3. ROTATIONAL MOTION

1. Give	A circ 0.2 m pass: perpe- torqu veloc the ro n : t M	cular c is se ing f endicu ie 10 ity of est. =	disc of t into throu tlar to Nm. the di 10 Na 10 ks	f mass rotatio gh it its pl Calcul sc at th m	10 kg and radius on about an axis is centre and ane by applying late the angular ne end of 6 s from	Give ∴ To Fi	n: D R Δ ω ₁ ω ₂ τ ind:	-	25 cm $\frac{25}{2}$ cm 25 kg 2 rad/ 12 rad/ 5 s	= 5 / s	0.25 m
	R	=	0.2 n) 1,			i) ii)	I T	= ?	•	
	t ወ	=	6s 0			Form	ula:	U	·		
To Fi	\mathbf{m}_1		U				•\	N/T.	(1	т	²
Form	ω_2	=	?				1)	M.I 0	i spher	2,1 =	$\frac{1}{5}$ MR ⁻
FOLI	i)	I	=	$\frac{1}{2}$ MF	22	Solu	ii) tion:	τ	= I	α	
	ii)	τ	=	2 Ια	~*		Ι	=	$\frac{2}{5}$ MR ²	2	
Solui	ion :	ω_2	-	$\boldsymbol{\omega}_1 + \boldsymbol{\omega}_2$	U t				2	(0.	$(25)^2$
Solu	Since	M.I o	f disc,	,			Ι	=	$\frac{2}{5} \times 25$	$\overline{5} \times \left(\frac{0}{2} \right)$	$\left(\frac{20}{2}\right)$
	Ι	=	$\frac{1}{2}$ M	R²			Ι	=	0.1562	kg m²	
<i>.</i>	Ι	=	$\frac{1}{2}$ x	10 × (().2) ²		τ	=	Iα	(·· c	$\boldsymbol{\alpha} = \frac{\boldsymbol{\omega}_1 - \boldsymbol{\omega}_2}{t} \right)$
	Ι	=	2 0.2 k	g m²			τ	=	$\int \frac{\omega_2}{\omega_2}$	- ω ₁	
Now	,τ	=	Iα				Ū		•	:)	
. . .	α	=	$\frac{\mathbf{\tau}}{\mathrm{I}}$	=	$\frac{10}{0.2}$			=	0.1562	$\times \left(\frac{12}{5}\right)$	$\left(\frac{-2}{5}\right)$
	α	=	50 ra	d/s			τ	=	0.3124	Nm	
	ω ₂ ω	=	$\omega_1 + 0 + 5$	α t 0 × 6		3.	Calcu	ılate n	noment	of ine	rtia of a ring of
<i>.</i> .	ω ₂ ω ₂	=	300 r	ad/sec			mass	500 g	and ra	dius (.5 m about an
2.	A solid sphere of diameter 25cm and mass 25 kg rotates about an axis through its centre. Calculate its moment of					Give	diameter and tangent perpendicularity its plane.				
	inertia, if its angular velocity changes					М	=	500 g			
	from	2 rad/ late th	s to 12	rad/s	in 5 second. Also		р	=	0.5 kg		
calculate the torque applied.						К	=	0.5 m	R	otational Motion	

