| 1 MOTION AND FORCES |
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## Displacement vs Distance

* 1. Displacement

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* Change in position of an object
* Can be positive or negative
* : Displacement [m]
* : Final Position [m]
* : Initial Position [m]
  1. Distance

| Distance Displacement |
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* The *magnitude* or size of displacement between two positions
* Distance travelled: the *total length* of the path traveled between two positions

1. Scalar VS Vector
2. Time, Velocity, Speed and Acceleration
3. Graphs: Distance-Time, Speed-Time and Acceleration-Time
4. Kinematic Equations (Constant Acceleration)
5. Falling Objects
6. Vectors
7. Projectile Motion
   1. Equations of Projectile Motion
   2. Horizontal Motion (direction)

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* 1. Vertical Motion (direction)

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* Change in position of an object
* Can be positive or negative
* : Displacement [m]
* : Final Position [m]
* : Initial Position [m]

| 2 CIRCULAR MOTIONS, ENERGY AND OSCILLATIONS |
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## Reflection

* 1. Law of Reflection

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* : Angle of reflection
* : Angle of incidence

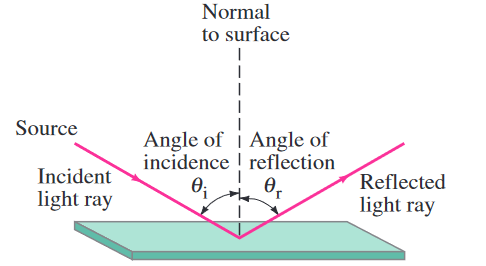
| 3 WAVES AND OPTICS |
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## Reflection

* 1. Law of Reflection

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* : Angle of reflection
* : Angle of incidence



## Mirrors

* 1. Objects appear *behind* the mirror

## Refraction

* 1. Velocity of light depends on material, just like sound

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* : Observed Speed of Light []
* : Speed of Light in Vacuum []
* : Index of Refraction
  + so
  1. Frequency depends on source - does not change; wavelength must

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| Proof: |

* : Frequency []
* :
* : Index of Refraction

|  |
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* : Frequency
* :
* : Index of Refraction
  1. Reduced velocity of wavefront passing across boundary

## Snell’s Law/Law of Refraction

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* : Index of Refraction for Medium 1
* : Index of Refraction for Medium 2
* : Angle between Ray and Surface Normal of Medium 1
* : Angle between Ray and Surface Normal of Medium 2
  1. Ray changes direction (refracts) because leading wavefront slows
  2. Wavelength decreases because frequency unchanged and speed reduced
  3. Beam in the glass is wider, hence intensity is less inside

## Total Internal Reflection

* 1. Critical Angle

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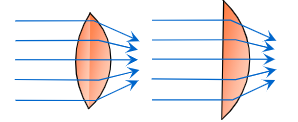
* : Critical Angle []
* : Present Value // Principal Value

## Image Formation

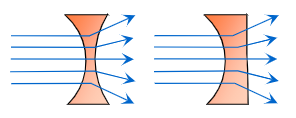
* 1. A lens converts the direction of rays to a common position (focal point)

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* : Critical Angle []
* : Present Value // Principal Value
* :
  1. Thin lenses
     1. Convex - converging - positive: thicker at the middle



* + 1. Concave - diverging - negative: thinner at the middle



* 1. Thin Lens Formula

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* : Critical Angle []
* : Critical Angle []
* : Present Value // Principal Value

| Variable | Positive () when... | Negative () when... |
| --- | --- | --- |
|  | Left of lens | Right of lens |
|  | Right of lens | Left of lens |
|  | Above optical axis | Below optical axis |
|  | Converging | Diverging |

## Human Eye

* 1. Lens Power

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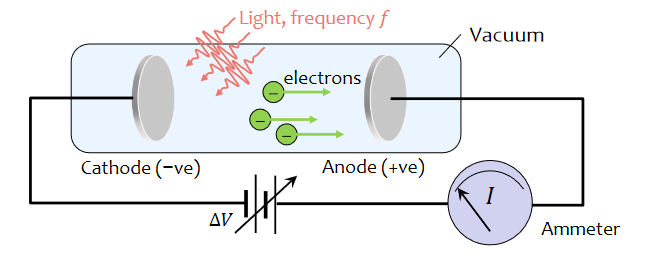
* : Lens Power [diopters, ]
* : []
  1. Colour Vision: Rods and Cones
     1. Rods: detect light and dark
     2. Cones: colour sensitive (red, green, blue) but less sensitive than Rods
  2. Accommodation
     1. Ciliary Muscle: changes radius of curvature
     2. Relaxed: focus to infinity
     3. Contract: focus nearer
  3. Vision Defects
     1. Myopia: Near-sighted; lens too strong - needs diverging lens
     2. Hyperopia: Far-sighted; lens too weak - needs converging lens

| 4 ELECTRICITY AND MAGNETISM |
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## Photons and Photoelectric Effect

| 5 ATOMIC PHYSICS, RADIATION AND POWER |
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## Photons and Photoelectric Effect

