PHYS 101: General Physics 1 KOÇ UNIVERSITY Fall Semestre 2010

College of Sciences

Section 1 Quiz 8 09 December 2010

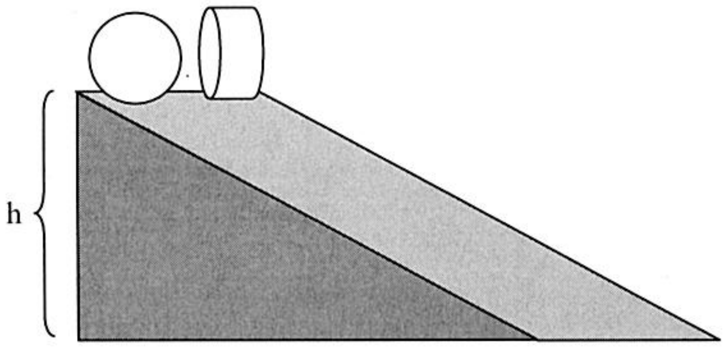
Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: Student ID: Signature:

A spherical shell and a solid cylinder are released from the top of the inclined plane with height h shown below while they were initially at rest. The masses and radii of the sphere and cylinder are equal and they are represented by M and R respectively. Using $I_{sphericalshell} = MR^2$ and $I_{cylinder} = \frac{1}{2}MR^2$ answer the following questions. Express your answers as functions of g, h, M, and R.

a) What are the speeds of the two objects at the bottom of the incline if they roll down without slipping?

b) Which of the two objects will reach the bottom of the incline first?



Cylinder $\rightarrow$ $$Mgh = \frac{1}{2}MV_1^2 + \frac{1}{2}I w^2$$

$$Mgh = \frac{1}{2}MV_1^2 + \frac{1}{4}MR^2\frac{V_1^2}{R^2} = \frac{3}{4}MV_1^2$$

$$V_1 = \sqrt{\frac{4}{3}gh} \text{ m/s}$$

Spherical shell $\rightarrow$ $$Mgh = \frac{1}{2}MV_2^2 + \frac{1}{2}MR^2\frac{V_2^2}{R^2} = MV_2^2$$

$$V_2 = \sqrt{gh} \text{ m/s}$$

Since $V_1 > V_2$ Cylinder arrives first.

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Section 2 Quiz 8 09 December 2010

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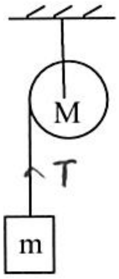
Quiz duration: 10 minutes

Name: Student ID: Signature:

A block of mass m is tied to the free end of a cable wrapped around a cylindrical shell with mass M and radius R. As the block falls, the cable unwinds without stretching or slipping. What is the tension on the string? ($I_{cylindrica\ lshell} = MR^2$ where R is the radius)



$\sum F = ma$

$\sum \tau = I\alpha$ $\quad \alpha = \frac{a}{R}$

$mg - T = ma \implies \underline{T = m(g-a)}$

$T\cancel{R} = MR^{\cancel{2}} \frac{a}{\cancel{R}} \implies \underline{T = Ma}$

Then $mg - ma = Ma$

$mg = (M+m)a \implies \boxed{a = \frac{mg}{M+m}}$

$$\boxed{T = \frac{Mmg}{M+m}}$$

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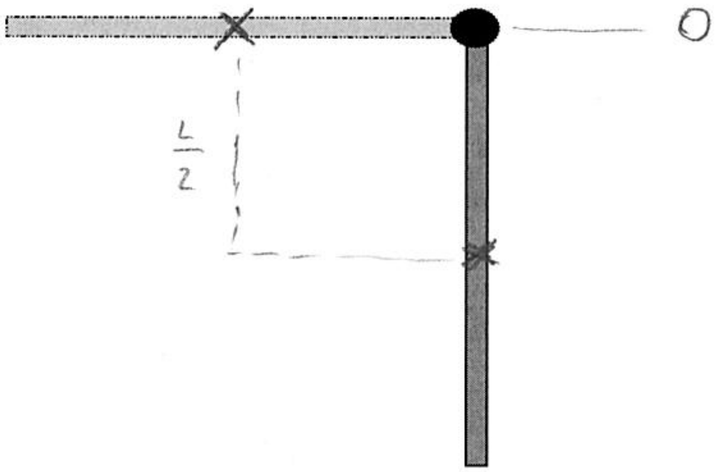
Section 3 **Quiz 8** **09 December 2010**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