To Find : $I_{a} = ?$ $I_{r} = ?$ Formula : i) $I_{a} = \frac{MR^{2}}{2}$ Solution : $I_{a} = \frac{MR^{2}}{2}$ $I_{a} = \frac{MR^{2}}{2}$ $I_{a} = \frac{MR^{2}}{2}$ $I_{a} = \frac{MR^{2}}{2}$ $I_{a} = \frac{0.5 \times (0.5)^{2}}{2}$ $I_{a} = 0.0625 \text{ kg m^{2}}$ $\therefore I_{f} = 2MR^{2} \text{ K}^{2} = \left[\sqrt{\frac{2}{5}}R\right]^{2} + R^{2}$ $K_{r}^{2} = \frac{2}{5}R^{2} + R^{2}$ $K_{r}^{2} = \frac{2}{5}R^{2} + R^{2}$ $K_{r}^{2} = \frac{2}{5}R^{2} + R^{2}$ $K_{r} = \frac{7}{5}R^{2}$ $K_{r} = \sqrt{\frac{7}{5}}R$ $K_{r} = \sqrt{\frac{7}{5}}R$ $K_{r} = \sqrt{\frac{7}{5}}R$ $K_{r} = \sqrt{\frac{7}{5}}R$ $K_{r} = 0.255 \times 10^{2} \text{ kg m^{2}}$ $K_{r} = 0.255 \times 10^{2} \text{ kg m^{2}}$ $K_{r} = 0.255 \times 10^{2} \text{ kg m^{2}}$ $K_{r} = 0.255 \times 10^{5} \text{ kg m^{2}}$ $K_{r} = 0.251 \times 10^{5} \text{ kg m^{2}}$ $K_{r} = 0.$	14										Ma	HESH TUTO	Drial	S SCI	ENCE
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	To Fi	nd :		2					I _T	=	I	_d + MR ²	[•.•	h = R]
Formula : $i_{r} = r$ Formula : $i_{r} = \frac{r}{r}$ Formula : $i_{r} = \frac{r}{r}$ $I_{d} = \frac{MR^{2}}{2}$ $i_{d} = \frac{MR^{2}}{2}$ $I_{d} = \frac{MR^{2}}{2}$ $I_{d} = \frac{0.5 \times (0.5)^{2}}{2}$ $= 0.0625 \text{ kg m^{2}}$ $\therefore I_{d} = 6.25 \times 10^{2} \text{ kg m^{2}}$ $I_{1} = 2 \times 0.5 \times (0.5)^{2}$ $I_{1} = 2 \times 0.5 \times (0.5)^{2}$ \vdots $I_{1} = 0.25 \text{ kg m^{2}}$ $I_{2} = 0.75 \text{ kg m^{2}}$ $I_{2} (2\pi \text{ kg m^{2}})$ $I_{2} (2\pi kg$		l _d	=	?				N	1K ²	=	Ν	$MK_{d}^{2} + MR^{2}$	(::I ₁	- = MI	$\begin{pmatrix} 2 \\ T \end{pmatrix}$
Formula : i) $I_a = \frac{MR^2}{2}$ ii) $I_r = 2MR^2$ $Solution : I_a = \frac{MR^2}{2}I_a = \frac{0.5 \times (0.5)^2}{2}= 0.0625 kg m^2\therefore I_a = 6.25 \times 10^{-2} kg m^2\downarrow_r = 2MR^2I_r = 2MR^2I_r = 2MR^2I_r = 2.5 kg m^24. A solid sphere has a radius 'R'. If the radius of gyration of this sphere about its diameter is \sqrt{\frac{2}{5}} R. Show that the radius of gyration about a tangentiat axis of rotation is \sqrt{\frac{7}{5}} R. Show that the radius of gyration about a tangentiat axis of rotation is \sqrt{\frac{7}{5}} R. Show that the radius of gyration about a tangentiat axis of rotation is \sqrt{\frac{7}{5}} R. Show that the radius of gyration about a tangentiat axis of rotation is \sqrt{\frac{7}{5}} R. Show that the radius of gyration about a tangentiat axis of rotation is \sqrt{\frac{7}{5}} R. Show that the radius of gyration about a tangentiat axis of rotation is \sqrt{\frac{7}{5}} R. Show that the radius of gyration about a tangentiat axis of rotation is \sqrt{\frac{7}{5}} R. Show that the radius of gyration about a tangentiat axis of rotation is \sqrt{\frac{7}{5}} R. Show that the radius of gyration about a tangentiat axis of rotation is \sqrt{\frac{7}{5}} R. Show that the radius of gyration about a tangentiation. Given :R_i = 90 r.p.m,I_i = 0.75I_i To I_i = I_2 \omega_2Solution :I_i (2\pi n_i) = I_2 (2\pi n_2) [:: \omega = 2\pi n_i]\therefore R_a = \sqrt{\frac{2}{5}} RTo Prove :K_r = \sqrt{\frac{7}{5}} RProof :From the theorem of parallel axes,I_0 = I_c + Mh^2$	Farmer	1 _T	=	?					1			u		= MK	2
i) $I_{d} = \frac{MR^{2}}{2}$ ii) $I_{r} = 2MR^{2}$ $I_{d} = \frac{MR^{2}}{2}$ $I_{d} = \frac{MR^{2}}{2}$ $I_{d} = \frac{MR^{2}}{2}$ $I_{d} = \frac{0.5 \times (0.5)^{2}}{2}$ $= 0.0625 kg m^{2}$ $\therefore I_{d} = 6.25 \times 10^{-2} kg m^{2}$ $I_{r} = 2MR^{2}$ $I_{r} = 2MR^{2}$ $I_{r} = 2 \times 0.5 \times (0.5)^{2}$ $\therefore I_{r} = 0.25 kg m^{2}$ $\therefore K_{r} = \sqrt{\frac{7}{5}} R$ 5. A ballet dancer spins about a vertical axis at 90 r.p.m with arms outstretched. With the arms folded, the moment of inertia about the same axis of rotation changes to 75 %. Calculate the new speed of rotation. Given : $M = mass of uniform solid sphere ka a radius of gyration about a tangentia axis of rotation is \sqrt{\frac{7}{5}} R.Given :M = mass of uniform solid sphere K_{a} = Radius of gyration about at angentia tangent I_{a} = 0.75I_{1}To Find :I_{a} = 0.75I_{1}To Find :I_{a} = 0.75I_{1}To Find :I_{a} = 0.75I_{1}To Find :I_{a} = 0.75I_{1}K_{r} = \sqrt{\frac{7}{5}} RTo Prove :K_{r} = \sqrt{\frac{7}{5}} RProof :From the theorem of parallel axes, I_{0} = I_{c} + Mh^{2}\therefore n_{2} = 120 r.p.m$	Form	ula :			-								(•a	1011	•a)
$\begin{array}{rcl} & \mathbf{j} & \mathbf{j} & \mathbf{k} & \mathbf{j} & \mathbf{k} \\ & \mathbf{j} & \mathbf{k} & \mathbf{j} & \mathbf{k} \\ & \mathbf{j} & \mathbf{k} & \mathbf{k} \\ & \mathbf{j} & \mathbf{k} & \mathbf{k} \\ & \mathbf{j} & \mathbf{k} \\ & \mathbf{k} & \mathbf{k} \\ & $		i)	т	=	MR^2	_			K_T^2	=	K	$C_d^2 + R^2$			
