

Electrical and Gravitational Fields: Comparison

	Electrical	Gravitational
Field	Region where [] experiences a force	Region where a [] experiences a force
Field lines	Direction followed by a [] test charge	Direction followed by a []
Field strength – definition	[] per unit [] on a positive test charge placed in the field ($E = F/q$)	[] per unit [] on a test mass placed in the field ($E = F/m$)
Field strength - equation	$E = \frac{q}{4\pi\epsilon_0 r^2} \Rightarrow E \propto \frac{q}{r^2}$	$E = \frac{Gm}{r^2} \Rightarrow E \propto \frac{m}{r^2}$
Force between two charges/masses	$F = \frac{q_1 q_2}{4\pi\epsilon_0 r^2} \Rightarrow F \propto \frac{q_1 q_2}{r^2}$	$F = \frac{Gm_1 m_2}{r^2} \Rightarrow F \propto \frac{m_1 m_2}{r^2}$
Electrical potential Energy - definition	[] done in bringing the [] from infinity to the point	[] done in bringing the [] from infinity to the point
Electrical Potential - definition	[] done per unit [] in bringing a positive test [] from infinity to the point	[] done per unit [] in bringing a test [] from infinity to the point
Electrical Potential - equation	$V = \frac{q}{4\pi\epsilon_0 r} \Rightarrow V \propto \frac{q}{r}$	$V = -\frac{GM}{r} \Rightarrow V \propto \frac{M}{r}$

Similarities

- Definitions of field lines, field strength, potential are virtually identical (mass is exchanged for charge)
- Equations for field strength, force between masses/charges, potential are very similar (essentially the same) – only differences are the values of the [] and mass is replaced with [] .
- [] of field is identical for a negative point-charge and a point mass, as are arrange of equipotentials

Differences

- [] can be negative or positive whilst [] can only be positive
- Electrical fields can be [] or [] whilst gravitational fields can only be []
- [] can only have negative potential energies, whilst [] can have negative or positive potential energies
- [] potential can only be negative, whilst [] potential can be negative or positive

Equipotentials

Equipotentials are lines or surfaces where potential is [], along the line or surface. They are like contour lines on maps, showing