&image&

r

p

`E\_{p} = (kQ/L [1/r – 1/(r+ L )]`

&image&

p

r

`E\_{p} = (2kQ)/(rsqrt(L^2 + 4r^2))`

&image&

Infinitely long

r

p

`E\_{p} = (2klambda)/r`

&image&

r

One end, extends till Infinity

`E\_{p} = (sqrt(2)klambda)/r`

&image&

W

`E = (kq)/R^2` `q = Q/(2piR)W`

&image&

q

q

x

q

q

`E = (kQx)/((x^2 + R^2)^(3/2))`

Maximum : `(dE)/(dx) = 0` at `x = plusminus R/sqrt(2)`

&image&

Ey

Ex

Θ2

Θ1

`E\_{x} = (klambda)/r[costheta\_{2} – costheta\_{1}]`

`E\_{y} = (klmbda)/r [sintheta\_{1} – sintheta\_{2}]`

Disc

`E = sigma/(2epsilon\_{0})[1- x/(sqrt(x^2 + R^2))]`

Large sheet

`R = infty` `E = sigma/(2epsilon\_{0})`

Metal sheet

&image&

+

+

+

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+

+

+

σ

σ

`E\_{p} = sigma/epsilon\_{0}`

Hemisphere

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+ + + +

`E = sigma/(4epsilon\_{0})`

Sphere

Nonmetal:

`E\_{out} = (kQ)/x^2`

`E\_{inside} = (kQx)/R^3 = (rhox)/(3epsilon\_{0})`

cylinder

`E\_{out} = (sigmaR)/(epsilon\_{0}x)`

`E\_{inside} = 0`

`E\_{s} = sigma/epsilon\_{0}`

Non-metal

`E\_{inside} = (rhox)/(2epsilon\_{0})`

`E\_{s} = (rhoR)/(2eplison\_{0})`

`E\_{out} = (rhoR^2) /(2epsilon\_{0}x)`

Thick sheet

Metal: `E = sigma/epsilon\_{0}`

Non-metal: `E\_{inside} = (rhox)/epsilon\_{0}`

`E\_{surface and out} = (rhod)/(2epsilon\_{0})` d = thickness

`E\_{outside} = sigma/epsilon\_{0}` for all conductors

Surface charge density `sigma propto 1/r` (isolated conductor only)

Electric potential

`V = (kq)/r`

`V = int E\*dx`

Ring (uniform and non-uniformly charged ring)

At center: `V = (kQ)/R`

Any point on the axis passing through center: `V = (kQ)/(sqrt(x^2 + R^2))`

Disc

`V =(sigmaR)/(2epsilon\_{0})`

&image&

dE

EE

B

A

`V\_{A} – V\_{B} = Ed = -int\_A^B E\*dr`

&image&

+

+

+

+

r1

A

B

r2

`V\_{A} – V\_{B} = -int\_r\_{1}^r\_{2} E\*dr`

Equipotential surface

E is perpendicular to surface at all points

Electric field is zero or constant at all points

`E = -(dV)/(dx) = -[(dv)/(dx)hat I + (dv)/(dy)hat j + (dv)/(dz)hat k]`

Closest distance of approach

&image&

1. `1/2mv^2 = (kq\_{1}q\_{2})/r\_{c}`

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1. `m\_{1}(0) + m\_{2}u = (m\_{1} + m\_{2})v\_{0}`

`1/2m\_{2}u^2 = 1/2(m\_{1} +m\_{2})v\_{0}^2 + (kq\_{1}q\_{2})/r\_{c}`

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1. `1/2mu^2 = 1/2mv^2 + (kq\_{1}q\_{2})/r\_{c}`

`Mud = mvr\_{c}`

Potential energy = `(kq\_{1}q\_{2})/r`

Electric potential = `(kq)/r`

It is a scalar quantity

Electric dipole moment vec p = qd

Electric dipole

`E\_{r}` is the radial component of E and `E\_{theta}` is the transverse component of E

`E\_{r} = (2kpcostheta)/r^3 `

`E\_{theta} = (kpsintheta)/r^3`

&image&

Transverse

radial

α

p

Eeq

Eaxis

θ

`E\_{axis} =(2kp)/r^3`

`E\_{eq} = (kq)/r^3`

`E\_{net} = sqrt(E\_{r}^2 + E\_{0}^2) = (kp)/r^3sqrt(1+ 3(cos)^2theta)`

`2tanalpha = tnatheta`

Potential at p `V = (kpcostheta)/r^2`

Dipole placed in EF

&Image&

V1 +q

d

V2 -q

`Tau = P xxE`

`U = - PE`

`V\_{1} – v\_{2} = Edcostheta`

Non-uniform EF

`U =-PE`

`Force = -(dU)/(dr)hat r`

`F = (P \* (dE)/(dr))hat r`

Potential inside a conducting body

&image&

+ + + + + ++++++++++ +++++++++++++++++++++++++++++ + + +

x

yu

E = 0 inside the body

`V\_{x} – v\_{y} = intEdr`

`V\_{x} = v\_{y}`

`v\_{s} = v\_{in} = (kQ)/R` for hollow and sphere with uniform charge

`v\_{out}= (kQ)/x`

potential due to no conducting body

`v\_{s} = (kQ)/R`

`v\_{out} = (kQ)/x `

`v\_{in} = (kQ)/(2R^3)(3R^2 – x^2)`

`x = 0` `v = 3/2(kQ)/R`

eg: a bullet strikes the sphere and moves inward to point M and stop

&image&

y

q

M

`q((kQ)/R) + 1/2mv^2 = (kQ)/(2R^3)(3R^2 – (R/2)^2)`

&image&

+q

b

qe

a

`V\_{inside} = (kq)/b + (kq\_{e})/a = 0` (due to earthing)

`(kq)/b = (-kq\_{e})/a`

&image&

E

q2

q1

qd

qa

qb

qc

`q\_{b} = -q\_{c}`

`q\_{a}= q\_{d} = (q\_{1} + q\_{2})/2`

`sigma = Eepsilon\_{0}`

electric pressure and energy density of EF

`P\_{e} = (sigma^2)/(2epsilon\_{0})`

Only for metal and body with `E\_{net inside} = 0`

` = 1/2epsilon\_{0}E^2 = U\_{c}`

Outside `E\_{net} = sigma/epsilon\_{0}`

`U\_{c} = 1/2epsilon\_{0}E\_{net}^2`

Self energy

Metal sphere = `U\_{s} = (kQ^2)/(2R)`

Non-metal sphere = `U\_{s} = 3/5(kQ^2)/R`