PHYS 101: General Physics 1 KOÇ UNIVERSITY Fall Semester 2012

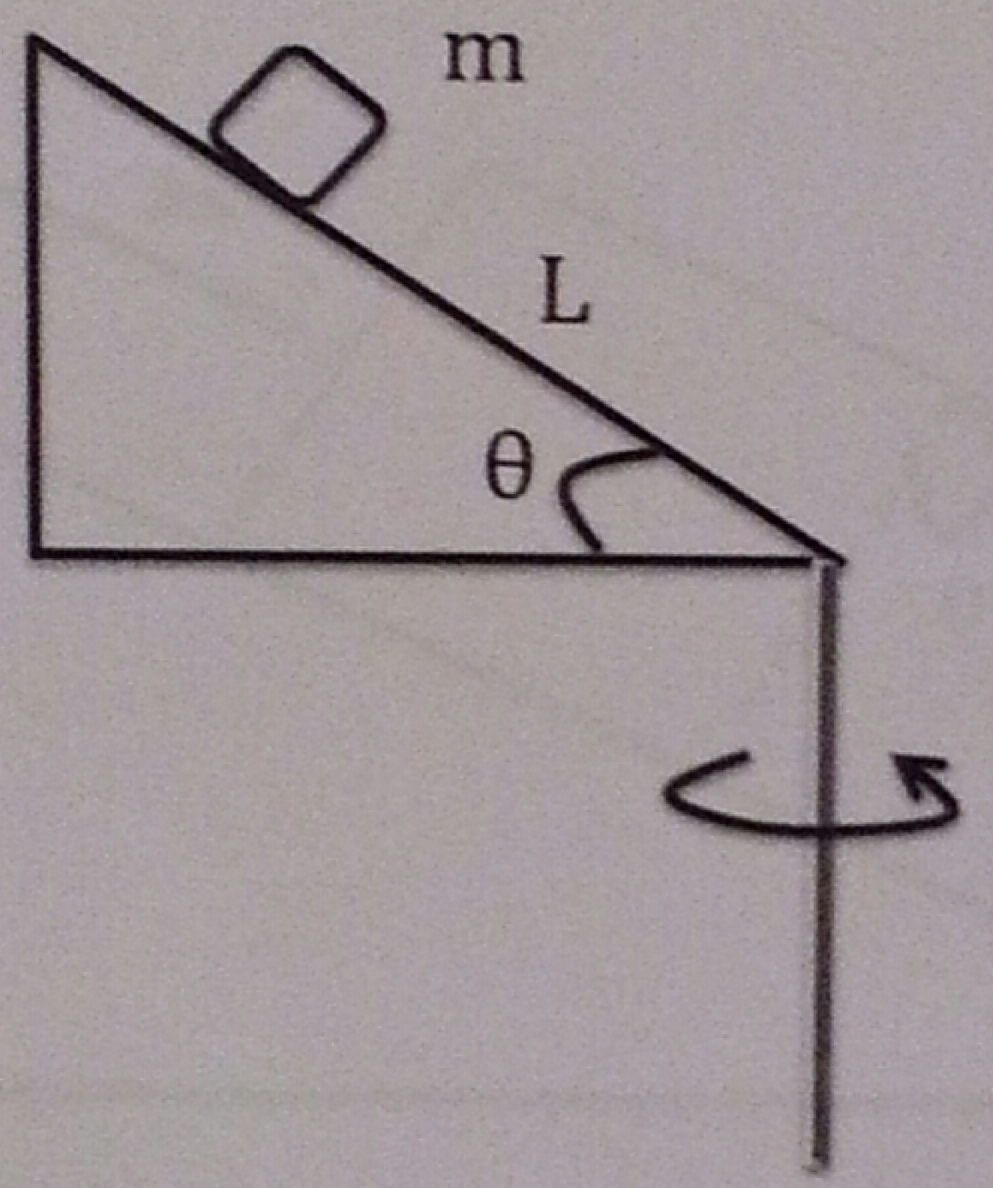
College of Sciences

Section 2 Quiz 5 1 November 2012

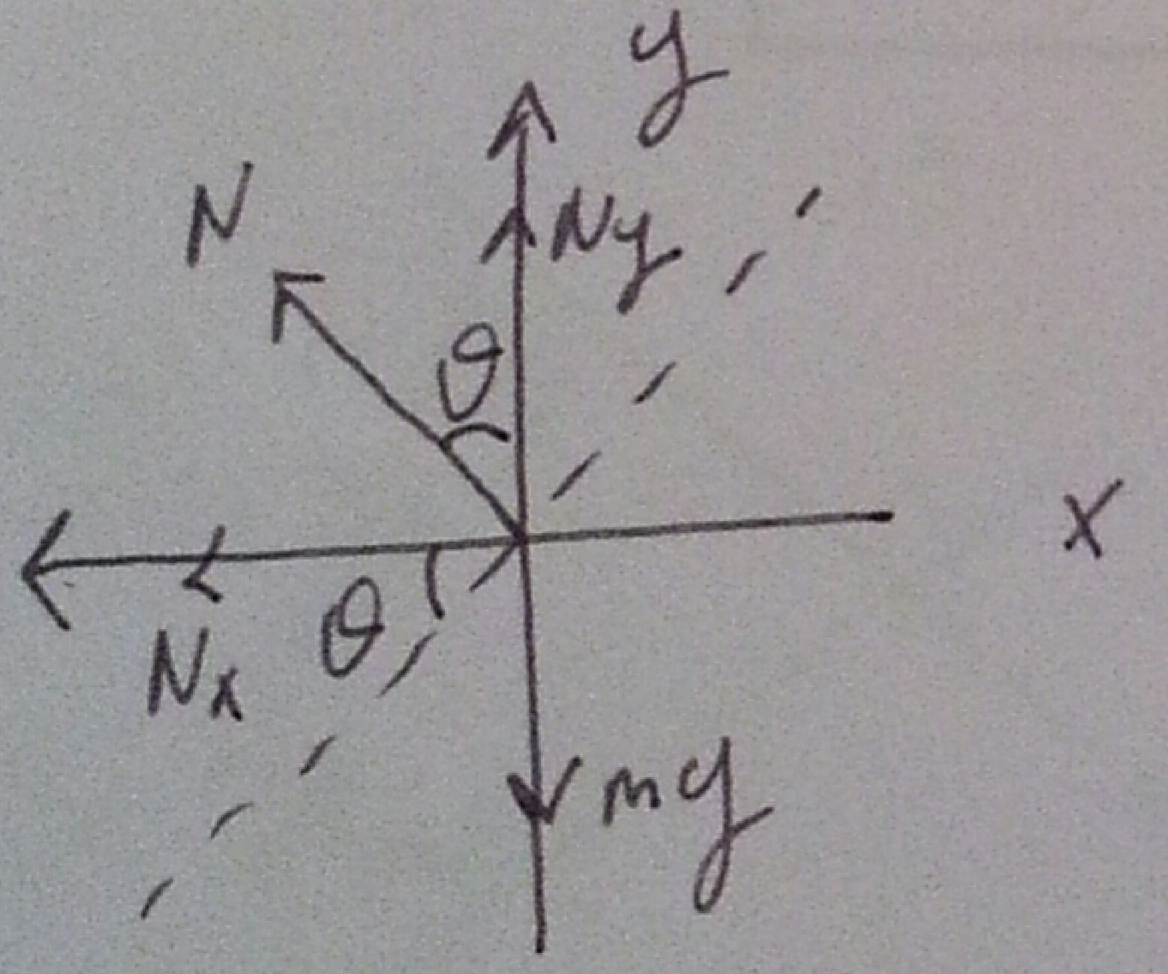
**Closed book. No calculators are to be used for this quiz.**
**Quiz duration: 10 minutes**

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

A particle of mass m remains at a constant height on a frictionless wedge, firmly attached to a vertical rod rotating at a certain constant rate. Find the velocity of the particle in terms of the parameters θ, L shown in the figure and the gravitational acceleration g.




Solution




$$mg \sin\theta = m a_{rad} \cos\theta$$

$$-N + mg\cos\theta = -m a_{rad} \sin\theta$$

$$N_y = N\cos\theta = mg$$

$$N_x = N\sin\theta = m\frac{v^2}{R}$$

$$v = \left[\frac{g\sin\theta R}{\cos\theta}\right]^{1/2} \; ; \; R = L\cos\theta$$

