Amazing PHYSICS FORMULA F4 & F5

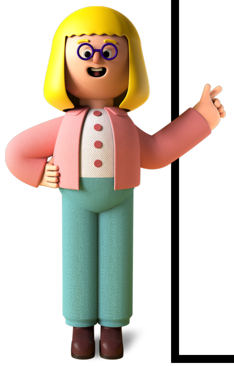
KSSM

alinaimanarif

DREAM BIG
AIM HIGH
NEVER GIVE UP

CHAPTER 2

FORCE & MOTION I



EQUATIONS OF MOTION

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$s = \frac{(u + v)}{2}t$$

$$v^2 = u^2 + 2as$$

ELASTIC COLLISION:

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

INELASTIC COLLISION:

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v$$

FORCE:

$$F = ma$$

SPEED / VELOCITY: $v = \frac{s}{t}$

ACCELERATION: $a = \frac{v - u}{t}$

MOMENTUM: $p = mv$

IMPULSIVE FORCE:

$$F = \frac{m(v - u)}{t}$$

IMPULSE:

$$Ft = mv - mu$$

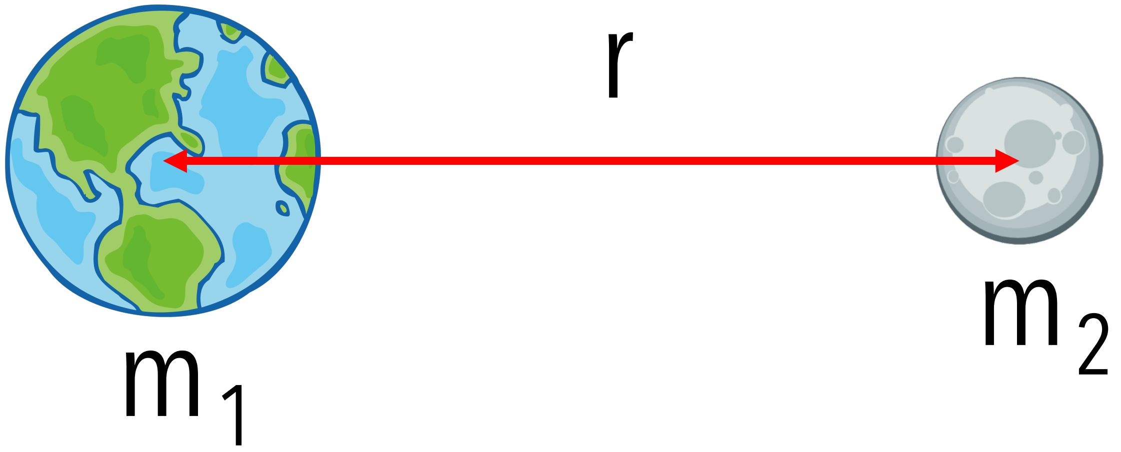
WEIGHT:

$$W = mg$$

CHAPTER 3

GRAVITATION

GRAVITATIONAL FORCE



$$F = \frac{G m_1 m_2}{r^2}$$

F = Gravitational force between two objects

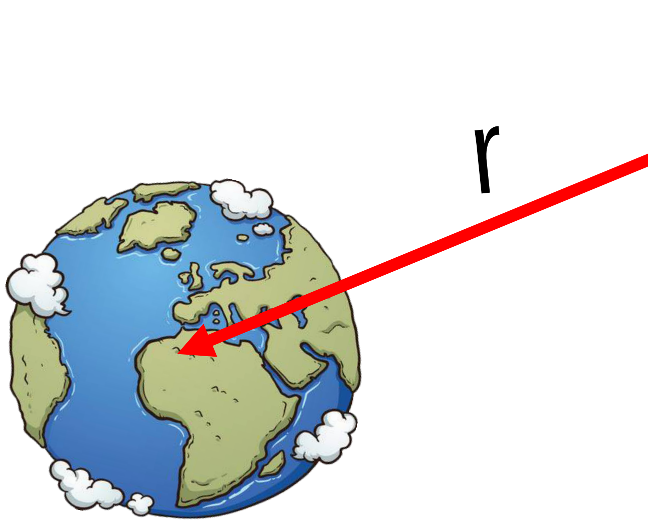
G = Universal gravitational constant ($6.67 \times 10^{-11}\ N\ m^2\ kg^{-2}$)

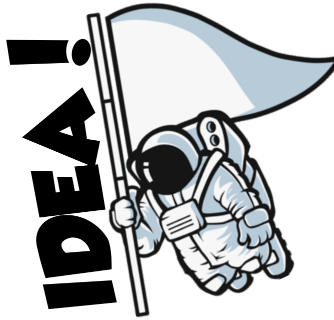
m_1 = mass of first object

m_2 = mass of second object

r = distance between the center of two objects

RELATIONSHIP BETWEEN g and G





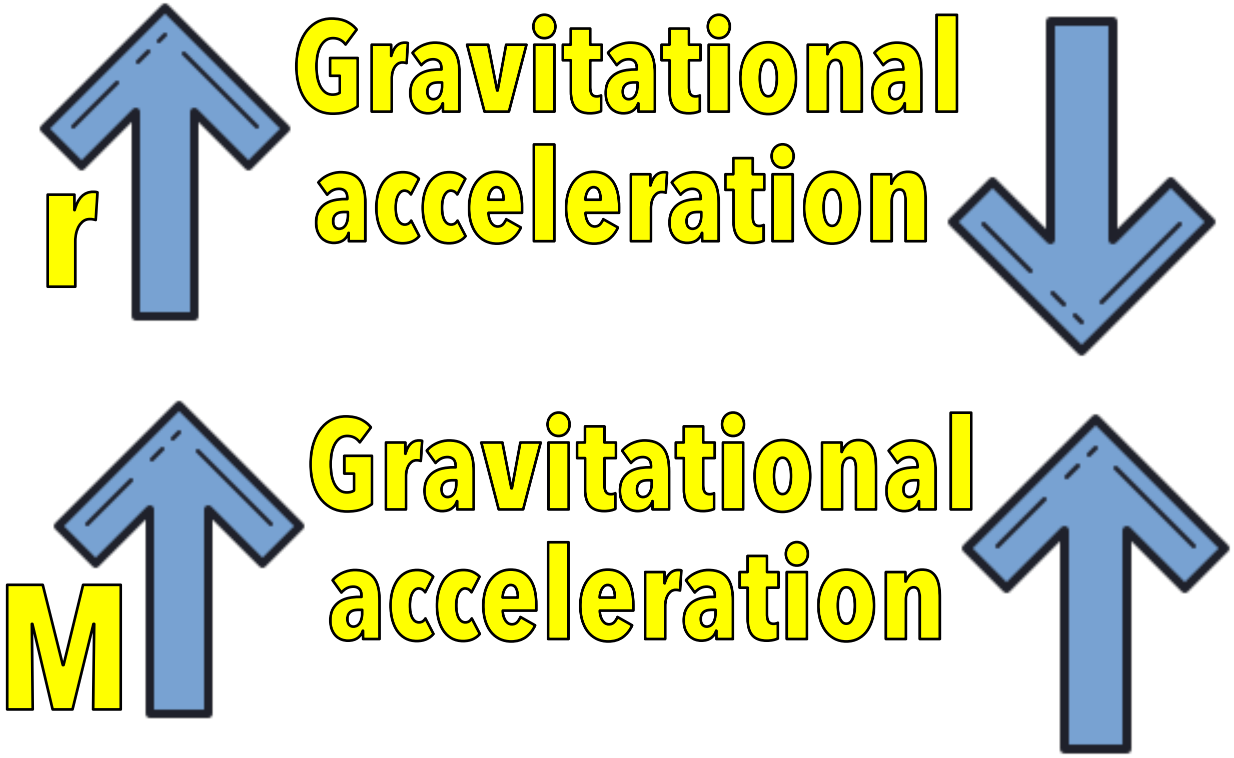
Newton's Second Law of Motion $F = mg$ 1

Newton's Universal Law of Gravitation $F = \frac{GmM}{r^2}$ 2

Equation 1 = Equation 2

$$mg = \frac{GmM}{r^2}$$

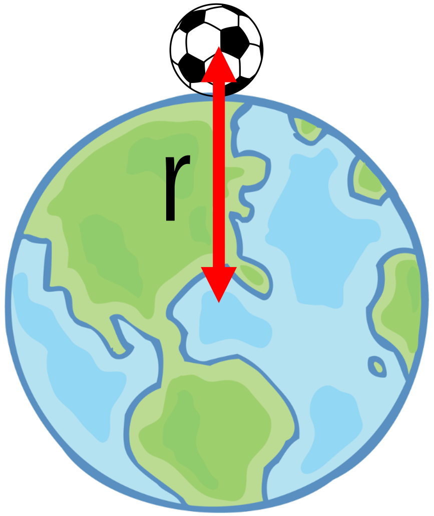
$$g = \frac{GM}{r^2}$$



RELATIONSHIP BETWEEN g and G

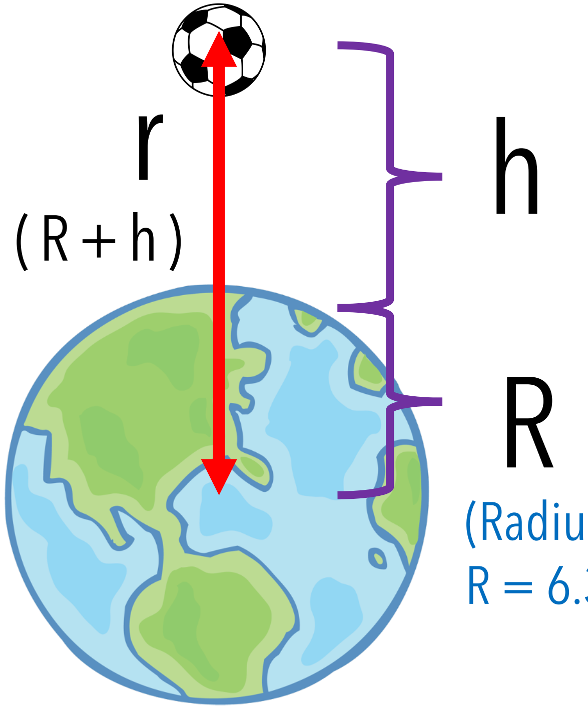
g = Gravitational acceleration
G = Universal gravitational constant (6.67×10^{-11} N m² kg⁻²)
M = mass of object
r = distance between the centers

