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

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Assignment PHY141_WW3 due 09/23/2022 at 11:59pm EDT

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1. **(1 point)** setPHY141_WW3/spring.pg

On amplitude and phase of harmonic motion

A harmonic oscillator has displacement
$x(t) = A\cos(\omega t + \phi_0)$
and velocity
$v(t) = \frac{dx}{dt} = -A\omega\sin(\omega t + \phi_0)$
The angular frequency of oscillation is $\omega = 2$ radians per second.
$x(0), v(0)$ are the initial conditions and $x(t), v(t)$ are the solution at all later times.
At $t = 0$ the displacement is $x(0) = 1$ m and the velocity is $v(0) = 2$ m/s.
What are the amplitude A and phase ϕ_0?
Enter the amplitude $A =:$ ___ m
Enter the phase $\phi_0 :$ ___ radians
Note see this ¡a href="https://en.wikipedia.org/wiki/Atan2"¿ arctan link ¡/a¿ on quadrants if you are using an arctan function. You may need to add π to your phase. Enter numbers accurate to 1 decimal place. Enter $\phi_0 \in (-\pi, \pi]$.
atan2 link

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2. **(1 point)** setPHY141_WW3/spring2.pg

On sine and cosine coefficients for harmonic motion

A harmonic oscillator has displacement
$x(t) = A\cos(\omega t) + B\sin(\omega t)$
and velocity
$v(t) = \frac{dx}{dt} = -A\omega\sin(\omega t) + B\omega\cos(\omega t)$
The angular frequency of oscillation is $\omega = 1.5$ radians per second.
$x(0), v(0)$ are the initial conditions and $x(t), v(t)$ are the solution at all later times.
At $t = 0$ the displacement is $x(0) = 1$ m and the velocity is $v(0) = 4$ m/s.
What are the coefficients A and B?
Enter the coefficient $A =:$ ___ m
Enter the coefficient $B =:$ ___ m
(Enter numbers accurate to 1 decimal place).

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3. **(2 points)** setPHY141_WW3/dampedmotion.pg

On damped motion

A velocity dependent force is exerted on a particle giving equation of motion
$m\frac{d^2x}{dt^2} = -\alpha\frac{dx}{dt}$
where m is the particle mass and α is a damping coefficient.
The velocity $v = \frac{dx}{dt}$ obeys
$\frac{dv}{dt} = -\frac{\alpha}{m}v$

The particle has mass $m = 5$ kg, damping coefficient $\alpha = 1$ s^{-1} and initial velocity $v(t = 0) = v_0 = 5$ m/s.

A general solution for the velocity is
$v(t) = Ae^{-at}$
with coefficients A, a.
What are the coefficients A, a?
Enter a value for A: ___ m/s
Enter a value for a: ___ s

At what time t is the velocity equal to 0.5 m/s?
Enter a value for t : ___ s
(All answers should be numbers accurate to 1 decimal place).

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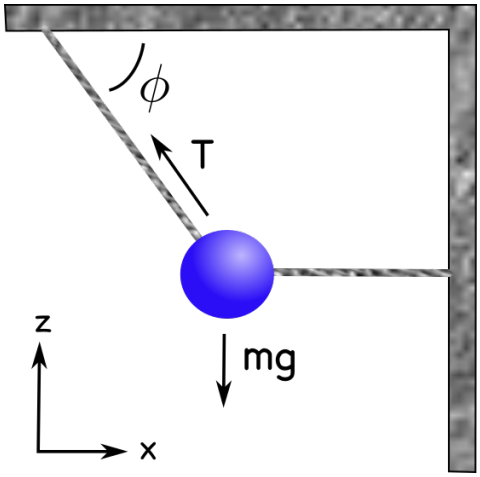
4. **(1 point)** setPHY141_WW3/2strings.pg

On Force directions



A ball of mass m is suspected by two strings. The one on the right is horizontal. The angle between the leftmost string and horizontal is ϕ.
The tension the leftmost string tension exerts a force **T** on the ball.
Gravity exerts a downward force on the ball.
x, z coordinate axes are shown on the left.
Which is equivalent to T_x, the x component of the tension force vector?

- A. mg
- B. $T\cos\phi$
- C. $T\sin\phi$
- D. $-T\cos\phi$
- E. $-T\sin\phi$
- F. $-mg$

Which is equivalent to T_z, the z component of **T** ?

- A. mg
- B. $-mg$

- C. $T\cos\phi$
- D. $-T\sin\phi$
- E. $-T\cos\phi$
- F. $T\sin\phi$

(Note: you have to have all correct answers checked and none of the incorrect answers checked for the problem to be marked as correct).

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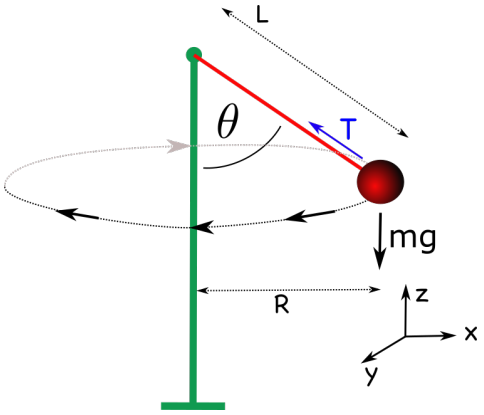
5. **(2 points)** `setPHY141_WW3/tether.pg`

On force directions.

A tether ball is undergoing circular motion while attached to a pole by a string.



The angle between pole and the string is $\theta = 60\ ^\circ$.

The tension on the string is $T = 3$ N (here N is Newtons).
A Cartesian coordinate system is shown on the lower right.
At a particular moment, the ball is on the x axis (it has a maximum x value in its orbit). At this moment in time what are the vector components of the force on the ball due to tension in the string?
$\mathbf{T} =$ _____ $\hat{\mathbf{x}}$ + _____ $\hat{\mathbf{z}}$ (N).
Here $\hat{\mathbf{x}}, \hat{\mathbf{z}}$ are unit vectors pointing in x and z coordinate directions, respectively. Enter numbers good to 1 or 2 decimal places. Check your signs.
What is the mass of the ball?
$m =$ _____ kg.
Enter a number good to 1 or 2 decimal places.

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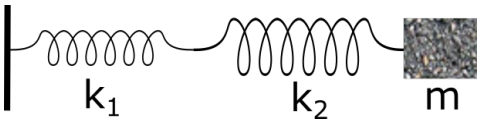
6. **(1 point)** `setPHY141_WW3/twospring.pg`

On springs in series

Two springs are connected in series to a mass that rests on a frictionless surface.



The spring constants are $k_1 = 2$ N/m, $k_2 = 1$ N/m, and the mass is $m = 4$ kg.
Enter a value for the Period of oscillation P: _____ s.
(Enter a number good to 1 decimal place).