lecture:	A	too fast	3%
	B	just right	77%
	C	too slow	20%

try: 1 page
hand written

exams:	A	too easy	16%
	B	just right	73%
	C	too hard	10%

hand written	A	OK restriction	79%.
	B	not OK – need to type	21%

Imperial Units

200 lb

lbm pound mass

lbf pound force

1 lbm = 0.45359237 kg exactly.

1 lbf = 4.4482216152605 N exactly.

$m = 100$ lb means $m = 100$ lbm ≈ 45 kg

$W = 100$ lb means $F_g = 100$ lbf ≈ 445 N

$g = 9.81\ ms^{-2}$

$g = 9.81\ ms^{-2} = 32\ ft/s^2$

$g \approx 1 \dfrac{lbf}{lbm}$

$F = ma$

$a = \dfrac{F}{m}$

$\Rightarrow$ weight of a 100 lbm person on earth is 100 lbf

$$\text{slug} = \frac{\text{lbf}}{\text{ft}/\text{s}^2} = \text{lbf ft}^{-1}\,\text{s}^2$$

one lbf acting on a mass of one slug accelerates it at one ft/s^2.

$$\Rightarrow \quad \text{ft}/\text{s}^2 = \frac{\text{lbf}}{\text{slug}}$$

$$g = 32\ \text{ft}/\text{s}^2$$

$$g = 32\ \frac{\text{lbf}}{\text{slug}}.$$

$$g = 1\ \frac{\text{lbf}}{\text{lbm}}$$

$$\Rightarrow \quad 32\ \frac{\text{lbf}}{\text{slug}} = 1\ \frac{\text{lbf}}{\text{lbm}}$$

$$1\ \text{slug} = 32\ \text{lbm}$$

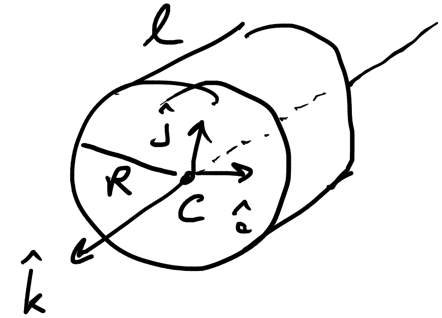
Euler's equns for rigid bodies : $\sum_i \vec{F}_i = m\,\vec{a}_c$

$\sum_i \vec{M}_{c,\hat{k},i} = I_{c,\hat{k}}\, \vec{\alpha}$

center of mass

moment of inertia

<u>ex</u> cylinder MoI.



$I_{c,\hat{k}}$

mass m

density $\rho = \dfrac{m}{\pi R^2 \ell}$

r = distance from $\hat{k}$ axis through C

$$I_{c,\hat{k}} = \int_V \rho r^2 \, dV$$

$$= \iiint \rho (x^2+y^2)\, dx\, dy\, dz$$

cyl coords r, θ, z

$$= \int_{-\ell}^{0}\int_0^{2\pi}\int_0^R \rho \underbrace{r^2\, r}_{r^3}\, dr\, d\theta\, dz$$

$$J = \begin{vmatrix} \frac{\partial x}{\partial r} & \frac{\partial x}{\partial \theta} & \frac{\partial x}{\partial z} \\ -- & -- & -- \\ -- & -- & -- \end{vmatrix} = r$$

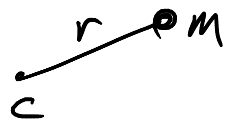
$$= \int_{-\ell}^{0}\int_0^{2\pi} \rho \frac{R^4}{4}\, d\theta\, dz$$

$$= \rho \frac{R^4}{4} 2\pi l$$

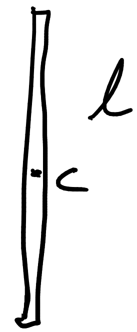
$$= \frac{m}{\cancel{\pi}\cancel{R^2}\cancel{l}} \frac{R^{\cancel{4}\,2}}{4} 2\cancel{\pi}\cancel{l}$$

$$= \frac{1}{2} m R^2$$

$$I_c = mr^2$$



$$I_c = mr^2$$



$$I_c = \frac{ml^2}{12}$$