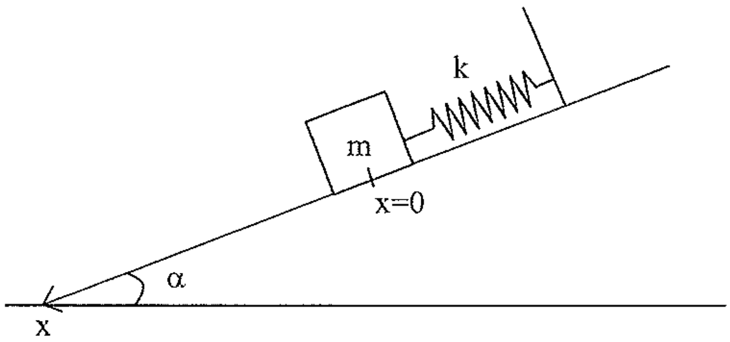
PHYS 101: General Physics	KOÇ UNIVERSITY College of Sciences	Fall Semester 2012
Section 1	Quiz 7	15 November 2012

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes
First Name: Last name: Student ID: Signature:



A block of mass m is situated on a frictionless plane inclined by α. The block is connected to a spring of negligible mass with force constant k. The block is initially at rest and located at the unstretched position of the spring (x=0). The block is then released, and it starts performing its motion. Find out the maximum elongation of the spring (maximum x value) during the motion of the block? Consider the x-axis to be along the inclined plane as shown in the figure above. Your answer should be a function of m, g, α, and k.

From energy conservation: $K_1 + U_1 = K_2 + U_2$

$K_1 = 0 \Rightarrow$ The block is initially at rest

$K_2 = 0 \Rightarrow$ maximum elongation

$U_1 = U_2$

$mg x_{max} \sin\alpha = \frac{1}{2} k x_{max}^2$

$$\boxed{x_{max} = \frac{2mg\sin\alpha}{k}}$$

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Section 2 | **Quiz 7** | **15 November 2012**

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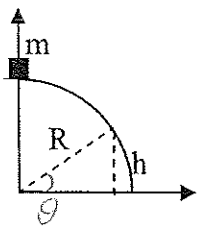

Consider a particle with mass m that is initially at rest located at the top of a circular frictionless track with radius R. After it is released from the top, the particle moves down along the circular track until a critical position at which it looses contact with the track. Find an expression for the vertical position h of the particle at this position. (Gravitational acceleration is g)

Surface reaction force, $\vec{n}$, becomes zero after particle loses contact with the track.

$$mgR = mgh + \frac{1}{2}mv^2 \Rightarrow \frac{1}{2}v^2 = g(R-h)$$ [From Energy Conservation]

$$mg\sin\theta = \cancel{n}^{\,0} + m\frac{v^2}{R} \qquad \sin\theta = \frac{h}{R}$$

$$mg\frac{h}{R} = m\frac{v^2}{R} \Rightarrow v^2 = gh.$$

Substituting v^2 above: $\frac{1}{2}\cancel{g}h = (R-h)\cancel{g}$

$$\frac{1}{2}h = R-h \Rightarrow \boxed{h = \frac{2R}{3}}$$

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Section 3 | Quiz 7 | 15 November 2012

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Quiz duration: 15 minutes

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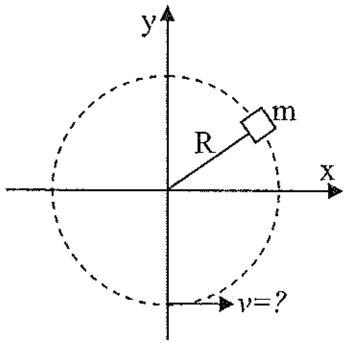

A particle of mass m suspended with a massless, unstretchable string of length R makes vertical circular motion. The speed of the mass is minimum at the highest point so as it barely swings through a complete vertical circle. (Gravitational acceleration is g)

a) What is the speed of the mass at the highest point of the vertical circle?
b) What is the speed of the mass at the lowest point of the vertical circle?

a) "Barely swinging" implies that tension in the string is zero, and $m\frac{v_1^2}{R} = mg \Rightarrow v_1 = \sqrt{gR}$

b) From conservation of energy;

$$K_1 + U_1 = K_2 + U_2 \quad , \quad U_2 = 0$$

$$\frac{1}{2}mv_1^2 + 2mgR = \frac{1}{2}mv_2^2$$

$$\frac{1}{2}\cancel{m}gR + 2\cancel{m}gR = \frac{1}{2}\cancel{m}v_2^2$$

$$v_2 = \sqrt{5gR}$$

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Section 4	Quiz 7	15 November 2012

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Quiz duration: 15 minutes
First Name: Last name: Student ID: Signature:

A particle moves along the x-axis while acted on by a single conservative force parallel to the x-axis. The force corresponds to the potential energy function: $U(x) = x^3 - 4x$.

(a) Which value or values of x correspond to the equilibrium points?
(b) What is the work done by the force as the particle moves from $x=0$ to $x=4\ m$.
(c) What is the x-component of the force applied on the particle at $x=4\ m$.

a) At equilibrium points $\frac{dU}{dx} = 0$

$\frac{dU}{dx} = 3x^2 - 4$ $\quad 3x^2 - 4 = 0$ $\quad x = \pm\sqrt{\frac{4}{3}}$

b) $W = U_1 - U_2$

$= U(0) - U(4)$

$= -48\ J$

c) $F_x = -\frac{dU}{dx}$

$F_x = -3x^2 + 4$

$F_x(4) = -44\ N$

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Section 5 | Quiz 7 | 15 November 2012

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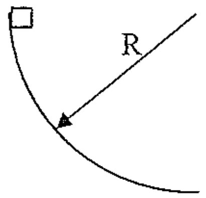
Quiz duration: 10 minutes

First Name: **Last name:** **Student ID:** **Signature:**



A block of mass m slides on a frictionless quarter - circular curved path of radius R. The block starts from the rest. (Gravitational acceleration is g)

a) What is the speed of the block at the bottom of the curve?
b) What is the net force on the block at the bottom of the curve?
c) What is the magnitude of the normal applied to the block at the bottom of the curve?

a) Using conservation of energy:

$$\cancel{K_1}^{0} + U_1 = K_2 + \cancel{U_2}^{0}$$

$$mgR = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{2gR}$$

b) Block is subject to angular acceleration.

$$F_{net} = m\frac{v^2}{R} = 2mg, \quad \text{upward.}$$

c) $n = mg + m\frac{v^2}{R}$

$= mg + 2mg$

$= 3mg$