solution : i) $I_r = 2MR^2$ $I_a = \frac{MR^2}{2}$ $I_a = \frac{0.5 \times (0.5)^2}{2}$ $= 0.0625 kg m^2$ $\therefore I_a = 6.25 \times 10^{-2} kg m^2$ $I_r = 2MR^2$ $I_r = 2MR^2$ $I_r = 2MR^2$ $I_r = 2.5 kg m^2$ 4. A solid sphere has a radius 'R'. If the radius of gyration of this sphere about its diameter is $\sqrt{\frac{2}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Given : $M = mass of uniform solid sphere K_a = Radius of gyration about a tangential diameter K_a = Radius of gyration about a tangential diameter K_a = Radius of gyration about a tangent\therefore K_a = \sqrt{\frac{2}{5}} RFrom the theorem of parallel axes, I_o = I_c + Mh^2K_r = I_c + Mh^2K_r = 120 r.p.m$		1)	¹ d		2						Г	2			
Solution : $I_{a} = \frac{MR^{2}}{2}$ $I_{a} = \frac{0.5 \times (0.5)^{2}}{2}$ $= 0.0625 \text{ kg m^{2}}$ $\therefore I_{a} = 6.25 \times 10^{-2} \text{ kg m^{2}}$ $I_{1} = 2MR^{2}$ $I_{1} = 2MR^{2}$ $I_{1} = 2 \times 0.5 \times (0.5)^{2}$ $\therefore I_{1} = 0.25 \text{ kg m^{2}}$ $\frac{1}{I_{1}} = 2.5 \times 0.5 \times (0.5)^{2}$ $\therefore I_{1} = 0.25 \text{ kg m^{2}}$ $\frac{1}{I_{1}} = 2.5 \times 0.5 \times (0.5)^{2}$ $\therefore I_{1} = 0.25 \text{ kg m^{2}}$ $\frac{1}{I_{1}} = 2.5 \times 0.5 \times (0.5)^{2}$ $\frac{1}{I_{1}} = 0.25 \text{ kg m^{2}}$ $\frac{1}{I_{1}}$	Salut	ii)	l _T	=	$2MR^2$				K²	=		$\sqrt{\frac{2}{\pi}R}$ + I	R ²		
$I_{a} = \frac{MR^{2}}{2}$ $I_{a} = \frac{0.5 \times (0.5)^{2}}{2}$ $= 0.0625 \text{ kg m^{2}}$ $\therefore I_{4} = 6.25 \times 10^{-2} \text{ kg m^{2}}$ $I_{T} = 2MR^{2}$ $I_{T} = 2MR^{2}$ $I_{T} = 0.25 \text{ kg m^{2}}$ $\therefore I_{T} = 0.25 \text{ kg m^{2}}$ $\therefore K_{T} = \sqrt{\frac{7}{5}} R$ $form this of gyration of this sphere about its diameter is \sqrt{\frac{2}{5}} R. Show that the radius of gyration about a tangential axis of rotation is \sqrt{\frac{7}{5}} R. Given : M = \text{ mass of uniform solid sphere K_{a} = Radius of gyration about a tangential diameter K_{a} = Radius of gyration about tangent \therefore K_{a} = \sqrt{\frac{2}{5}} R To Prove : K_{r} = \sqrt{\frac{7}{5}} R Proof : From the theorem of parallel axes, I_{0} = I_{e} + Mh^{2} K^{2} = \frac{2}{5} R^{2} + R^{2} K_{T} = \frac{7}{5} R^{2} K_{T} = \sqrt{\frac{7}{5}} R K_{T} = \sqrt{\frac{7}{5}} R K_{T} = \sqrt{\frac{7}{5}} R R_{T} = 0.25 \text{ kg m^{2}} K_{T} = 0.25 \text{ kg m^{2}} K_{T$	Solut	10n :							- т		L	<u></u> \ \ 5]			
$I_{d} = \frac{0.5 \times (0.5)^{2}}{2}$ $= 0.0625 \text{ kg m^{2}}$ $\therefore I_{a} = 6.25 \times 10^{-2} \text{ kg m^{2}}$ $I_{T} = 2 \text{ MR}^{2}$ $I_{T} = 2 \text{ MR}^{2}$ $I_{T} = 2 \times 0.5 \times (0.5)^{2}$ $\therefore I_{T} = 0.25 \text{ kg m^{2}}$ 4. A solid sphere has a radius 'R'. If the radius of gyration of this sphere about its diameter is $\sqrt{\frac{2}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Show that the radius of gyration about tangent $K_{c} = \text{ Radius of gyration about tangent}$ $\therefore K_{d} = \sqrt{\frac{2}{5}} \text{ R}$ To Prove: $K_{T} = \sqrt{\frac{7}{5}} \text{ R}$ Proof: $From the theorem of parallel axes, I_{0} = I_{c} + \text{ Mh}^{2}$ $K_{T} = 120 \text{ r.p.m}$		т	_	MR	_				1/2	_	2	$\frac{2}{2}$			
$I_{d} = \frac{0.5 \times (0.5)^{2}}{2}$ $= 0.0625 \text{ kg m^{2}}$ $\vdots I_{a} = 6.25 \times 10^{-2} \text{ kg m^{2}}$ $I_{r} = 2MR^{2}$ $I_{r} = 2 \times 0.5 \times (0.5)^{2}$ $\vdots I_{r} = 0.25 \text{ kg m^{2}}$ $4. A solid sphere has a radius 'R'. If the radius of gyration of this sphere about its diameter is \sqrt{\frac{2}{5}} R. Show that the radius of gyration about a tangential axis of rotation is \sqrt{\frac{7}{5}} R. Show that the radius of gyration about a tangential axis of rotation is \sqrt{\frac{7}{5}} R. Given :M = mass of uniform solid sphere K_{d} = R_{d} addius of gyration about tangent:K_{r} = R_{d} is of gyration about a tangential diameter K_{d} = \sqrt{\frac{2}{5}} R. To Prove :K_{q} = \sqrt{\frac{7}{5}} R. Proof :From the theorem of parallel axes, I_{0} = I_{c} + Mh^{2} K_{r} = R_{d} + Mh^{2}$		ď		2					κ_{T}^{-}	-	5	$\frac{1}{2}$ K ² + K ²			
$I_{d} = (1000000000000000000000000000000000000$				0.5 x	$(0.5)^2$						5	7			
$= 0.0625 \text{ kg m}^{2}$ ∴ $I_{a} = 6.25 \times 10^{-2} \text{ kg m}^{2}$ $I_{T} = 2 \text{ MR}^{2}$ $I_{T} = 2 \text{ MR}^{2}$ $I_{T} = 2 \times 0.5 \times (0.5)^{2}$ ∴ $I_{T} = 0.25 \text{ kg m}^{2}$ 4. A solid sphere has a radius 'R'. If the radius of gyration of this sphere about its diameter is $\sqrt{\frac{2}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Given : M = mass of uniform solid sphere K_{a} = Radius of gyration about diameter K_{d} = Radius of gyration about tangent ∴ K_{d} = \sqrt{\frac{2}{5}} R To Prove : K _T = $\sqrt{\frac{7}{5}} R$ Proof : From the theorem of parallel axes, $I_{0} = I_{c} + \text{ Mh}^{2}$ $\therefore K_{T} = \sqrt{\frac{100}{75}} \times 90$ $\therefore n_{2} = 120 \text{ r.p.m}$		I _d	=		$\frac{1}{2}$			·.	K _t	=		$\frac{1}{2}$ R ²			
