Any n independent variables $q_1, q_2 \ldots\ldots q_n$ which correcty define the position of ~~the~~ the system are called generalised co-ordinates of the system. These generalised co-ordinates may be cartisian co-ordinates, sperical polar co-ordinates e.t.c.

The time ~~diri~~ derivatives of generalised co-ordinates q_i are called generalised velocities $\dot{q}_i$ $(i = 1, 2, 3, \ldots\ldots n)$

Generalised momentum :-

The position vector $\vec{r}_i$ is a vector function of generalised co-ordinates $q_1, q_2, q_3 \ldots\ldots q_n$ i.e.

$$\vec{r}_i \equiv \vec{r}_i (q_1, q_2 \ldots q_n) \ldots (1)$$

The momentum of the system can be written as

$$\vec{p} = \sum_i m_i \dot{\vec{r}}_i \quad \ldots\ldots (2)$$

From (1)

$$dr_i = \sum_{j=1}^{n} \frac{d\vec{r}_i}{dq_j} dq_j$$

Hence,

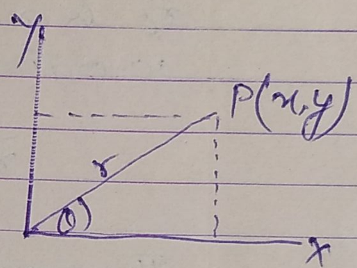
$$\dot{\vec{r}}_i = \frac{d\vec{r}_i}{dt} = \sum_{j=1}^{n} \frac{d\vec{r}_i}{dq_j} \frac{dq_j}{dt}$$

$$= \sum_j \frac{d\vec{r}_i}{dq_j} \dot{q}_j \ldots (3)$$

Generalised Co-ordinates :-

In order to locate the position of a particle we may use Cartision co-ordinates x, y, z. Hence it has three degree of freedom, If a system contains N particles. Then it is ~~ness~~ necessary to have 3N co-ordinates. Hence the system has 3N degree of freedom.

The choise of co-ordinates depends on the condition of the problem. For example for a particle moving in a central force in a plane. It is more convinient to use plane polar co-ordinates (r, θ). They are related to ~~cart~~ cartisian co-ordinates (x, y)



$$x = r\cos\theta$$
$$y = r\sin\theta$$
or $$r = \sqrt{x^2+y^2}$$
$$\theta = \tan^{-1}(y/x)$$

Similarly we may use spherical polar co-ordinates (r, θ, ϕ) where ~~fors~~ force is symetric. Thus we use different type of co-ordinates for different types of problem. The choise in governed by the condition of problem concerned. However the number of co-ordinates used must be sufficient in number to difine the state of a system correctly.