0. **(0 points)** /opt/webwork/webwork2/conf/snippets/ASimpleCombinedHeaderFile.pg

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Assignment PHY141_WW10 due 11/18/2022 at 11:59pm EST

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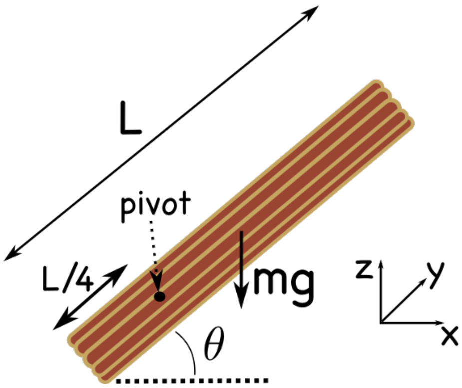
1. **(1 point)** setPHY141_WW10/log.pg

On torque



A log of mass m and length L is held by a pivot that is 1/4 of the distance from its left end. The log has a uniform density per unit length. The angle between horizontal and long axes is $\theta = 30$ degrees. The gravitational acceleration is g.

What is the torque on the log (about the pivot) due to gravity?

Enter a value for the magnitude of the torque:

$\tau =$ ___ m g L

You can enter a number!

Torque has a direction. Using the right-handed coordinate system defined in the above figure fill in the blanks with numbers

$\frac{\tau}{mgL} =$ ___ $\hat{\mathbf{x}} +$ ___ $\hat{\mathbf{y}} +$ ___ $\hat{\mathbf{z}}$

(Numbers should be accurate to 1 or 2 digits of precision.)

Check your signs!

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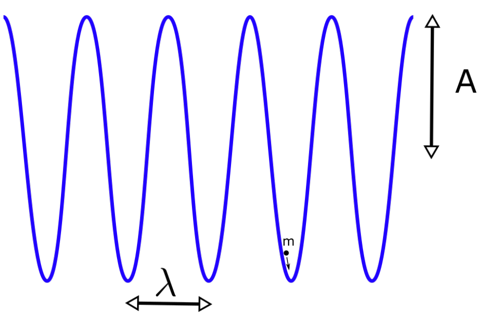
2. **(1 point)** setPHY141_WW10/small_osc.pg

On small oscillations



A particle of mass m is moving along the x axis. It feels a force with potential energy that is sinusoidal

$U(x) = -A\cos\left(\frac{2\pi x}{\lambda}\right)$

Here constant A is an amplitude and constant λ is a wavelength for the potential energy function.

The particle is near an equilibrium point.

The angular frequency ω of small oscillations about the equilibrium point is equal to

- $\sqrt{A 4\pi/m}$
- $\sqrt{\frac{A}{m}\frac{2\pi}{\lambda}}$
- $\sqrt{\frac{k}{m}}$
- $\sqrt{\frac{A}{\lambda m}}$
- None of these

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3. **(1 point)** setPHY141_WW10/unstable.pg

On an unstable equilibrium point

A particle of mass m is moving along the x axis under the influence of a force

$F = kx$

Notice that the force has the opposite sign as that of a spring that obeys Hooke's law.

The equation of motion is

$m\ddot{x} = kx$

Initial conditions at $t = 0$ are

$x(0) = \varepsilon$ and velocity $v(0) = 0$.

We assume that ε is small.

Here $v = \dot{x} = \frac{dx}{dt}$.

The solution at later times is approximately

$x(t) \approx$

- $\varepsilon\cos(\sqrt{\frac{k}{m}}t)$
- $\varepsilon\sin(\sqrt{\frac{k}{m}}t)$
- $\frac{\varepsilon}{2}e^{\sqrt{\frac{k}{m}}t}$
- $\frac{\varepsilon}{2}e^{-\sqrt{\frac{k}{m}}t}$
- $\varepsilon e^{-\sqrt{\frac{k}{m}}t}$
- $\varepsilon e^{\sqrt{\frac{k}{m}}t}$
- None of these

Hint: If $a > 0$ the exponential e^{at} grows quickly with time, whereas if $a < 0$ the exponential decays quickly.

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