$\begin{array}{rcl} & \prod_{q} & = & 6.25 \times 10^{-2} \text{kg m}^2 \\ I_{T} & = & 2MR^2 \\ I_{T} & = & 2 \times 0.5 \times (0.5)^2 \\ \hline & I_{T} & = & 0.25 \text{kg m}^2 \end{array}$ $\begin{array}{ll} & \therefore & K_{T} & = & \sqrt{\frac{7}{5}} R \\ \hline & A \text{ solid sphere has a radius 'R'. If the radius of gyration of this sphere about its diameter is \sqrt{\frac{2}{5}} R. \text{Show that the radius of gyration about a tangential axis of rotation is } \sqrt{\frac{7}{5}} R. \\ \hline & \text{Given :} \\ M & = & \text{mass of uniform solid sphere K_{d} & = & \text{Radius of gyration about tangent} \\ K_{r} & = & \text{Radius of gyration about at angential diameter } \\ K_{r} & = & Radius of gyration about a tangent \\ \hline & \vdots & K_{q} & = & \sqrt{\frac{2}{5}} R \\ \hline & \text{To Prove :} \\ K_{T} & = & \sqrt{\frac{7}{5}} R \\ \hline & \text{Proof :} \\ From the theorem of parallel axes, \\ I_{O} & = & I_{c} + \text{Mh}^2 \end{array} \begin{array}{ll} \therefore & K_{T} & = & \sqrt{\frac{7}{5}} R \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{2} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 r.p.m \\ \hline & \vdots & n_{3} & = & 120 $			=	0.062	- 25 kg n	1 ²									
$I_{T} = 2MR^{2}$ $I_{T} = 2 \times 0.5 \times (0.5)^{2}$ $\therefore I_{T} = 0.25 \text{ kg m}^{2}$ 5. A ballet dancer spins about a vertical axis at 90 r.p.m with arms outstretched. With the arms folded, the moment of inertia about the same axis of rotation changes to 75 %. Calculate the new speed of rotation. Given : $I_{T} = 0.25 \text{ kg m}^{2}$ 5. A ballet dancer spins about a vertical axis at 90 r.p.m with arms outstretched. With the arms folded, the moment of inertia about the same axis of rotation changes to 75 %. Calculate the new speed of rotation. Given : $I_{T} = 90 \text{ r.p.m},$ $I_{I} = 0.75I_{I}$ To Find : $I_{2} = 0.75I_{I}$ To Find : $I_{1}(2\pi n_{1}) = I_{2}(2\pi n_{2}) [\because \omega = 2\pi n]$ $\therefore n_{2} = \left(\frac{I_{1}}{I_{2}}\right) n_{I}$ $= \frac{I_{1}}{0.75I_{1}} \times 90$ $= \frac{100}{75} \times 90$ $\therefore n_{2} = 120 \text{ r.p.m}$	•	L	=	6.25	× 10 ⁻² 1	kg m²		·.	K,	=	1	$\frac{7}{2}$ R			
$I_{T}^{T} = 2 \times 0.5 \times (0.5)^{2}$ ∴ $I_{T} = 0.25 \text{ kg m}^{2}$ 4. A solid sphere has a radius 'R'. If the radius of gyration of this sphere about its diameter is $\sqrt{\frac{2}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Show that the radius of gyration about a tangential diameter K _a = Radius of gyration about tangent K_r = Radius of gyration about tangent K_r = $\sqrt{\frac{7}{5}}$ R R. To Prove : $K_r = \sqrt{\frac{7}{5}}$ R R. Proof : From the theorem of parallel axes, $I_o = I_c + Mh^2$ 5. A ballet dancer spins about a vertical axis at 90 r.p.m, with arms outstretched. With the arms folded, the moment of inertia about the same axis of rotation changes to 75 %. Calculate the new speed of rotation. Given : $n_1 = 90$ r.p.m, $I_1 = M.I$ with arms out stretched $I_2 = 0.75I_1$. To Find : $n_2 = 7$. Formula : $I_1(2\pi n_1) = I_2(2\pi n_2)$ [∴ $\omega = 2\pi n$] ∴ $n_2 = (\frac{I_1}{I_2}) n_1$ $= \frac{11}{0.75I_1} \times 90$ $= \frac{100}{75} \times 90$		-d I	=	2MR	2				1		1	¥5			
$\therefore I_{T} = 0.25 \text{ kg m}^{2}$ a. A solid sphere has a radius 'R'. If the radius of gyration of this sphere about its diameter is $\sqrt{\frac{2}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Given : M = mass of uniform solid sphere K _d = Radius of gyration about tangent $I_{1} = 0.75I_{1}$. Given : M = mass of uniform solid sphere K _d = Radius of gyration about tangent $I_{1} = 0.75I_{1}$. Given : M = mass of uniform solid sphere K _d = Radius of gyration about tangent $I_{1} = I_{2}\omega_{2}$. Golution : K _r = $\sqrt{\frac{2}{5}}$ R. To Prove : K _r = $\sqrt{\frac{7}{5}}$ R. Proof : From the theorem of parallel axes, $I_{0} = I_{c} + Mh^{2}$. $(I - I - I - I - I) = I_{0} + I - I - I - I - I - I - I - I - I - I$		I _T	=	2 × 0).5 × (0	0.5) ²		5.	A ba	llet d	anc	er spins abo	out a v	ertica	laxis
