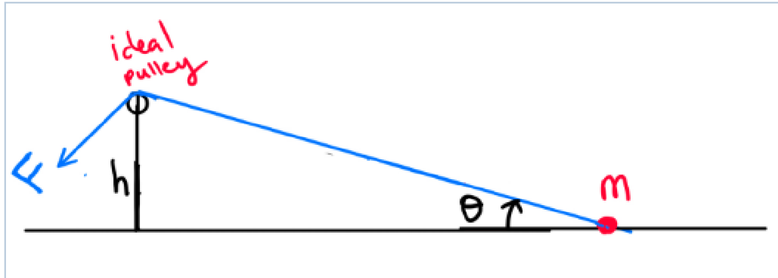
Problem 1

A small object with mass 2.20 kg is initially at rest on the ground, and it is attached to an ideal (massless) rope. The initial angle of the rope with the ground is θ_0 = 0.11 rad. Then the object is pulled by a constant force/tension 97.7 N until the object lifts off the ground. The height h of the ideal pulley is 60.0 cm . The rope remains tight in this problem, i.e., it forms the hypotenuse of the right triangle between the pulley, ground and object as shown in the figure. You may ignore all possible sources of fiction.



Part A

Find the angle θ at which the object lifts off the ground.

Express your answer in radians.

ANSWER:

θ = ______ rad

Part B

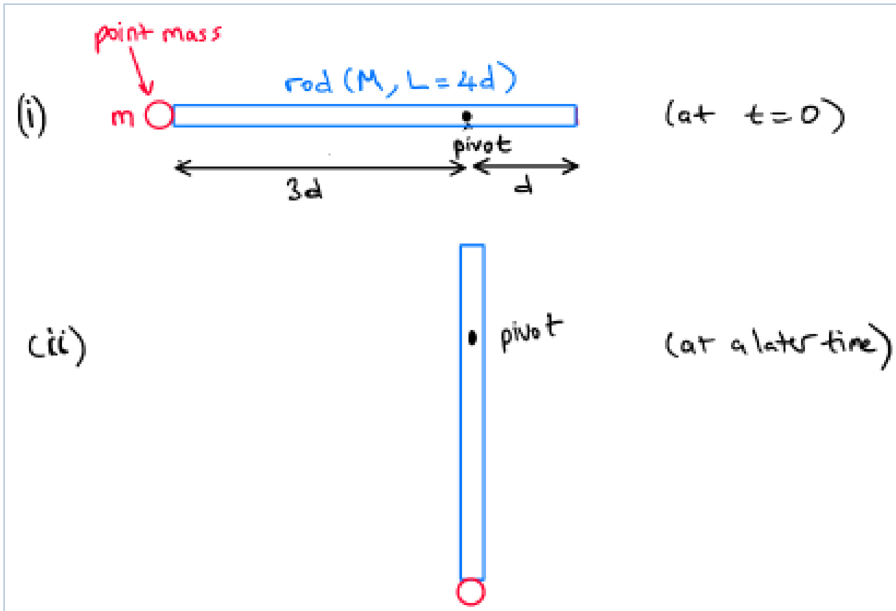
Find the speed of the object when it lifts off the ground.

ANSWER:

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

Problem 2

A thin, uniform 3.50 kg rod, 80.0 cm long, has very small 1.20 kg ball glued on one end. The radius of the ball is negligible. It is supported horizontally by a thin, horizontal, frictionless axle passing through perpendicular to the bar. The bar is released from rest at t = 0 s as shown in (i).



Part A

Find the angular acceleration of the rod just after its release.

Express your answer in radians per second squared.

ANSWER:

$|\alpha_z|$ = ______ $\mathrm{rad/s^2}$

Part B

Find the angular velocity of the rod just as it swings through its vertical position as shown in (ii).

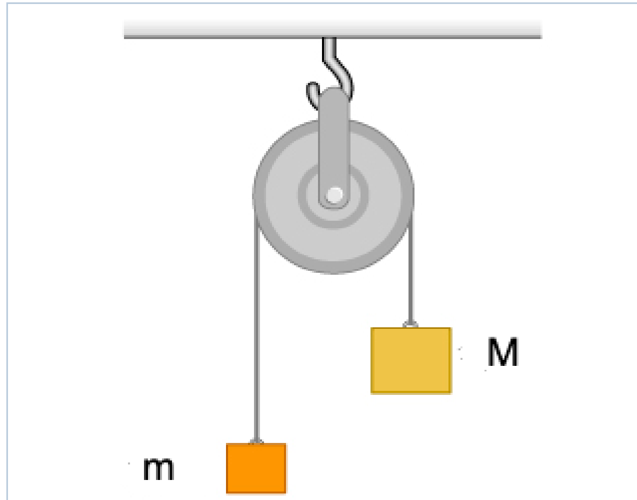
Express your answer in radians per second.