**PHYS 101: General Physics 1** **KOÇ UNIVERSITY** **Fall Semester 2012**

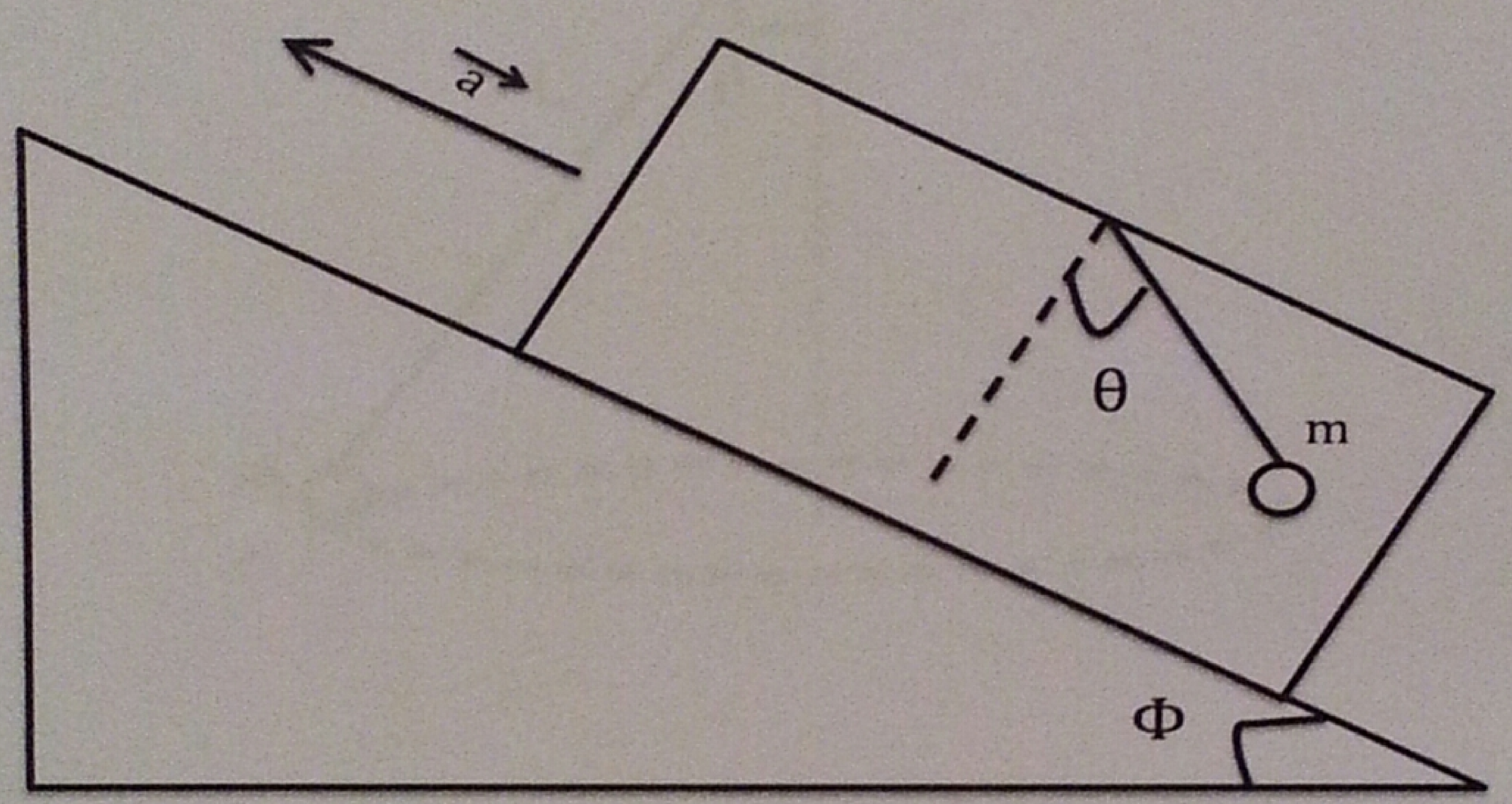
**College of Sciences**

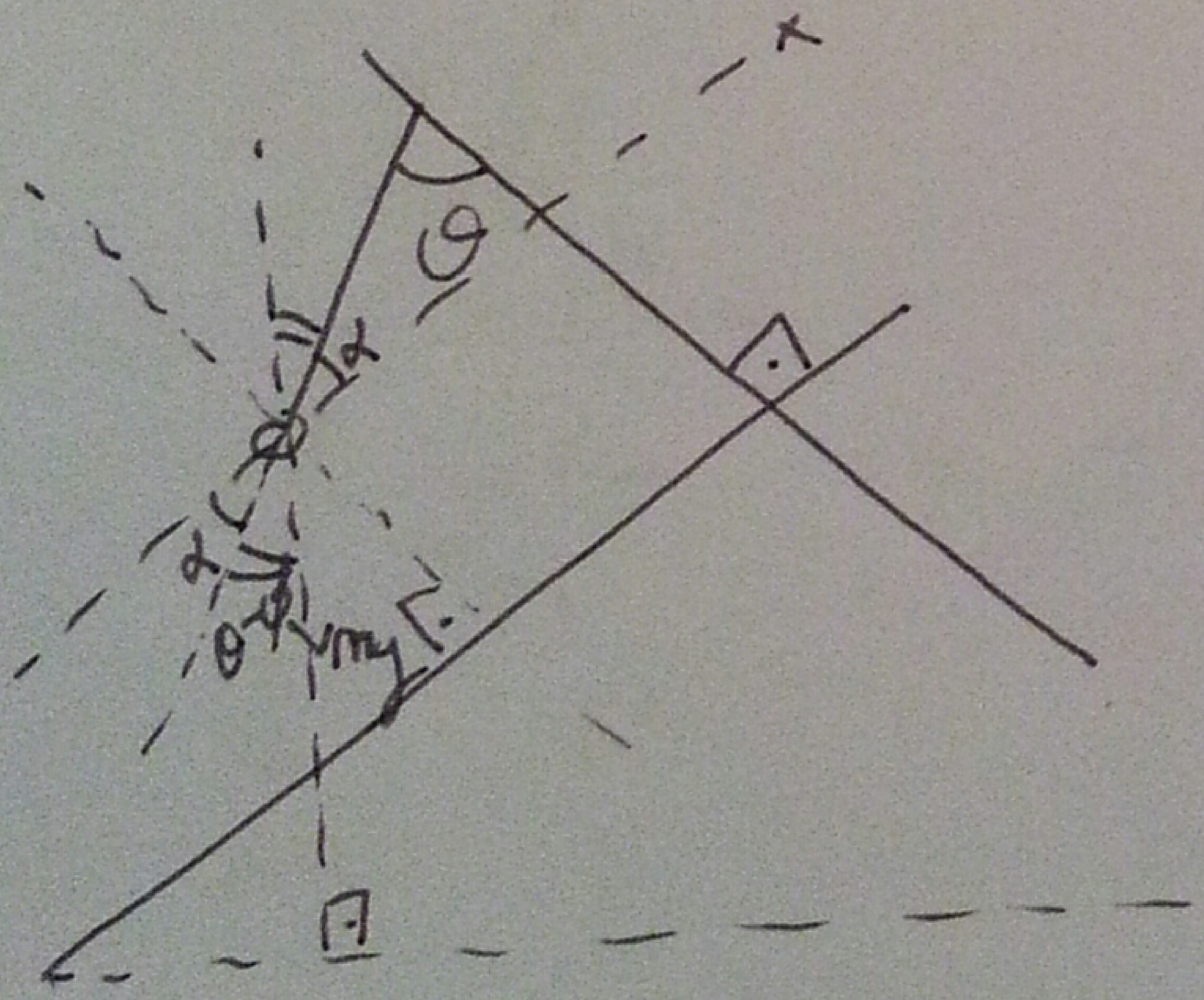
**Section 5** **Quiz 5** **1 November 2012**

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

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

A particle of mass m is suspended from the ceiling of a hollow block by a massless cord as shown in the figure. The block is pulled up a wedge that makes an angle Φ with the horizontal at a constant accelaration a. If the cord makes a constant angle θ the perpendicular to the ceiling, what is a in terms of Φ, θ and gravitational acceleration g.




