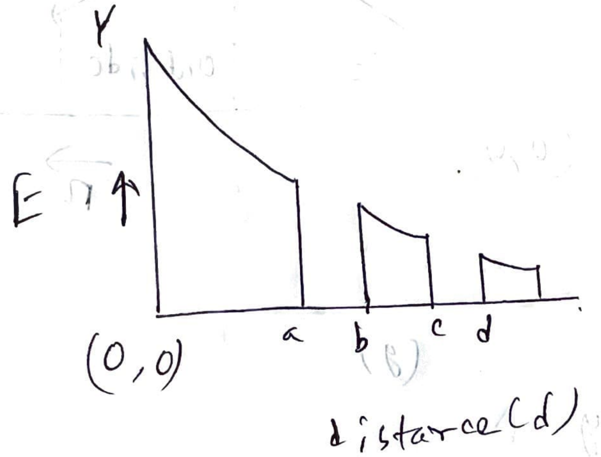
Sub :

Day

Time : Date : / /

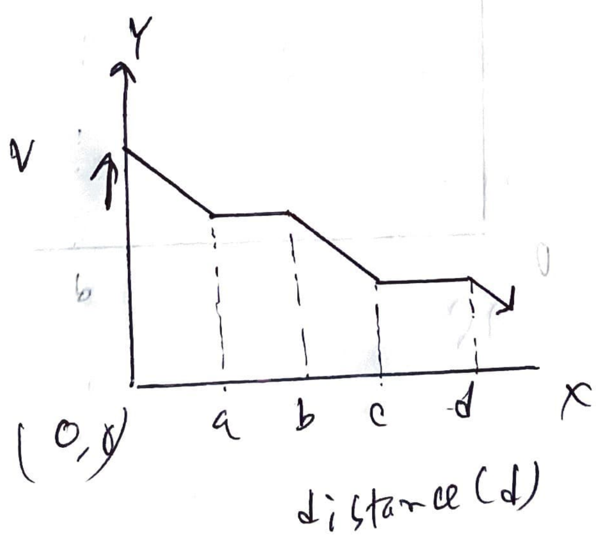
(f)

Here E is in y axis and d is in x axis.



(g)

Here, v is in y axis and d is in x axis



Sub :

Day

Time : Date : / /

Ans to the Q: No: 3.3

(a)

$\vec{r}_1 = \frac{4}{2} \times 10^{-9} \hat{i}$

$= 2 \times 10^{-9} \hat{i}$

$\vec{r}_2 = -2 \times 10^{-9} \hat{i}$

$\vec{r}_3 = 2 \times 10^{-9} \hat{i} - 4 \times 10^{-9} \hat{j}$

$\therefore \vec{p} = q_1 \vec{r}_1 + q_2 \vec{r}_2 + q_3 \vec{r}_3$

$= (3e \times 2 \times 10^{-9}) \hat{i} + (2e \times 2 \times 10^{-9}) \hat{i}$

$-(5e \times 2 \times 10^{-9}) \hat{i} + (5 \times 4 \times 10^{-9}) \hat{j}$

$= -8e \times 10^{-9} \hat{i} + 20e \times 10^{-9} \hat{j}$

$= 1.2817 \times 10^{-27} \hat{i} - 3.2043 \times 10^{-27} \hat{j}$

Sub :

Day

Time : Date : / /

(b)

$$r_{p_1} = \sqrt{2} \times 4 \times 10^{-9} \text{ m}$$
$$= 5.656 \times 10^{-9} \text{ m}$$

$$r_{p_2} = 4 \times 10^{-9} \text{ m}$$

$$r_{p_3} = 4 \times 10^{-9} \text{ m}$$

$$\therefore V = \sum k \cdot \frac{q}{r_p}$$
$$= k \cdot \left(\frac{q_1}{r_{p_1}} + \frac{q_2}{r_{p_2}} + \frac{q_3}{r_{p_3}} \right)$$
$$= 8.987 \times 10^{9} \times \left(\frac{3e}{5.656 \times 10^{-9}} + \frac{2e}{4 \times 10^{-9}} - \frac{5e}{4 \times 10^{-9}} \right)$$

$$= (-0.7636 - 0.7198 + 1.7996) \text{ volts}$$
$$= 0.3162 \text{ volts}$$

Sub : Day Time : Date : / /

(c)