$$g = \frac{GM}{r^2}$$



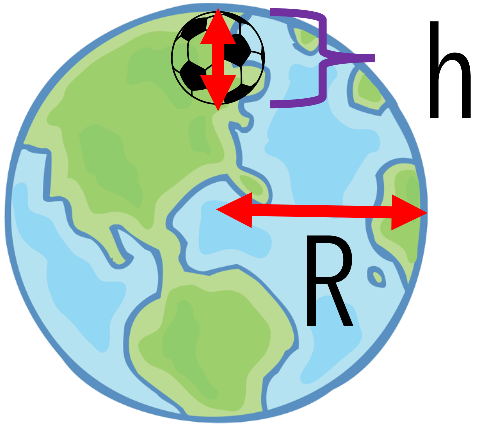
On the surface

$$g = \frac{GM}{(R+h)^2}$$



At a height

$$g = \frac{GM}{(R-h)^2}$$



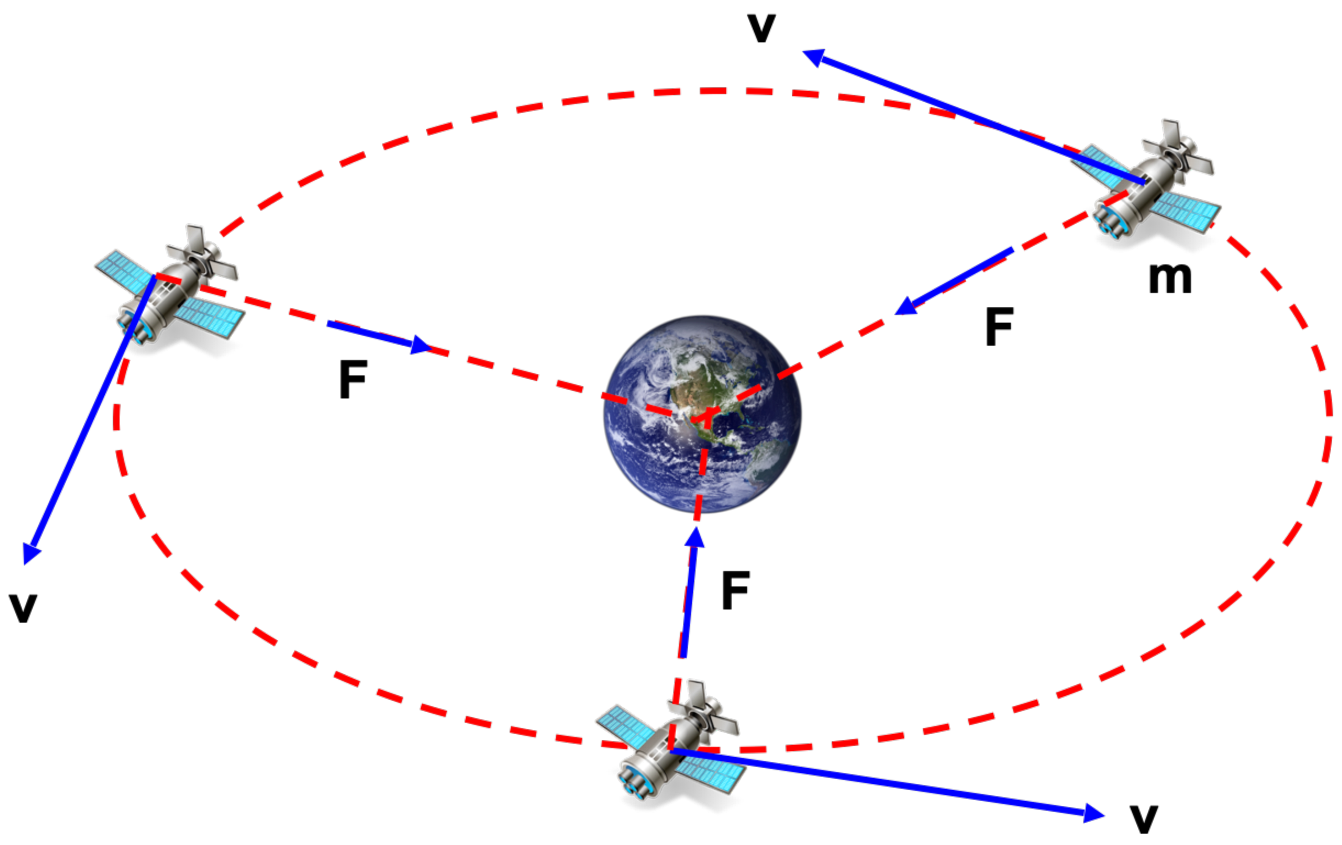
Below the surface

CENTRIPETAL FORCE

For an object in a circular motion

$$F = \frac{mv^2}{r}$$

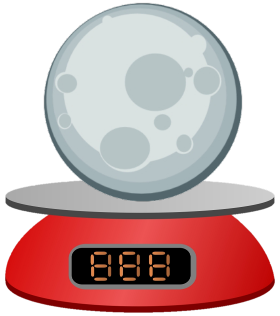
F = Centripetal force
m = mass of orbiting body
v = linear speed
r = radius of orbit



CENTRIPETAL FORCE

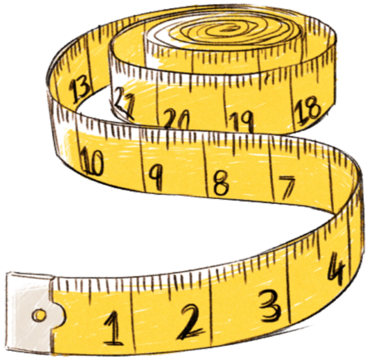
For an object in a circular motion

$$F = \frac{mv^2}{r}$$



Mass ↑ F ↑

Speed ↑ F ↑



r ↑ F ↓

CHAPTER 3

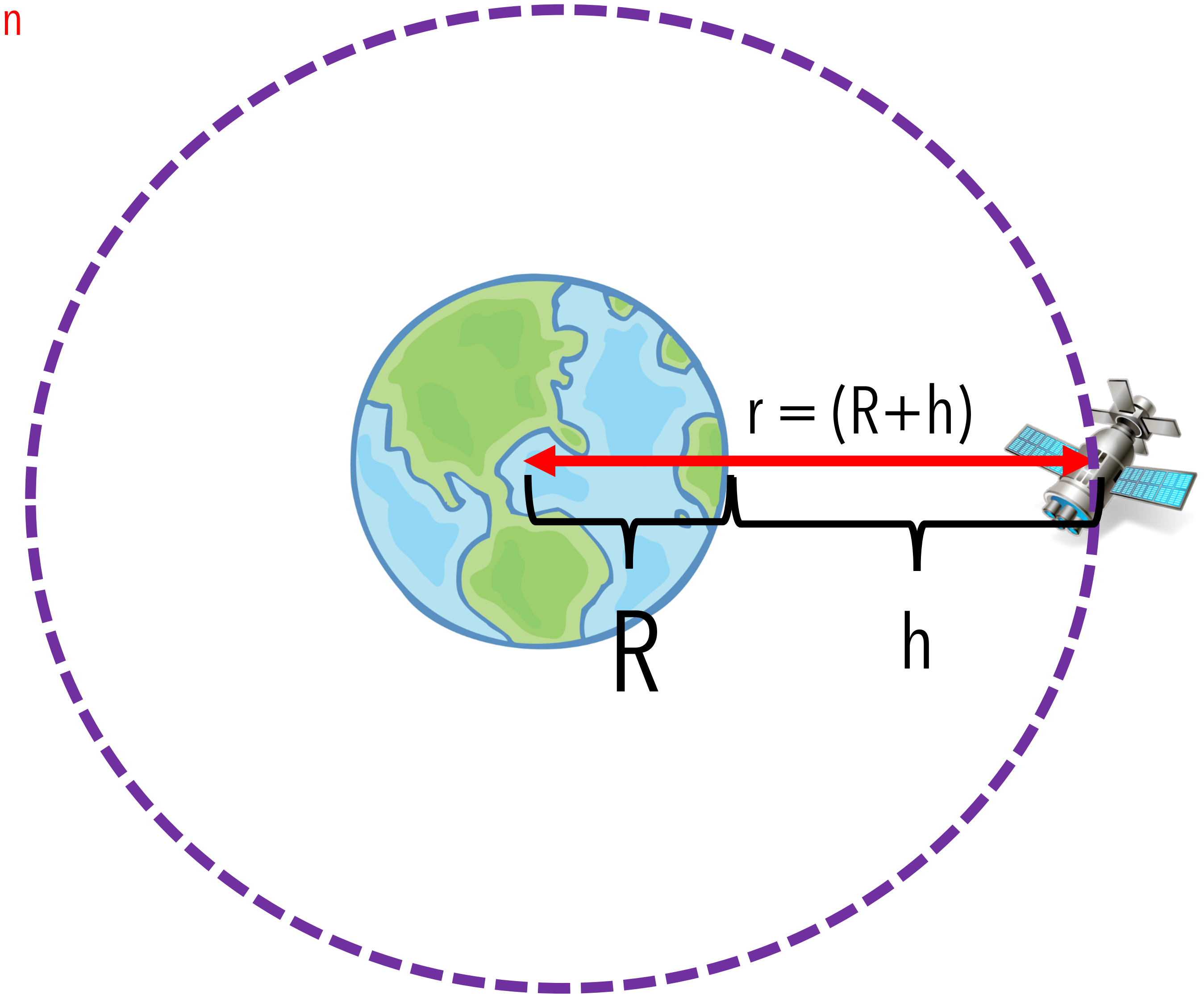
GRAVITATION

CENTRIPETAL ACCELERATION

Acceleration of an object in a circular motion

$$a = \frac{v^2}{r}$$

a = Centripetal acceleration
v = linear speed
r = radius of orbit



CHAPTER 3

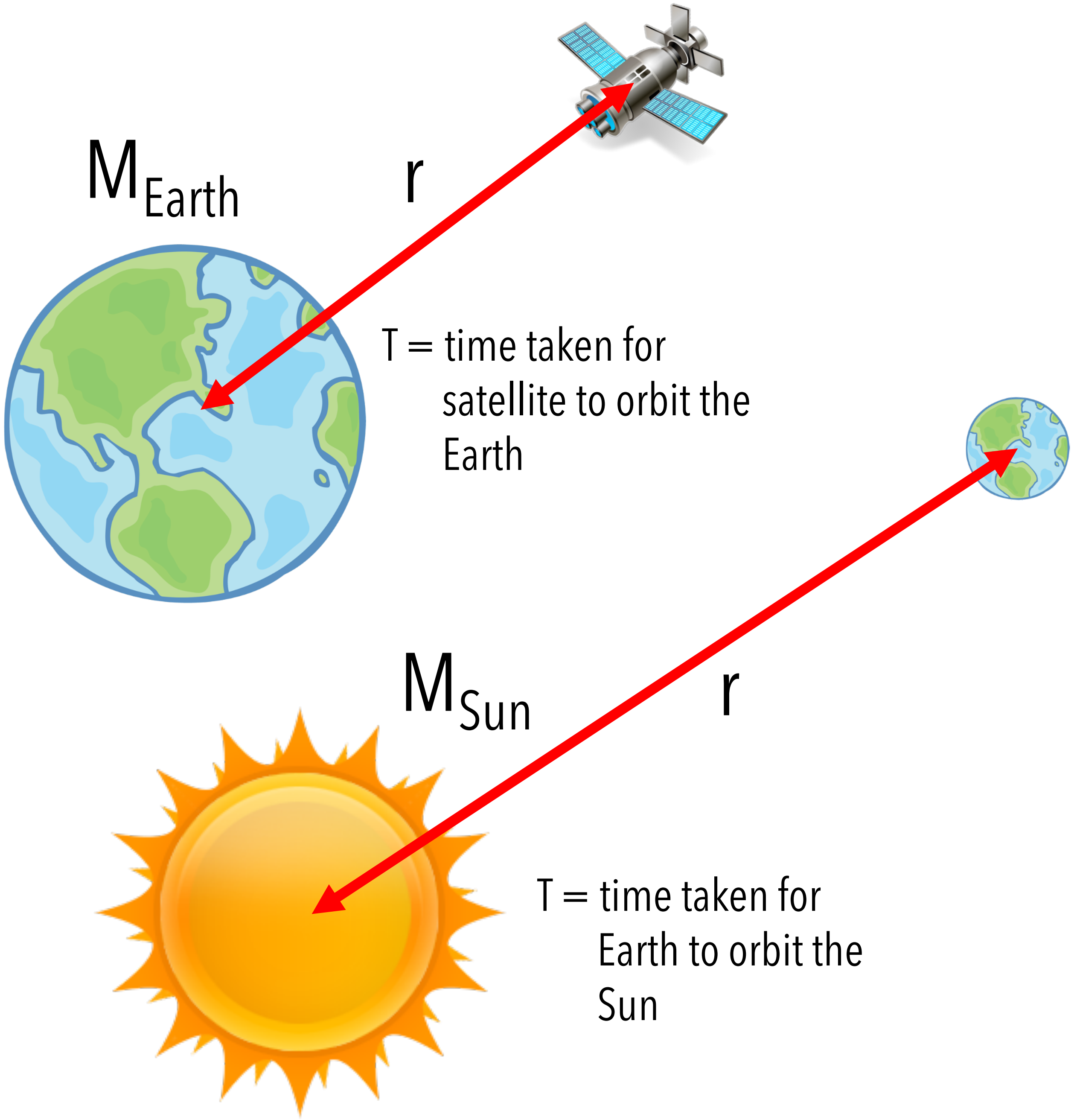
GRAVITATION

MASS OF A BODY

Mass of a body at the centre of an orbit

$$M = \frac{4\pi^2 r^3}{GT^2}$$

M = Mass (object at center)
G = gravitational constant
(6.67×10^{-11} N m^2 kg^{-2})
r = radius of orbit
T = Period of revolution
(time taken to circle the orbit)

