4.0 Exercise 1

11/11 Excellent!

- Angular momentum lense because 2 angular momentums are being compared.

$\ell_A = I\vec{w}$

$\ell_A = I_A w_A$

$\ell_B = I_B w_B \rightarrow I_B(\frac{1}{3} w_A)$

Disks are identical

$\therefore I_A = I_B \quad \vec{\ell}_B = \frac{1}{3}\vec{\ell}_A$

so $\vec{\ell}_A = 3\vec{\ell}_B$

- Rotational kinetic energy because we know energy is being transfered.

$E_R = \frac{1}{2} I \vec{w}^2$

$I_A = I_B = I$

$E_{R(B)} = \frac{1}{2} I_B \vec{w}^2 = \frac{1}{2} I \vec{w}_B^2 \qquad 3^2 = 9$

$E_{R(A)} = 9 E_{R(B)}$

- Linear analogue could be two blocks colliding
- Angular momentum lense because we are dealing with an isolated system and we know with this system there are no outside forces so momentum is conserved.

$\vec{\ell}_i = \vec{\ell}_f$

$I_A\vec{w}_A + I_B\vec{w}_B = (I_A + I_B)\vec{w}_F$

$I_A = I_B = I$

$W_F = \frac{I_A\vec{w}_A + I_B\vec{w}_B}{I_A + I_B} = \frac{I(3\vec{w}_B) - I\vec{w}_B}{2I} = \frac{2I\vec{w}_B}{2I} = \vec{w}_B$

$W_B = \frac{1}{3} W_A$

$W_F = W_B = \frac{1}{3} W_A \qquad \frac{1}{3} W_A = W_F$

- Energy lense because there is a transformation of energy in a collision

$\sum \vec{E}_{Ri} = \sum \vec{E}_{R(A)} + \sum E_{R(B)}$

$= 9E_{R(B)} + E_{R(B)} = 10E_{R(B)}$

$= 10(\frac{1}{2} I W_B^2)$

$= 5I\vec{W}_B^2 = 10(\frac{1}{2} I \vec{W}_B^2)$

$= 10\vec{E}_{R(B)} = 2\vec{E}_{R(i)}$

$\sum \vec{E}_{Rf} = \frac{1}{2} I_{A+B} \vec{W}_f^2$

$= \frac{1}{2}(I_A + I_B)(\frac{1}{3} w_a)^2$

$= 9I(3w_B)^2$

$= IW_B^2 = 2(\frac{1}{2} I W_B)^2$

$= 2E_{R(B)} \quad \sum \vec{E}_{Rf}$

#4 A 1 kg block ...
int
co

$8/10 = 80\%$

$E_{RA} = 9E_{RB}$

$\Sigma E_{RT} = 10E_{RB}$ $\quad E_{Rf} = 2E_{RB}$

$10-2 = 8E_{RB}$

Great!

80% of the original energy turned to thermal energy which lost as heat

4.1 Example 1

c)  Rotational Acceleration lense

The torque is going in the left $-\hat{x}$ direction

4.2 Exercise 1

a) Rotational kinematics lense because we are studying the rotational motion of the rod as an explicit function of time

$$\vec{w} = \frac{10\text{ rad}}{s} \times \frac{1\text{ rev}}{2\pi} \times \frac{60s}{\text{min}} = \boxed{95.5\text{ rpm}}$$

C

b) Rotational kinematics lense because again we are studying the rotational motion of the rod as an explicit function of time

$$\vec{w} = 10\text{ rad}/s$$

$$\rightarrow v = \frac{\Delta s}{\Delta t} = \frac{r\Delta\theta}{\Delta t} = r\vec{w}$$

$$\vec{V}_A = 2m(10\text{ rev}/s) = \boxed{20\text{ m/s}}$$

$$\vec{V}_B = 1m(10\text{ rev}/s) = \boxed{10\text{ m/s}}$$

c) Rotational KE lense because we are trying to calculate the KE of the structures masses

$$E_{RK} = \tfrac{1}{2}Iw^2$$

$E_{RK(A)} = \tfrac{1}{2}I_A(w_A)^2$

$\tfrac{1}{2}m_A(r_A)^2(w_A)^2 = \tfrac{1}{2}(1)(2m)^2(10)^2$

$= \boxed{200J}$

$E_{RK(B)} = \tfrac{1}{2}I_B(w_B)^2$

$= \tfrac{1}{2}M_B(R_B)^2(w_B)^2 = \tfrac{1}{2}(2)(1)^2(10)^2$

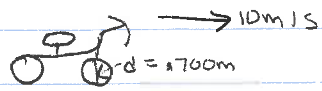
$= \boxed{100J}$

Na

D) Rotational kinetic energy lense because we are calculating the KE for the total structure

$$\Sigma E_R = 200J + 100J = \boxed{300J}$$

4.2 Exercise 2



$\Delta t = 5s$

$v = 10m/s$

a) Kinematics lense

$$\vec{a} = \frac{\Delta v}{\Delta t} = \frac{10m/s}{5s} = \boxed{2m/s^2}$$ yes it is possible

b) Rotational kinematics lens

$$\vec{\omega} = \vec{v}/r = 10/\tfrac{1}{2}(.7m) = \boxed{28.6\ rad/s}$$

c) $$\vec{\alpha} = \frac{\Delta \omega}{\Delta t} = \frac{28.57}{5} = \boxed{5.71\ rad/s^2}$$

d) $$\vec{\omega} = \frac{\Delta \theta}{\Delta t} = \frac{28.57rad}{2}(5) = \boxed{71.45rad}$$

