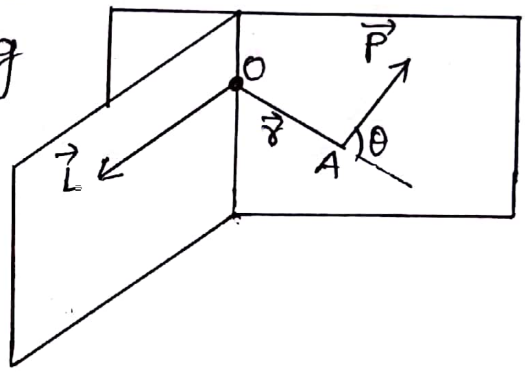
Prof. Vidya Sagar
Department of physics
B.Sc (part-1) Hons

Paper-1

Conservation of Angular Momentum.

In translatory motion, the linear momentum of a single particle is expressed as $p = mv$. Now the question is that what is the analogue of linear momentum in rotational motion? In rotational motion, the analogue of linear momentum is angular momentum.

Consider the case of a particle A having linear momentum p. The angular momentum L of the particle A with respect to fixed point O as origin is defined as



$$L = r \times p \quad \text{——} \quad (1)$$

where r is the vector distance of the particle from origin O.

The angular momentum is a vector quantity. Its magnitude is given by

$$L = rp\sin\theta \quad \text{——} \quad (2)$$

Where θ is the angle between r and p

The direction of L is perpendicular to the plane formed by r and p.

When a particle moves with angular velocity $\vec{\omega}$ in a circle, then its angular momentum is given by

$$L = r \times P$$
$$= r \times mv$$
$$= m(r \times v)$$
$$= m[r \times (\vec{\omega} \times r)]$$

$$\text{or, } L = mr^2\omega \quad \text{——— (3)}$$

Torque:- When a force acts on a particle A, then the moment of the force or torque about O is defined as

$$\vec{\tau} = r \times F$$

We know that

$$F = \frac{dp}{dt}$$
$$F = \frac{d}{dt}(mv)$$
$$\therefore \tau = r \times \frac{d}{dt}(mv)$$
$$\tau = \frac{d}{dt}(mv \times r)$$
$$\text{or, } \tau = \frac{d}{dt}L$$

This Torque:= rate of change of angular momentum

When $\vec{\tau} = 0$, $\frac{dL}{dt} = 0$, or $L =$ Constant

So If the total torque on a particle is zero, the angular momentum of the particle is conserved. This is known as conservation of angular momentum.