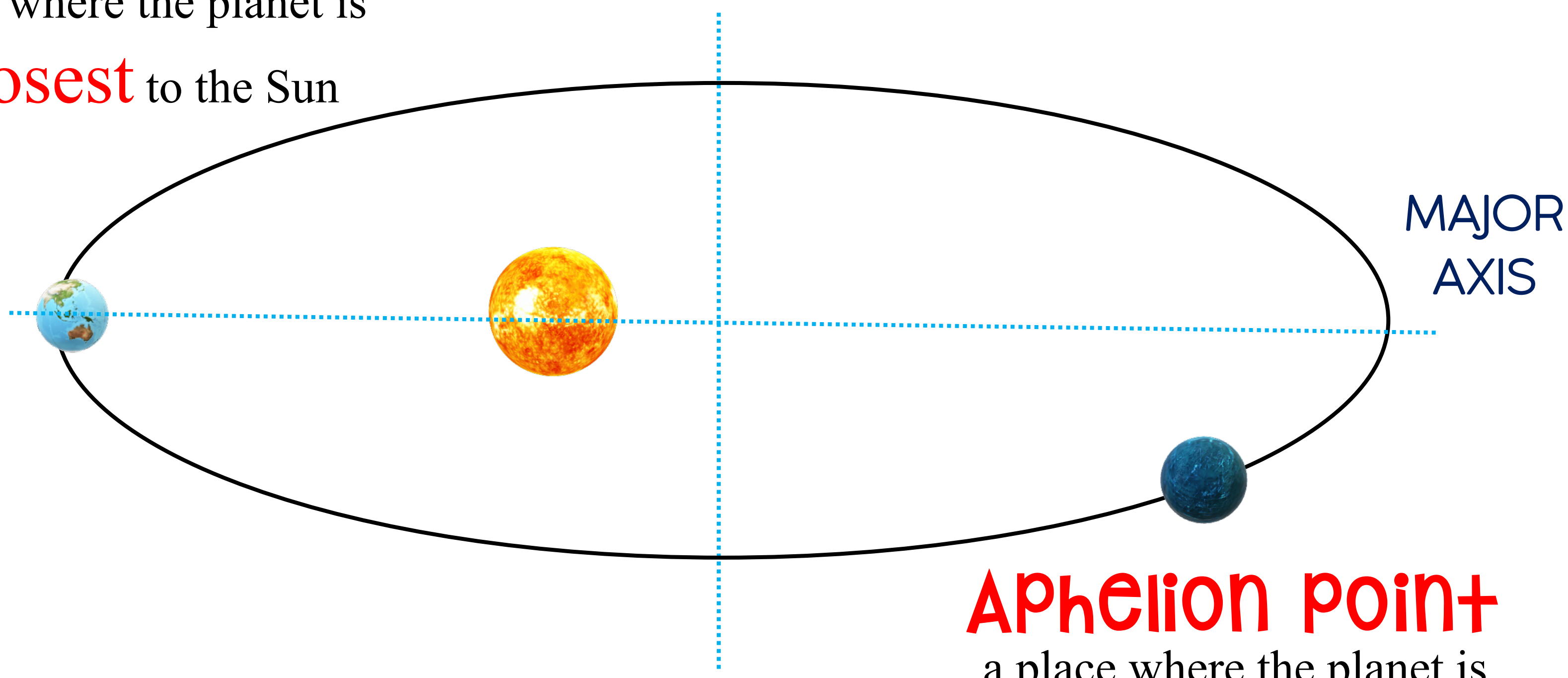


KEPLER'S 1

All planets move in **elliptical orbits** with the **sun at one focus**

Perihelion point

a place where the planet is the closest to the Sun



Aphelion point

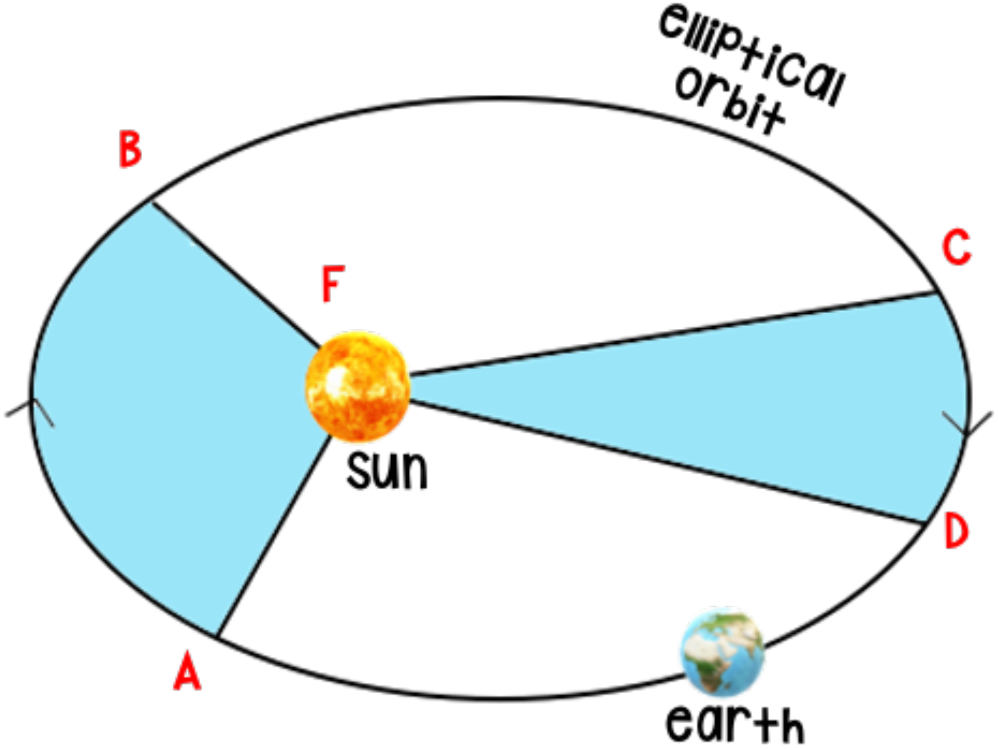
a place where the planet is the farthest to the Sun

KEPLER'S 2
(Law of Areas)

A **line** that connects a planet to the sun sweeps out **equal areas in equal times**




time:	A to B	=	C to D
area:	AFB	=	CFD
distance:	AB	>	CD
linear speed:	A to B	>	C to D



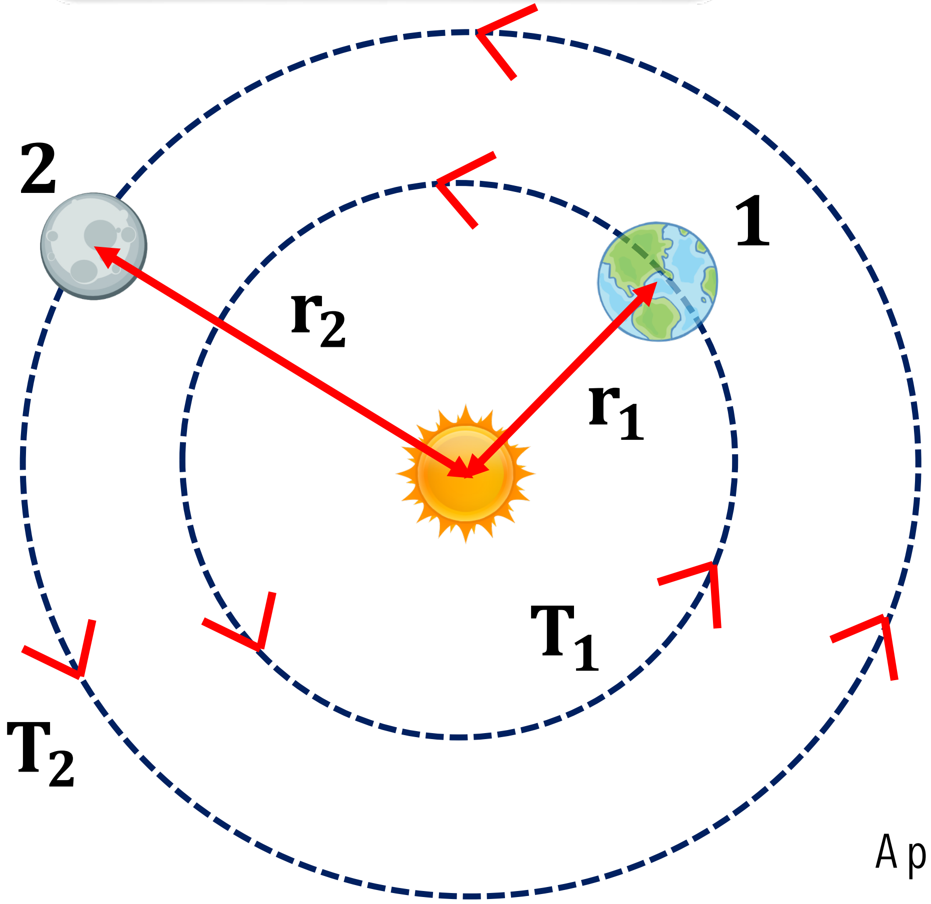
CHAPTER 3

GRAVITATION

KEPLER'S 3

(Law of Period)

The square of **period** of any planet is **directly proportional to the cube of the radius** of its orbit



$$T^2 \propto r^3$$

$$\frac{T_1^2}{T_2^2} = \frac{r_1^3}{r_2^3}$$

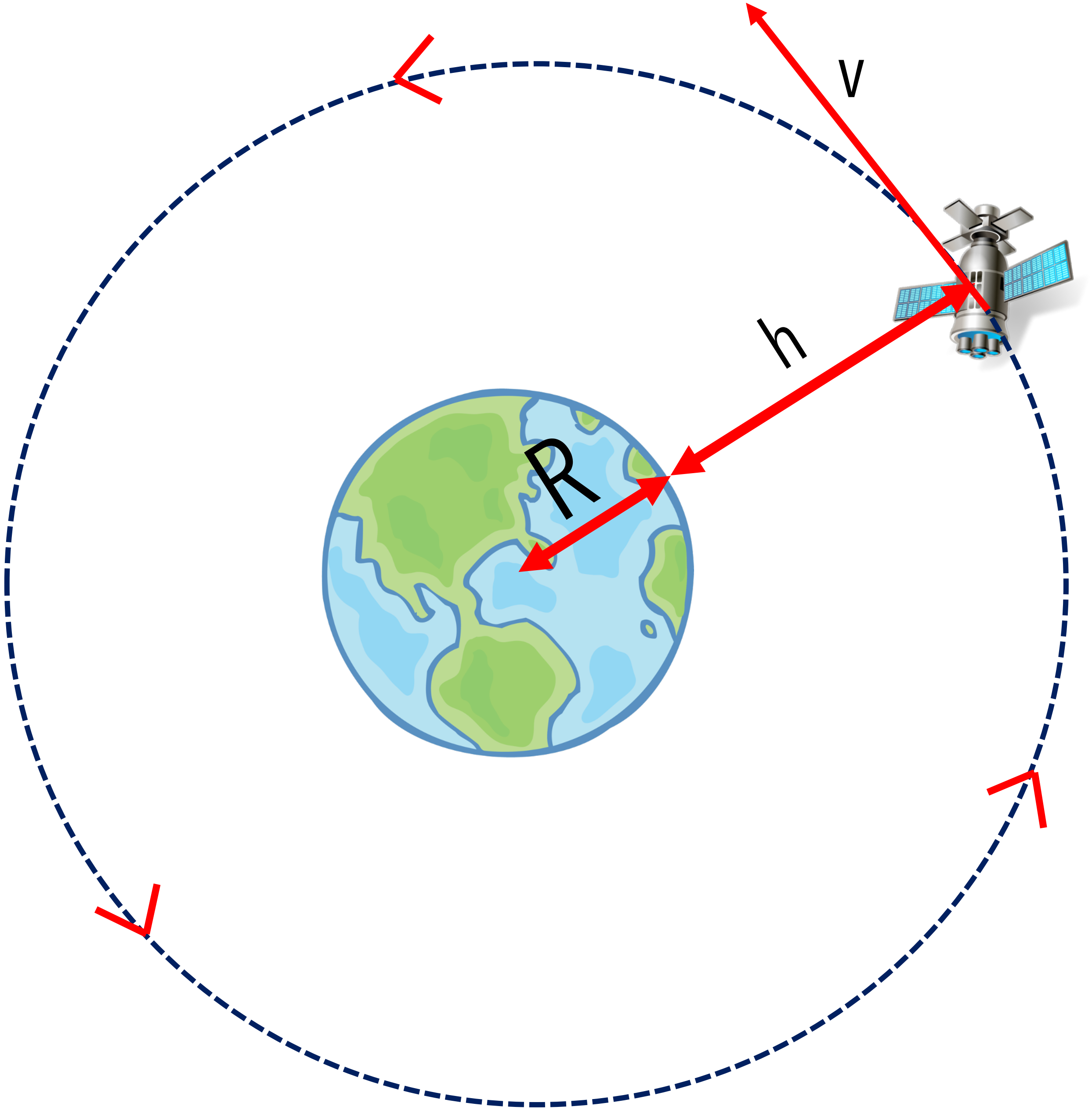
A planet which orbits with a larger radius has a longer orbital period

LINEAR SPEED

For satellite orbiting Earth

$$v = \sqrt{\frac{GM}{r}}$$

M = Mass of Earth
G = gravitational constant (6.67×10^{-11} N m^2 kg^{-2})
r = radius of orbit
v = linear speed

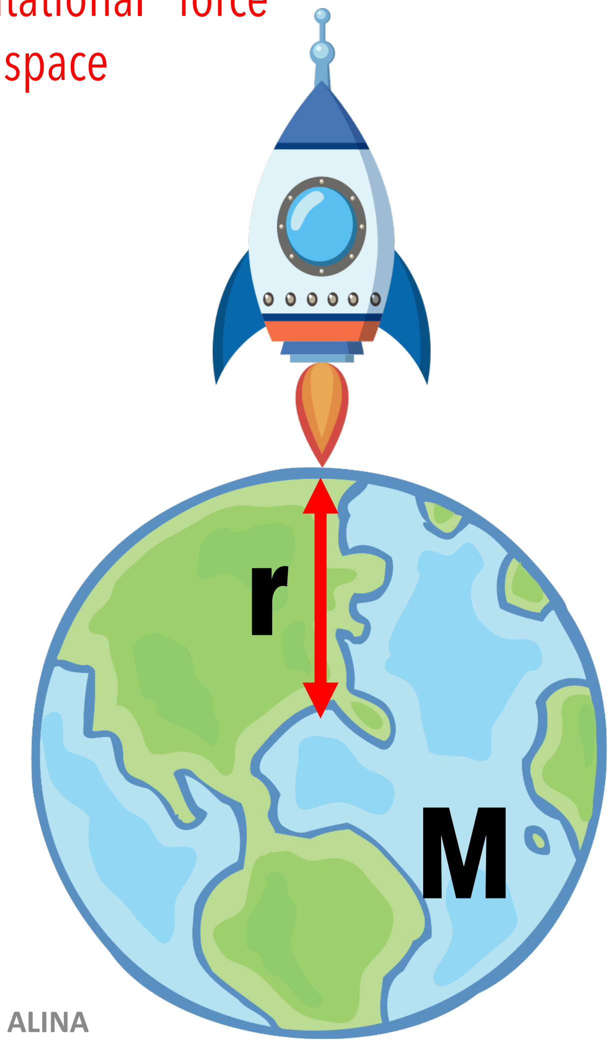


CHAPTER 3

GRAVITATION

ESCAPE VELOCITY

Minimum velocity needed by an object on the surface of the Earth to overcome gravitational force and escape to outer space



$$v = \sqrt{\frac{2GM}{r}}$$

M = Mass of Earth
G = gravitational constant (6.67×10^{-11} N m^2 kg^{-2})
r = Distance of object (From the centre of Earth)
v = linear speed

