Problems 1 – 5 (2 pts each) – Circle the letter of each correct answer.

1. A long thin rod is fastened to a frictionless pin at one end, held horizontally, and then released. Which statement is true about its angular momentum?
   A. It does not change
   B. It decreases in magnitude
   C. It increases in magnitude

2. A car is slowing down while going around a banked turn as shown. (You are looking at the front headlights of the car.) What is the direction for the tangential acceleration?
   A. Right
   B. Left
   C. Up
   D. Down
   E. Up the incline
   F. Down the incline
   G. Out of the paper
   H. Into the paper

3. The value of $(\mathbf{\theta} \times \mathbf{v})$ is:
   A. $\mathbf{i}$
   B. $\mathbf{j}$
   C. $\mathbf{k}$
   D. $\mathbf{0}$
   E. $\mathbf{E}$
   F. $\mathbf{1}$

4. A hollow ring and a solid cylinder are rolled down an incline. If they start from the same location at the same time, which one reaches the bottom first?
   A. the hollow ring
   B. the solid cylinder
   C. the object with the greater mass
   D. the object with the greater radius
   E. a tie
   F. cannot determine

5. A person stands at the edge of a rotating circular platform and starts walking towards the center. What happens?
   A. The platform slows down
   B. The platform speeds up
   C. The rotation speed is unchanged

6. The object shown has uniform density and thickness. Determine the y-coordinate of the center of mass. All units are ft.

   $\bar{y} = \frac{48(y) + 120(6) + 8(1)}{48 + 120 + 8} = \frac{5,68}{216 + 6} = \frac{5,68}{222}$

7. A car is going around a 220 ft radius curve. At a given instant, the car has a speed of 64 ft/sec, its speed is decreasing, and it has a total acceleration of 22 ft/sec$^2$. How fast will the car going 3 seconds later?

   $a = \frac{v^2}{r} = \frac{64^2}{220} = 18.62 \text{ ft/sec}^2$

   $a = \sqrt{a_{x}^2 + a_{y}^2}$

   $a_{x} = \frac{v^2}{r} = \frac{64^2}{220}$

   $a_{y} = \sqrt{a_{x}^2 - a_{y}^2}$

   $v = v_0 + at$

   $v = 59.2 \text{ ft/sec}$

   $2a = \text{positive}$

   $v = 64 - 11.72(3)$

   $= 20.8 \text{ ft/sec}$
8. (15 pts) This 1.0 kg uniform rectangular object is positioned flat on a table and is constrained to rotate freely about an axis through point A that is perpendicular to the table. The moment of inertia about a parallel axis through its center of mass is 7.4 slug-ft<sup>2</sup>. Two forces act on the object as shown. Determine the angular acceleration and direction (CW or CCW).

\[
I = I_{CM} + md^2 = 7.4 + 1 \left( \sqrt{2} \right)^2 = 9.4 \text{ slug-ft}^2
\]

\[
T_A = -24 \cos 30 \cdot 5 + 24 \sin 30 \cdot 1.5
\]

\[
\alpha = \frac{T}{I} = \frac{37.92 \text{ ft-lb}}{9.4 \text{ slug-ft}^2} = 4.03 \text{ rad/sec}^2 \quad \text{CW}
\]

9. (15 pts) A string is wrapped around a 0.25m radius hollow cylinder with a mass of 0.5 kg. Determine the tension in the string as the cylinder falls.

\[
T = \frac{m}{I} = \frac{0.5}{4} \cdot (2) = 0.03125
\]

\[
T = 2.45 \text{ N}
\]

10. (15 pts) A 94 kg person is standing at the edge of a 6.0 m diameter platform rotating at a constant speed of 5 rpm. A 60 kg person then steps on the edge of the platform. What is the new rotational speed in rpm? (I_{platform} = 300 \text{ kg-m}^2)

\[
I = I_p + I_{qu} = 300 + 94(3)^2 + 60(3)^2 = 1686 \text{ kg-m}^2
\]

\[
\omega = \frac{I}{I_p} \omega_0 = \frac{300}{1686} \cdot 3 = 3.4 \text{ rev/min}
\]

11. (15 pts) Two objects are attached by a rope going around a heavy pulley that rotates freely. The system is released from rest. The 10 lb box slides on a rough horizontal surface while the pulley turns and the 30 lb block goes downward. Determine the speed of the 30 lb block when it hits the ground. The energy loss due to friction on the 10 lb object will be 12.5 ft-lbs.

\[
\text{COE} = -3 \text{ per term (10 A$/\text{s}$) if missing } \frac{m\gamma^2}{2}\frac{\text{m}}{2}\frac{\text{m}}{2}
\]

\[
PE = KE_t + KE_t + KE_P + E_{loss}
\]

\[
v = 8.97 \text{ ft/s}
\]