Ch 9 Supplemental [Edit]

Overview Summary View Diagnostics View **Print View with Answers**

Ch 9 Supplemental

Due: 6:59pm on Wednesday, November 16, 2016

To understand how points are awarded, read the Grading Policy for this assignment.

Exercise 9.10

Description: An electric fan is turned off, and its angular velocity decreases uniformly from omega_1 to omega_2 in a time interval of length Deltat. (a) Find the angular acceleration in (rev)/s^2. (b) Find the number of revolutions made by the motor in the time ...

An electric fan is turned off, and its angular velocity decreases uniformly from 510 $\mathrm{rev/min}$ to 160 $\mathrm{rev/min}$ in a time interval of length 3.90 s .

Part A

Find the angular acceleration in $\mathrm{rev/s^2}$.

ANSWER:

$\alpha = \dfrac{\frac{-(\omega_1-\omega_2)}{\Delta t}}{60}$ = -1.50 $\mathrm{rev/s^2}$

Part B

Find the number of revolutions made by the motor in the time interval of length 3.90 s .

ANSWER:

$N = \dfrac{\frac{(\omega_1+\omega_2)\Delta t}{60}}{2}$ = 21.8 rev

Part C

How many more seconds are required for the fan to come to rest if the angular acceleration remains constant at the value calculated in part A?

ANSWER:

$t = \dfrac{\omega_2}{\omega_1-\omega_2}\Delta t$ = 1.78 s

Exercise 9.24

Description: An electric turntable d in diameter is rotating about a fixed axis with an initial angular velocity of omega_0. The angular acceleration is alpha. (a) Compute the angular velocity after a time of t. (b) Through how many revolutions has the blade...

An electric turntable 0.800 m in diameter is rotating about a fixed axis with an initial angular velocity of 0.230 $\mathrm{rev/s}$. The angular acceleration is 0.905 $\mathrm{rev/s^2}$.

Part A

Compute the angular velocity after a time of 0.210 s .

ANSWER:

$\omega = \omega_0 + \alpha t$ = 0.420 $\mathrm{rev/s}$

Part B

Through how many revolutions has the blade turned in this time interval?

ANSWER:

$N = \dfrac{2\omega_0 + \alpha t}{2} t$ = 6.83×10^{-2} rev

Part C

What is the tangential speed of a point on the tip of the blade at time t = 0.210 s ?

ANSWER:

$v = \dfrac{(\omega_0 + \alpha t)\cdot 2\pi d}{2}$ = 1.06 $\mathrm{m/s}$

Part D

What is the magnitude of the resultant acceleration of a point on the tip of the blade at time t = 0.210 s ?

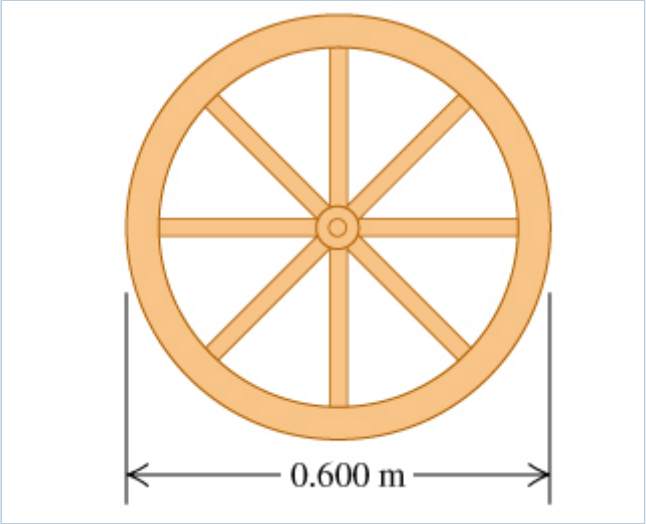
ANSWER:

$a = \sqrt{\left(\dfrac{((\omega_0 + \alpha t)\cdot 2\pi)^2 d}{2}\right)^2 + \left(\dfrac{2\pi\alpha d}{2}\right)^2}$ = 3.60 $\mathrm{m/s^2}$

Exercise 9.33

Description: A wagon wheel is constructed as shown in the figure . The radius of the wheel is 0.300 m, and the rim has mass m_1. Each of the eight spokes, that lie along a diameter and are 0.300 m long, has mass m_2. (a) What is the moment of inertia of the...

A wagon wheel is constructed as shown in the figure . The radius of the wheel is 0.300 m, and the rim has mass 1.34 kg . Each of the eight spokes, that lie along a diameter and are 0.300 m long, has mass 0.290 kg .



Part A

What is the moment of inertia of the wheel about an axis through its center and perpendicular to the plane of the wheel?