Geostationary versus non-geostationary satellites

FUNCTION: Orbit the Earth

LINEAR SPEED:

$$v = \sqrt{\frac{GM}{r}}$$

ORBITAL PERIOD:

$$T = \sqrt{\frac{4\pi^3 r^3}{GM}}$$

Geostationary satellites

Orbit at: Geostationary Earth Orbit

Direction of rotation: **same** to Earth's rotation

Orbital period: **24 hours** (period of Earth's rotation)

Specific FUNCTION: **COMMUNICATION** satellite

Example: **MEASAT**

Non-geostationary satellites

Orbit at: **LOWER** or **HIGHER** Geostationary Earth Orbit

Direction of rotation: **same** to Earth's rotation

Orbital period: < or > than **24 hours**

Specific FUNCTION: EARTH IMAGING, GPS & WEATHER FORECAST

Example: TiungSAT, RazakSAT, Pipit, ISS

CHAPTER 4

HEAT

TEMPERATURE OF LIQUID:

$$T(\theta) = \frac{l_\theta - l_0}{l_{100} - l_0} \times 100\ ^{o}\mathrm{C}$$

TRANSFORMATION OF ENERGY:

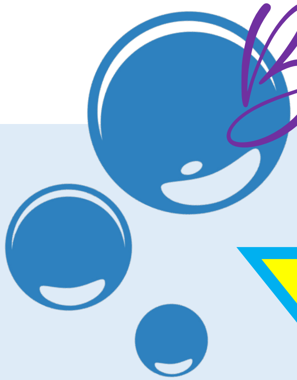
$$\frac{1}{2}mv^2 = mc\theta$$

$$\mathrm{mgh} = \mathrm{mc}\theta$$

$$\mathrm{Pt} = \mathrm{mc}\theta$$

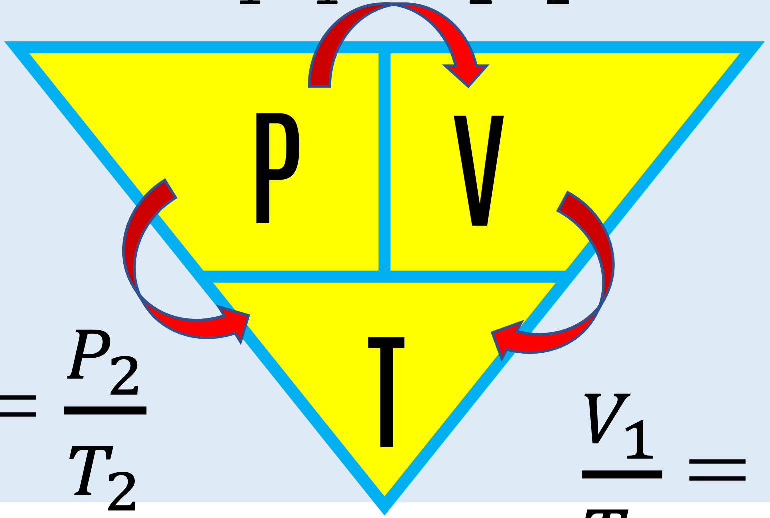
HEAT ENERGY: $Q = mc\theta$

LATENT HEAT ENERGY: $Q = mL$



Boyle's law

$$P_1V_1 = P_2V_2$$



$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

Pressure law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Charles' law

Important Notes:

$$T = (\boldsymbol{\theta}\ ^{o}\mathrm{C} + 273)\ \mathrm{K}$$

CHAPTER 5

LIGHT + OPTIC

REFRACTIVE INDEX:

$$\eta = \frac{\sin i}{\sin r}$$

$$= \frac{\text{speed in air}}{\text{speed in medium}}$$

$$= \frac{H\ (\text{Real})}{h\ (\text{Apparent})}$$

$$\eta = \frac{1}{Sin\ C}$$

POWER OF LENS:

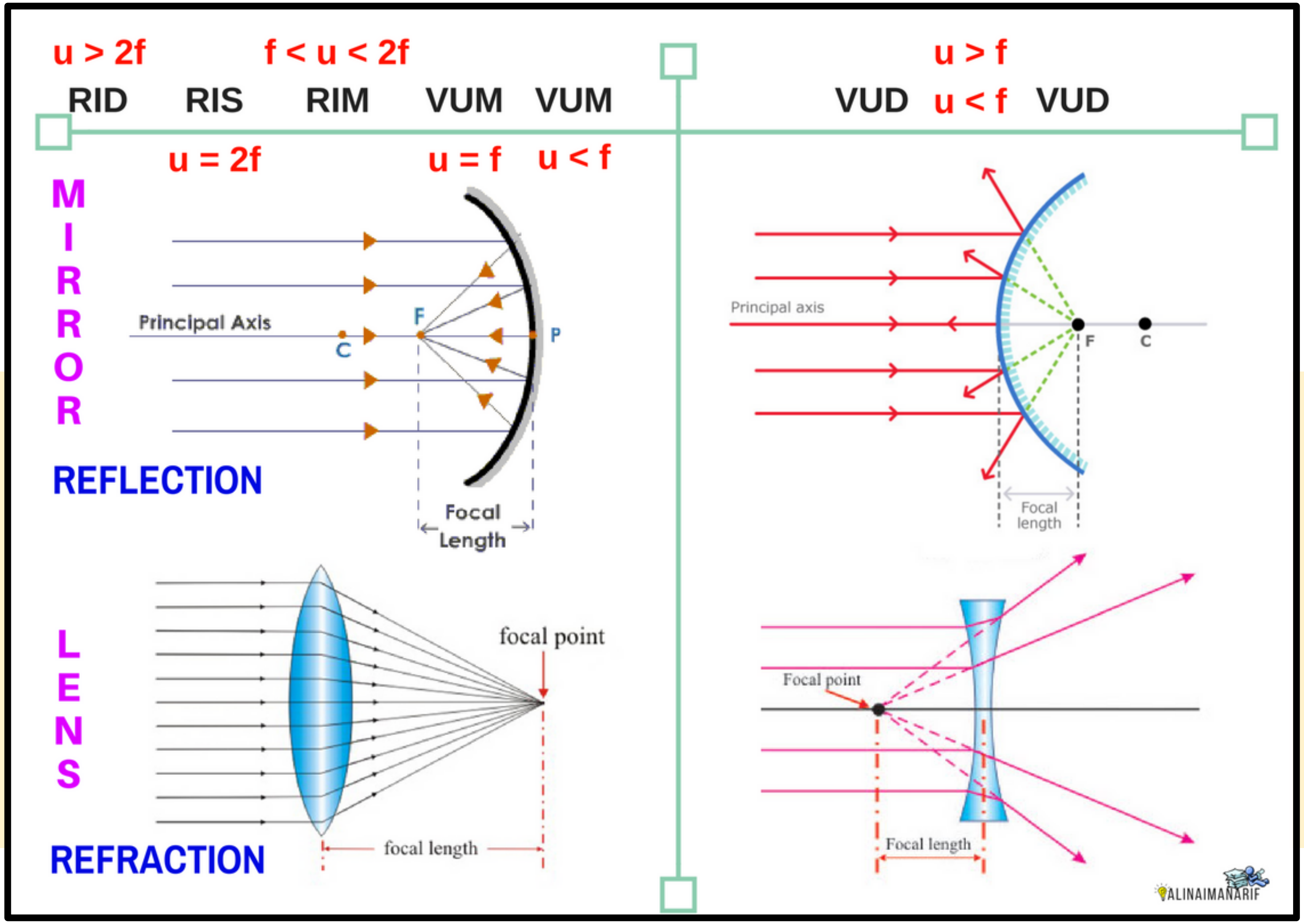
$$P = \frac{1}{f}$$

LINEAR MAGNIFICATION:

$$m = \left| \frac{v}{u} \right| = \frac{h_i}{h_o}$$

LENS EQUATION:

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$



CHAPTER 5

LIGHT + OPTIC

POWER OF LENS:

$$P = \frac{1}{f}$$

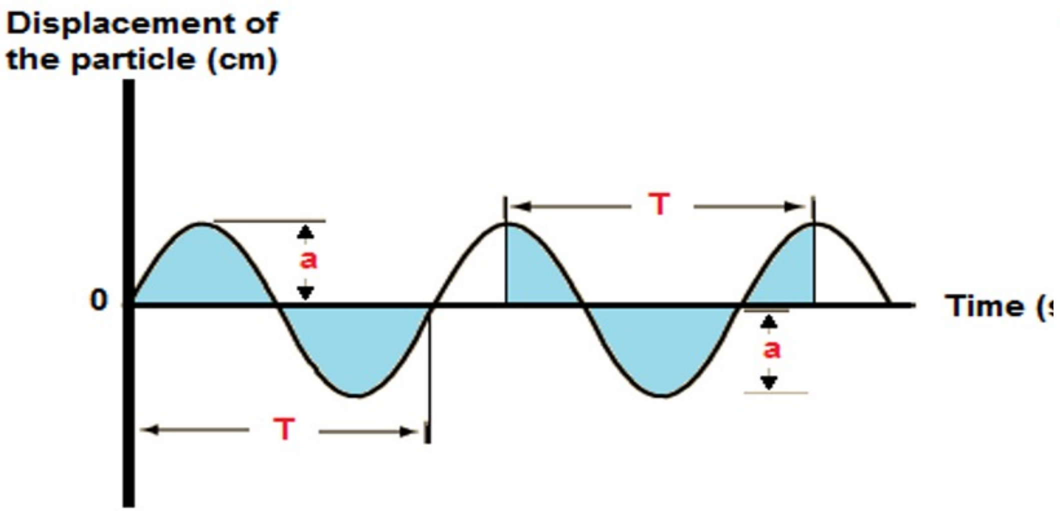
LINEAR MAGNIFICATION:

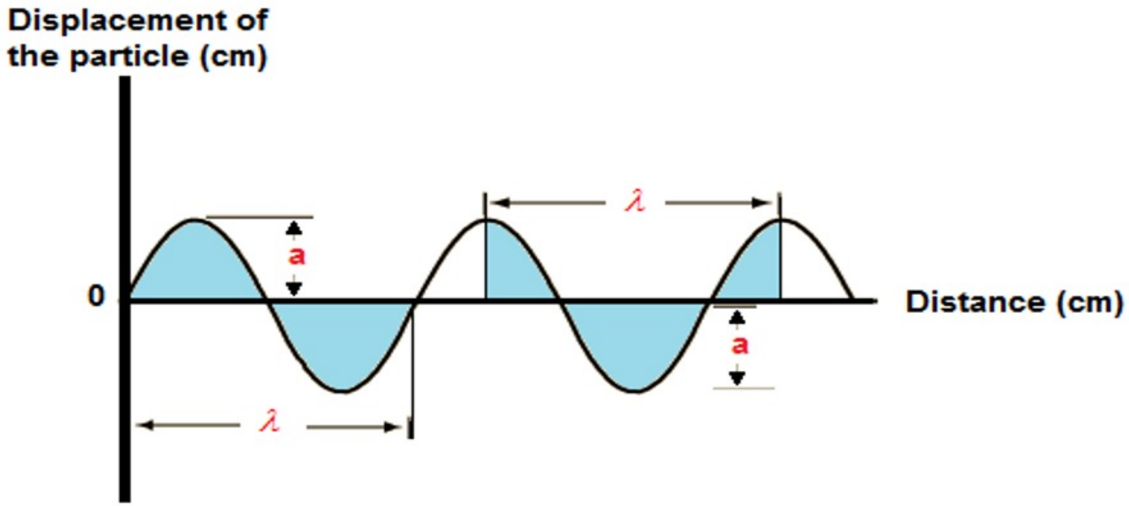
$$m = \frac{f_o}{f_e}$$

CHARACTERISTICS	MICROSCOPE	TELESCOPE
DIAGRAM		
fo (objective lens)	P↑ so f↓ To produce bigger image	P↓ so f↑ To produce a higher magnification
fe (eyepiece lens)	f↑	f↓
D (normal adjustment)	D > fo + fe To produce bigger image from the eyepiece // to increase the magnification	D = fo + fe To produce sharp & bright image
u (object distance)	f < u < 2f (RIM)	Infinity (oo) (RID)
First image	RIM	RID (at f)
Final image	VIM	VIM (oo)

