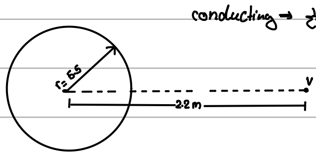
Leen Sabri

Q1 $R=5.5\,cm$, $V=75\,V$, $d=2.2m$, $V_\infty=0$

conducting → الشحنة بتتوزع على السطح



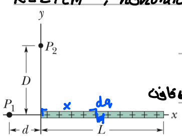
a) $V_s=?? \Rightarrow V=\frac{kQ}{r} \Rightarrow Q=\frac{Vd}{k}=\frac{75\times 2.2}{9\times10^{9}}=18.34\times10^{-9}C$

(d) المسافة من مركز

$V_{surface}=\frac{kQ}{r}=\frac{(9\times10^{9})(18.34\times10^{-9})}{5.5}\,V=30.01$

b) $\sigma=\frac{Q}{\text{المساحة}}=\frac{Q}{4\pi R^2}=\frac{18.34\times10^{-9}}{4\pi(5.5\times10^{-2})^2}=4.827\times10^{-7}$

Q3 $L=24cm$, nonuniform linear charge density $\lambda=Cx$, $C=28.9\,pC/m^2$, $V_\infty=0$, $d=3cm$



a) $V_{P_1}=??$ $\rightarrow \lambda=\frac{q}{x} \Rightarrow q=\lambda x \Rightarrow dq=\lambda dx \Rightarrow dq=cx\,dx$

$dV=\frac{1}{4\pi\epsilon_0}\frac{dq}{r} \Rightarrow V=\frac{1}{4\pi\epsilon_0}\int\frac{dq}{r}=\frac{1}{4\pi\epsilon_0}\int\frac{cx\,dx}{x+d}=kc\int\frac{x\,dx}{x+d}=kc\int\frac{x+d-d}{x+d}dx=kc\int\left(1-\frac{d}{x+d}\right)dx=kc\left[\int dx-\int\frac{d\,dx}{x+d}\right]=kc\left[\int dx-d\int\frac{dx}{x+d}\right]$

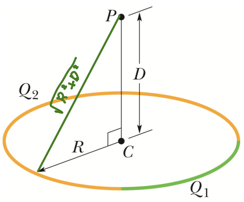
(d+x) المسافة من

$=kc\int dx-kcd\int_0^L\frac{dx}{d+x}=kcx\Big|_0^L-kcd\ln(d+x)\Big|_0^L=(kcL-0)-(kcd\ln(d+L)-kcd\ln d)=kcL-kcd(\ln(d+L)-\ln(d))$ → $\ln\left(\frac{d+L}{d}\right)=\ln\left(1+\frac{L}{d}\right)$

$V=kcL-kcd\ln\left(1+\frac{L}{d}\right)=\boxed{kc\left[L-d\ln\left(1+\frac{L}{d}\right)\right]}=(8.99\times10^{9})(28.9\times10^{-12})\left[(24\times10^{-2})-(3\times10^{-2})\ln\left(1+\frac{24\times10^{-2}}{3\times10^{-2}}\right)\right]=\dots$

Q9 bent: ثني , circumference: محيط

$R=8.2\,cm$, $Q_1=+7.07\,pC$, $Q_2=-6Q_1$, $V_\infty=0$

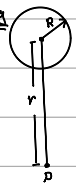


$V=\frac{Q}{4\pi\epsilon_0 R}$ ⇒ ولكن يوجد Q_1 و Q_2

$V_C=\frac{kQ_1}{R}+\frac{kQ_2}{R}=\frac{k}{R}(Q_1+Q_2)=\frac{8.99\times10^{9}}{8.2\times10^{-2}}\left[(7.07\times10^{-12})+(-6(7.07\times10^{-12}))\right]=\dots$

$V_P=\frac{k}{\sqrt{R^2+D^2}}[Q_1+Q_2]=\dots$

Q10 spherical conducting shell of radius R , $V=-170\,V$, $r>>R$, isolating

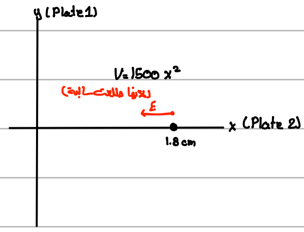


Kinetic energy $(K)=\frac{1}{2}mv^2\dots(1)$

$U=qV\dots(2)$

isolating ⇒ $U=K \Rightarrow qV=\frac{1}{2}mv^2 \Rightarrow v=\sqrt{\frac{2qV}{m}}=\sqrt{\frac{2(1.6\times10^{-19})(170)}{(9.109\times10^{-31})}}=7.73\times10^{6}\,m/s$

