General Revision

- **Physics:** Is the science concerned with the study of the universal phenomena by setting up mathematical laws & relations to explain them logically.
- **Measurement:** Comparing an unknown quantity to a known one of the same kind called measuring unit to find out how many times does the first include the last.

Physical quantities

Fundamental	Derived
- Mass $\rightarrow$ Kg - Length $\rightarrow$ m - Time $\rightarrow$ s - Quantity of material $\rightarrow$ Mole - Temperature $\rightarrow {}^{o}$Kelvin($={}^{o}$C+273) - Current intensity $\rightarrow$ Ampere - Light intensity $\rightarrow$ candela - Angular measures $\rightarrow$ radian - Solid angles $\rightarrow$ steradian	- Volume (vol) $\rightarrow m^3 \longrightarrow L^3$ - Density (ρ) $\rightarrow {}^{Kg}\!/_{m^3} \longrightarrow ML^{-3}$ - Pressure(p) $\rightarrow {}^{N}\!/_{m^2}$ (Kg $m^{-1}s^{-2}$) $\rightarrow ML^{-1}T^{-2}$ - Force (F) $\rightarrow$ N ($Kg\,m/s^2$) $\longrightarrow MLT^{-2}$ - Momentum (P) $\rightarrow$ ($Kg\,m/s$) $\longrightarrow MLT^{-1}$ - Velocity (v) $\rightarrow m/s \longrightarrow LT^{-1}$ - Acceleration(a) $\rightarrow m/s^2 \longrightarrow LT^{-2}$ - Work(W) $\rightarrow$ J($Kg\,m^2/s^2$) $\longrightarrow ML^{-2}T^{-2}$ - Electric Resistance $\rightarrow ohm\,(\Omega)$ - Electric potential $\rightarrow Volt\,(V)$ - Electric capacity $\rightarrow Farad\,(F)$

N.B:	**Gaussian**	Mass $\rightarrow g$	Length $\rightarrow$ cm	Time $\rightarrow$ S
	British	Mass $\rightarrow$ Pound	Length $\rightarrow$ Foot	Time $\rightarrow$ S
	S.I.	Mass $\rightarrow Kg$	Length $\rightarrow$ m	Time $\rightarrow$ S

Define:-

Standard m: is the distance between two marks engraved on an Ir/Pt rod kept at 0^{o}C near Paris.

Standard Kg: is the mass of an Ir/Pt cylinder of fixed dimensions kept at 0^{o}C near Paris.

Second: is equal to ${}^{1}\!/_{86400}$ of the average solar day.

N.B:

* Measuring devices may be:

- Simple (meter ribbon , Vernier caliper ,hydrometer, micrometer. …… scale …….)
- Analog (Pointer on a scale)
- Digital (electronic numbers)

- **Hydrometer measures:** Liquids densities
- **Graduated (measuring) cylinder measures:** Liquid volumes.
- **Ceasium watch used for scientific purposes** due to its high accuracy.
- **Vernier caliper:** used to measure diameters and small lengths accurately.

- **Measurements may be :**

Quantity	Direct measurement	Indirect measurement
Number of operations	One	More than one
Calculations	No calculations are needed	Measurements are used to calculate the desired quantity
Errors	Only one error	More than one error leading to an **accumulative error**
Examples	Measuring the volume using a graduated cylinder	Calculating the volume by multiplying (L x W x H) after measuring each of them

- How to calculate the error:

*** Direct measurements:-**

- Absolute error (Δx) : is the difference between the actual value (x_o) and the measured value (x).

where $\Delta x = x_o - x$ (the value of X always positive).

- Relative error (r) : Is the ratio of the absolute error to the actual value. $r = \frac{\Delta x}{x_o}$

*** Indirect measurements:-**

- Absolute error : $\Delta x = \Delta x_1 + \Delta x_2$

- Relative error: $r = r_1 + r_2$

- **A vector:** is a physical quantity having magnitude and direction.