ANSWER:

$I = m_1 \cdot 0.300^2 + \frac{8}{3} m_2 \cdot 0.300^2 = 0.190 \quad \mathrm{kg \cdot m^2}$

Exercise 9.40

Description: You need to design an industrial turntable that is d in diameter and has a kinetic energy of K when turning at omega (rev/min). (a) What must be the moment of inertia of the turntable about the rotation axis? (b) If your workshop makes this...

You need to design an industrial turntable that is 53.0 cm in diameter and has a kinetic energy of 0.300 J when turning at 31.0 $\mathrm{rpm\ (rev/min)}$.

Part A

What must be the moment of inertia of the turntable about the rotation axis?

ANSWER:

$I = \frac{2K}{\omega^2} = 5.71 \times 10^{-2} \quad \mathrm{kg \cdot m^2}$

Part B

If your workshop makes this turntable in the shape of a uniform solid disk, what must be its mass?

ANSWER:

$m = \dfrac{16K}{\omega^2 d^2} = 1.63 \ \text{kg}$

Exercise 9.52

Description: A thin uniform rod of mass M and length L is bent at its center so that the two segments are now perpendicular to each other. (a) Find its moment of inertia about an axis perpendicular to its plane and passing through the point where the two...

A thin uniform rod of mass M and length L is bent at its center so that the two segments are now perpendicular to each other.

Part A

Find its moment of inertia about an axis perpendicular to its plane and passing through the point where the two segments meet.

Give your answer in terms of given quantities.

ANSWER:

$I = \dfrac{1}{12}ML^2$

Part B

Find its moment of inertia about an axis perpendicular to its plane and passing through the midpoint of the line connecting its two ends.

Give your answer in terms of given quantities.

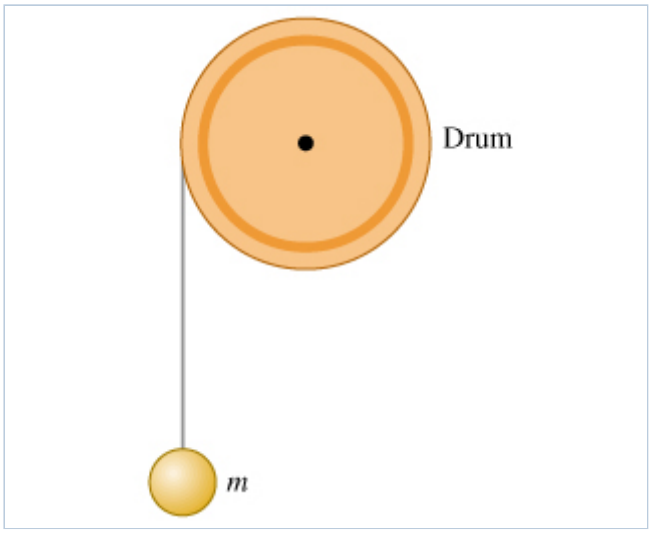
ANSWER:

$I = \dfrac{1}{12}ML^2$

Problem 9.62

Description: Engineers are designing a system by which a falling mass m imparts kinetic energy to a rotating uniform drum to which it is attached by thin, very light wire wrapped around the rim of the drum (the figure). There is no appreciable friction in the...

Engineers are designing a system by which a falling mass m imparts kinetic energy to a rotating uniform drum to which it is attached by thin, very light wire wrapped around the rim of the drum (the figure). There is no appreciable friction in the axle of the drum, and everything starts from rest. This system is being tested on earth, but it is to be used on Mars, where the acceleration due to gravity is 3.71 m/s^2. In the earth tests, when m is set to 17.0 kg and allowed to fall through 6.00 m , it gives 200.0 J of kinetic energy to the drum.



Part A

If the system is operated on Mars, through what distance would the 17.0-kg mass have to fall to give the same amount of kinetic energy to the drum?

ANSWER:

$h = \frac{g}{3.71}s = 15.8 \quad \mathrm{m}$

Part B

How fast would the 17.0-kg mass be moving on Mars just as the drum gained 200.0 J of kinetic energy?

ANSWER:

$v = \sqrt{2gs - \frac{2K}{m}} = 9.70 \quad \mathrm{m/s}$

Problem 9.66

Description: A computer disk drive is turned on starting from rest and has constant angular acceleration. (a) If it took t for the drive to make its second complete revolution, how long did it take to make the first complete revolution? (b) What is its angular...

A computer disk drive is turned on starting from rest and has constant angular acceleration.

Part A

If it took 0.680 s for the drive to make its *second* complete revolution, how long did it take to make the first complete revolution?

Express your answer with the appropriate units.

ANSWER:

$t = \dfrac{t}{\sqrt{2}-1} = 1.64\,\mathrm{s}$

Part B

What is its angular acceleration, in $\mathrm{rad/s^2}$?

