10. ELECTROSTATICS

HOMEWORK SOLUTION

1. Given :

$q = 10^{-7}C$

To Find :

$n = ?$

Formula :

$q = n \times e$

Solution :

$q = n \times e$

$\therefore n = \frac{q}{C} = \frac{10^{-7}}{1.6\times10^{-19}}$

$= 6.25 \times 10^{11}$ electrons

2. Given :

$F = \frac{1}{9}$ N

$q_1 = 100\ \mu C = 100 \times 10^{-6} = 10^{-4}$ C

$r = 9 \times 10^{-2}$

To Find :

$F = ?$

Solution :

$\therefore F = \frac{1}{4\pi\varepsilon_0}\ \frac{q_1q_2}{r^2}$

$\therefore 0.11 = \frac{1}{4\pi\varepsilon_0} \times \frac{10^{-7}\times q_2}{\left(9\times10^{-4}\right)}$

$\therefore 0.11 = 9 \times 10^9 \times \frac{10^{-7}\times q_2}{8\times10^{-4}}$

$\therefore q_2 = 10^{-3}\ \mu C$

3. Given :

$q = 0.20\ \mu C$

$= 0.20 \times 10^{-6}$ C

$E = 3.2 \times 10^6$ N/C

To Find :

$F = ?$

Formula :

$\therefore E = \frac{F}{q}$

Solution :

$\therefore F = Eq$

$= 3.2 \times 10^6 \times 0.2 \times 10^{-6}$

$= 0.64$ N

4. Given :

$m = 0.3$

$q = 3 \times e$

$= 3 \times 1.6 \times 10^{-19}$

$= 4.8 \times 10^{-19}$ C

$r = 1.5$ cm

$= 1.5 \times 10^{-2}$ m

To Find :

$E = ?$

$V = ?$

Formula :

$E = \frac{1}{4\pi\varepsilon_0} \times \frac{q}{r^2}$

Solution :

$E = 9 \times 10^9 \times \frac{4.8\times10^{-19}}{\left(1.5\times10^{-2}\right)^2}$

$= 9 \times 10^9 \times \frac{4.8\times10^{-19}}{\left(2.25\times10^{-4}\right)}$

$= 1.92 \times 10^{-13}$ V/m

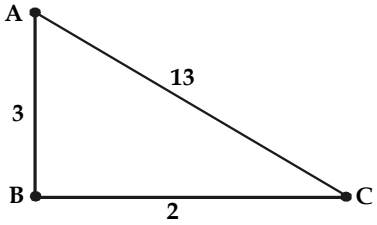
$V = \frac{1}{4\pi\varepsilon_0}\ \frac{q}{r}$

$= 9 \times 10^9 \times \frac{4.8\times10^{-19}}{1.5\times10^{-2}}$

$V = 2.88 \times 10^{12}$ V

5. Given :

q_1 = qnC, q_2 = 4nC
AB = 3cm, B = 2cm
$\angle B = 90^0$



To Find :

F = ?

Formula :

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 \cos_2}{r_2}$$

Solution :

$$F = \frac{9\times10^9\times9\times10^{-9}\times4\times10^{-9}}{13}$$

F_1 = 0.2130 N

6. Given :

n = 5e
q = n × e
q = 5 × 1.6 × 10^{-19}C
v = 8900 U

To Find :

KE = ?

Formula :

$$\therefore KE = \frac{1}{2}qv^2$$

Solution :

$$KE = \frac{1}{2}\times8\times10^{-19}\times(8900)^2$$
$$= 3.1684 \text{ J}$$

7. Given :

r = 25 × 10^{-2} m
W = 25J
q_1 = q_2 = 5C

To Find :

a) V = ?
b) Point at higher potential
c) E = ?

Formula :

$$V = \frac{W}{q}$$

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

Solution :

a) $$V = \frac{W}{q}$$
$$= \frac{25}{5}$$
V = 5 volts

b) Since work done is positive in moving form point A to point B, Hence point B is at a higher potential

c) $$E = \frac{V}{r}$$
$$= \frac{5}{25\times10^{-2}}$$
$$= 20\,V/m$$

8. Given :

r = 5 × 10^{-11} m
q_1 = q_2 = 5 C

To Find :

V = ?

Formula :

$$V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r}$$

Solution :

$$V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r}$$

$$V = 9\times10^9\times\frac{(-1.6)\times10^{-19}}{5.3\times10^{-11}\times1.6\times10^{-19}}$$
$$= -27.16 \text{ eV}$$

9. Given :

q_1 = + 2nC

= $+ 2 \times 10^{-9}$ C

q_2 = $- 2 \times 10^{-9}$ C

r = 1.5×10^{-2} m

θ = 90^0

E = 5000N/C

To Find :-

τ = ?

Formula :-

τ = pE sinθ

τ = q × 2l E sin θ

Solution :

τ = $2 \times 10^{-9} \times 1.5 \times 10^{-2} \times 5000 \times \sin 30$

= $15000 \times \frac{1}{2} \times 10^{-11}$

= 15000×10^{-11}

τ = 7.5×10^{-8} N-m

10. Given :

q = 2×10^{-6} C

2l = 4×10^{-2} cm

E = 10^5 N/C

θ = 180^0

To Find :-

W = ?

Formula :-

W = –pE cosθ

= –q × 2l.E cosθ

= $-2 \times 4 \times 10^{-2} \times 10^{-6} \times 10^5 \cos(180^0)$

= $-8 \times 10^{-3} \times (-1)$

W = 8×10^{-3}J