Q12 plates: متوازية , perpendicular: عمودية

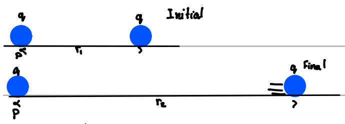


$E_x=-\frac{dV}{dx}$

$\frac{dV}{dx}=3000x \Rightarrow E=-3000x=-3000(1.8\times10^{-2})=-54\,V/m$

a) $|E_x|=54\,V/m$ b) toward plate 1

Q13



$q=3.1\mu C=3.1\times10^{-6}C$, $m=20mg=20\times10^{-6}kg$, $r_1=0.9mm$, $r_2=2.5mm$

$P_i=P_f$

$U_i=U_f+K_f$

في البداية لا يوجد طاقة حركية لأن الجسم ثابت فالطاقة الوحيدة هي electric potential energy ولكن في الحالة الثانية بعد ما الجسم الثاني تحرك أصبح يوجد طاقة حركة أيضا (K) والزخم محفوظ

$\frac{kqq}{r_1}=\frac{kqq}{r_2}+\frac{1}{2}mv^2 \Rightarrow 2\times\left[\frac{kq^2}{r_1}=\frac{kq^2}{r_2}+\frac{1}{2}mv^2\right]2$

$\frac{2kq^2}{r_1}=\frac{2kq^2}{r_2}+mv^2 = \frac{2kq^2}{mr_1}=\frac{2kq^2}{mr_2}+v^2$

يوجد خطأ بالحسابات

$v^2=\frac{2kq^2}{mr_1}-\frac{2kq^2}{mr_2}=\frac{2kq^2}{m}\left(\frac{1}{r_1}-\frac{1}{r_2}\right) \Rightarrow v=\sqrt{\frac{2kq^2}{m}\left(\frac{1}{r_1}-\frac{1}{r_2}\right)}=\sqrt{\frac{(2)(8.99\times10^{9})(3.1\times10^{-6})^2}{(20\times10^{-6})}\left(\frac{1}{0.9\times10^{-3}}-\frac{1}{25\times10^{-3}}\right)}=2.5\times10^{3}\,m/s$

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Q17 point $=(-1i-2j+4k)m$, $V=2xyz^2$

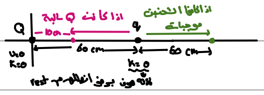
$E=-\left(\frac{du}{dx}i+\frac{du}{dy}j+\frac{du}{dz}k\right)$

$=-2\left((yz^2)i+(xz^2)j+(2zxy)k\right)$

at the point $\Rightarrow E=-2\left((-2\times4)^2 i+(-1)(4)^2 j+2(-1)(4)k\right)$

$=-(-64i-32j+32k)=(64i+32j-32k)\ N/C$

Q25 $q=+7.5\ \mu C\rightarrow x=60\ cm$, Q (fixed $\rightarrow x=0$) , $K=??\rightarrow x=50\ cm$



هو بالأصل الجسم وصل عند x=60 وبده لما يتحرك 50 فيصير عند x=110 بالحالة الأولى، اما بالثانية x=10

E محفوظة ∴ الطاقة الحركية = طاقة الوضع

Electric Potential energy (u) of a system of charged particles: $U_{12}=\frac{q_1q_2}{4\pi\epsilon_0 r_{12}}=\frac{Kq_1q_2}{r_{12}}=\frac{KqQ}{r_{12}}$ ← وجه آخر التفاضلي

$\frac{KqQ}{r_f}-\frac{KqQ}{r_i}=-(K_f-K_i)$ ⟸ $\boxed{\Delta U=-\Delta K}$

$KqQ\left(\frac{1}{r_f}-\frac{1}{r_i}\right)=-(K_f-K_i)$

a) $(9\times10^9)(7.5\times10^{-6})(20\times10^{-6})\left(\frac{1}{(110\times10^{-2})}-\frac{1}{(60\times10^{-2})}\right)=-(K_f-0)$

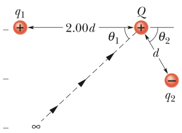
$1.35\left(\frac{1}{1.1}-\frac{1}{0.6}\right)=-K_f$

$1.023=K_f$ 0.9

b) $(9\times10^9)(7.5\times10^{-6})(20\times10^{-6})\left(\frac{1}{(10\times10^{-2})}-\frac{1}{(60\times10^{-2})}\right)=-K_f$

$1.35\left(\frac{1}{0.1}-\frac{1}{0.6}\right)=11.25\ J$

Q32



$Q=12e$, $q_1=+4e$, $q_2=\frac{-q_1}{2}=-2e$, $d=1.4cm$, $\theta_1=43°$, $\theta_2=60°$

