1) $W = 6.5 \times 10^{-5}\ J$

$q = 1.3 \times 10^{-7}\ C$

$V = \frac{W}{q} = \frac{6.5 \times 10^{2}}{1.3} V = 500\ V$

2) $q = 2.5 \times 10^{-6}\ C$

$V_A - V_B = \frac{W}{q}$

$4 = \frac{W}{2.5 \times 10^{-6}}$

$W = 10 \times 10^{-6} = 10^{-5}\ J$

3) $W = 5J$

$q = 0.5C$

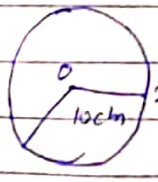
$V_A - V_B = \frac{W}{q}$

$= \frac{5}{0.5} = 10\ V$

4) $+q$ $4 \times 10^{-9}\ C$ $0.1\ m$

$V = \frac{kq}{R} = \frac{(9 \times 10^{9})(4 \times 10^{-9})}{0.1}$

$= 360\ V$

5) 

Intensity is zero at center

$V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r} = \frac{9 \times 10^{9} \times 250 \times 10^{-6}}{0.1}$

$= -2.25 \times 10^{7}\ V$

6) i) $q_0 = 10^{-12}\ C$

$V_A = \frac{1}{4\pi\varepsilon_0}\frac{q}{r_A} = 0.9\ V$

$V_B = \frac{1}{4\pi\varepsilon_0}\frac{q}{r_B} = 0.45\ V$

ii) $\Delta W = (V_A - V_B) q_0$

$= 0.45 \times 10 \times 10^{-12}$

$= 4.5 \times 10^{-12}\ J$

7) Potential due to A @ C

$= \frac{1}{4\pi\varepsilon_0}\frac{q}{r} = \frac{9\times10^9 \times 10^{-6} \times 8}{0.5}$

Potential due to B @ C

$= \frac{1}{4\pi\varepsilon_0}\frac{q}{r} = 9\times10^9 \times \frac{-2\times10^{-6}}{0.5} =$

$V_{AC} + V_{BC} = 1.08\times10^5 V$

Potential at D due to A & B

$V_{DA} = 9\times10^9 \times \frac{8\times10^{-6}}{0.8} = 9\times10^4 V$

$V_{DB} = 9\times10^9 \times \frac{2\times10^{-6}}{0.2} = -9\times10^4 V$

$V_D = 0$

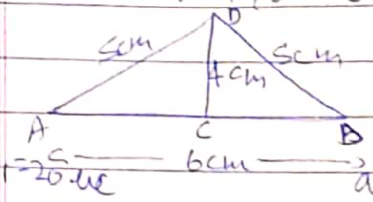
potent. diff. b/w D & C $= 1.08\times10^5 V$

$W = Pd \times q$

$= 1.08\times10^5 \times 0.02\times10^{-6}$

$= 2.16\times10^{-3} J$

8)



$q_1 = 20\mu C$ $\qquad$ $q_2 = -10\mu C$

$V_1 = 9\times10^9 \times \frac{20\times10^{-6}}{5\times10^{-2}}$

$= 36\times10^5 V$

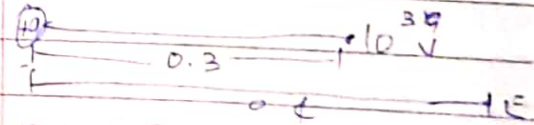
$V_2 = 9\times10^9 \times \frac{(-10)\times10^{-6}}{5\times10^{-2}}$

$= -18\times10^5 V$

$V = V_1 + V_2$

$= 18\times10^5 V$

9)



$\eta = 0.5m$

$r_2 = 0.4m$

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

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

$= 10^5 \times \frac{0.3}{(0.4)^2} = 1875 V/m$

10) $E = 20\ N/C$

$V = 10\ J/C = 10V$

$r = ?$

$q = ?$

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

$20 = \frac{1}{4\pi\varepsilon_0} \times \frac{q}{(0.5)^2} = 5.55 \times 10^{-10}\ C$

11) $q = 6 \times 10^{-8}\ C$

$r_1 = 3m \ ; \ r_2 = 6m$

$V_1 - V_2 = 9 \times 10^9 \left[\frac{q}{r_1} - \frac{q}{r_2}\right]$

$= 9 \times 10^9 \times 6 \times 10^{-8} \left[\frac{2-1}{6}\right]$

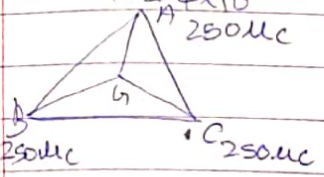
$= 90\ V$

$W = V \times q$

$= 1.6 \times 10^{-18} \times 90$

$= 1.44 \times 10^{-17}$

12)



$V_{net} = \frac{q}{4\pi\varepsilon_0 r} \times 3$

$= \frac{3 \times 9 \times 10^9 \times 250 \times 10^{-6}}{0.18}$

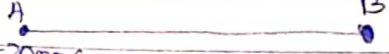
$= 3.75 \times 10^7 V$

13) $q = 100 \times 10^{-6}\ C$

diagonal $= 2m$

$V_0 = \frac{4 \times 100 \times 10^{-6}}{4 \times \pi \times \varepsilon_0 \times 1} = 3.6 \times 10^6 V$

