X PHYSICS SHORT NOTES

1. Force

A) MOMENT OF A FORCE AND EQULIBRIUM.

- **Linear or translational motion:** Linear or translational motion is when a force acts on a free to move stationary rigid body and the body starts moving in a straight path in the direction of force.
- **Rotational motion:** Rotational motion is the motion when a force acts on a suitable point on a pivoted body and the body begins to rotate about its axis, producing a turning effect of the force.
- **Moment (Turning effect) of a Force or Torque :** The turning effect of force acting on a body about an axis is called the moment of force or torque.
- **Factors affecting the turning of a body:**
  - The magnitude of the force applied – **Directly Proportional.**
  - The perpendicular distance of line of action of the force from the axis of rotation – **Directly Proportional.**
- **Anticlockwise moments:** If turning effect is **anticlockwise**, the moment of force is called **anticlockwise moment** and is **positive**.
- **Clockwise Moments:** If turning effect is **clockwise**, the moment of force is called **clockwise moment** and is **negative**.
- **Units of moment of force:**
  - **SI unit:** Newton × meter. **C.G.S:** dyne × cm.
  - **Relation between Newton and Dyne:** 1 N m = 10^7 dyne.cm.
- **Couple and Moment of couple:** The **moment of couple** is equal to the product of either force & the perpendicular distance between the line of action of both the forces.
- **Moment of couple = Either force × couple arm.**
- **Equilibrium of bodies:**-Equilibrium is the state of a body, when a number of forces acting on it produces no change in its state of rest or of motion.
- **Static equilibrium:** When a body remains in a state of rest under the influence of number of forces, the body is in static equilibrium.
- **Dynamic equilibrium:** Under the influence of the several forces, if a body remains in the same state of motion, the body is said to be in dynamic equilibrium.
- **Conditions for equilibrium:**
  - The resultant of all forces acting on the body should be equal to zero.
  - The resultant moment of all the forces acting on the body about the point of rotation should be zero.

➢ **Principle of Moments:** According to the principle of moments: If the algebraic sum of all moments of forces, acting on the body, about an axis of rotation is zero, then the body is in equilibrium. Thus, Sum of anticlockwise moments = Sum of clockwise moments. A physical/beam balance works on the principle of moments.

➢ **FORMULAE:**

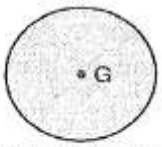
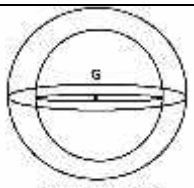
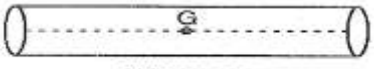
1. **F** = **ma**
2. **F** = **mg**
3. **Moment of force** = **F** × **Perpendicular distance**
4. **Moment of couple** = **F** × **diameter**
5. **Sum of anticlockwise moments** = **Sum of clockwise moments**

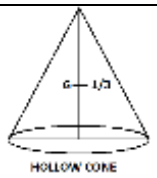
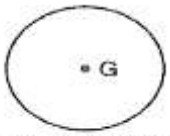
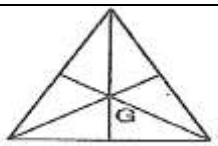
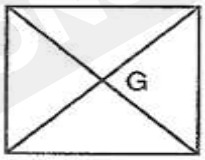
B) CENTRE OF GRAVITY

➢ **Centre of gravity:** Centre of gravity of a body is the point about which the algebraic sum of moments of weights of all the particles constituting the body is equal to zero.

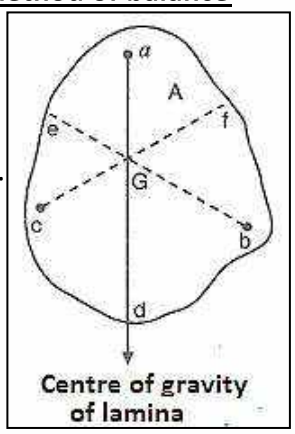
➢ **Factor on which C.G. depends:** The position of center of gravity of a body of a given mass depends on the shape of the body – i.e. the distribution of mass of all the particles contained in it.