4. A solid sphere has a radius 'R'. If the radius of gyration of this sphere about its diameter is $\sqrt{\frac{2}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Given : M = mass of uniform solid sphere K _d = Radius of gyration about diameter K _r = Radius of gyration about tangent ∴ K _d = $\sqrt{\frac{2}{5}}$ R From the theorem of parallel axes, I ₀ = I _c + Mh ² the arms folded, the moment of inertia about the same axis of rotation changes to 75 %. Calculate the new speed of rotation. Given : n ₁ = 90 r.p.m, I ₁ = M.I with arms out stretched I ₂ = 0.75I ₁ To Find : n ₂ = ? Formula : I ₁ (2πn ₁) = I ₂ (2πn ₂) [∴ ω = 2πn] ∴ n ₂ = $(\frac{11}{12})$ n ₁ = $\frac{100}{75} \times 90$ ∴ n ₂ = 120 r.p.m		I _T	=	0.25	kg m²			5.	at 90	r.p.n	n wi	ith arms ou	tstret	ched.	With
4. A solid sphere has a radius 'R'. If the radius of gyration of this sphere about its diameter is $\sqrt{\frac{2}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Given : $M = \max_{\text{mass of uniform solid sphere}} K_{d} = Radius of gyration abouttangentK_{r} = Radius of gyration abouttangentK_{r} = \sqrt{\frac{2}{5}} RTo Prove :K_{r} = \sqrt{\frac{7}{5}} RProof :From the theorem of parallel axes,I_{0} = I_{c} + Mh^{2}A solid sphere aboutK_{r} = I_{c} + Mh^{2}about the same axis of rotation changesto 75 %. Calculate the new speed ofrotation.Given :n_{1} = 90 r.p.m,I_{1} = M.I with arms out stretchedI_{2} = 0.75I_{1}To Find :n_{2} = ?Formula :I_{1}\omega_{1} = I_{2}\omega_{2}Solution :I_{1}(2\pi n_{1}) = I_{2}(2\pi n_{2}) [:: \omega = 2\pi n]\therefore n_{2} = (\frac{I_{1}}{I_{2}}) n_{1}= \frac{100}{75} \times 90\therefore n_{2} = 120 r.p.m$		1			0				the a	irms	fold	ded, the m	omen	t of ir	ertia
radius of gyration of this sphere about its diameter is $\sqrt{\frac{2}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Given : $M = \max_{1} \max_{1} (m_1) = m_1$ with arms out stretched $I_2 = 0.75I_1$ To Find : $n_2 = 2$? Formula : $I_1 \omega_1 = I_2 \omega_2$ Solution : $I_1 \omega_1 = I_2 \omega_2$ Solution : $I_1 (2\pi n_1) = I_2 (2\pi n_2)$ [$\because \omega = 2\pi n$] $\therefore n_2 = (\frac{I_1}{I_2}) n_1$ $\therefore n_2 = \frac{1}{0.75I_1} \times 90$ $\therefore n_2 = (\frac{I_1}{I_2}) n_1$ $= \frac{100}{75} \times 90$ $\therefore n_2 = 120 \text{ r.p.m}$	4.	A so	lid sp	here	has a i	radius 'R	'. If the		abou	t the	e sai	me axis of 1	otatio	on cha	inges
its diameter is $\sqrt{\frac{2}{5}}$ R. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Given : $M = \max_{\text{mass of uniform solid sphere}} K_d = Radius of gyration aboutdiameterK_r = Radius of gyration abouttangent\therefore K_d = \sqrt{\frac{2}{5}} RTo Prove :K_r = \sqrt{\frac{7}{5}} RProof :From the theorem of parallel axes,I_0 = I_c + Mh^2K_r = I_c + Mh^2K_r = K_r + Mh^2$		radit	is of g	gyratio	$\frac{1}{2}$ of t	nis sphei	e about		to /: rotat	5 %0. -ion	Ca.	iculate the	e new	spee	ea or
ris difficter is $\sqrt{5}$ K. Show that the radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Given : M = mass of uniform solid sphere K_d = Radius of gyration about diameter K_r = Radius of gyration about tangent \therefore K_d = $\sqrt{\frac{2}{5}}$ R To Prove : K_T = $\sqrt{\frac{7}{5}}$ R Proof : From the theorem of parallel axes, I_0 = I_c + Mh ² K_1 = K_c Find that the theorem of parallel axes, I_0 = I_c + Mh ² K_1 = K_1 Solution is R_1 = 90 r.p.m, I_1 = $M.I$ with arms out stretched I_2 = $0.75I_1$ To Find : n_2 = $I_2\omega_2$ Solution : $I_1(2\pi n_1)$ = $I_2(2\pi n_2)$ [$\therefore \omega = 2\pi n$] $\therefore n_2$ = $(\frac{I_1}{I_2}) n_1$ $= \frac{100}{75} \times 90$ $\therefore n_2$ = 120 r.p.m		ite d	iamet	or is	$\frac{2}{2}$ R	Show t	hat the	Give	en :	1011.					
radius of gyration about a tangential axis of rotation is $\sqrt{\frac{7}{5}}$ R. Given : $M = \max_{\text{mass of uniform solid sphere}} K_d = Radius of gyration about \dim_{\text{diameter}} K_r = Radius of gyration about \operatorname{tangent}^T\therefore K_d = \sqrt{\frac{2}{5}} RTo Prove :K_r = \sqrt{\frac{7}{5}} RProof :From the theorem of parallel axes,I_0 = I_c + Mh^2K_1 = I_c + Mh^2I_1 = M.I with arms out stretched I_2 = 0.75I_1To Find :n_2 = ?Formula :I_1(2\pi n_1) = I_2(2\pi n_2) [\because \omega = 2\pi n]\therefore n_2 = \left(\frac{I_1}{I_2}\right) n_1= \frac{I_1}{0.75I_1} \times 90\therefore n_2 = 120 \text{ r.p.m}$		115 u	ianicu	CI 15	1 5 ∩		inat the		n ₁	=	9	0 r.p.m,			
axis of rotation is $\sqrt{\frac{7}{5}}$ R. Given : $M = mass of uniform solid sphere K_d = Radius of gyration about diameter K_r = Radius of gyration about tangent \therefore K_d = \sqrt{\frac{2}{5}} RTo Prove :K_r = \sqrt{\frac{7}{5}} RProof :From the theorem of parallel axes,I_0 = I_c + Mh^2I_2 = 0.75I_1To Find :n_2 = ?Formula :I_1 (2\pi n_1) = I_2 (2\pi n_2) [\because \omega = 2\pi n]\therefore n_2 = (\frac{I_1}{I_2}) n_1= \frac{100}{75} \times 90\therefore n_2 = 120 r.p.m$		radiı	is of	gyrati	on ab	out a tar	ngential		I ₁	=	Ν	A.I with arr	ns ou	t stret	ched