14)



i) since work is being done on charge; A has higher potential

ii) $W = V \times q$

$V = 10J/200 = 0.05V$

iii) $V_B - V_A = -0.05V$

$E = -\frac{dV}{dV} = \frac{0.05}{4 \times 10^{-2}} = 1.25\ V/m$

15) $E = \frac{dv}{dr}$

$W = 3.29 \times 10^{-4} J$

$R = 3.0 \times 10^{-8} C$

$r = 0.12 m$

$dV = \frac{W}{q} = 1.08 \times 10^{4} V$

$E = \frac{-dv}{dr} = 9 \times 10^{4} V$

16) $E = \frac{-dv}{dr} = \frac{1000}{0.02} = 5 \times 10^{4} V/m$

$F = Eq = 5 \times 10^{4} \times 1.6 \times 10^{-9} C$

$= 8 \times 10^{-15} N$

17) $E = \frac{-dv}{dr} = \frac{120}{0.02} = 6 \times 10^{3} V/m$

$F = Eq = 6 \times 10^{3} \times 1.6 \times 10^{-9}$

$= 9.6 \times 10^{-16} N$

$W = F \times d$

$= 9.6 \times 10^{-16} \times 0.02$

$= 1.92 \times 10^{-17} J$

18)i) $q = 2 \times 1.6 \times 10^{-9} C$

$K = qV$

$= 2 \times 1.6 \times 10^{-9} \times 10^{6}$

$= 3.2 \times 10^{-3} J$

ii) If the proton $= 1.6 \times 10^{-13} J$

iii) Proton as it is lighter.

21) $r = 5.3 \times 10^{-11} m$

$q = 1.6 \times 10^{-19} C$

$V = \frac{9 \times 10^{9} \times 1.6 \times 10^{-19}}{5.3 \times 10^{-11}}$

$= 27.16 V$

$U = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r} = \frac{9 \times 10^{9} \times (1.6 \times 10^{-19})}{5.3 \times 10^{-11}} = 27.2 eV$

$V_{He} = \frac{9 \times 10^{9} \times 1.6 \times 10^{-19} \times 2}{5.3 \times 10^{-11}}$

$= 54.4 V$

28) $KE = 2 \times \frac{1}{2} mv^2$

$U = \frac{ke^2}{r}$

$KE = U$

$2 \times \frac{1}{2} MV^2 = \frac{ke^2}{r}$

$r = \frac{ke^2}{mv^2}$

$r = \frac{9 \times 10^9 \times (1.6 \times 10^{-19})^2}{9.1 \times 10^{-31} \times (10^6)^2} \times 10^{-10} m$

$= 2.63 \text{ Å}$

29) i) $\tau = PE \sin\theta$

$8\sqrt{3} = P \times 10^5 \times \sin 60^\circ \quad (\because \sin 60 = \sqrt{3}/2)$

$P = \frac{8\sqrt{3} \times 2}{\sqrt{3} \times 10^5}$

$P = 1.6 \times 10^{-4} \text{ cm}$

$P = q \times 2a$

$1.6 \times 10^{-4} = q \times 2 \times 10^{-2}$

$\frac{1.6 \times 10^{-4}}{2 \times 10^{-2}} = q$

$0.8 \times 10^{-2} C = q$

ii) $U = -PE \cos\theta$

~~$U = -1.6 \times 10^4 \times 10^5 \times \frac{1}{2}$~~

~~$U = -0.8 \times 10$~~

$U = -1.6 \times 10^4 \times 10^5 \times \frac{1}{2}$

$= -0.8 \times 10$

$= -8 J$

31) $V = \frac{k(ze)}{R}$

$= \frac{9\times10^9 \times 47 \times 1.6\times10^{-19}}{3.1\times10^{-14}}$

$= 2.0\times10^6\ V$

32) $V_s = \frac{1}{4\pi\varepsilon_0}\frac{Q}{R}$ potential at the center of the sphere is same as that of the surface.

$V_s = 9\times10^9 \times \frac{12}{0.1}$

$= 1.08\times10^6\ V$

33)i) $V = \frac{kq}{r}$

$V = \frac{9\times10^9 \times 2.4\times10^{-9}}{0.12}$

$V = \frac{9\times24\times10}{12}$

$= 160\ V$

ii) $E = \frac{1}{4\pi\varepsilon_0}\frac{q}{d^2}$

$= \frac{9\times10^9 \times 2.4\times10^{-9}}{16}$

$= 1.35\ V/m$

34) $V_6 = \frac{9\times10^9 \times q}{0.6}$

$\frac{100\times0.6}{9\times10^9} = q$

$q = 6.7\times10^{-9}$

$V_s = \frac{9\times10^9 \times 6.7\times10^{-9}}{0.12}$

$= \frac{9\times6.7}{0.12}$

$= 502\ V$

24) $U_0 = -10^{-6} \times 10^5 \times 0.02$

$= -2 \times 10^{-3}$

$U = -\vec{P} \times \vec{E}$

$= -PE\cos\theta$

$= -2 \times 10^{-3} \times -1 = 2 \times 10^{-3}$ N/m

$W = PE(1 - \cos 180)$

$= 2 \times 2 \times 10^{-3}$

$= 4 \times 10^{-3}$ J

25) dip $p = q \times 2d$

$= 2 \times 2 \times 10^{-6}$

$= 4 \times 10^{-6}$

i) $U = -\vec{P}\vec{E}$

$= -PE\cos\theta$

$= -(4 \times 10^{-6} \times 1 \times 10^5)$

$= -4 \times 10^{-1}$

ii) $W = PE(\cos 0 - \cos 180^\circ)$

$= 2PE$

$= 2 \times 4 \times 10^{-1}$

$= 0.8$