$$T\sin\theta - mg\sin\phi = ma$$

$$-mg\cos\phi + T\cos\theta = 0$$

$$\Rightarrow T = \frac{mg\cos\phi}{\cos\theta}$$

$$\Rightarrow mg\tan\theta\cos\phi - mg\sin\phi = ma$$

$$\Rightarrow a = g(\tan\theta\cos\phi - \sin\phi).$$

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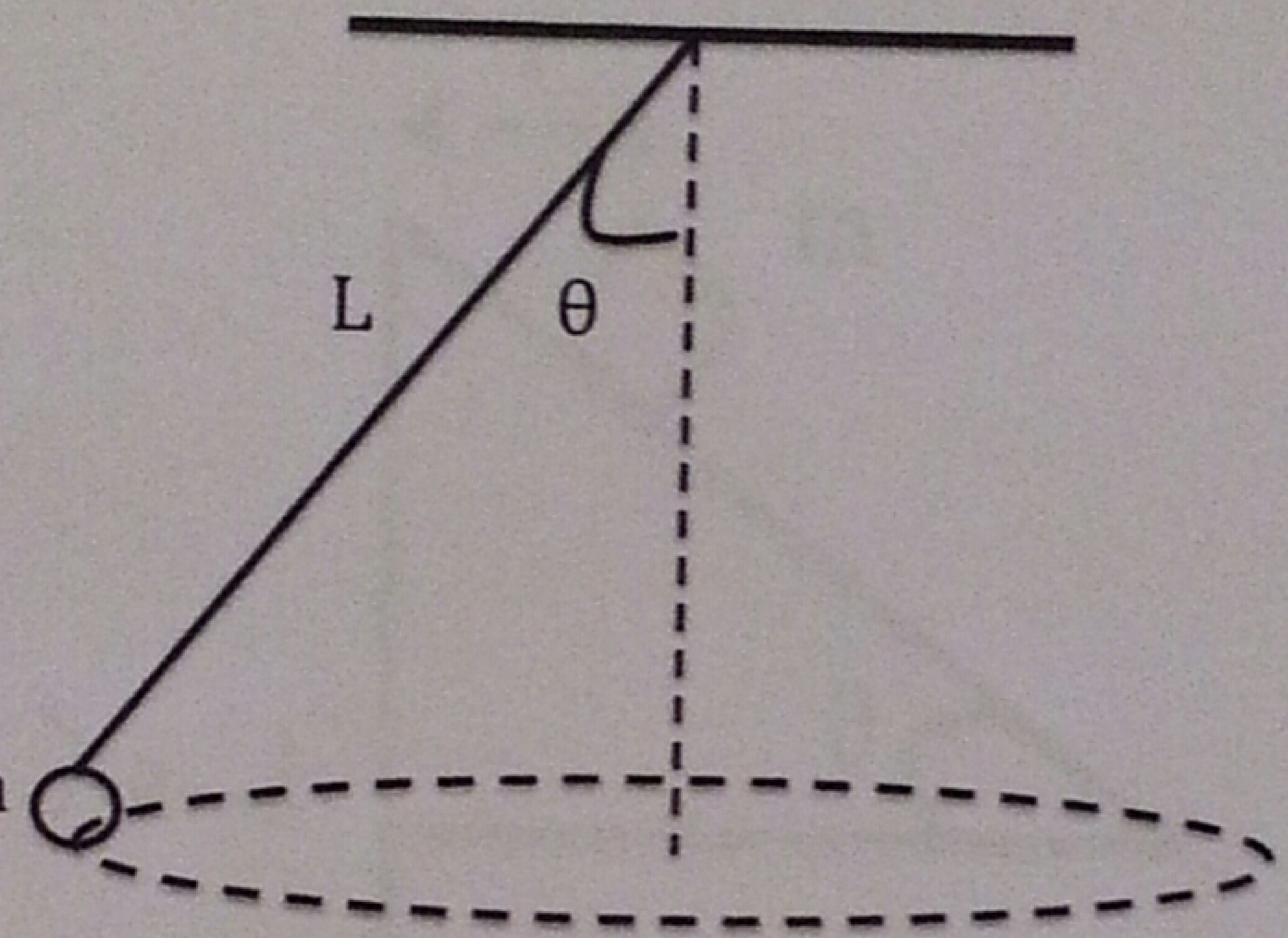
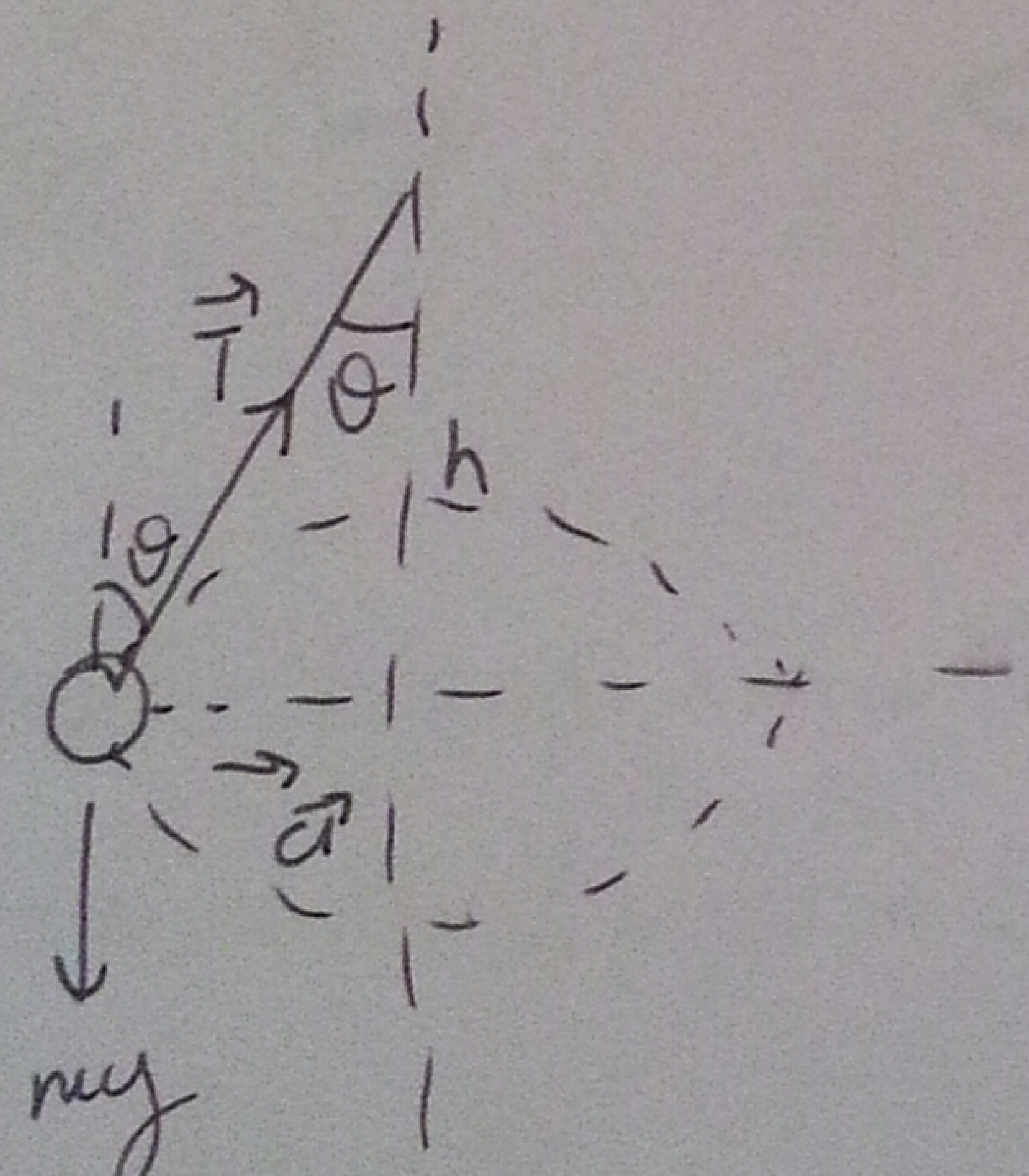
Section 4 — Quiz 5 — 1 November 2012

