Chapter 16 Charge and Field

Magnetic Field: a region in space where there is a force on a moving charge (eg wire carrying current)
Electric Field: a region in space where there is a force on a charge

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

Voltage (V)

Distance (m)

Electrical Field Strength (Nc^{-1} or Vm^{-1})

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

Force (N)

Charge (q)

When a charge is accelerated through a pd 'V' the speed it gains a velocity:

$v = \sqrt{\frac{2qV}{m}}$

For all fields: **$E = -$potential gradient $= -\frac{dV}{dr}$**

Circular motion of charged particles in a uniform field:

$r = \frac{p}{Bq}$

Energy = Mass

- No limits to the total Energy gained by an electron in a particle accelerator
- No limits to the momentum 'p' gained by the electron

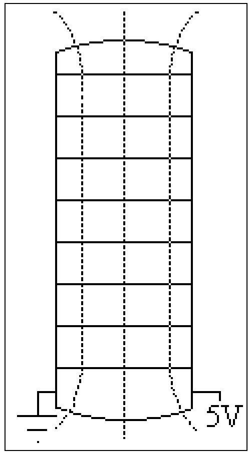
New definition of mass: total energy of an object at 'rest'.

$E = mc^2$

As an approximation: as v ⟶ c
$E_{tot} \approx pc$ where $p = \frac{h}{\lambda}$

Total Energy E = Kinetic energy (E_k) + Rest Energy (E_{rest})

Field Lines and

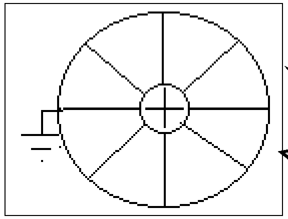


Rules for Equipotential Diagrams
- Equipotential surfaces are always at 90° to field lines field lines
- Equipotantials never touch
- Equipotentials are parallel in a uniform field and curved in a no uniform field.
- No energy is transferred in movement along equipotentials

Non uniform fields

Radial fields:

$E \alpha \frac{1}{r}$



Point charges: Electric field strength

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

Electrical potential:

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