$m = 1\ N/Cm^2$

$n = 1\ N/Cm$

$P = -2\times10^{-9}\hat{i} - 4\times10^{-9}\hat{j}$

$V(x,y) = 3xy(m\cancel{x} + n)$

$= 3xy(\cancel{x} + 1)$

$= 3\times(-2\times10^{-9})\times(4\times10^{-9})\times(-2\times10^{-9}+1)$

$= (-4.8\times10^{-26} + 2.4\times10^{-17})$ volts

$= 2.3999\times10^{-17}$ volts

(Ans)

Sub: Day Time: Date: / /

(d)

~~V_t =~~

Total potential $= V_p + V_{(x,y)}$

$= 0.3162 + (2.3999 \times 10^{-17})$

$= 0.3162$ (Ans)

After placing a proton, potential energy $= (V_t \times e_p)$

$= (0.3162 \times 1.602 \times 10^{-19})$ J

$= 5.0655 \times 10^{-20}$ J

Sub :

Day

Time : Date : / /

(e)

Electric field at point P

$$= \left\{ \frac{ke}{r^2} \cdot \left(5 - \frac{3}{2\sqrt{2}}\right) + 3r(1-r) \right\} \hat{i}$$

$$+ \left\{ \frac{ke}{r^2} \left(-2 - \frac{3}{2\sqrt{2}}\right) + \frac{3r}{2}\left(1 - \frac{r}{2}\right) \right\} \hat{j}$$

Here,

$r = 5 \times 10^{-9}$

$\therefore$ Electric field $= -355571006\,\hat{i} + 275505356.5\,\hat{j}$

Sub :

Day

Time : Date : / /

(f)

(i)

force at P,

$$\vec{F}_p = q.E_x\hat{i} + q.E_y\hat{j}$$

$$= e_p.E_x\hat{i} + e_p.E_y\hat{j}$$

$$= (1.602\times10^{-19} \times -35457 1006)\hat{i}$$

$$+ 1.602\times10^{-19} \times (275905356.5)\hat{j}$$

$$= -5.679\times10^{-11}\hat{i} + 4.5119\times10^{-11}\hat{j}$$

Sub: Day Time: Date: / /

(ii)

~~Mg~~

Magnitud of acceleration, $= \frac{|\vec{F_P}|}{m_P}$

$$= \frac{\sqrt{(-5.679\times10^{-11})^2 + (5.5119\times10^{-11})^2}}{1.6726\times10^{-27}}$$

$$= 4.2975\times10^{16}\ m/s^2$$

(Ans)

(b)

$$s_1 = 2\times10^{-9}\,\hat{i} + 2\times10^{-9}\,\hat{j}$$

$$s_2 = -2\times10^{-9}\,\hat{i} + (2\times10^{-9})\,\hat{k}$$

Sub: Day Time: Date: / /

Potential at $s_1 = 3xy(x+1)$

$= 3 \times 2 \times 10^{-9} \times 2 \times 10^{-9} (2 \times 10^{-9} + 1)$

$= 1.2 \times 10^{-17}$ V (Ans)

Potential at $s_2 = 3xy(x+1)$

$= 3 \times -2 \times 10^{-9} \times 2 \times 10^{-9} \times (-2 \times 10^{-9} + 1)$

$= -1.19 \times 10^{-17}$ V

(Ans)

Sub :

Day

Time :

Date : / /

(h)

Potential at $S_1 = k\left(\frac{q_1}{r_1} + \frac{q_2}{r_2} + \frac{q_3}{r_3}\right)$

$$= k\left(\frac{3e}{\sqrt{5^2+\left(\frac{5}{2}\right)^2}\times 10^{-9}} + \frac{2e}{\left(\frac{5}{2}\times 10^{-9}\right)} - \frac{5e}{\sqrt{\left(5+\frac{5}{2}\right)^2+5^2}\times 10^{-9}}\right)$$

$= -1.51\ V$

(i)

Potential at $S_1 = \{(1.2\times 10^{-17}) - 1.605\}\ V$

$= -1.605\ V$

Potential at $S_2 = \{(-1.17\times 10^{-17}) - 1.51\}\ V$

$= -1.51\ V$

Sub:

Day

Time: Date: / /

(i)

We know,

$$V_1 = \frac{kq}{r}$$

$$= \frac{8.987\times10^{9}\times1.6\times10^{-19}}{4\times10^{-9}}$$

$= 0.35948$

$\therefore V_t = 0.35948 + (-1.41)$

$= -1.05052$

$\therefore$ potential energy $= (-1.05052\times1.6\times10^{-19})$ J

$= -1.68\times10^{-19}$ J