➢ **Centre of gravity of some regular objects:**

OBJECT	POSITION OF CENTRE OF GRAVITY	Diagram
1) Rod	Mid-point of rod.	 ROD
2) Circular disc.	Geometric centre.	 CIRCULAR DISC
3) Solid or hollow sphere.	Geometric centre of the sphere.	 HOLLOW SPHERE
4) Cylinder.	Mid-point on the axis of cylinder.	 CYLINDER
5) Solid cone.	At a height h/4 from the base, on its axis. (h = height of the cone).	 SOLID CONE

6) Hollow cone.	At a height h/3 from the base on its axis.	 HOLLOW CONE
7) Circular ring.	Centre of ring.	 CIRCULAR RING
8) Triangular lamina.	The point of intersection of the medians.	 TRIANGULAR LAMINA
9) Parallelogram or rectangular lamina or square.	The point of intersection of the diagonals.	 PARALLELOGRAM  RECTANGLE  SQUARE

➢ **Determination of centre of gravity of an irregular lamina by the method of balance using a plumb line.**



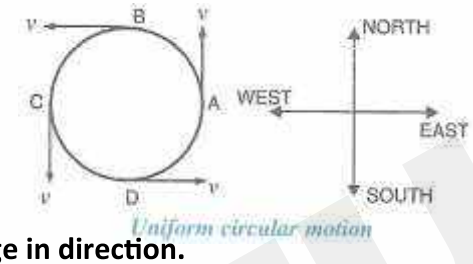
Centre of gravity of lamina

- Let 'A' be an irr egular lamina for which the centre of gravity is to be determined.
- Make three holes at a, b and c, near the edge of the lamina.
- Suspend the lamina using a pin/nail clamped on a stand.
- Hold a plumb line from the hole 'a' on the lamina.
- When lamina comes to rest, draw a straight line along the plumb line.
- Repeat this experiment by suspending the lamina through the remaining holes 'b' and 'c'.
- Obtain 3 straight lines 'ad', 'be' and 'cf' respectively.
- It will be observed that all 3 lines intersect each other at a common point 'G' which is the position of centre of gravity of this lamina.

C) UNIFORM CIRCULAR MOTION

➢ **Uniform circular motion:**

- **Definition:** When a particle moves in a circular path with a constant speed, its motion is said to be the uniform circular motion.
- **Direction of velocity at any instant in a circular path:**
  - At point A – motion is towards north.
  - At point B – motion is towards west.
  - At point C – motion is towards south.
  - At point D – motion is towards east.
  - **Thus, the velocity of a particle in a circular motion is variable due to change in direction.**
  - **Hence the circular motion is accelerated even though the speed of particle is uniform.**



Uniform circular motion

➢ **Centripetal forces:**

- Centripetal force is the force acting on a body moving in a circular path, in a direction which is always towards the centre of the circular path.
- This force is variable because its direction changes at each point of circular path.
- This force is a real force.
- **Examples:** Motion of electrons, planets, a stone tied to the string and whirled.

➢ **Centrifugal force:**

- Force acting away from the centre of the circular path is called centrifugal force.
- The centrifugal force away from the centre is **not** a real force; it is fictitious or virtual force.
- It is not the force of reaction of centripetal force.
- Its magnitude is same as that of centripetal force.

➢ **Conclusion of merry go round experiment:**

- Centrifugal force is not the real force.
- The only force involved is the force of tension acting towards the center.
- Centrifugal force is not the reaction force of centripetal force, though it is same in magnitude.

➢ **Differences:**

- **Uniform linear motion and uniform circular motion:**

Uniform linear motion	Uniform circular motion
The velocity is constant.	The velocity is variable.
Acceleration is zero.	Acceleration is variable.
It is an un accelerated motion.	It is an accelerated motion.

- **Centripetal force and centrifugal force:**

Centripetal Force	Centrifugal Force
Acts towards the centre.	Acts away from the centre.
Real force.	Fictitious force.