SYSTEM OF PARTICLES AND ROTATIONAL MOTION

(1). According to the theorem of perpendicular axes moment of inertia of a body about perpendicular axis is $I_z = \text{-F} I_y$

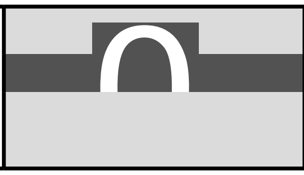
vwltier , I_v are the moment of inertia of the rigid body about x. y and 2 axes respectiwelyx ard y axes lie in the plane of the body and z-axis lies perpendicular to the plane of the hcidy and passes through the point of intersection of x. and v.

{211. According to the theorem of parallel axes II = I_c + Noe

vaere I_c is the moment /Tr inertia of the t)ody about an axis pas5ing through its centre of mass and d is the perpendicular distance between the two axes.

Table 1: Moment of inertia of same symmetrical bodies

	Body	Axis	Figuire	Pilit
1211	Rod (Length LI	Perp.endicular to rod, at the m icloairrt terkre. of rnas.	CiS i	MC 12
{211	Circular ring Г.acli115 P)	Passing through centre and perroendicular the plane		MR2
011	Circular on i Rad i1,15	Diameter		MRa 2
{4	arcular Disc radius R i	Perpendicular to the disc at centre.	4O	MR2 2
(5]	Circular Disc radius Ili	Diameter	0"-li:D	MR2 4
(5]	Hollow cylinder {radius. Ft)	Axis circylinder	19	MR2
(711	Solid cylinder (radius RI	Axis of tvli rider		IVIFE2
{all	Solid sphere (radius R}	Diameter		2 IA R 2 5

{9	Hollow sphere (radius RI	Diameter		-2 2]M R

(3). Relation between moment of inertia (I) and angular momentum L is given Ery L =1 (7)

MIL Relation between moment of inertia Wand kinetic energy of rotation Is given by

2
z 1(6

(5). Relation between of inertia (I) and torque CO = =

{E . If no external torque acts on the system, the. total angular rnomtriturn of the. system remains 'unchanged I ι ca ι = 1₁00₂

(7). Position vector of centre of mass of a discrete particle system

111 = "·1 r̄1 + If ______ +1111n / IT1₁ 1 M₂ F ...... 4 111n = Xrini i-1

Where m is the mass of the particle and c i5 the position of the Particle corresponding.

xcpii • YCM and ! cm co-ordinates are

; Crvi= D 1 i i / n i-i rn, YCM = n E RIM / i-i E rn, ZCIA = n mizi / i-i E r'n%

{sp. Velocity of centre of mass, %;11 OA = Erni n E rrv i

{9). Acceleration of CM, .6 CFA = = n rnA / rn%

DC). Momentum of system, 0 = li:\ -F i5 2 +_.._, + 0n = (E r'r' Ticro
i=1

{11]. Centre of mass of continuolas mass distribution

rpm = i dmf / dm   xcllA = fxdrn   YCII = f drn / dm   = fzdrn / 'dm

02). Eiwen below are the positiOnS of trbtre of rrkas of sOrrIE tOrrirntitily u5t-t1 Objects_

SAID_	Object	Location of centre of mass
i_	YA 0 *Uniform rod of length L	L
'i'	yt L Uniform semicircular rind of radius R	2R II
ill_	Y.1. ay. 01 ....) x Uniform 5ernicizcular disic of radius. Ft	$X_{ciA} = 0, yr_{,,,,} = \frac{4R}{3rr}, z_{,poi} = 0$
lW.	Y Or Uniform quarter of a ring 04 radius R	'cm_ $\frac{2R}{A}$• Ycki = $\frac{a}{71}$• zovi '°

UOISSIUIPV MOSUOV

v.	Y...1.. ...\\ n1/2, 01 Uniform quarter of a 'disc of radius R	Acm = 4R 3ir •..VL" = 4R 311 "- = '0
vi_	ci:-------- ---) x Uniform spherical shell of radius R	R
till.	Y idelk 41 M1111; Uniform Spherical gf raclim R.	3R)Nal =C r YCIVI = 8 r zcm C

(13). Head -ors col ii 8iC1111

1 rr 71-, m1 → $\vec{u}_2$ m1 → $\vec{v}_1$ m2 → $\vec{v}_2$

Before collision After collision

Velocity of bodies 111 1 r noi after collision are

$\vec{v}_1 = \frac{(m_1 - ern_2}{ni_1 \; rri} \vec{u}_1 \frac{rn_2(1 \; 4 \; e)}{ra_i \; rn_2} 6_2$.; $\vec{v}_2 = \left(\frac{m}{ni_1 \; 4 \; rri} \right) u_2$ ¯F $\frac{m \; 4}{111_1 \; -I- \; n^1 2}$ U1

Here e is coefficient of iregltution

Loss in kinetic energy, ,EKE = $\frac{rThi \; m2}{2 \; m_i + 111_2}$)(1 $- e^2$)

{14). For elastic collision AKE 0 and e. 1,. then velocities after collision are

$\vec{v}_1 = \left(\frac{"11 \quad m}{Pnr1_1 \quad -1_2} \right) 6_1 \quad \frac{2m2}{171_1 \; I^- \; m2})62$; 112 $\frac{(rri_a}{rin_1 \; -F \; rri_2}$ 2 $\frac{2m1}{m_1 + rn_2}$ 1

{15). For perfectly inelastic collision, = P, then velotitieS after collision are

$\vec{v}_1 = \vec{v}_2 = \frac{m141 \; m1211712}{mi + M2}$ and loss in kinetic energy is ICE — $\frac{1}{2} \frac{min^1 2}{rn_i - H11_2}$ 12