$V(\infty)=0$

The potentia from point charge q is : $V=\frac{Kq}{r}$

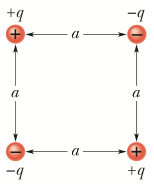
The initial potential: $V_i=V_\infty=0$

The final potential: $V_f=K\left(\frac{q_1}{2d}+\frac{q_2}{d}\right)=K\left(\frac{q_1}{2d}-\frac{1}{2d}\right)=0$

The potential difference is : $V_f-V_i=0-0=0$

The total work is: $\boxed{W=Q(V_f-V_i)}=0$

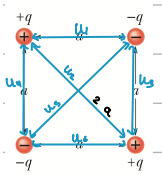
Q33



$q=5\ pC$, $a=64cm=0.64\ m$

$\boxed{W=\Delta U}\Rightarrow W=U_f-U_i$ but $U_i=U_\infty=0$ ∴ $W=U_f$

U for system of charged particals: $U=\frac{q_1q_2}{4\pi\epsilon_0 r}=\frac{Kq_1q_2}{r}$



$U_1=\frac{K(-q)q}{a}=\frac{-Kq^2}{a}$, $U_2=\frac{Kqq}{a\sqrt2}=\frac{Kq^2}{a\sqrt2}$, $U_3=\frac{K(-q)(q)}{a}=\frac{-Kq^2}{a}$

$U_4=\frac{K(-q)q}{a}=\frac{-Kq^2}{a}$, $U_5=\frac{Kqq}{a\sqrt2}=\frac{Kq^2}{a\sqrt2}$, $U_6=\frac{K(-q)(q)}{a}=\frac{-Kq^2}{a}$

$W=U_f=U_1+U_2+U_3+U_4+U_5+U_6$

$=\frac{Kq^2}{a}\left[-1+\frac{1}{\sqrt2}-1-1+\frac{1}{\sqrt2}-1\right]$

$=\frac{Kq^2}{a}\left[-4+\frac{2\sqrt2}{\sqrt2}\right]$

a) $=\frac{Kq^2}{a}\left[-4+\sqrt2\right]=-9.1\times10^{-13}\ J$ b) $=+9.1\times10^{-13}$ c) $=-9.1\times10^{-13}$

Q46 $V=+300\ V$, $V_{ground}=0$, $q=5\times10^{-9}\ C$

* The electric field inside a conductor is zoro : $\boxed{E=-\frac{du}{dx}}\Rightarrow 0=-\frac{du}{dx}$ → دبا ان مشتقة V نادي صفر هنا يعني ان V ثابت

So V is constant ∴ $V_{in}=V_{out}=+300\ V$

انو نع الطلع من out

Leen Sabri

Q47 $V_{electron(i)} = 1.6\times10^{5}\ m/s$, $9.11\times10^{-31}\ Kg =$ كتلة الالكترون , $1.6\times10^{-19}\ C =$ شحنة الالكترون

$K_{electron(i)} = \frac{1}{2} m v_i^2 = \frac{1}{2}(9.11\times10^{-31})(1.6\times10^{5})^2 = 1.16608\times10^{-20}\ J$

Work done by electron, $W = qV = q\left(\frac{Kq}{r}\right) = \frac{Kq^2}{r}$

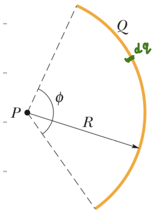
The potenial energy of the system, $V = \frac{1}{4\pi\epsilon_0}\frac{q}{r} = \frac{Kq}{r}$

When the speed of the electron equal to twice the initial value $\Rightarrow K = \frac{1}{2}m(2v_i)^2 = \frac{1}{2}m(4)v_i^2 = 2m v_i^2 = 2(9.11\times10^{-31})(1.6\times10^{5})^2 = 4.66432\times10^{-20}\ J$

now $\Rightarrow \Delta K = W \rightarrow \Delta K = qV \Rightarrow \Delta K = q\frac{Kq}{r} = \frac{Kq^2}{r}$

$\underset{\text{energy}}{\Delta K} = \frac{\overset{\text{cons}}{K}\, q_e^2}{r} \Rightarrow 4.66432\times10^{-20} - 1.16608\times10^{-20} = \frac{(8.99\times10^{9})(1.6\times10^{-19})^2}{r} \Rightarrow r = \ldots\ m$

Q60



$Q = -28.9\ pC$, $R = 3.71\ cm$ $\phi = 120^\circ$, $V_\infty = 0$

$dv = \frac{1}{4\pi\epsilon_0}\frac{dq}{r} = \frac{K\,dq}{r} \Rightarrow$ V [illegible]

$\int dv = \int \frac{K\,dq}{r} \Rightarrow V = \frac{K}{r}\int dq = \frac{KQ}{r} = \frac{(9\times10^{9})(-28.9\times10^{-12})}{(3.71\times10^{-2})} = \ldots\ V$