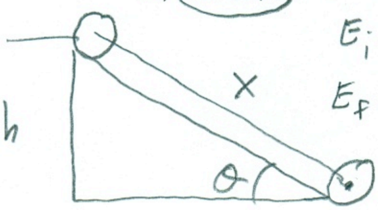
$I = \frac{1}{2} m R^2$ $\qquad V_t = R\omega$

5) A solid disk is released from rest and rolls without slipping down an inclined plane that makes an angle of 25.0° with the horizontal. What is the speed of the disk after it has rolled 3.00 m, measured along the plane? Use conservation of energy 5) A

A) 4.07 m/s B) 6.29 m/s C) 3.53 m/s D) 2.04 m/s E) 5.71 m/s



$E_i = mgh$, $h = X\sin\theta$

$E_f = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{1}{2}mR^2\right)\left(\frac{V}{R}\right)^2 = \frac{1}{2}mv^2 + \frac{1}{4}mv^2$

$= \frac{3}{4}mv^2 = mgx\sin\theta \Rightarrow V = \boxed{\sqrt{\frac{4}{3}gX\sin\theta}} = \sqrt{\frac{4}{3}(9.81)(3)\sin 25°}$

$= \boxed{4.07\ m/s}$

6) A disk, a hoop, and a solid sphere (all of mass M and radius R) are released at the same time at the top of an inclined plane. They all roll without slipping. In what order do they reach the bottom? 6) B

A) hoop, sphere, disk
B) sphere, disk, hoop
C) hoop, disk, sphere
D) disk, hoop, sphere
E) hoop, sphere, disk

$I_{disk} = \frac{1}{2}MR^2$, $I_{hoop} = MR^2$, $I_{sphere} = \frac{2}{5}MR^2$

$E_{tot} = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$

the small I, the larger K_{trans}

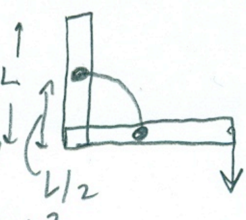
7) A figure skater is spinning slowly with arms outstretched. She brings her arms in close to her body and her angular speed increases dramatically. The speed increase is a demonstration of 7) A

A) conservation of angular momentum: her moment of inertia is decreased, and so her angular speed must increase to conserve angular momentum.
B) Newton's second law for rotational motion: she exerts a torque and so her angular speed increases.
C) conservation of energy: her moment of inertia is decreased, and so her angular speed must increase to conserve energy.
D) This has nothing to do with mechanics, it is simply a result of her natural ability to perform.

$L_i = L_f$ or $I_i\omega_i = I_f\omega_f$

8) A pencil, 15.7 cm long, is released from a vertical position with the eraser end resting on a table. The eraser does not slip. Treat the pencil like a uniform rod. What is the angular speed of the pencil just before it hits the table? 8) E

A) 3.70 rad/s
B) 7.23 rad/s
C) 16.8 rad/s
D) 24.5 rad/s
E) 13.7 rad/s



$I = \frac{1}{3}mL^2$

$E_i = mg\frac{L}{2}$, $E_f = \frac{1}{2}I\omega^2$

$mg\frac{L}{2} = \frac{1}{2}\left(\frac{1}{3}mL^2\right)\omega^2$

$\Rightarrow \omega = \sqrt{\frac{3g}{L}} = \sqrt{\frac{3(9.81)}{0.157}} = \boxed{13.7\ rad/s}$

9) Earth's radius is 6.38 × 106 m, and it completes one revolution every day. What is the tangential speed of a person standing on the equator? 9) D

A) 21.5 m/s B) 232 m/s C) 148 m/s D) 464 m/s E) 73.8 m/s

$V_t = R\omega$, $T = \frac{2\pi}{\omega}$

$V_t = \frac{2\pi R}{T}$

$= \frac{2\pi(6.38\times10^6)}{86400} = \boxed{463.97\ \frac{m}{s}}$

$T = 1\ day \times \frac{24\ hr}{1\ day} \times \frac{60\ min}{1\ hr} \times \frac{60\ sec}{1\ min}$

$= 86400\ s$