axis of rotation is $\sqrt{5}$ R. Given : M = mass of uniform solid sphere K _d = Radius of gyration about diameter K _r = Radius of gyration about tangent \therefore K _d = $\sqrt{\frac{2}{5}}$ R To Prove : K _r = $\sqrt{\frac{7}{5}}$ R Proof : From the theorem of parallel axes, I ₀ = I _c + Mh ² To Find : n ₂ = ? Formula : I ₁ (2π n ₁) = I ₂ (2π n ₂) [$\because \omega = 2\pi$ n] \therefore n ₂ = $(\frac{I_1}{I_2})$ n ₁ $= \frac{I_1}{0.75I_1} \times 90$ \therefore n ₂ = 120 r.p.m			_		7	_			I ₂	=	0	.75I ₁			
Given : $M = \max s of uniform solid sphere K_{d} = Radius of gyration about diameter K_{r} = Radius of gyration about tangent K_{r} = \frac{\sqrt{2}}{5} R To Prove :K_{r} = \sqrt{\frac{7}{5}} R Proof :From the theorem of parallel axes,I_{o} = I_{c} + Mh^{2} n_{2} = \frac{n_{1}}{2} Formula :I_{1}(2\pi n_{1}) = I_{2}(2\pi n_{2}) [\because \omega = 2\pi n] I_{1}(2\pi n_{1}) = \frac{1}{2}(2\pi n_{2}) [\because \omega = 2\pi n] R_{r} = \frac{1}{0.75I_{1}} \times 90 R_{r} = \frac{100}{75} \times 90 R_{r} = I_{c} + Mh^{2}$		axis	of rota	ation i	$\sqrt{5}$	R.		To F	ind :						
$M = \text{mass of uniform solid sphere}_{K_{d}} = \text{Radius of gyration about}_{diameter}$ $K_{r} = \text{Radius of gyration about}_{tangent}$ $K_{r} = \text{Radius of gyration about}_{tangent}$ $K_{r} = \sqrt{\frac{2}{5}} R$ $To Prove: \qquad \qquad$	Giver	n :							n ₂	=	?				
$K_{d} = Radius of gyration about diameter K_{r} = Radius of gyration about tangent K_{r} = \frac{\sqrt{2}}{5} R Solution:I_{1}(2\pi n_{1}) = I_{2}(2\pi n_{2}) [\because \omega = 2\pi n] I_{1}(2\pi n_{1}) = I_{2}(2\pi n_{2}) [\because \omega = 2\pi n] \vdots n_{2} = \left(\frac{I_{1}}{I_{2}}\right) n_{1} = \frac{I_{1}}{0.75I_{1}} \times 90 = \frac{100}{75} \times 90 \therefore n_{2} = 120 \text{ r.p.m}$		М	=	mass	of uni	form solid	d sphere	Forn	nula :			-			
Solution : $K_{r} = Radius of gyration about tangent $ $K_{r} = \sqrt{\frac{2}{5}} R$ $To Prove :$ $K_{r} = \sqrt{\frac{7}{5}} R$ $K_{r} = \sqrt{\frac{7}{5}} R$ $K_{r} = I_{c} + Mh^{2}$ Solution : $I_{1} (2\pi n_{1}) = I_{2} (2\pi n_{2}) [\because \omega = 2\pi n]$ \vdots $n_{2} = \left(\frac{I_{1}}{I_{2}}\right) n_{1}$ $= \frac{I_{1}}{0.75I_{1}} \times 90$ $= \frac{100}{75} \times 90$ $\therefore n_{2} = 120 \text{ r.p.m}$		K _d	=	Radi	ius of	gyratior	n about		l ₁ ω ₁	:	=	$1_2 \omega_2$			
$\therefore K_{d} = \sqrt{\frac{2}{5}} R$ $To Prove:$ $K_{T} = \sqrt{\frac{7}{5}} R$ $Proof:$ $From the theorem of parallel axes,$ $I_{0} = I_{c} + Mh^{2}$ $K_{T} = \sqrt{\frac{1}{5}} R$ $R_{T} = \frac{100}{75} \times 90$ $R_{T} = \frac{100}{75} \times 90$		К	=	Radi	ius of	ovration	n about		tion:		_	$I(2\pi n)$	ſ	(a) -	2m n]
$\therefore K_{d} = \sqrt{\frac{2}{5}} R$ $To Prove:$ $K_{T} = \sqrt{\frac{7}{5}} R$ $From the theorem of parallel axes,$ $I_{0} = I_{c} + Mh^{2}$ $\therefore n_{2} = \left(\frac{I_{1}}{I_{2}}\right) n_{1}$ $= \frac{I_{1}}{0.75I_{1}} \times 90$ $= \frac{100}{75} \times 90$ $\therefore n_{2} = 120 \text{ r.p.m}$		r,		tang	ent	8,14101	ubout	1 ₁	(2 1 11 ₁)		-	$I_2(2\pi I_2)$	[ω –	2 1(11]
$\therefore K_{d} = \sqrt{\frac{2}{5}} R$ To Prove: $K_{T} = \sqrt{\frac{7}{5}} R$ Proof: From the theorem of parallel axes, $I_{0} = I_{c} + Mh^{2}$ $\therefore H_{2} = (I_{2}) H_{1}$ $= \frac{1}{0.75I_{1}} \times 90$ $= \frac{100}{75} \times 90$ $\therefore n_{2} = 120 \text{ r.p.m}$				5				Ι.	n		_	$\left(\frac{\mathbf{I_1}}{\mathbf{I_1}}\right)$			
To Prove : $K_{T} = \sqrt{\frac{7}{5}} R$ $= \frac{I_{1}}{0.75I_{1}} \times 90$ $= \frac{100}{75} \times 90$ $\therefore n_{2} = 120 \text{ r.p.m}$. .	K _d	=	$\sqrt{\frac{2}{5}}$	R			•••	11,2	2	-	$(I_2)^{II_1}$			
From the theorem of parallel axes, $I_0 = I_c + Mh^2$ $= \frac{1}{0.75I_1} \times 90$ $= \frac{100}{75} \times 90$ $\therefore n_2 = 120 \text{ r.p.m}$	To Pr	ove ·		10								I1			
$K_{\rm r} = \sqrt{\frac{7}{5}} R$ $= \frac{100}{75} \times 90$ $\therefore n_2 = 120 \text{ r.p.m}$	1011									:	=	$\frac{1}{0.75I_1}$ ×	90		
Proof: From the theorem of parallel axes, $I_0 = I_c + Mh^2$ $= \frac{100}{75} \times 90$ $\therefore n_2 = 120 \text{ r.p.m}$		K,	=	$\sqrt{\frac{7}{5}}$	R							100			
From the theorem of parallel axes, $I_0 = I_c + Mh^2$ $(arrow n_2 = 120 \text{ r.p.m})$	D. 1	1 • .		γ5						:	=	$\frac{100}{75} \times 90$)		
$I_0 = I_c + Mh^2$	Proof	: : From	the t	hearer	n of n	arallol av	25	Ι.	~	-	=	/5 120 r n m			
U c		I	=	I +	Mh ²		<i>C</i> 3,	••	112	2	-	120 r.p.m	L		
Rotational Motion	Rotati	onal M	<i>lotion</i>	c											