4.3 Exercise 2

a) Dynamics lense because we are looking at αs and τs

$$\tau = F(r) = 200 \times .4 = \boxed{80Nm}$$

Energy lense because work is being done on the nut while its being turned

$$W = \tau(\Delta\theta)$$
$$= 80(2\pi) = \boxed{500J}$$

b) Energy is lost to heat because of friction

c) $$P = \frac{W}{\Delta t} = \frac{500J}{2s} = \boxed{250W}$$

Exercise 4 4.3

a) Rotational dynamics lens

$$\tau = r\vec{F}_\perp$$
$$= .175(200)$$
$$= \boxed{35Nm}$$

$$\frac{90v}{1min} \cdot \frac{2\pi rad}{1} \cdot \frac{1min}{60s} = \boxed{9.42\ rad/s}$$

$P = \frac{\Delta E}{\Delta t} = \frac{W}{\Delta t} = \tau \Delta \vec{\omega} = 35(9.42) = \boxed{330W}$ ✓

b) Rotational kinematics lens ✓

$\vec{v} = \frac{\Delta s}{\Delta t} = r(\vec{\omega}) = .175(9.42) = \boxed{1.64 m/s}$ ✓

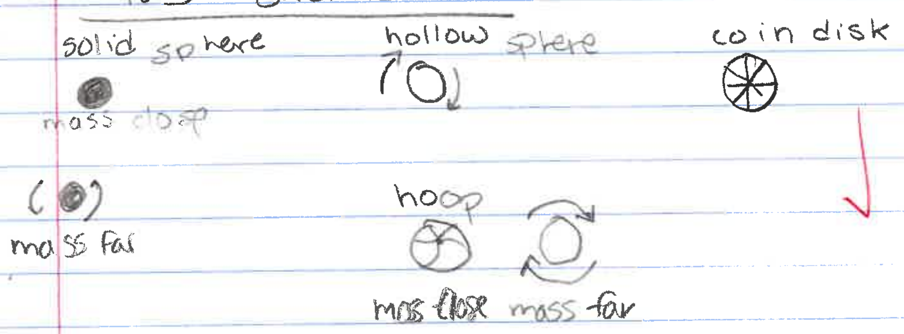
$P = \frac{\Delta E}{\Delta t} = F(\vec{v}) = 200(1.64) = \boxed{300W}$ ✓

E

4.4 Exercise 2

- $I = m r_1^2 + m_2 r_2^2$
  $= 2kg(1m)^2 + 1kg(2m)^2$
  $I = \boxed{6 kgm^2}$ ✓
- $E_R = 1/2 I \omega^2$
  $= 1/2 (6)(10)^2$
  $= \boxed{300J}$ ✓
- Yes
- Finding KE w/ rotational equations because there isnt as many steps

4.5 Exercise 1



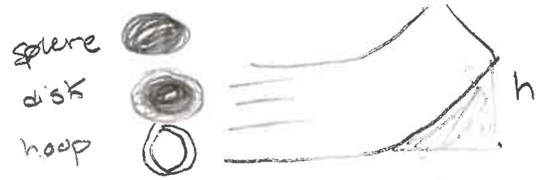
✓

solid sphere < hollow sphere < coin disk < Standing hoop < disk < ...

Why? lens?

#4
ir
c
2n
Nam

Miranda For...



I_{hoop} : $2/5\,mr^2$
I_{disk} : $1/2\,mr^2$
$I_{solid\ sphere}$: mr^2

4.5 Exercise 2

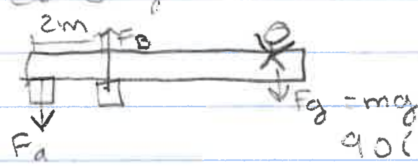
Rotational dynamics lense. Rotational acceleration is being caused by torques. The more inertia on a body, the harder it is to apply angular acceleration. The hoop will go further up the hill because it has the highest inertia so its harder for the Fg and friction to apply angular acceleration which would be how it slows down.

4.6 Exercise 2

Rotational Dynamics and dynamics

$\sum \vec{\tau} = 0$ $\sum \vec{F} = 0$

The sum of $\vec{F} = 0$ and there are forces causing an acceleration



$90(10) = 900N$

$T_A + T_g + F_B = 0$

$rF_A + rF_g + rF_B = 0$

$(2)(F_A) + (4)(900) + 0(F_B) = 0$

$2\,mF_A (= 3600\,Nm) = 0$

$\frac{2m\,F_A = 3600}{2}$

$F_A = \boxed{1800N}$

$0(F_A) + 2(F_B) = 6(900N) = 0$

$2m(F_B) - 5400 = 0$

$F_B = \frac{5400Nm}{2}$ $\boxed{2700\,nM}$

$\sum \vec{F} = F_A + F_B + F_G = 0$

$= -1800 + 2700 - 900Nm$

$= 0$

$\sum \vec{\tau} = T_A + T_B + T_G = 0$

$F_A(2) + F_B(0) + F_G(4) = 0$

$-3600Nm + 3600Nm = 0$

$0 = 0$