CHAPTER 6

WAVES

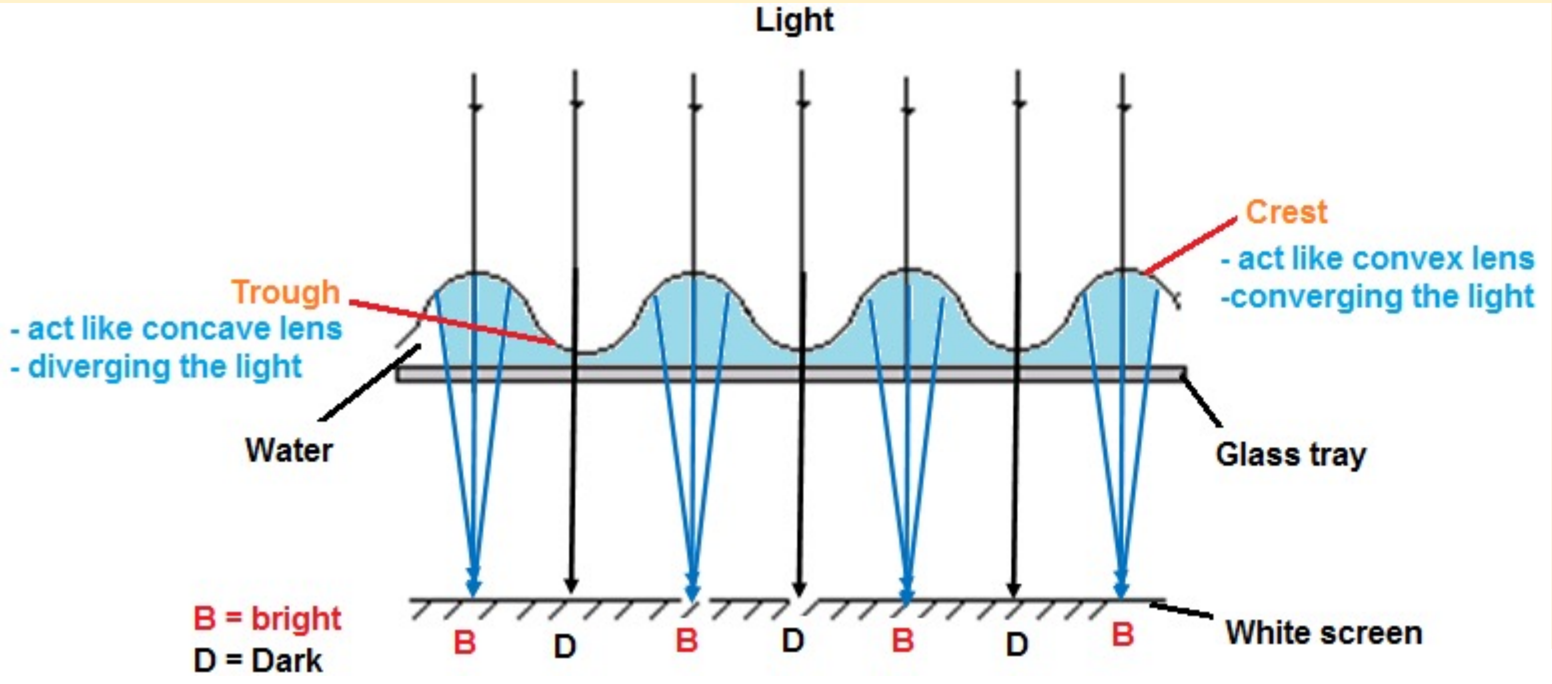




PERIOD: $T = \frac{1}{f}$

FREQUENCY: $f = \frac{1}{T}$

SPEED OF WAVES: $v = f\lambda$



Characteristics of the **REFLECTION** of waves:

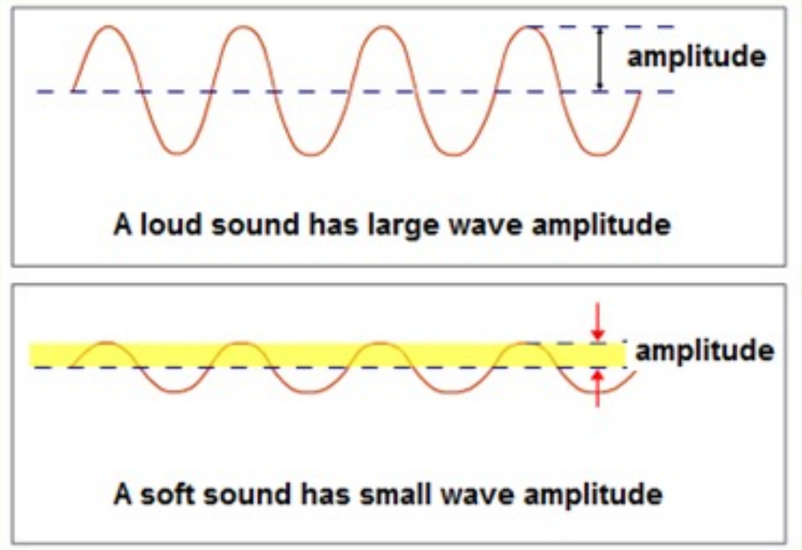
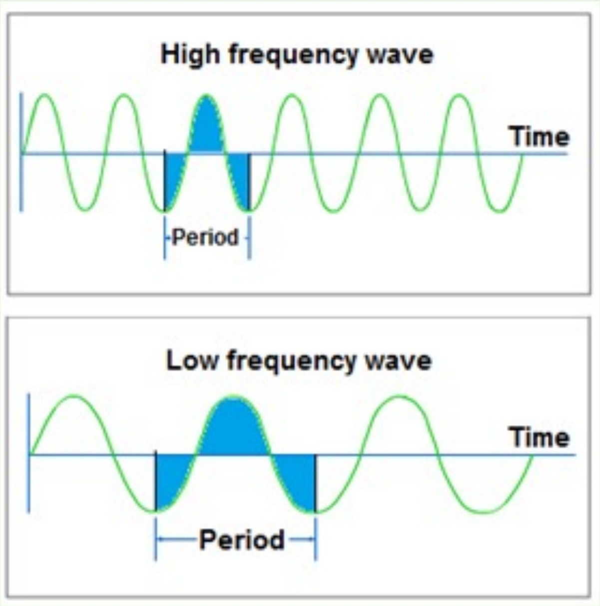
Physical Quantity	INCIDENCE WAVE	REFLECTED WAVE
Frequency	Unchanged (come from the same source; water wave)	
Speed	Unchanged	
Wavelength	Unchanged	
Direction of Propagation	Changed	

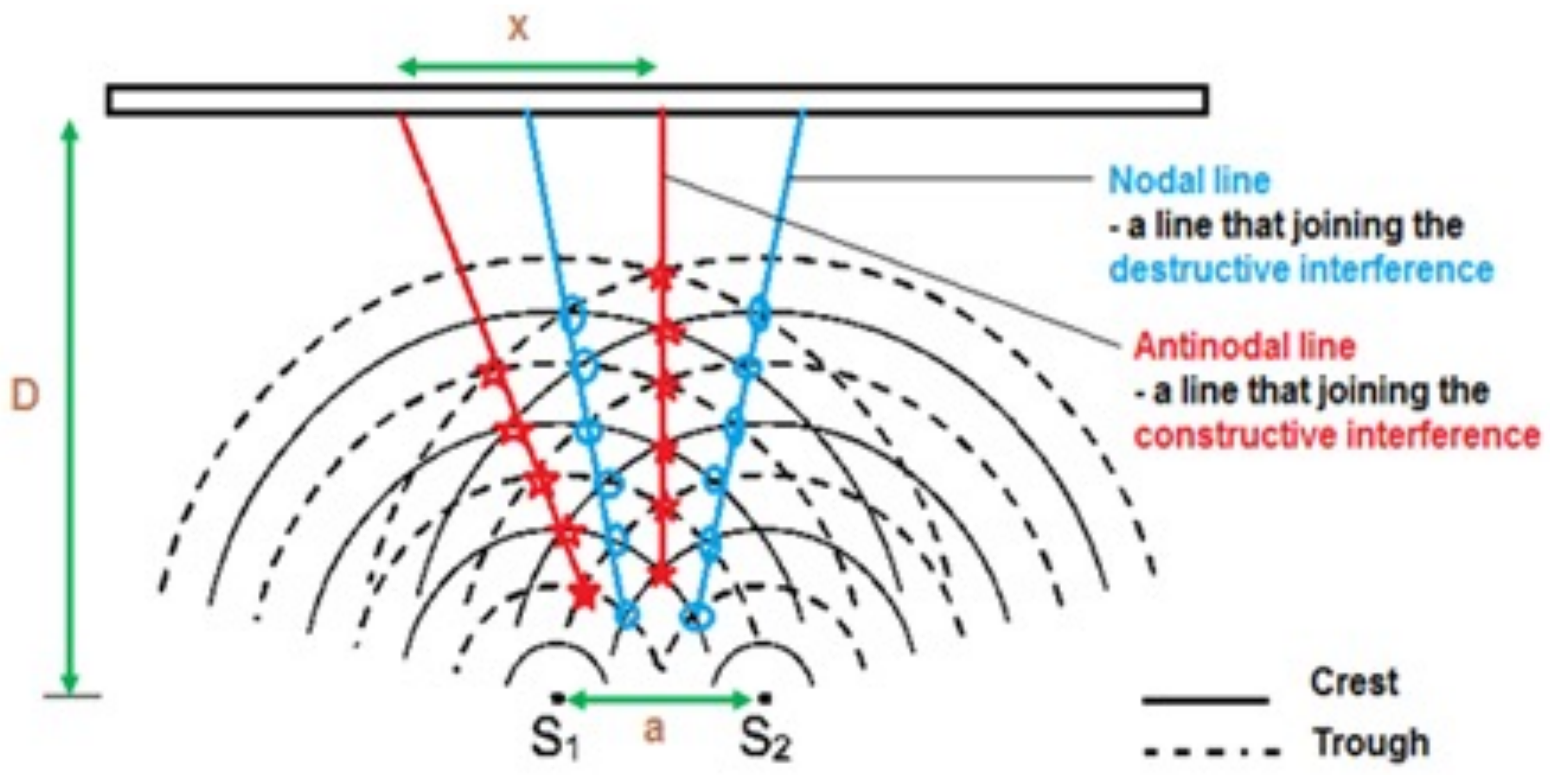
Characteristics of the **REFRACTION** of waves:

Physical Quantity	SHALLOW AREA	DEEP AREA
Frequency	Unchanged (come from the same source; water wave)	
Velocity	Decrease	Increase
Wavelength	Decrease	Increase
Direction of Propagation	Bends towards the normal line	Bends away the normal line

Characteristics of the **DIFFRACTION** of waves:

Physical Quantity	Condition (diffracted waves)
Frequency	Unchanged (come from the same source; water wave)
Speed	Unchanged
Wavelength	Unchanged
Amplitude (Energy)	Decrease

LOUDNESS	PITCH
	
Loudness increase, amplitude (energy) increase	Frequency increase, pitch increase Frequency increase, period decrease



$$\lambda = \frac{ax}{D}$$

λ = wavelength of water waves

a = distance between two dippers

x = distance between two consecutive antinodal line or nodal line

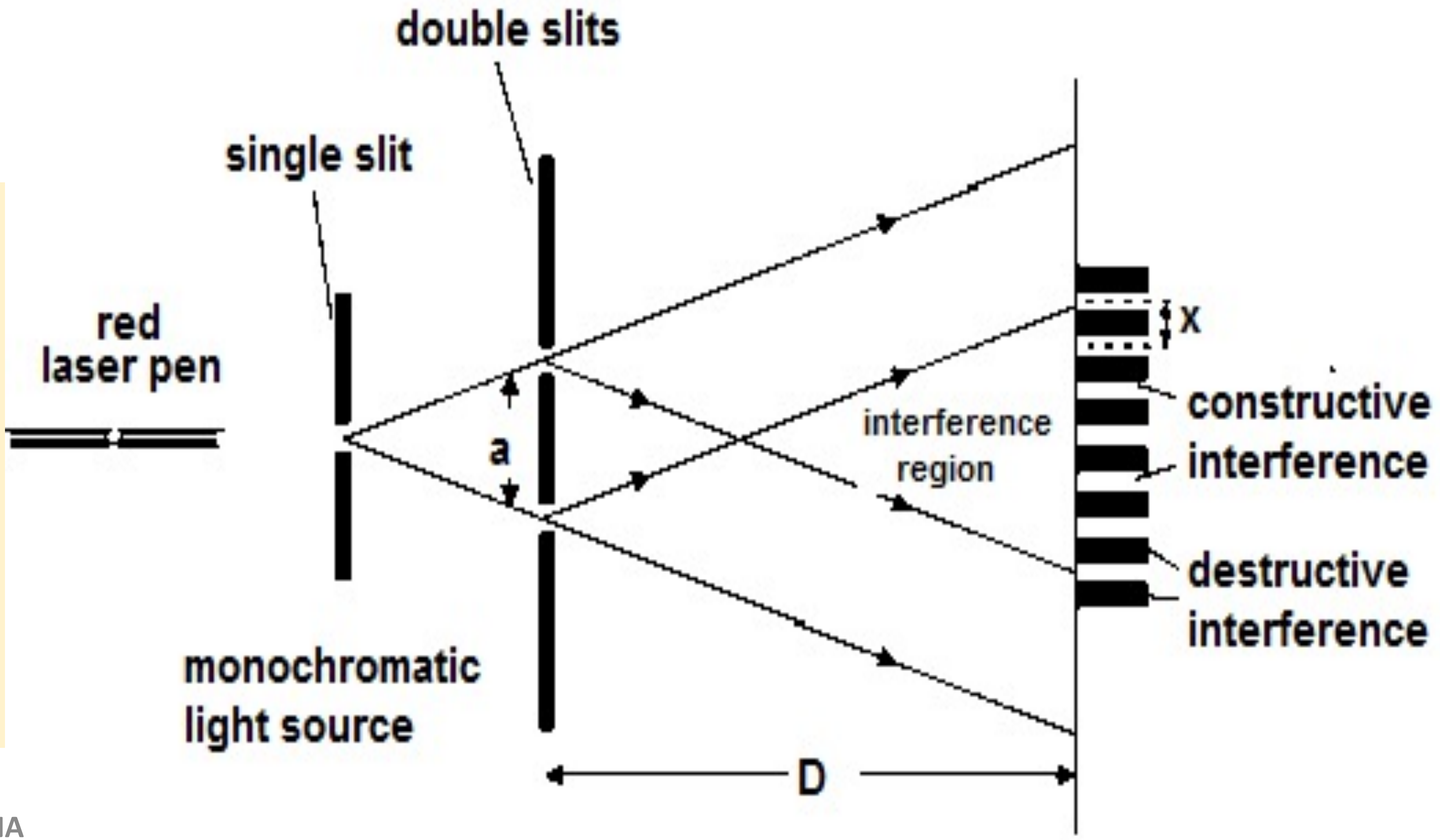
D = distance between dippers and screen

The wavelength of **monochromatic** light can be found by the formula:

$$\lambda = \frac{ax}{D}$$

a = distance between two slits
x = distance between two consecutive bright fringe or dark fringe
D = distance between slits and screen

