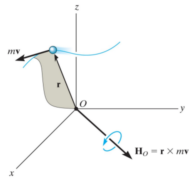
19 Planar Kinetics – Impulse & Momentum

Particle:

Linear momentum: $m\vec{v}$

Angular momentum: $\vec{H}_O = \vec{r} \times m\vec{v}$

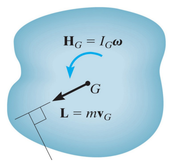


Rigid Body (planar motion):

Linear momentum: $m\vec{v}_G$

Angular momentum: $\vec{H}_G = I_G\vec{\omega}$

note: for planar motion $\vec{v}_G$ is always perpendicular to $\vec{\omega}$ (and $\vec{H}$)



19.1 Momentum

Angular momentum can be calculated about any point.

$$\vec{H}_G = I_G\vec{\omega}$$

$$\vec{H}_P = \vec{r}_G \times (m\vec{v}_G) + I_G\vec{\omega}$$

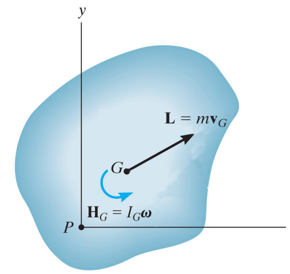
$$\vec{H}_P = \vec{r}_G \times (m\vec{v}_P) + I_P\vec{\omega}$$

These relations are similar to the rotational equations of motion:

$$\sum \vec{M}_G = I_G\vec{\alpha}$$

$$\sum \vec{M}_P = \vec{r}_G \times (m\vec{a}_G) + I_G\vec{\alpha}$$

$$\sum \vec{M}_P = \vec{r}_G \times (m\vec{a}_P) + I_P\vec{\alpha}$$



19.1 Momentum

$$\vec{H}_P = \vec{r}_G \times (m\vec{v}_P) + I_P\vec{\omega}$$

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$$\vec{H}_G = I_G\vec{\omega}$$

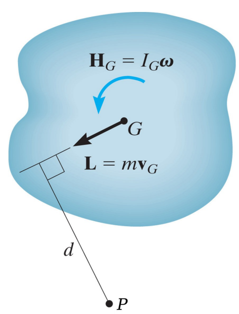
Scalar form: $H_P = dmv_G + I_G\omega$

For rotation about a ***fixed axis*** at P:

$$H_P = I_P\omega$$

Angular momentum about an instantaneous center of rotation:

$$H_{IC} = I_{IC}\omega$$



19.2 Impulse & Momentum

Equations of motion		Principle of Impulse & Momentum
$\sum \vec{F} = \frac{d}{dt}(m\vec{v}_G)$	⟶	$\sum \int \vec{F}\,dt = \Delta\,(m\vec{v}_G)$
$\sum \vec{M}_P = \frac{d}{dt}\vec{H}_P$	⟶	$\sum \int \vec{M}_P\,dt = \Delta\vec{H}_P$
	for rotation about a fixed point O :	$\sum \int M_O\,dt = \Delta\,(I_O\omega)$

19.2 Impulse & Momentum