NO Reading assignment

H.W Due Friday

Action Center Thursday

Group problem

Torque and moments of

Inertia

D2L updated

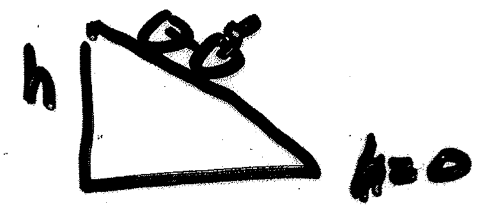
Review

K.E rolling $\frac{1}{2}I\omega^2$

Total K.E = $\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$

translation rotation

ex) Two bicycles roll down a hill 20 m high. Both have a mass of 12 kg and wheels of radius .35 m. 1st bicycle has wheels that are 0.6 kg each. 2nd bicycle has wheels that are 0.3 kg each. Which bicycle has faster speed at bottom?



conserve Energy

$K_i + U_i = K_f + U_f$

$$0 + mgh = \left(\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2\right) + 0$$

$$mgh = \frac{1}{2}mv^2 + 2\cdot\frac{1}{2}I\omega^2 \qquad I = MR^2$$

bike mass

2 tires

Tire mass

$\omega = \frac{v}{R}$

$$mgh = \frac{1}{2}mv^2 + (M\cancel{R^2})\left(\frac{v}{\cancel{R}}\right)^2$$

$$mgh = \frac{1}{2}mv^2 + Mv^2 \qquad v = \sqrt{\frac{mgh}{\frac{1}{2}m + M}}$$

$M = 0.3\text{kg}$ $v = 19.3\text{ m/s}$

$M = 0.6\text{kg}$ $v = 18.9\text{ m/s}$

Interactive Question

A solid sphere (S), a thin hoop (H), and a solid disk (D), all with the same radius, are allowed to roll down an inclined plane without slipping. In which order will they arrive at the bottom? (The fist one down listed first).

A) H,D,S

B) H,S,D

C) S,D,H

D) S,H,D

E) D,H,S

$I_S = \frac{2}{5} mR^2$

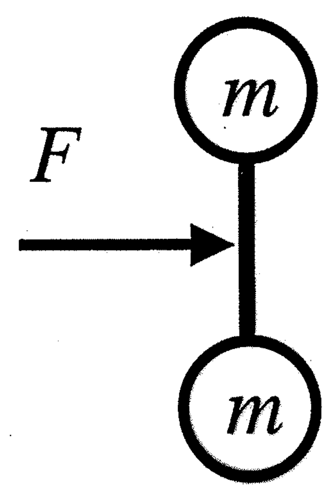
$I_H = mR^2$

$I_D = \frac{1}{2} mR^2$

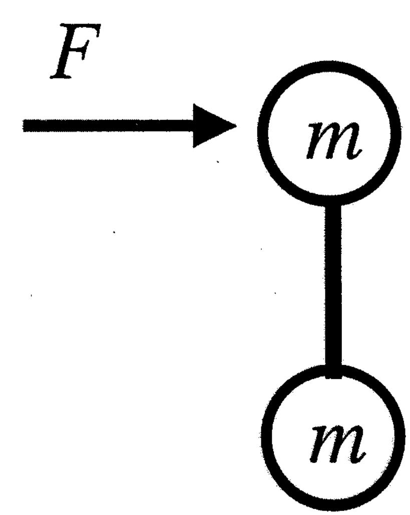
Interactive Question

A force F is applied to a dumbbell for a time interval Δt, first as in (a) and then as in (b). In which case does the dumbbell acquire the greater energy?

(a)



(b)



A) (a)

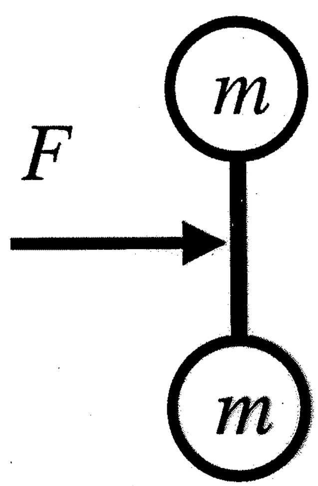
B) (b)

C) no difference

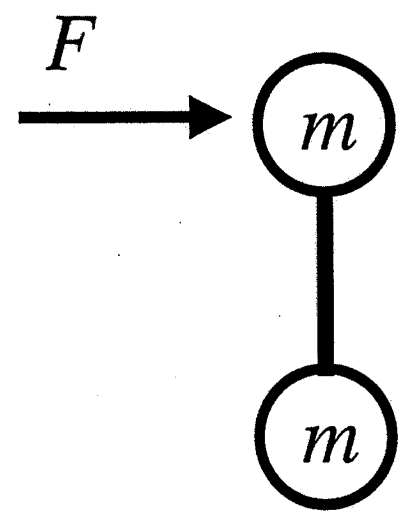
Interactive Question

A force F is applied to a dumbbell for a time interval Δt, first as in (a) and then as in (b). In which case does the dumbbell acquire the greater center-of-mass speed?

(a)



(b)



A) (a)

B) (b)

C) no difference

Conservation of <u>angular momentum</u>

We know linear momentum ($\vec{p}$) is conserved
Let's look at angular momentum

Linear	Angular	
Force (F)	Torque (τ)	$x \leftrightarrow \theta$
Kinetic Energy $\frac{1}{2}mv^2$	$\frac{1}{2}I\omega^2$	$v \leftrightarrow \omega$
		$a \leftrightarrow \alpha$
		$m \leftrightarrow I$
Linear momentum $\vec{p} = m\vec{v}$	angular momentum $\vec{L} = I\vec{\omega}$	
$\Sigma \vec{F} = m\vec{a} = \frac{\Delta \vec{p}}{\Delta t}$	$\Sigma \vec{\tau} = I\vec{\alpha} = \frac{\Delta \vec{L}}{\Delta t}$	
linear momentum conserved if no net external forces	angular momentum conserved if no net external torques	
$\Sigma \vec{p}_i = \Sigma \vec{p}_f$	$\Sigma \vec{L}_i = \Sigma \vec{L}_f$	
	$\Sigma I_i \omega_i = \Sigma I_f \omega_f$	
	$\Sigma m r_i^2 \omega_i = \Sigma m r_f^2 \omega_f$	