MAHESH TUTORIALS SCIENCE

6. A torque of 400 Nm acting on a body				ody Sol	Solution :							
	of n	iass	40 kg produces an angi	ular			~					
	2000	lorati	on of 20 rad/s^2 Calculate	the	т	=	$\frac{2}{2}$	MR ²				
	mon	onto	of inartia and radius of arra	tion	¹ 1	_	5 1	vii\ ₁				
			1 mentia and faulus of gyla	11011			~					
~.	of th	le bo	dy.		T	=	$\frac{2}{2}$	MR ²				
Give	en:				¹ 2		5 1	viit ²				
	τ	=	400 Nm					•		•		
	Μ	=	40 kg		Iı		(R.	$()^2$		$(R_1)^2$		
	α	=	20 rad/s^2		<u> </u>	=			=	$\left \frac{1}{2P}\right $		
To F	ind :				12			2)		$(2N_1)$		
	I	=	?					2				
	ĸ	=	?			_	$\left(\begin{array}{c} 1 \end{array} \right)$)_	_	1		
Forn			·			-	(2))	-	4		
rom	iuia .	_	– I <i>a</i>				. ,					
	1)	ſ	- 1 u		I_1							
					<u> </u>	=	1:4	Ł				
	ii)	Κ	$= \sqrt{\frac{1}{2}}$		12							
	,		V IM	0	A £1-		1 : - 11	a for		fadice note	tine	
Solu	tion :			0.	Any	wheel	. in ti	101 101		r a disc, rota	mp	
			~ 400		abou	it an a	xis pa	assin	g th	rougn its ce	entre	
	Ι	=	$\frac{1}{2} = \frac{400}{1}$		and	perpe	ndic	ular	to il	s plane, lo	oses	
			α 20		100	J of e	nergy	y, wl	hen	slowing d	owr	
	Ι	=	20 kg m ²		fron	1 60 r	.p.m	to	30 r	.p.m. Find	1 its	
					mom	nent of	f ine	rtia a	ıbou	t the same	axis	
	Now	, К =	= 1		and	chang	e in i	its ar	ngul	ar moment	um	
	INOW	, к -	- \/ M	Giv	en :	0	-		0		-	
				011	n .	_	60 #	. n m				
			20 1		11		00 1	·p.m	•			
<i>.</i> •.	K	=	$\sqrt{\frac{1}{40}} = \sqrt{\frac{1}{2}}$				60					
			10 12			=	60	=	-	r.p.s,		
<i>.</i> .	Κ	=	$\sqrt{0.5}$		n	_	20 #	. n m				
•	К	=	0 707 m		112	_	50 1	·p.m	•			
••	1						30			1		
						=	60	=		[–] r.p.s,		
7.	If th	e rad	ius of solid sphere is doub	oled	A E	_	100	т		<u>~</u>		
	by k	eepi	ng its mass constant, comp	pare		_	100	J				
	the	mon	nent of inertia about	any ¹⁰¹	Find :	-		•				
	dian	ieter.		5	i)	I	=	?				
Cive					ii)	ΔL	=	?				
Give	л. р	_	JD.	For	nula :							
		_	2N ₁					1				
	M	=	constant		i)	КE	=	<u> </u>	۲ տ²			
ToF	ind :				1)	П.П.		2	100			
	L				ii)	L	=	Iω)			
	<u>-1</u>	=	?	Solt	ution :							
	¹ 2											
Forn	nula :				;)	VE		$\frac{1}{2}$		$(\mathbf{z}_{n})^{2}$		
			3		1)	КС ₁	-	2 × 1	L X (.	$(2\pi n_1)$		
	I	=	$\stackrel{2}{=}$ MR ²				= 7	$2\pi^2n^2I$				
	-		5		Simi	larlu	2	-,• 11 ₁ 1	-			
					JIIII. TZ	E	_	n	2 ₁₀ 9T			
					•/		_					
					K	.Е ₂	=	ZN	⁻¹¹ ⁻¹			