A thin uniform rod of length L and mass M is attached from one end to a freely rotating pivot. The rod is released at a horizontal position and swings downwards under the influence of gravity. Find the angular velocity of the rod when it comes to a vertical position as shown in the figure. (The moment of inertia of a rod with mass M and length L about its center of mass is $I_{rod,\ CM} = \frac{1}{12}ML^2$)



$$I = I_{cm} + Md^2$$

$$= \frac{1}{12}ML^2 + \frac{ML^2}{4}$$

$$= \frac{1}{3}ML^2$$

$$K_1 + U_1 = K_2 + U_2$$

$$0 + 0 = \frac{1}{2}Iw^2 - mg\frac{L}{2} \Rightarrow w = \sqrt{\frac{mgL}{I}}$$

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Section 4 **Quiz 8** **09 December 2010**

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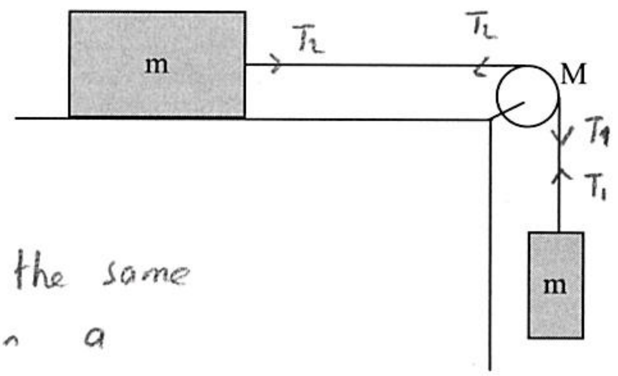
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

A box with mass m resting on a horizontal, frictionless surface is attached to another box with mass m by a thin, light wire that passes over a frictionless pulley. The pulley has the shape of a uniform solid disk of mass M and radius R. After the system is released, find acceleration of both boxes. ($I_{disk}=\frac{1}{2}MR^2$ where R is the radius)



$\Sigma F = ma$

$\Sigma \tau = I\alpha$

Both will have the same acceleration a

$mg - T_1 = ma$ (1)

$T_2 = ma$ (2)

$(T_1 - T_2)R = \frac{1}{2}MR^2\frac{a}{R} \Rightarrow T_1 - T_2 = \frac{1}{2}Ma$ (3)

(1) + (2) + (3)

$mg = 2ma + \frac{Ma}{2}$

$a = \frac{mg}{2m + M/2}$

PHYS 101: General Physics 1 **KOÇ UNIVERSITY** **Fall Semestre 2010**

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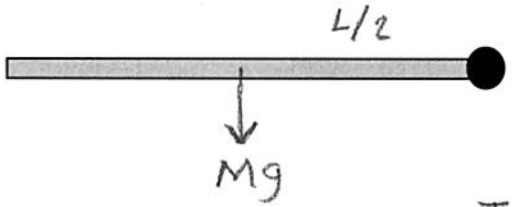
Section 5 **Quiz 8** **09 December 2010**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

A thin uniform rod of length L and mass M is attached from one end to a freely rotating pivot. The rod is released at a horizontal position and swings downwards under the influence of gravity. Find the angular accelaration of rod immediately after it is released. (The moment of inertia of a rod with mass M and length L about its center of mass is $I_{rod,\,CM}=\frac{1}{12}ML^2$)



$$\sum \tau = I\alpha$$

$$\cancel{M}g\frac{L}{2} = \frac{1}{3}\cancel{M}L^{\cancel{2}}\cdot\alpha$$

$$\alpha = \frac{3g}{2L}$$

$$I = I_{cm} + Md^2$$

$$= \frac{1}{12}ML^2 + M\frac{L^2}{4}$$

$$= \frac{1}{3}ML^2$$