When **constructive** occurs there will be a **bright fringe.**
When **destructive** occurs there will be a **dark fringe.**

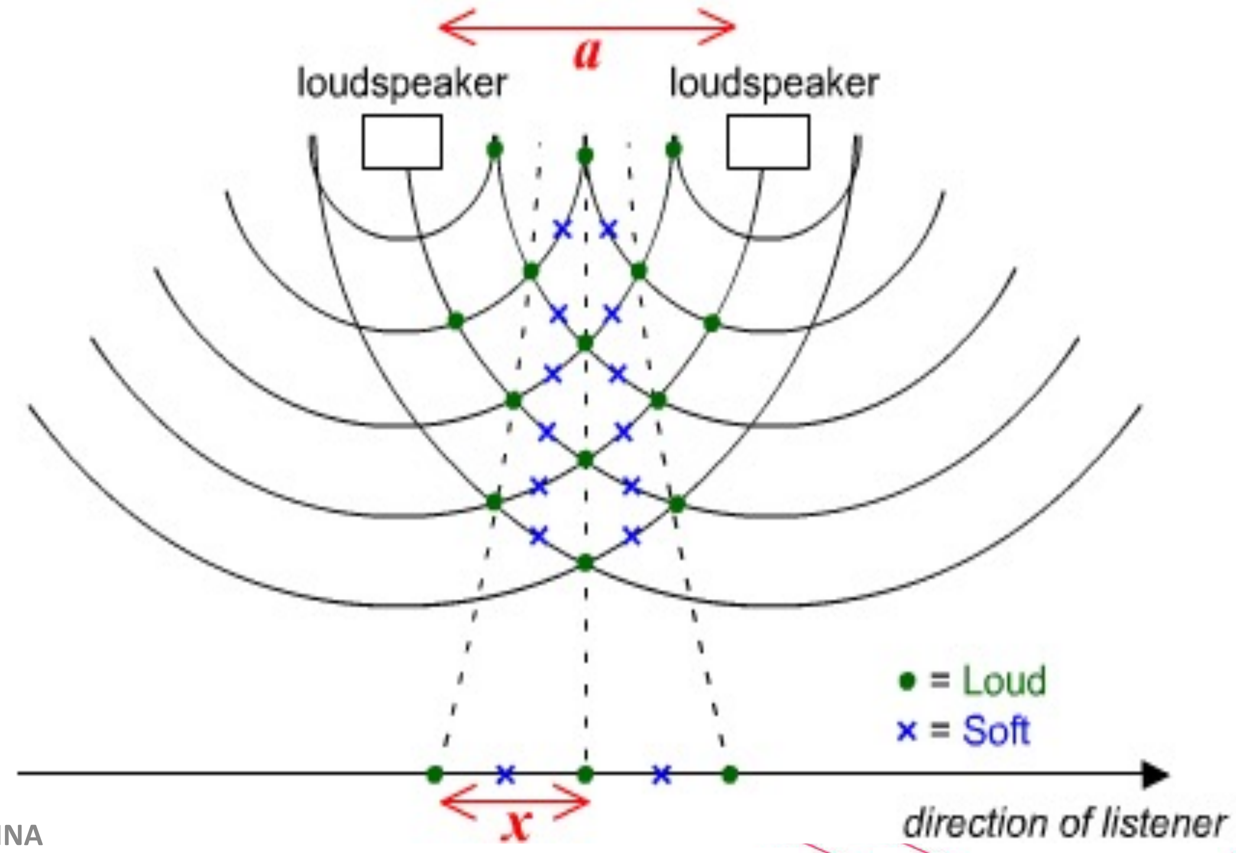


The wavelength of **sound wave** can be found by the formula:

$$\lambda = \frac{ax}{D}$$

a = distance between two loudspeakers
x = distance between two consecutive loud sound or soft sound
D = distance between loudspeakers and where the sound heard

When **constructive** occurs there will be a **loud sound.**
When **destructive** occurs there will be a **soft sound.**



CHAPTER 7

FORCE & MOTION II

WORK DONE / ENERGY: $W = Fs$

POWER: $P = \frac{W}{t} = \frac{E}{t}$

KINETIC ENERGY: $E_k = \frac{1}{2}mv^2$

HOOKE'S LAW:

$$F = kx$$

SPRING CONSTANT:

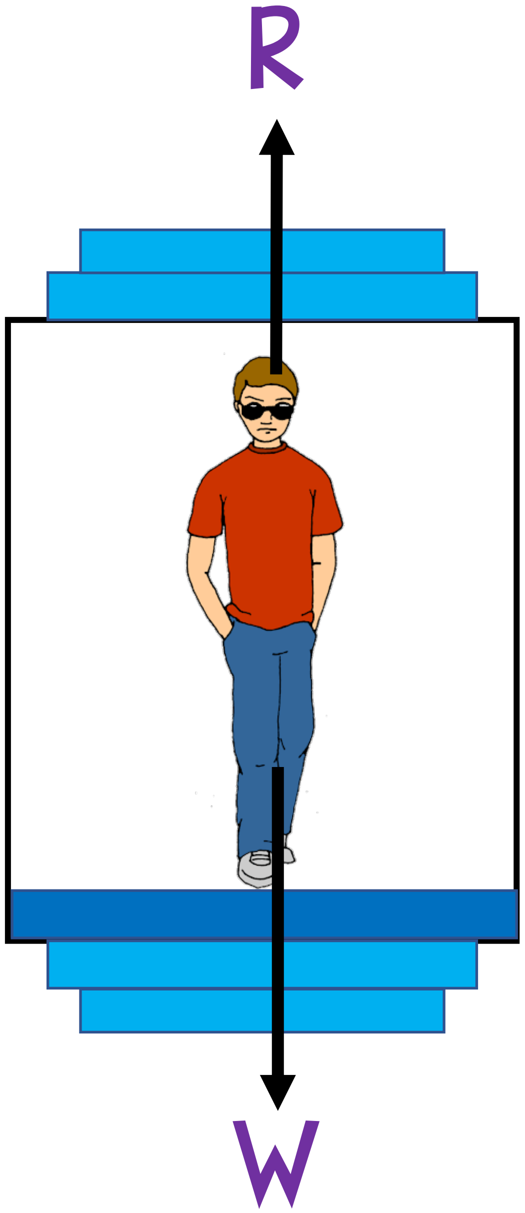
$$k = \frac{F}{x}$$

GRAVITATIONAL POTENTIAL ENERGY: $E_p = mgh$

EFFICIENCY: $E = \frac{E_{out}}{E_{in}} x100\%$

ELASTIC POTENTIAL ENERGY:

$$E_p = \frac{1}{2}Fx = \frac{1}{2}kx^2$$



Moving **upwards** with acceleration of $a\ m\ s^{-2}$

upwards

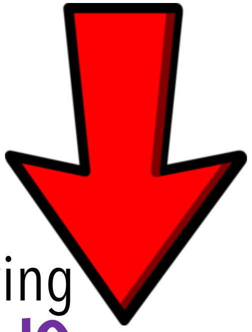
$R > W$

$R > mg = ma$

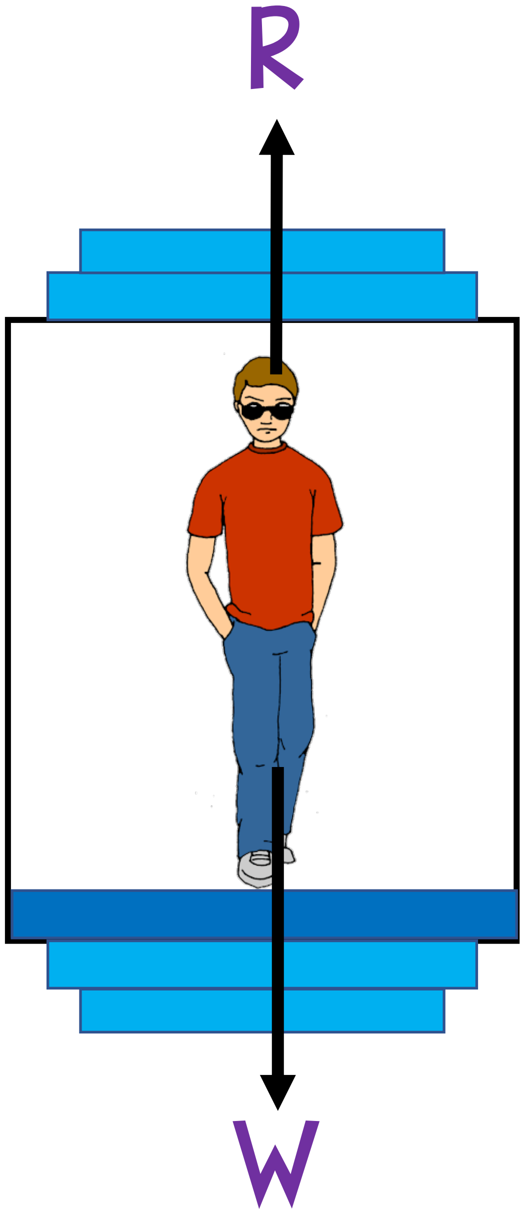
$R - mg = ma$

$R = ma + mg$

*R = reading of the weighing scale



Moving **downwards** with acceleration of $a\ m\ s^{-2}$



downwards

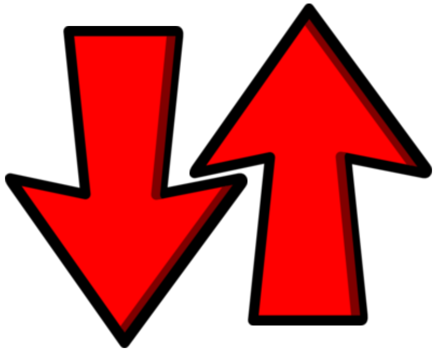
$W > R$

$W > R = ma$

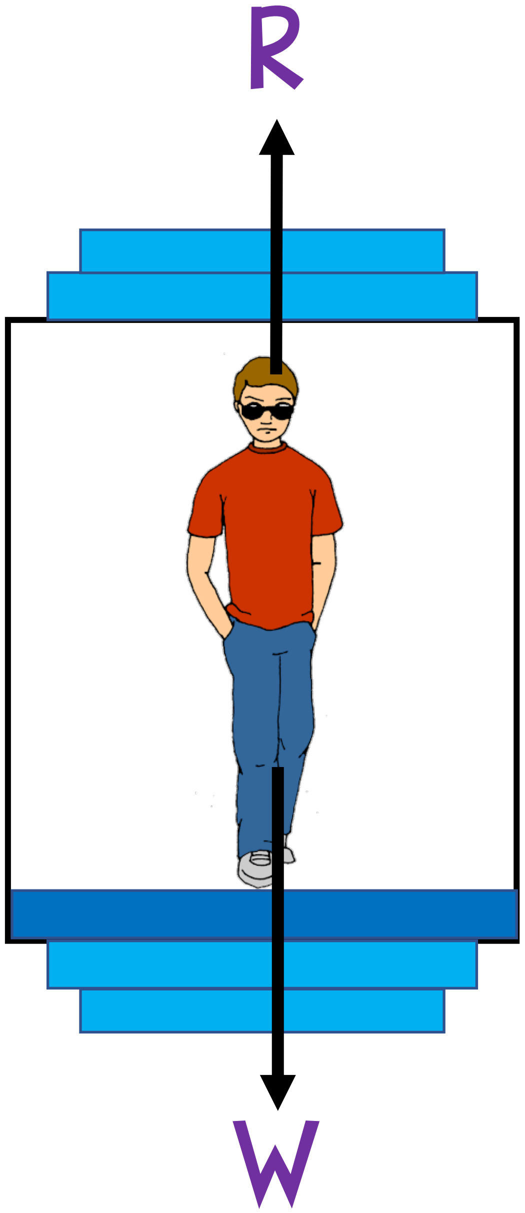
$mg - R = ma$

$R = mg - ma$

*R = reading of the weighing scale



Stationary
lift of moving
upwards & downwards
at constant velocity



$a = 0 \text{ m s}^{-2}$ (constant velocity)

