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"Analogous system"
"Physical system"
Mathematical Model of Physical system

Modelling of Mechanical system:

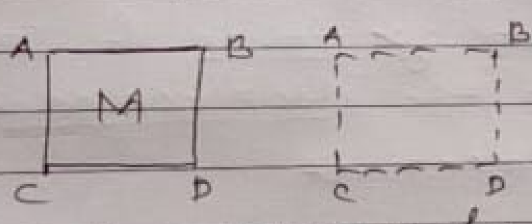
① Translational Motion ② Rotational Motion

The Motion of the body during Translational motion is along a straight line or curve path. whereas during rotation Motion, the motion of the body is about its own axis.

Translation motion: There are three element which are dominently involved in the analysis of Translation motion. These are

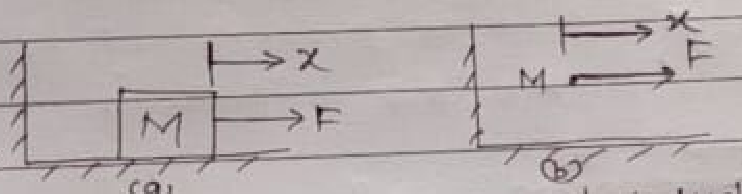
(a) Mass ⓑ Spring ⓒ Damper

(a) Mass: ~~In~~ the Physical model of a Mass, it is Assumed that its mass is concentrated at the centre of the Mass.



~~fig ① movement of a Block of mass.~~

fig ① shows that when a block ABCD of Mass M is moved all its Particles undergo an equal displacement. Therefore, mass has only one displacement.



~~fig(2) Displacement of mass~~ — ~~equivalent displacement of mass.~~

~~fig ② only one displacement is enough for Mass.~~

Reference

[w.r.t → with respect to]

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x → can be put any where of the mass as reference

x → represent the displacement w.r.t reference

The relation between force (f) and mass (M) is given by

$f = Ma$

$= M\frac{du}{dt} = M\frac{d}{dt}\left(\frac{dx}{dt}\right)$

$= M\frac{d^2x}{dt^2}$

M → Mass of the body

a → is the accⁿ of the body

u → Mass of the velocity

x → is the displacement of the mass.

$M\frac{dv}{dt}$

$M\frac{d}{dt}\left(\frac{dx}{dt}\right)$

$M\frac{d^2x}{dt^2}$

$v = \frac{dx}{dt}$

[According to Newton's 2nd law of Motion inertia force will be equal to the product of Mass M and Acceleration a.]

(b) Spring: A spring stores the potential energy. the restoring force of spring is proportional to the displacement

$f \propto$ displacement

* When a force is applied to the spring (in fig) then the spring force (Restoring force) or reaction force is produced which oppose the motion of spring and it is proportional to the displacement (Hook's law) is given by

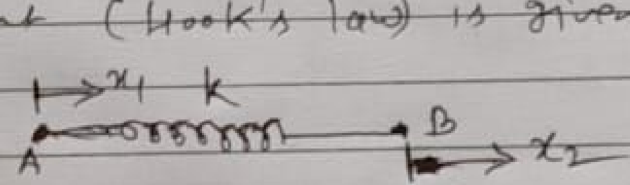

fig: Spring k

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BAMBOOS

We know that

$$f \propto x$$ — x is displacement

$$f = kx \quad \text{—} (1)$$ — k is spring.

let x_1 is the displacement of end A.
x_2 " " " B.

If the force is applied at end A.

$$x = x_1 - x_2 \quad \therefore f = k(x_1 - x_2) \quad \text{—} (2)$$

If the force is applied at end B.

$$x = x_2 - x_1 \quad \therefore f = k(x_2 - x_1) \quad \text{—} (3)$$

(c) Damper: It is denoted by D.
one of best example for damper are is daspot or shock absober, consist of piston and cylinder.) ~~are the another example~~.

~~Motion is opposed by friction.~~
~~frictional force are three type~~

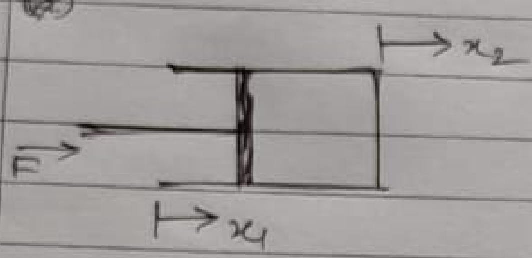

fig: Daspot

Force opposes the applied force when a force is applied to the damper as shown in fig. Then the damping force for viscous friction is proportional to the difference in Velocity of two ends of the damper and is given by.

$$f \propto \text{velocity}$$

$$f = D\frac{dx}{dt} = D\frac{dx}{dt}$$

$$= D\frac{d}{dt}(x_1 - x_2)$$

x_1 & x_2 are displacement here x_1 & x_2 are diffrence in velocity.

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