* Light(photons) knocks electrons out of metal plates if it meets the minimum threshold energy/frequency required (this minimum energy is given by the Work Function, )
  + After reach minimum threshold, if intensity, number of electrons knocked out
* Current is proportional to intensity
* Current appears immediately
* Current only if frequency is above some minimum threshold
* Threshold frequency depends on cathode metal
* Current stopped by applying some minimum stopping potential (Vstrop)
* Stopping potential depends on frequency
* 
  1. Photon Energy

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* 1. Kinetic Energy of Ejected Electron

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* 1. Least tightly held Electron Energy
* Least tightly held electrons will be ejected with the most kinetic energy ()

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* 1. Stopping potential/stopping voltage

| [eV]  [V] |
| --- |
| Conservation of Energy (Gain in PE=Loss of KE) |

* : Photon energy [J]
* : Planck’s constant
  + [Js]
  + [eVs]
* : Frequency [Hz]
* : Kinetic Energy of Ejected Electron [J]
* : Planck’s constant = [Js]
* : Frequency [Hz]
* : stopping potential/stopping Voltage [V]
  + Voltage when the current in the circuit is 0
* : Planck’s constant = [Js]
* : Frequency [Hz]
* : Work function/Binding Energy [eV]
* : Work function/Binding Energy as Voltage [V]
* : Threshold frequency
  + Minimum energy required to free an electron
* eV : Electron Volts
  + [J]

## Magnetic Resonance Imaging

* 1. Magnetic Dipole Moment

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* 1. Potential Energy of Magnetic Dipole

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* 1. Energy Difference

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* : Magnetic Dipole Moment [J/T]
* : Area in the ‘current(I) circle’[m^2]
  + Vector because current moves in specific direction
* : current in the loop
* : [T]
* : Potential Energy [J]

## Matter Waves

* 1. De Broglie wavelength of a particle

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* : Magnetic Dipole Moment [J/T]
* : Area in the ‘current(I) circle’[m^2]
  + Vector because current moves in specific direction
* : current in the loop
* : [T]
  1. Standing Waves

## Quantized Energy

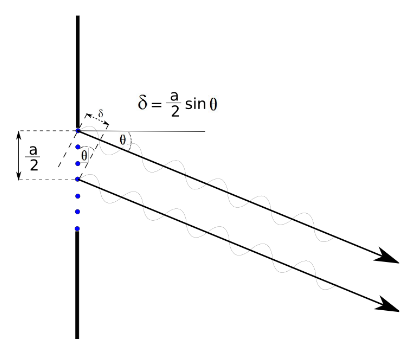
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* 1. Energy levels
* When particle confined to specific regions of space
  + They bounce back and forth between the walls/boundaries of the confined space
  + This creates a standing wave
  + The wavelength of the standing wave is
* Quantum systems (like the one described) can only exist at specific energy levels ()
  + Can make transitions between energy levels by *absorbing* or *emitting* photons
  + Ground state:
  + ALWAYS INTEGERS

## Photons, Huygens Principle, Diffraction

* 1. Huygens’ Principle
* The new position of the wavefront is a surface tangent to the wavelets
  1. Single-slit diffraction

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## Heisenberg Uncertainty

* 1. Huygens’ Principle

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* : Angle of reflection
* : Angle of incidence

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* : Angle of reflection

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* : Angle of reflection

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* : Angle of reflection

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* : Angle of reflection

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* : Angle of reflection

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* : Angle of reflection

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* : Angle of reflection

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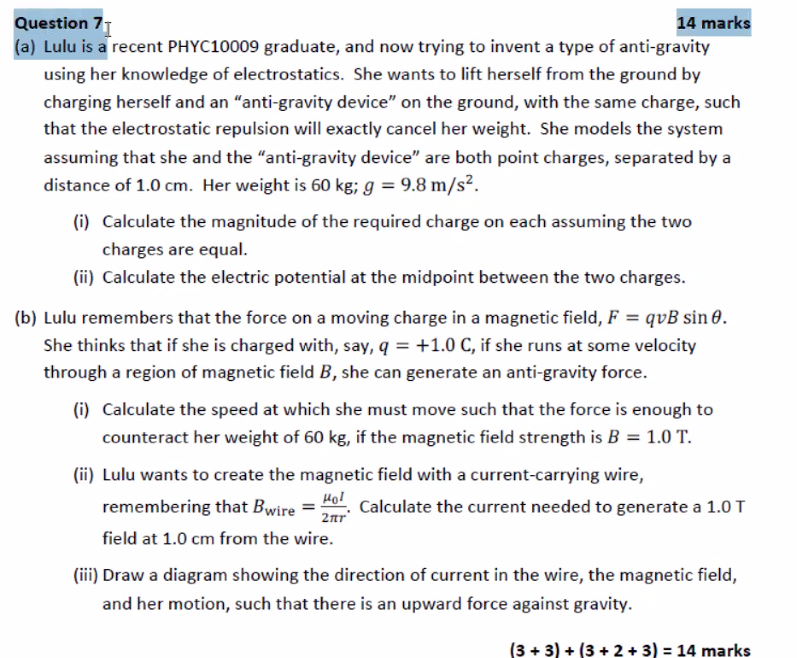
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* : Angle of reflection

## Photons and Photoelectric Effect

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