$F_{net} = 0$ N

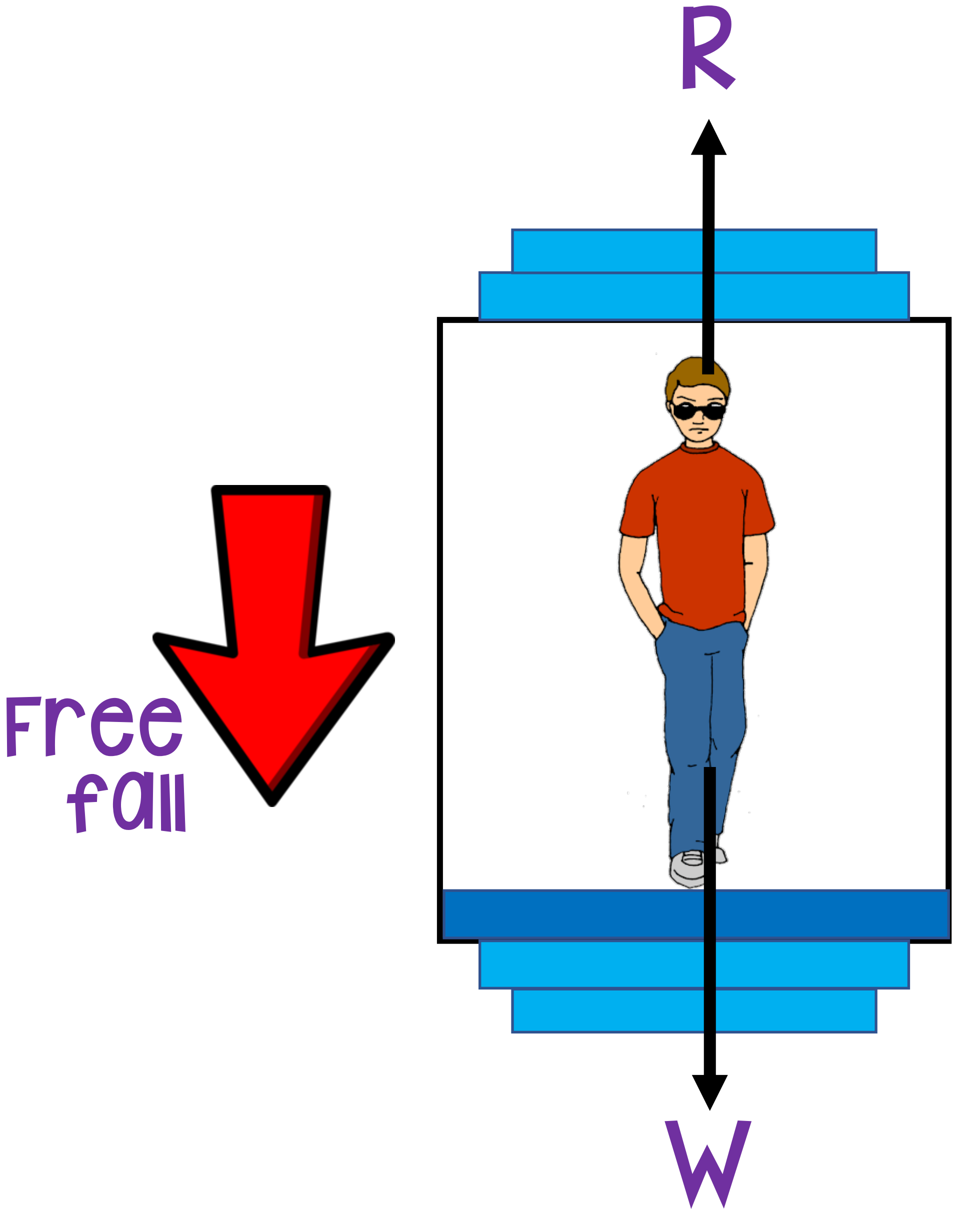
R > W

$R > mg = ma$

$R - mg = 0$

$R = mg$

*R = reading of the weighing scale



Free fall

a = g (gravitational acceleration)

W > R

W > R = ma

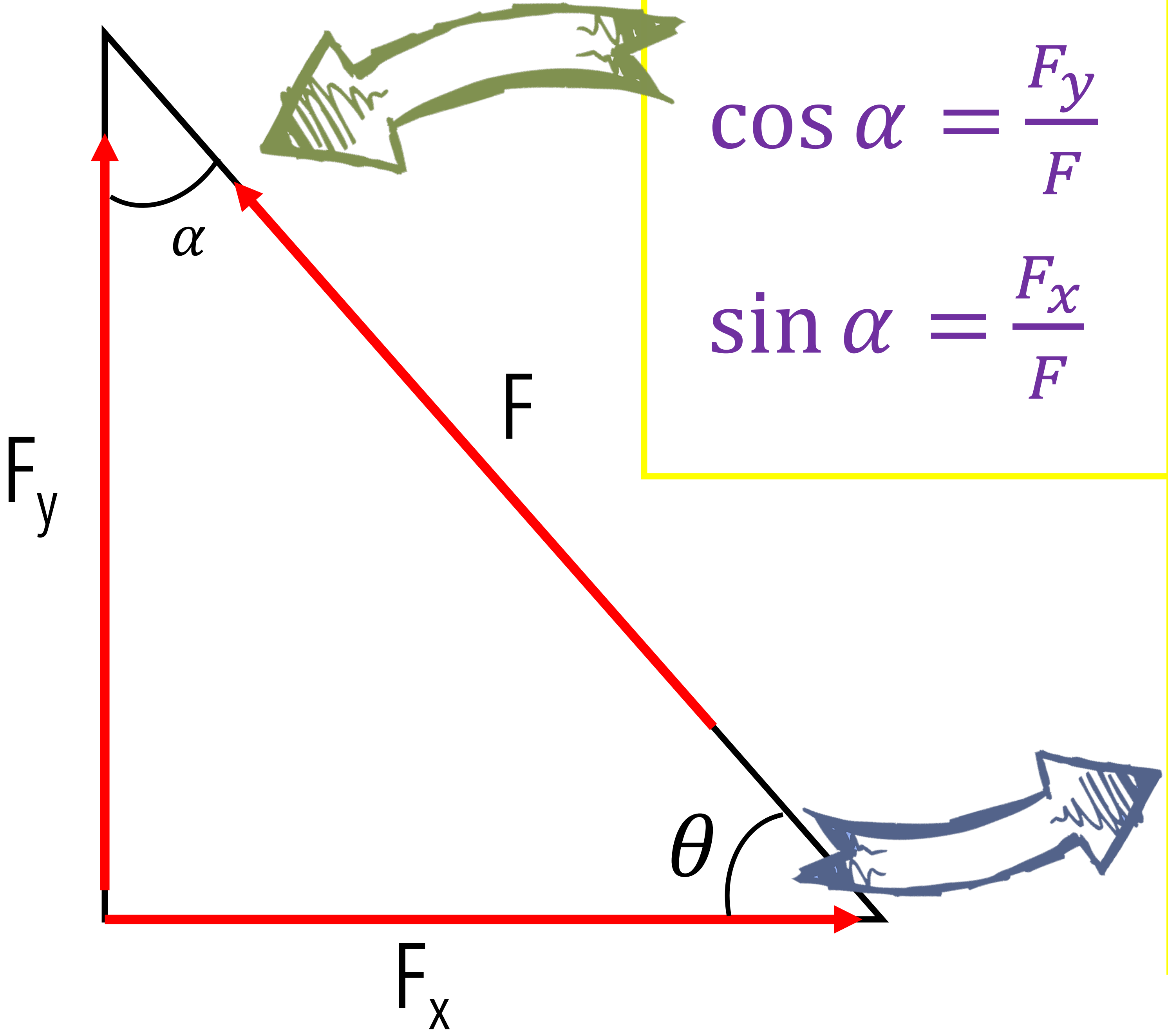
W > R = mg

mg – R = mg

R = mg – mg

R = 0 N

*R = reading of the weighing scale



$$\cos\alpha = \frac{F_y}{F}$$

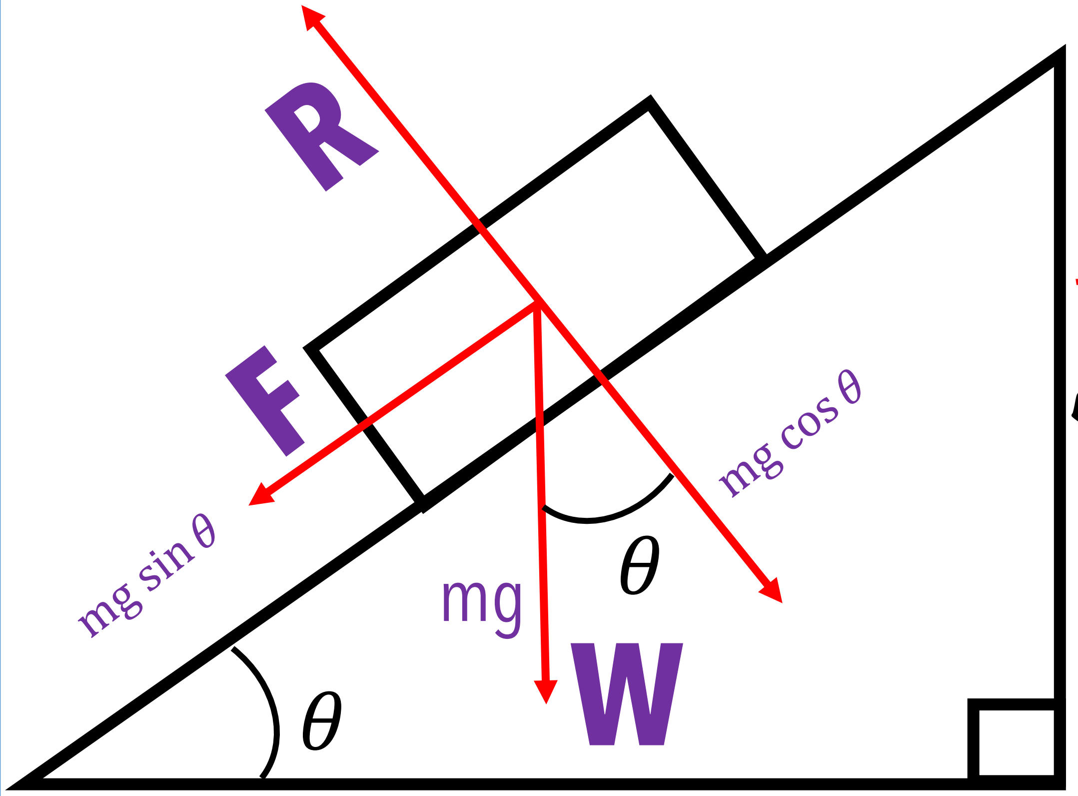
$$\sin\alpha = \frac{F_x}{F}$$

$$\cos\theta = \frac{F_x}{F}$$

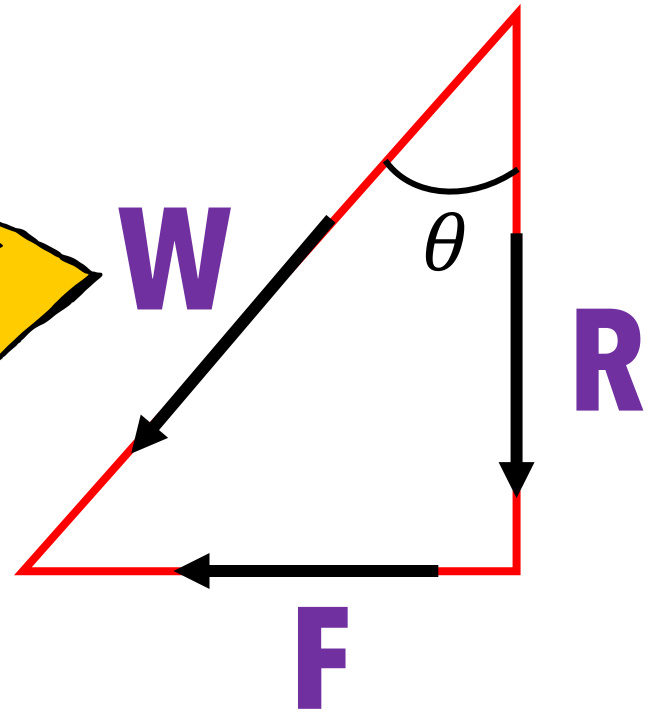
$$\sin\theta = \frac{F_y}{F}$$

Component **parallel** to the plane: $F = mg \sin\theta$

Component **perpendicular** to the plane: $R = mg \cos\theta$



Using a concept of **trigonometry**



CHAPTER 8

PRESSURE

PRESSURE: $$P = \frac{F}{A}$$

PRESSURE IN LIQUID: $$P = \rho g h$$

$$P_{atm} = 1.0 \text{ X } 10^5 \text{ Pa}$$

$$= 76 \text{ cm Hg}$$

$$= 10.3 \text{ m } H_2O$$

$$= 1 \text{ Bar}$$

$$= 1 \text{ atm}$$

PASCAL'S PRINCIPLE:

$$P = \frac{F_1}{A_1} = \frac{F_2}{A_2}$$

$$P = A_1 h_1 = A_2 h_2$$

BUOYANT FORCE:

$$F_B = \rho V g$$

CHAPTER 9

ELECTRICITY

ELECTRIC CURRENT:

$$I = \frac{Q}{t} = \frac{ne}{t}$$

POTENTIAL DIFFERENCE:

$$V = \frac{W}{Q} = \frac{E}{It} = IR$$

RESISTANCE:

$$R = \frac{V}{I} = \frac{\rho l}{A}$$

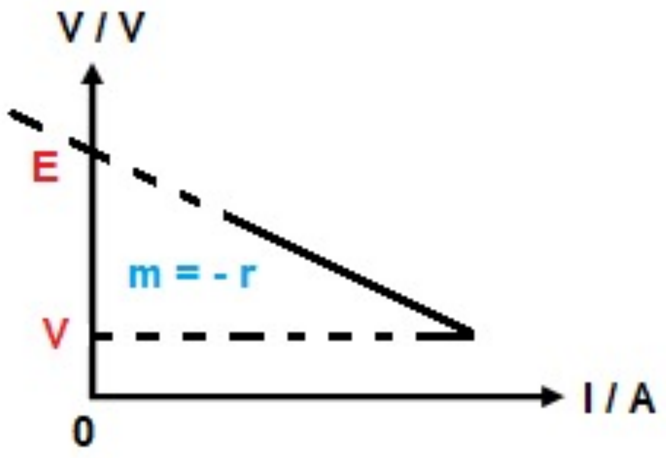
OHM'S LAW:

$$V = IR$$

ELECTROMOTIVE FORCE:

$$E = I(R + r)$$

$$E = V + Ir$$



INTERNAL RESISTANCE:

$$m = -r$$

$$= -\left(\frac{E - V}{I}\right)$$

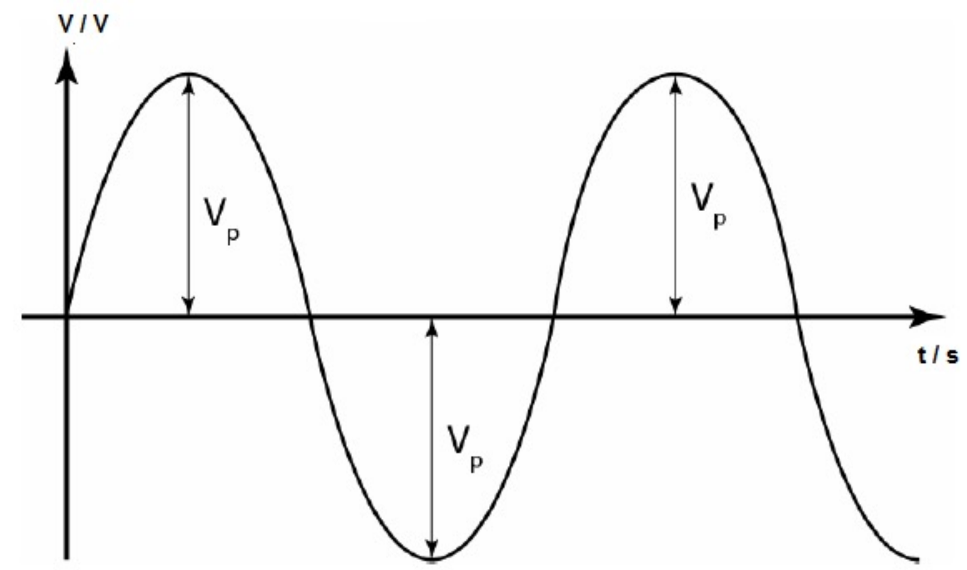
ELECTRICAL POWER:

$$P = \frac{W}{t} = \frac{E}{t} = IV = I^2R = \frac{V^2}{R}$$

ELECTRICAL ENERGY:

$$E = Pt$$

ROOT MEAN SQUARE VALUE:



$$V_{rms} = \frac{V_p}{\sqrt{2}}$$

V_{rms} = root mean square voltage (V)

V_p = peak voltage (V)

$$I_{rms} = \frac{I_p}{\sqrt{2}}$$

I_{rms} = root mean square current (A)

I_p = peak current (A)

TRANSFORMER: $$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

IDEAL TRANSFORMER: $$V_pI_p = V_sI_s$$

NON-IDEAL TRANSFORMER: $$\text{Efficiency} = \frac{V_sI_s}{V_pI_p} x100\%$$

ENERGY CHANGE OF ELECTRON IN AN ELECTRON GUN:

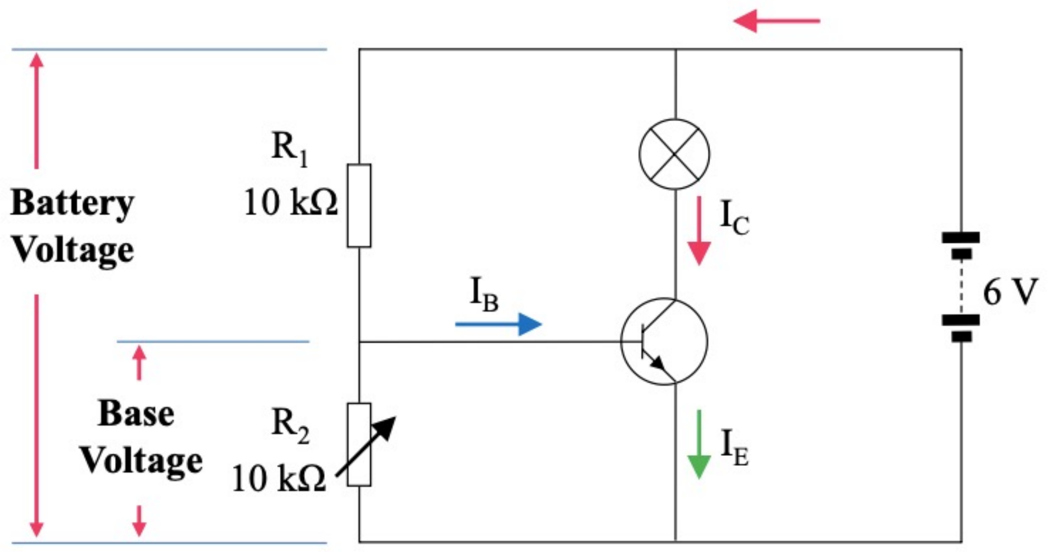
Kinetic Energy ⟶ Electrical Potential Energy

$$\frac{1}{2}mv^2 = eV$$

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

v = speed of electron (ms^{-1})
V = potential difference across the electron gun (V)
e = charge of 1 electron (1.66×10^{-19} C)
m = mass of 1 electron (3.11×10^{-31} kg)

TRANSISTOR – POTENTIAL DIVIDER:



$$V_1 + V_2 = V$$

$$V_1 = \left(\frac{R_1}{R_1 + R_2}\right) V$$

$$V_2 = \left(\frac{R_2}{R_1 + R_2}\right) V$$

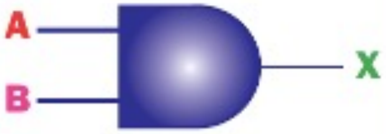
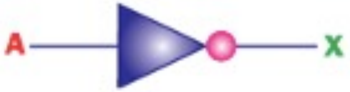
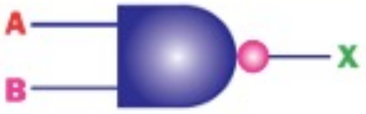
CHAPTER 11

EXTRA

ELECTRONIC

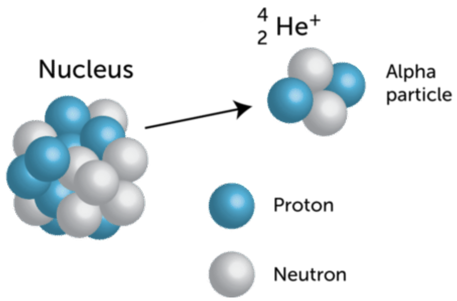
Logic Gate

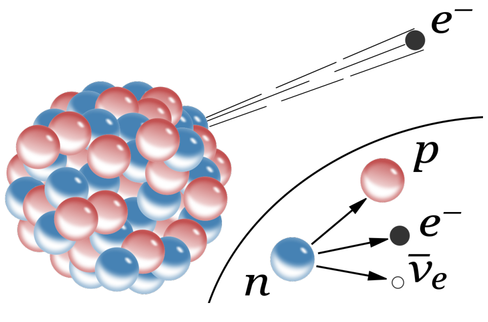
has **one** or **more input** signals but only **one output** signal

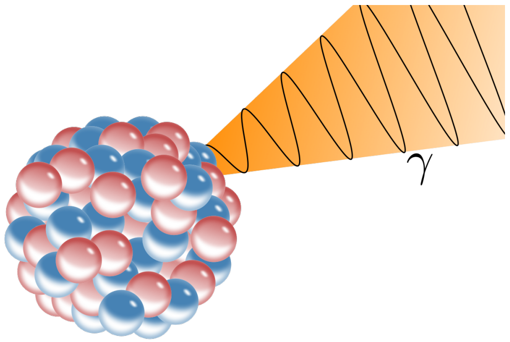
GATES	SYMBOL	BOOLEAN EXPRESSION	TRUTH TABLE
AND gate		$X=A\cdot B$	INPUT: A B; OUTPUT: X 0 0 0 0 1 0 1 0 0 1 1 1
OR gate		$X=A+B$	INPUT: A B; OUTPUT: X 0 0 0 0 1 1 1 0 1 1 1 1
NOT gate		$X=\overline{A}$	INPUT: A; OUTPUT: X 0 1 1 0
NAND gate		$X=\overline{A\cdot B}$	INPUT: A B; OUTPUT: X 0 0 1 0 1 1 1 0 1 1 1 0
NOR gate		$X=\overline{A+B}$	INPUT: A B; OUTPUT: X 0 0 1 0 1 0 1 0 0 1 1 0

CHAPTER 12

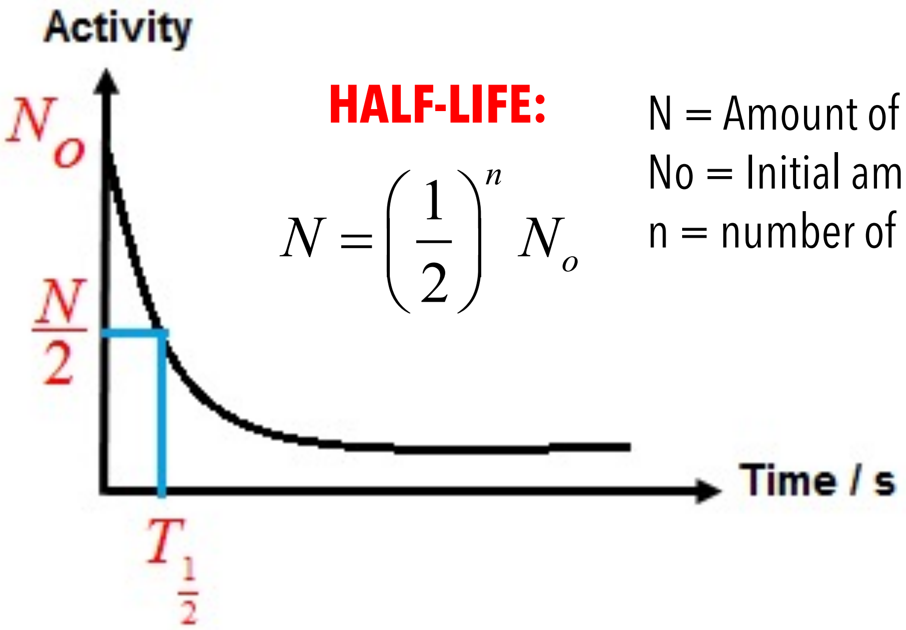
RADIOACTIVITY







α- decay	β– decay	γ– decay
$^{A}_{Z}X \rightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}He$	$^{A}_{Z}X \rightarrow {}^{A}_{Z+1}Y + {}^{0}_{-1}e$	$^{A}_{Z}X \rightarrow {}^{A}_{Z}X + \gamma$



HALF-LIFE:

$$N = \left(\frac{1}{2}\right)^n N_o$$

N = Amount of radioisotope particles after nth half-life
No = Initial amount of radioisotope particles
n = number of half-life

NUCLEAR ENERGY:

$$E = mc^2$$

m = mass change (kg)
c = speed of light (3×10^8 ms^{-1})
E = energy changed (J)

CHAPTER 13

QUANTUM PHYSICS

$$E = hf = \frac{hc}{\lambda}$$

E = Photon energy (J)
h = Planck's constant (6.63×10^{-34} Js)
f = frequency of the light waves (s^{-1})

$$c = f\lambda$$

c = speed of light (3×10^{8} ms^{-1})

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

λ = wavelength
h = Planck's constant (6.63×10^{-34} Js)
p = momentum of the particle
m = mass of the particle
v = velocity of the particle

$$P = nE = nhf = \frac{nhc}{\lambda}$$

P = Power (total energy transfer per second)
n = Number of photon emitted per second (s^{-1})

$$h = \frac{me}{c}$$

e = Charge of electron (1.60×10^{-19}C)
m = $\frac{hc}{e}$

FOR THE ELECTRONS ON THE METAL SURFACE

Photon Energy =

MINIMUM energy required to release a photoelectron	+	MAXIMUM kinetic energy of a photoelectron

$$E = W + K_{max}$$

$$hf = W + \frac{1}{2}mv^2_{max}$$

$$\frac{1}{2}mv^2_{max} = hf - W$$

*Accordance with the Principle of Conservation of Energy

AT THE THRESHOLD FREQUENCY, f_o

Photoelectrons are emitted without kinetic energy

$$\frac{1}{2}mv^2_{max} = 0$$

$$0 = hf_0 - W$$

$$W = hf_0$$

$$\frac{1}{2}mv^2_{max} = hf - W$$

$$\frac{1}{2}mv^2_{max} = hf - hf_0$$

$$\frac{1}{2}mv^2_{max} = h(f - f_0)$$