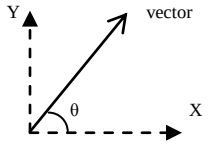
* The resultant of two vectors having the same direction: $\Sigma F = \mathbf{F_1 + F_2}$

* The resultant of two vectors having the opposite direction: $\Sigma F = F_1 + (-F_2) = \mathbf{F_1 - F_2}$

* The resultant of two perpendicular vectors (forces):- $F = \sqrt{F_1^2 + F_2^2}$

* Resolution of vectors (forces):-

- Vector (x) = vector cos θ
- Vector (y) = vector sin θ

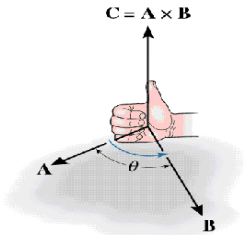


- Multiplying vectors:

1- Dot (scalar) product: $\vec{A}.\vec{B} = AB\cos\theta$

2- The cross (vector) product: $\vec{C} = \vec{A} \wedge \vec{B} = AB\sin\theta\,\vec{n}$

* The direction of $(\vec{C})$ is determine by the right hand rule: By moving the fingers of the right hand from the first vector towards the second one through the smaller angle separating them, while keeping the thumb directed towards the direction of their product (perpendicular to the plane carrying them).



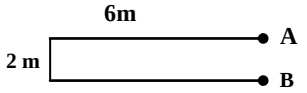
Motion

Translatory	Periodic
- Has a beginning and an end (straight line)	- Has no beginning or end (circular – vibratory)

Physical quantities

Scalar	Vector
Distance, Speed, mass, t^o, density, work	Displacement, velocity, acceleration, force, momentum

Distance and displacement:



d_{AB} = 6+6+2=14 m

S_{AB} = 2 m

Displacement(d) (S) (X) (y):- is the distance covered in a certain direction (position with respect to the start point)

Velocity(v): rate of change in displacement.($V = \frac{\Delta S}{\Delta t} \rightarrow m/s$)

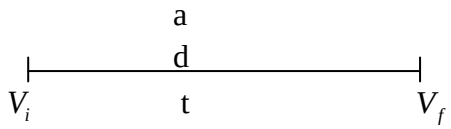
* uniform velocity: Body covers equal S in equal time intervals.
* Non uniform velocity: Body covers unequal S in equal time intervals.

Acceleration(a):- rate of change in velocity. ($a = \frac{\Delta V}{\Delta t} \rightarrow m/s^2$)

* uniform acceleration: Body increases its velocity by equal amounts in equal times.
* Non uniform acceleration: Body increases its velocity by unequal amounts in equal times.

- Deceleration = retardation = decrease in velocity.

Laws of motion



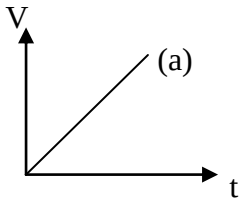
1st Law:

$$a = \frac{\Delta V}{\Delta t}$$

$$\Delta V = V_f - V_i$$

$$a = \frac{V_f - V_i}{t}$$

$$\boxed{V_f = V_i + at}$$



2nd Law:

$$d = \vec{V}\, t$$

$$\because V = \frac{V_i + V_f}{2} \quad , \quad \therefore d = (\frac{V_i + V_f}{2})t$$

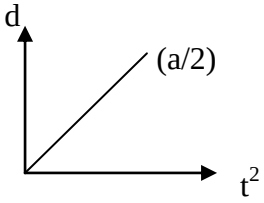
$$\because V_f = V_i + at$$

$$\therefore d = (\frac{V_i + at + V_i}{2})t$$

$$d = (\frac{2V_i + at}{2})t$$

$$d = \frac{2V_i t + at^2}{2}$$

$$\boxed{d = V_i t + \frac{1}{2}at^2}$$



3rd Law:

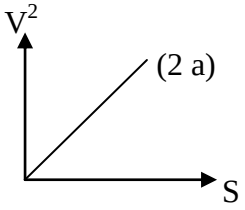
$$V_f = V_i + at$$

$$V_f^{\,2} = V_i^2 + 2V_i\, at + a^2t^2$$

$$V_f^{\,2} - V_i^2 = 2a(V_i t + \frac{1}{2}at^2)$$

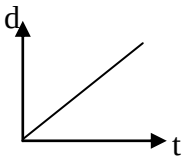
$$V_f^{\,2} - V_i^2 = 2ad$$

$$\boxed{V_f^{\,2} - V_i^2 = 2ad}$$

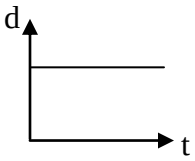


N.B: V_i=0

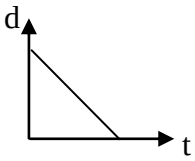
- **Graphs:**



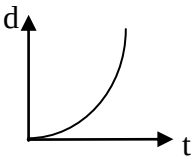
unif. Vel.



