

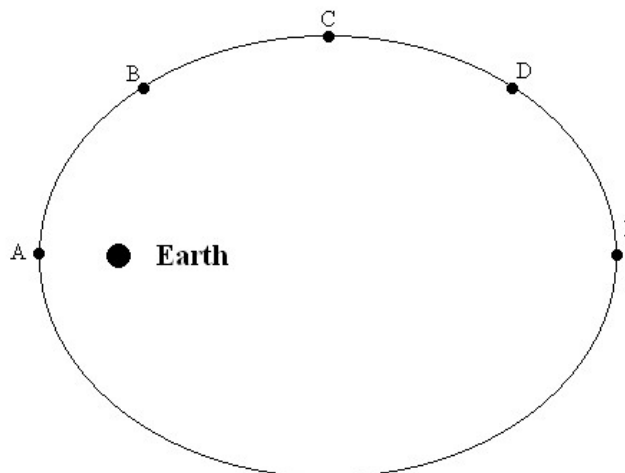
Sample Exam III

MULTIPLE CHOICE (4 pts each)

- 1) Consider a solid sphere of radius R and mass M , and a disk of mass m ($=\frac{1}{2} M$) and radius r ($=\frac{1}{2} R$). In a race rolling (without slipping) down an incline, the solid sphere wins. Which of the following is true?
 - A) The solid sphere and disk have the same moment of inertia.
 - B) The moment of inertia of the solid sphere is larger than that of the disk.
 - C) The moment of inertia of the disk is larger than that of the solid sphere.
 - D) There is no way to know which moment of inertia is larger.
 - E) There is no Choice E.
- 2) Consider a rigid body, not necessarily in equilibrium. Which of the following statements is always true?
 - A) If $\Sigma \vec{F}_n = 0$, then $\Sigma \vec{\tau}_n = 0$.
 - B) If $\Sigma \vec{\tau}_n = 0$, then $\Sigma \vec{F}_n = 0$.
 - C) If $\Sigma \vec{F}_n \neq 0$, then $\Sigma \vec{\tau}_n \neq 0$.
 - D) If $\Sigma \vec{\tau}_n \neq 0$, then $\Sigma \vec{F}_n \neq 0$.
 - E) None of these is always true.
- 3) Consider a solid sphere of mass M and radius R . What is the sphere's moment of inertia about an axis tangent to the surface of the sphere?
 - A) $\frac{2}{5} MR^2$
 - B) $\frac{3}{5} MR^2$
 - C) $\frac{7}{5} MR^2$
 - D) $\frac{3}{2} MR^2$
 - E) $2 MR^2$
- 4) Consider two point masses on the x -axis. M_1 has mass 45 kg and is at $x = 4\text{m}$, while M_2 has mass 35 kg and is located at $x = 9\text{m}$. Where is the center of mass?
 - A) 1.0 m
 - B) 6.2 m
 - C) 6.5 m
 - D) 6.8 m
 - E) 38 m

- 5) The moon orbits the earth on a path that is not circular, but elliptical, as shown with great exaggeration in the figure. At which of the labeled points will the moon's speed be greatest?

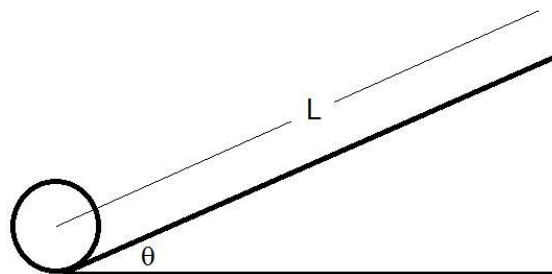
- A) A
- B) B
- C) C
- D) D
- E) E



PROBLEM I (20 pts)

Suppose that a solid sphere (mass M and radius R) is launched up an incline, as shown, and subsequently rolls without slipping. How far up the incline (L) will the disk go before stopping?

Let $M = 4 \text{ kg}$, $R = 0.02 \text{ m}$, $v_i = 12 \text{ m/s}$, and $\theta = 53^\circ$.

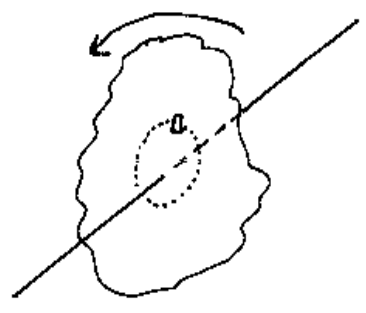


PROBLEM II (20 pts)

Consider a playground merry-go-round, a disk of mass 80 kg and radius 1.5 meters , rotating about a frictionless axis through its center. There are two twins, each of mass 30 kg , sitting at the edge of the disc. The angular speed of the ride is 7 rad/sec . Now, one of the twins moves to the center of the disk. What is the new angular speed?

PROBLEM III (20 pts)

Prove that the rotational kinetic energy of a rigid object as it turns about some axis with angular velocity ω is $KE_{\text{rot}} = \frac{1}{2}I\omega^2$, where $I (= \sum_n m_n r_n^2)$ is the moment of inertia of the object about that axis.



PROBLEM IIII (20 pts)

The blade of a circular saw of diameter 0.3 m accelerates uniformly from rest to 2800 rev/min in 32 seconds.

- A) Convert the final angular velocity to radians/second.
- B) What is the angular acceleration of the blade?
- C) Through what angle did the blade turn in this process?
- D) If the mass of the blade is 0.1kg, and the blade can be considered to be a disk, what net torque was applied to the blade during this process?