							-	•••
	Δ E	=	к е. , - К. Е.	Formula :				
		=	$(2\pi^2 n_2^2 - 2\pi^2 n_1^2)$ I	L =		Ι ω =	cons	stant
	Δ E	=	$2\pi^2 (n_2^2 - n_1^2)$ I	Solution :	,		<i>, </i>	
			ΔΕ	L	,	=	L 	,,
· ·	Ι	=	$2\pi^2 \left[n_n^2 - n_n^2 \right]$	1	ω	=	Ιω) //
				$1(\boldsymbol{\omega}_2 - \boldsymbol{\omega}_2)$	ω ₂)	=	(1 +	1) ω
			100	$1 \times 2\pi (n_2 - n_2)$	1 ₁)	=	21 ×	2 π n
		=	$\overline{\left[\left(1\right)^{2},1\right]^{2}}$	n ₂ - 1	n ₁	=	2n	
			$2(3.14)^{-}\left[\left(\frac{-}{2}\right)^{-1^{2}}\right]$	$\frac{240 - 12}{2}$	20	=	n"	
		=	-100	n	,,	=	60 r	pm
			$2(3.14)^2\left(\frac{3}{4}\right)$	10. A unifo horizor	orm ntal	circula is rotat	r disc ting a	with its plane bout a vertical
		=	$\frac{-200}{3(3.142)^2}$	axis pas of 180 mass 1	ssing r.p.r 9 o f	g throug n. A sr	gh its c nall p	entre at a speed iece of wax of on the disc and
•	т	=	-6.753 kg m^2	sticks t	o it	at a dis	stance	of 25 cm from
••	Negative	sign sł	nows that energy is lost	the axis	5. If	the spe	ed of	rotation is now
	I =	6.759	9 kg m²	reduced	d by	60 r.p.1	m., cal	culate moment
	L =	Iω		Given :	1a 0	the al	sc.	
	L =	I (2π	($:: \boldsymbol{\omega} = 2\boldsymbol{\pi} n$)	n ₁ =		180 r.p	.m	
	L =	2 π In		1		180		
·•	Δ L =	L ₂ –	$L_1 = 2\pi I (n_2 - n_1)$	=		60	=	3 r.p.s,
	=	2 × 3	$3.14 \times 6.753 \left(\frac{1}{2} - 1\right)$	n ₂ =		(180 - 0	60) r.p	.m
	=	- 3.1	42×6.753	=		$\frac{120}{60}$	=	2 r.p.s,
<u></u>	ΔL =	21.2	l kg m ² /s	m =		1.9 g	=	1.9 × 10 ⁻³ kg,
9.	Two who	eels of	moment of inertia 4 kg	n =		r 25 cm	=	0 25 m
	m ² rotat	e side	by side at the rate of	I, =		M.I of t	the dis	about vertical
	120 rev/	min a velvint	he opposite directions	1		axis		
	If now b	oth the	wheels are coupled by	I ₂ =		M.I of	disc a	bout same axis
	means of	f weigh	tless shaft so that both	To find :		with w	ax	
	the whee	els now	rotate with a common	I I =		?		
	angular	speed.	Find the new speed of	Formula :				
Give	en :			$I_1 \omega_1 =$		Ι ,ω ,		
	I =	4 kg	m²	I_ =		I_ + I		
	n ₁ =	120 1	rpm	2		ı wax (Par	allel a	xes theorem)
	n ₂ =	240 1	rpm	Solution :		(1 41		, <u>, , , , , , , , , , , , , , , , , , </u>
To f	ind :	2		I ₂ =		$I_1 + I_{wax}$	c	

? 'n =

Rotational Motion

MAHESH TUTORIALS SCIENCE

	I,	=	$I_1 + mr^2$
	Consider,		-
	$I_1 \omega_1$	=	$I_2 \omega_2$
<i>.</i> .	$I_1 (2\pi n_1)$	=	$(I_1 + mr^2) \times (2\pi n_2)$
. .	I ₁ n ₁	=	$(I_1 + mr^2) n_2$
<i>.</i> .	$I_{1}(n_{1} - n_{2})$	=	mr ² n ₂
. . .	I ₁ =	$\frac{\mathrm{mr}^2\mathrm{n}_2}{\mathrm{n}_1-\mathrm{n}_2}$	
	=	1.9×10	$\frac{-3\times(0.25)^2\times 2}{3-2}$
	I ₁ =	2.375 × 2	10 ⁻⁴ kg m ²

11. A thin uniform rod of length 1 m and mass 1 kg is rotating about an axis passing through its centre and perpendicular to its length. Calculate moment of inertia and radius of gyration of the rod about an axis passing through a point mid way between the centre and its edge, perpendicular to its length.

Given :			
Μ	=	1 kg	7
1	=	1 m	
h	=	$\frac{l}{4}$	
To find	:		
i)	Ι	=	?
ii)	Κ	=	?
Formula	ı :		
i)	I_0	=	$I_c + Mh^2$
ii)	K	=	$\sqrt{\frac{I}{M}}$

Solution :

M. I of rod about an axis through its \therefore centre is given by

$$I_{c} = \frac{Ml^{2}}{12}$$

$$I_{0} = I_{c} + Mh^{2}$$

$$\therefore I_{0} = \frac{Ml^{2}}{12} + M\left(\frac{l}{4}\right)^{2}$$

$$\therefore \omega$$

$$= \frac{Ml^2}{12} + \frac{Ml^2}{16}$$

$$= \frac{7}{48} Ml^2 = \frac{7}{48} (1) (1)^2$$

$$I_o = 0.1458 \text{ kg m}^2$$

$$K = \sqrt{\frac{1}{M}} = \sqrt{\frac{0.1458}{1}}$$

$$K = 0.3818 \text{ m}$$

12. A homogenous rod XY of length L and mass 'M' is pivoted at the centre 'C' such that it can rotate freely in vertical plane. Intially the rod is in the horizontal position. A blob of wax of same mass 'M' that of the rod falls vertically with the speed 'V' and sticks to the rod midway between points C and Y. If the rod rotates with angular speed 'ω' what will be angular speed in terms of V and L?

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:.

$$I_{Total} = I_{rod} + I_{wax}$$

$$= \frac{ML^2}{12} + Mr^2$$

$$= \frac{ML^2}{12} + \frac{ML^2}{4} \quad \left(\because r = \frac{L}{2}\right)$$

$$I_{Total} = \frac{7ML^2}{48}$$

Since angular momentum is conserved, Initial angular = Final angular momentum momentum

$$MV\left(\frac{L}{4}\right) = \left(\frac{7ML^2}{48}\right)\boldsymbol{\omega}$$

$$\frac{V}{4} = \frac{7L}{48}\omega$$

$$\boldsymbol{\omega} = \frac{V}{4} \times \frac{48}{7L}$$

7 L

-Rotational Motion