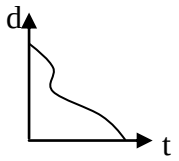
Rest



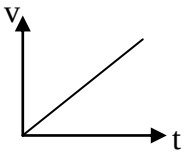
unif.(-ve) Vel.



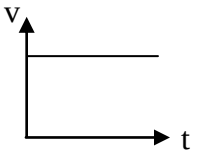
Non unif. V.



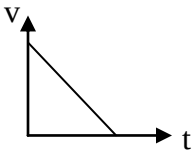
non unif. Vel.



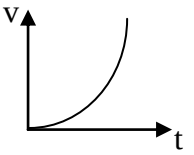
unif. a



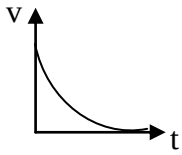
unif. V (a=0)



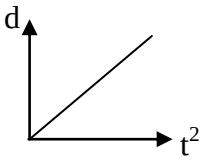
Unif. dec.



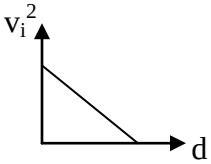
Non unif. a



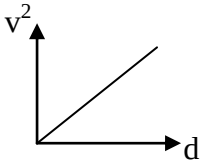
Non unif. dec.



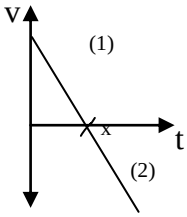
Unif. a



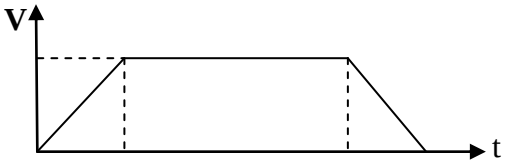
Body thrown up (decelerating)



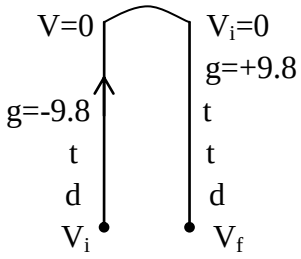
Body falling freely (acc)



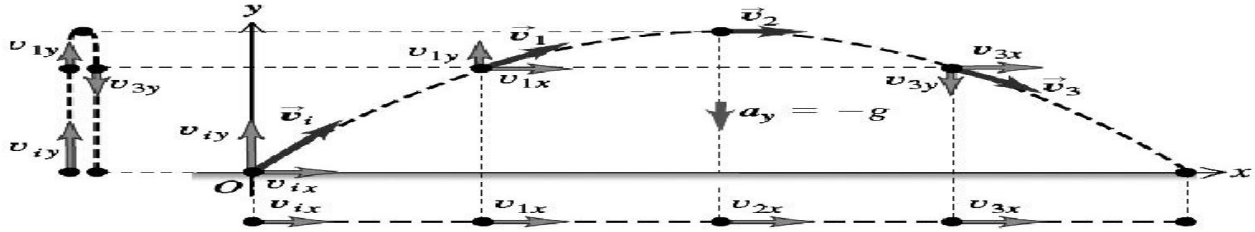
1- unif. dec.
X- At rest (Max. height).
2- unif. a in opposite direction.
* Body thrown up then left to fall.



d_{total} = total area below the slope
= A△ + A□ + A△



- Projectiles projected at an angle (motion in 2 dimensions):



The vertical and horizontal components of a projectile's motion are independent.