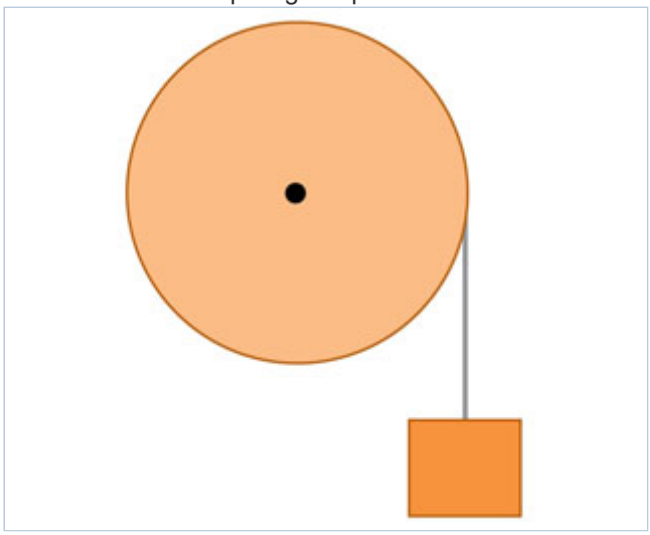
ANSWER:

$\alpha = \dfrac{2 \cdot 2\pi}{\left(\frac{t}{\sqrt{2}-1}\right)^2} = 4.66 \quad \mathrm{rad/s^2}$

Problem 9.69

Description: As an intern at an engineering firm, you are asked to measure the moment of inertia of a large wheel for rotation about an axis perpendicular to the wheel at its center. You measure the diameter of the wheel to be D. Then you mount the wheel on ...

As an intern at an engineering firm, you are asked to measure the moment of inertia of a large wheel for rotation about an axis perpendicular to the wheel at its center. You measure the diameter of the wheel to be 0.600 m . Then you mount the wheel on frictionless bearings on a horizontal frictionless axle at the center of the wheel. You wrap a light rope around the wheel and hang an 8.20-kg block of wood from the free end of the rope, as in . You release the system from rest and find that the block descends 12.0 m in 4.00 s.



Part A

What is the moment of inertia of the wheel for this axis?

Express your answer with the appropriate units.

ANSWER:

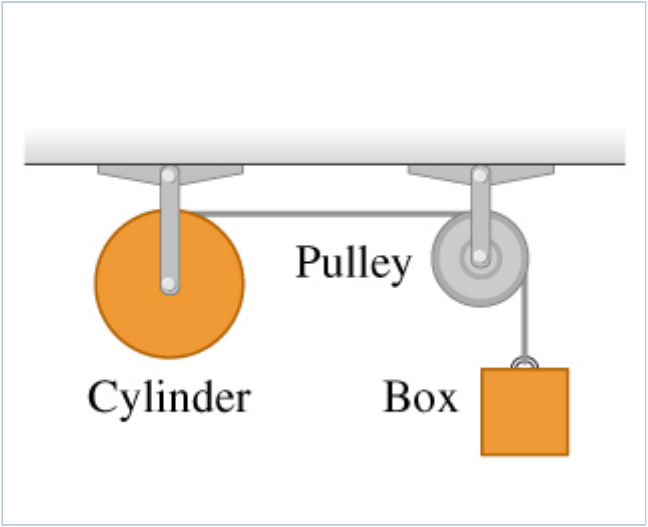
$I = \dfrac{\left(8.20\left(9.80 - \frac{2 \cdot 12}{4^2}\right)\right)\left(\frac{D}{2}\right)^2}{\frac{2 \cdot 12}{4^2}} = 4.08\,\mathrm{kg \cdot m^2}$

Also accepted: $\dfrac{\left(8.20\left(9.81 - \frac{2 \cdot 12}{4^2}\right)\right)\left(\frac{D}{2}\right)^2}{\frac{2 \cdot 12}{4^2}} = 4.09\,\mathrm{kg \cdot m^2}$, $\dfrac{\left(8.20\left(9.80 - \frac{2 \cdot 12}{4^2}\right)\right)\left(\frac{D}{2}\right)^2}{\frac{2 \cdot 12}{4^2}} = 4.08\,\mathrm{kg \cdot m^2}$

Problem 9.80

Description: In the following figure , the cylinder and pulley turn without friction about stationary horizontal axles that pass through their centers. A light rope is wrapped around the cylinder, passes over the pulley, and has a 3.00-kg box suspended from its...

In the following figure , the cylinder and pulley turn without friction about stationary horizontal axles that pass through their centers. A light rope is wrapped around the cylinder, passes over the pulley, and has a 3.00-kg box suspended from its free end. There is no slipping between the rope and the pulley surface. The uniform cylinder has mass 5.00 kg and radius 40.0 cm. The pulley is a uniform disk with mass 2.00 kg and radius 20.0 cm. The box is released from rest and descends as the rope unwraps from the cylinder.



Part A

Find the speed of the box when it has fallen 2.50 m.

ANSWER:

$v =$ 4.76 $\mathrm{m/s}$

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