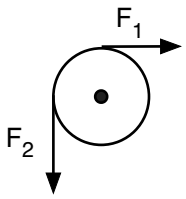
Rotation Problems Examples

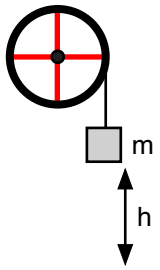
1. A disc of mass 3 kg and radius 0.25 meters is free to rotate about its center of mass. There are two forces acting on the disc as shown in the diagram. Both forces are tangent to the edge of the disc. F_1 is 5 N and F_2 is 9 N. What is the angular acceleration of the disc?



Extension: After 10 seconds, what is the change in angular velocity of the disc?

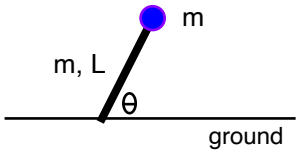
Rotation Problems Examples

2. A wheel is free to rotate about its center and is made of a hoop of mass 4 kg and radius 0.3 meters supported by two thin rods perpendicular to each other, each of mass 5 kg and length 0.6 meters. There is a 10 kg mass attached by a string that is wrapped around wheel. After the 10 kg mass has fallen 25 cm, what is the angular velocity of the wheel? The system started at rest.



Rotation Problems Examples

3. A thin rod of mass m and length L is leaning at an angle ø as shown in the diagram. The rod is on a hinge that is free to rotate, but otherwise held in place on the ground. At the end of the rod is an additional mass m. (Consider the extra mass a point mass.)

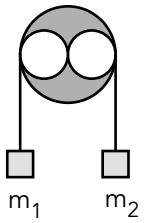


   a. What is the initial angular acceleration of the rod?

   b. What is the linear speed of the additional mass when it hits the ground?

Rotation Problems Examples

4. An Atwood's machine is made from a round shape that is free to rotate about its center of mass. The shape was made from a solid uniform disc of mass 10 kg and radius 0.5 meters from which two circular regions of radius 0.25 meters were cut out and removed. The cutouts were tangent to the center of the disc and to the edge of the disc, as shown. Two masses are attached via a light string wrapped around the shape (m_1 = 2 kg and m_2 = 3 kg.) What is the initial angular acceleration of the shape?



Answers:

1) α *= 10.7 rad/s² (counter-clockwise / out of the paper) &* $\Delta\omega$ *= 107 rad/s* *2)* ω *= 5.66 rad/s*

3.a) $\alpha = \frac{9g}{8L}cos\theta$ *b)* $v = \sqrt{\frac{9gL}{4}sin\theta}$ *4)* α *= 2.46 rad/s² (&* $I_{shape} = \frac{5}{16}MR^2$ *= 0.781 kg•m²)*