- **The horizontal velocity**: $V_{ix}=V_i\cos\theta$
- **The vertical velocity**: $V_{iy}=V_i\sin\theta$
- **The final velocity**: $V_f=\sqrt{V_{fx}^{\ 2}+V_{fy}^{\ 2}}$
- **The time taken to reach the maximum height**: $t=\frac{-V_{iy}}{g}$

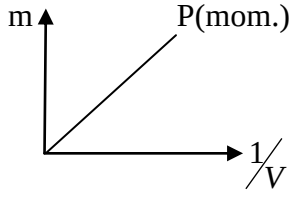
*** The total time taken from the projection time till reaching the ground back :** $T=2t=\frac{-2V_{iy}}{g}$

- **The maximum height:** $\boxed{h=\frac{-V_{iy}^2}{2g}}$
- **The Range of the horizontal distance:** $\boxed{R=V_{ix}\,T=2V_{ix}\,t}$

N.B: the maximum range of a projectile is attained on projecting it at an **angle of 45°**

*** Inertia:-** Is the tendency of a body to retain its state of rest or motion with a uniform velocity.

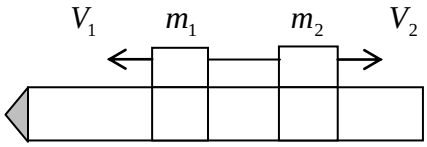
Inertia and mass: (inertia α mass)



$m_1V_1 = m_2V_2$

$\frac{m_1}{m_2}=\frac{V_2}{V_1}$

$m \alpha \frac{1}{V}$



Air track (frictionless surface)

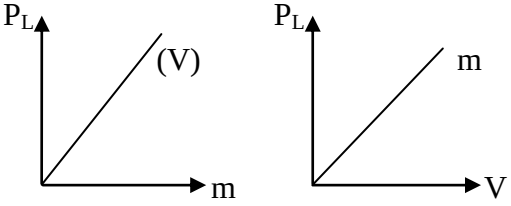
N.B:- P= mV $\rightarrow$ Kg m/s , $\frac{m_1d_1}{t}=\frac{m_2d_2}{t}$

Newton's laws

1st law	2nd law	3rd law
A body tends to retain its state of rest or motion with a uniform velocity unless it is affected by an external force. $\Sigma F = F_1 + F_2 .....$ $\Sigma F = 0 \rightarrow inertia$	The net force acting on a body is equal to the rate of change of its momentum and its direction is that of the change in momentum. $F=\frac{\Delta mV}{\Delta t}=\frac{m\Delta V}{\Delta t}=ma$	For every action there is an equal and opposite reaction. $F_1=F_2$

N.B: Momentum:-

is the product of the mass of the body by its velocity.



* for the same mass: $\frac{P_{L1}}{P_{L2}}=\frac{V_1}{V_2}$, for the same momentum : $\frac{m_1}{m_2}=\frac{V_2}{V_1}$

*** Complete:-**

1. If the magnitudes of two vectors $\vec{A}\&\vec{B}$ are 3 & 6 respectively and the angle between them is 30°, then the value of their dot product = …… and that of their cross product = ……..
2. If a force of 10 N forms an angle of 60° with horizontal , then its vertical vector is = …… N, while the horizontal one is = ……..N.
3. A body is affected by a vertical force of 20N and a horizontal one of 40N then the resultant force acting on that body = …….. and its direction is at an angle …… with the horizontal.
4. If the momentum of a body is doubled then its mass is …….. and its velocity is…….

*** What is meant by:**

1. A body moves with a uniform velocity of 5 m/s.

- Body covers equal S of ……. m in equal times intervals of 1 sec.

2. A body moves with a non- uniform velocity.

- Body covers unequal S in equal time intervals.

3. A body moves with a uniform acceleration of 10 m/s^2.
- Body increases its velocity by ……. m/s each sec.
4. Body moves with a uniform deceleration of 5 m/s^2.
- Body decreases its velocity by …… m/s each sec.
5. A body is accelerated by 9.8 m/s^2 due to gravity.
- Body falling freely increases its velocity by 9.8 m/s each sec.
6. A body is decelerated by 9.8 m/s^2 due to gravity.
- Body projected upwards decreases its velocity by 9.8 m/s each sec.
7. A body moves inertially.
- A body tend to retain its state of rest or motion with a uniform velocity as $\Sigma F = 0$.
8. The momentum of a body =0
- The body is at rest and the product of its mass by its velocity=0.

*** <u>Give reasons for:</u>**

1- The (d-t) curve is a straight line when v is uniform.

