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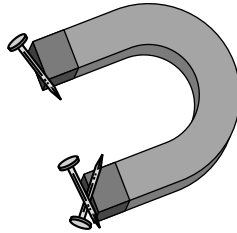
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Data

speed of light in free space	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
permeability of free space	$\mu_0 = 4\pi \times 10^{-7} \text{ H m}^{-1}$
permittivity of free space	$\epsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$
elementary charge	$e = 1.60 \times 10^{-19} \text{ C}$
the Planck constant	$h = 6.63 \times 10^{-34} \text{ Js}$
unified atomic mass constant	$u = 1.66 \times 10^{-27} \text{ kg}$
rest mass of electron	$m_e = 9.11 \times 10^{-31} \text{ kg}$
rest mass of proton	$m_p = 1.67 \times 10^{-27} \text{ kg}$
molar gas constant	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
the Avogadro constant	$N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
the Boltzmann constant	$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$
gravitational constant	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
acceleration of free fall	$g = 9.81 \text{ m s}^{-2}$

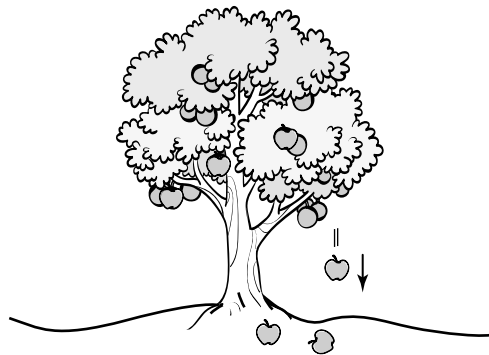
Introduction

- › Frictional and tensional forces are contact forces
- › Produced when objects come into contact with each other
- › Electric, Magnetic and Gravitational forces are non-contact forces
- › Their effects are prevalent even at a distant
- › Example: Magnet attracting a nail



Magnetic force

- › Example: Apple falling to the ground from a tree

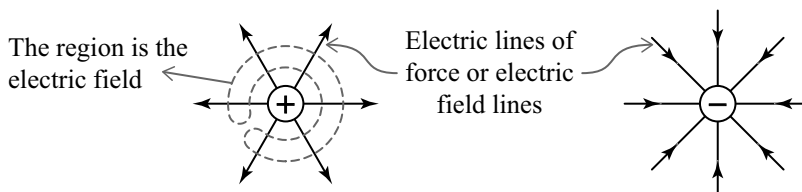


Gravitational force

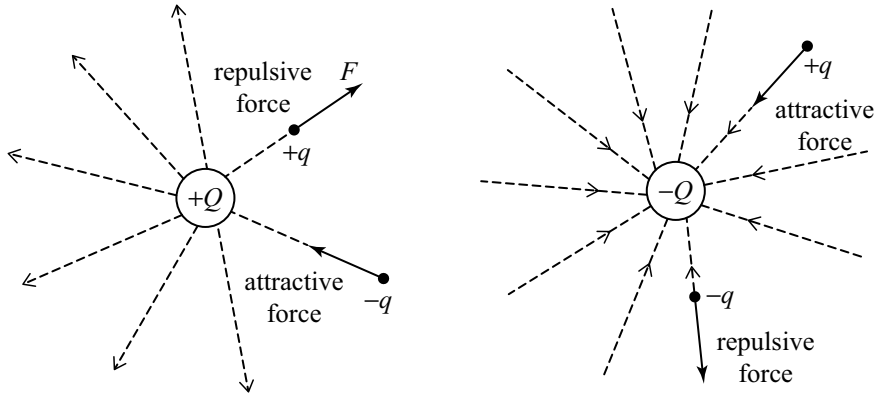
- › This was an action-at-a-distance phenomenon
- › This puzzled many scientists back then
- › To resolve this, the concept of a field was introduced.

Concept of a field

- › An electric field is a region of space in which a charge experiences an electric force
- › A positive or negative charge produces an electric field that emanates into space surrounding the charge



- › When another charge is brought into the field, it experiences a force

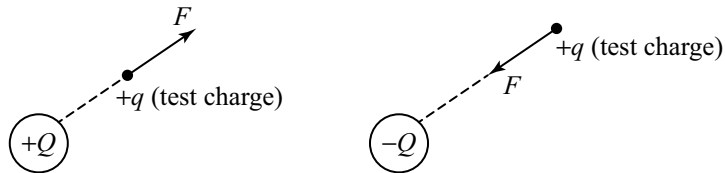


Test Charge

- › Used to detect an electric field
- › By definition, it is so small it will not affect the original electric field
- › By convention, they are positive

Electric Lines of Force or Electric Field Lines

- › Path along which a positive test charge will move in an electric field



- › When 2 charges are placed close to each other, the lines of force are curved
- › The direction of force on the test charge will be tangential to these lines of force