ANSWER:

ω = ______ $\mathrm{rad/s}$

Problem 3

Two masses are connected by a very light, flexible cord that passes over an 68.0 N frictionless pulley of radius 0.1 m. The pulley is a solid uniform disk and is supported by a hook connected to the ceiling. The mass on the right is 10 kg and the one on the left is 5.8 kg. The system is released from rest at time t = 0 s. Answer the following questions when the time is 7.5 s.



Part A

What force does the ceiling exert on the hook?

Express your answer with the appropriate units.

ANSWER:

F =

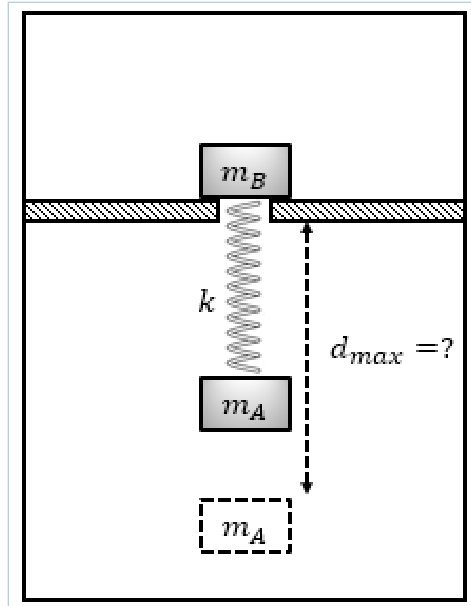
Part B - What is the total angular momentum of the system with respect to the center of the pulley?

ANSWER:

$|L_z|$ = kgm^2/s

Phys101F20Mt3Q4 - Copy

The figure shows two blocks A and B with respective masses m_A =250 g and m_B =380 g that are connected by an ideal spring of default length L =34 cm and spring constant k =2.4 N/m . Block B is held by two horizontal thin supports and block A is suspended underneath. The system is at rest. Take gravitational acceleration $g = 9.81 \mathrm{m/s^2}$. Check that your result is in the required unit and has 3 significant figures.



Part A -

Calculate the largest distance between the blocks, such that, when released from this distance, block A performs simple harmonic motion while block B remains at rest.

ANSWER:

d_{max} = m

Part B

Calculate the maximum speed block A can gain after it was released in part (a).

ANSWER:

v_{A-max} = m/s

Part C -

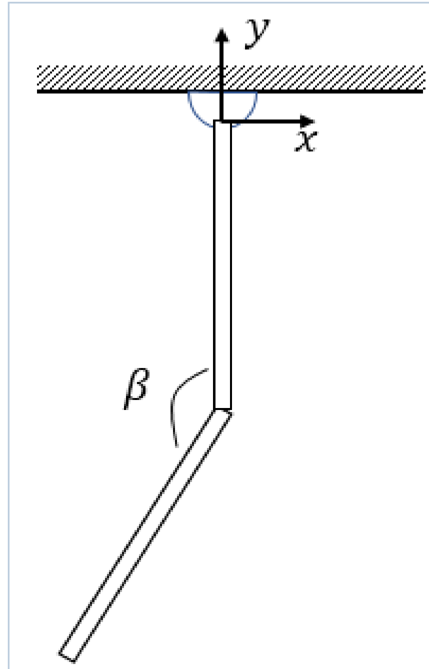
How many seconds after the release of block A does the normal force on B by the supports equal to its own weight?

ANSWER:

t = s

Phys101F20Mt3Q5

Two identical rods each of length $L = 0.7\ \mathrm{m}$ and mass m are joined at one end with an angle $\beta = 145\ \mathrm{degrees}$ between their axes to form a rigid body pendulum. Take $g = 9.81\mathrm{m/s^2}$. Make sure that your results are in the required unit and has 3 significant figures.



Part A

Find the coordinates of the center of mass of the object in the given coordinate system. Enter the coordinates in the form x, y (separated by comma).

ANSWER:

x_{CM}, y_{CM} = m

Part B -

Calculate the frequency of small oscillations of the joint rods, when it is hinged at one end. (Hint: Use the result of part-a)

ANSWER:

ω = s^{-1}

Part C

The joint rod system is released from rest when the hinged rod was in vertical position as shown in the figure. Find the maximum angular speed of the pendulum during oscillations.(Hint: What is the change in the vertical position of the center of mass when the angular speed is maximum?)

ANSWER:

ω_θ = rad/s