……

2- The mass is a scalar quantity.

……

3- New standard meter is preferable than standard meter.

……

4- Volume is a derived quantity.

……

5- A body thrown up reduces its velocity.

……

6- Oscillatory motion is a periodic motion.

……

7- Passengers fall forwards when a car stops suddenly.

……..

8- Passengers fall backwards when a car moves suddenly.

……..

9- A gun moves backwards when a bullet is fired.

……..

10- The velocity of a bullet is high relative to that of the gun firing it.

……

11- It is easier to push a light body than a heavy one.

……..

12- A body may be affected by two equal and opposite forces but doesn't reach equilibrium.

……..

13- The momentum of a body increases at high speed.

……..

14- The action and reaction are equal and opposite but cause no equilibrium.

……..

15- The Cesium watch is preferably used by scientists.

……..

16- The relative error is more accurate than the absolute error.

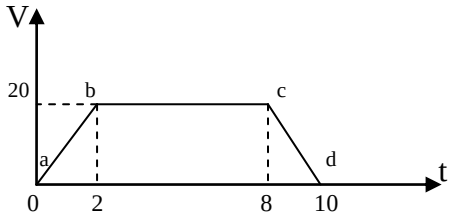
……..

* **Problems:**

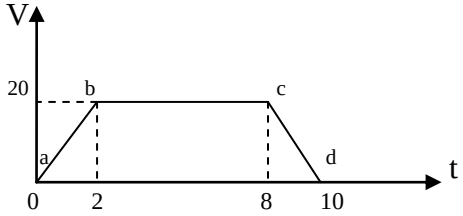
1. Calculate the relative error and the absolute error while measuring the area of a rectangle whose length $=(6\pm0.1)\,\text{m}$ and width $=(5\pm0.2)\,\text{m}$.

2. Prove using the Dimensional Formula (international units) that:
   1- $V_f^2 - V_i^2 = 2\,a\,d$.
   2- $d = V_i\,t + \frac{1}{2}\,a\,t^2$.
   3- $F\,d = \frac{1}{2}\,m\,V^2$.

3. Relations expressing motion of a body:- $V=\sqrt{36+5S}$, $t=\frac{1}{3}V-2$, $S=5t+t^2$

4. 

   Find 1- The maximum velocity.
   2- The total d.
   3- The acceleration of the car at (a-b).
   4- The acceleration of the car at bc.

5. 

   Find 1- The total d.
   2- The average speed.
   3- The acceleration at cd

6. A body starts to move from rest till it velocity became 10 m/s in 5 sec. Find:
   1- The change in velocity.
   2- Rate of change in velocity.
   3- Change in velocity per sec.
   4- Acceleration.
   5- The displacement covered.

7. A ball of mass 2 Kg starts to fall freely from rest neglecting the air resistance and knowing that g=10 m/s^2. Calculate:- 1- The displacement of that ball after 2 sec.
   2- The velocity of the ball after 3 sec.

8. A projectile is thrown up at 40 m/s forming an angle of 35^o with the horizontal.
   Find : 1. The time taken to reach the top of its trajectory.
   2. The maximum height the projectile can reach.
   3. How far does the projectile lands from the starting point.
   4. The time taken till it gets back to the ground.

9 . A football is kicked with an initial velocity of 25 m/s at an angle of 45^o with the horizontal, Find the time of flight, the horizontal displacement and the peak height of the football.

10. A bullet of mass 5 gm is fired at a velocity of 20 m/s and collides against a target, stopped 1/200 sec later inside the target.

    Calculate: 1- The momentum of the bullet before collision.
    2- The change in momentum through 1/200 sec.
    3- The rate of change in velocity.
    4- The deceleration of the bullet.
    5- The displacement covered to stop.

11. A car's engine is exerting a force of 1200 N while the car is exposed to an air resistance of 200 N and a frictional force of 100 N. use the suitable calculations to explain if the car is accelerating or not.

12.

V in m/s	10	20	30	30	30
t in sec	1	2	3	4	5

Draw the graph then:- 1- Find the value of the slope in the first stage (first 3 sec.)
2- Explain the motion of the car between the 3^{rd} and 5^{th} sec.