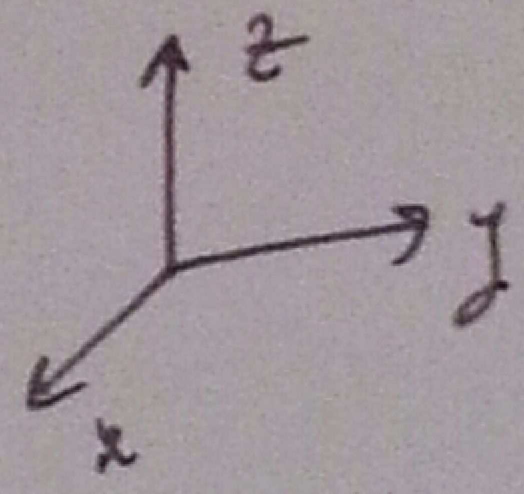
**Closed book. No calculators are to be used for this quiz.**
**Quiz duration: 10 minutes**

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

A conical pendulum with a bob of mass m on a string of length L that makes an angle of θ with the vertical is shown in the figure. Calculate the period of the rotation of the bob in terms of L, θ and the gravitational accelaration g.




$$T\cos\theta - mg = 0 \Rightarrow T = \frac{mg}{\cos\theta}$$

$$T\sin\theta = ma$$

$$\Rightarrow v = \sqrt{gR\tan\theta} = \frac{\overset{\omega}{2\pi} R}{T}$$

$$\Rightarrow \omega = \left[\frac{g}{R}\tan\theta\right]^{1/2}$$

$$T_x = (T\sin\theta)\cos\phi, \quad \phi = \omega t, \quad \tan\theta = \frac{R}{h} \Rightarrow \omega\sqrt{\frac{g}{h}}$$

$$; h = L\cos\theta$$

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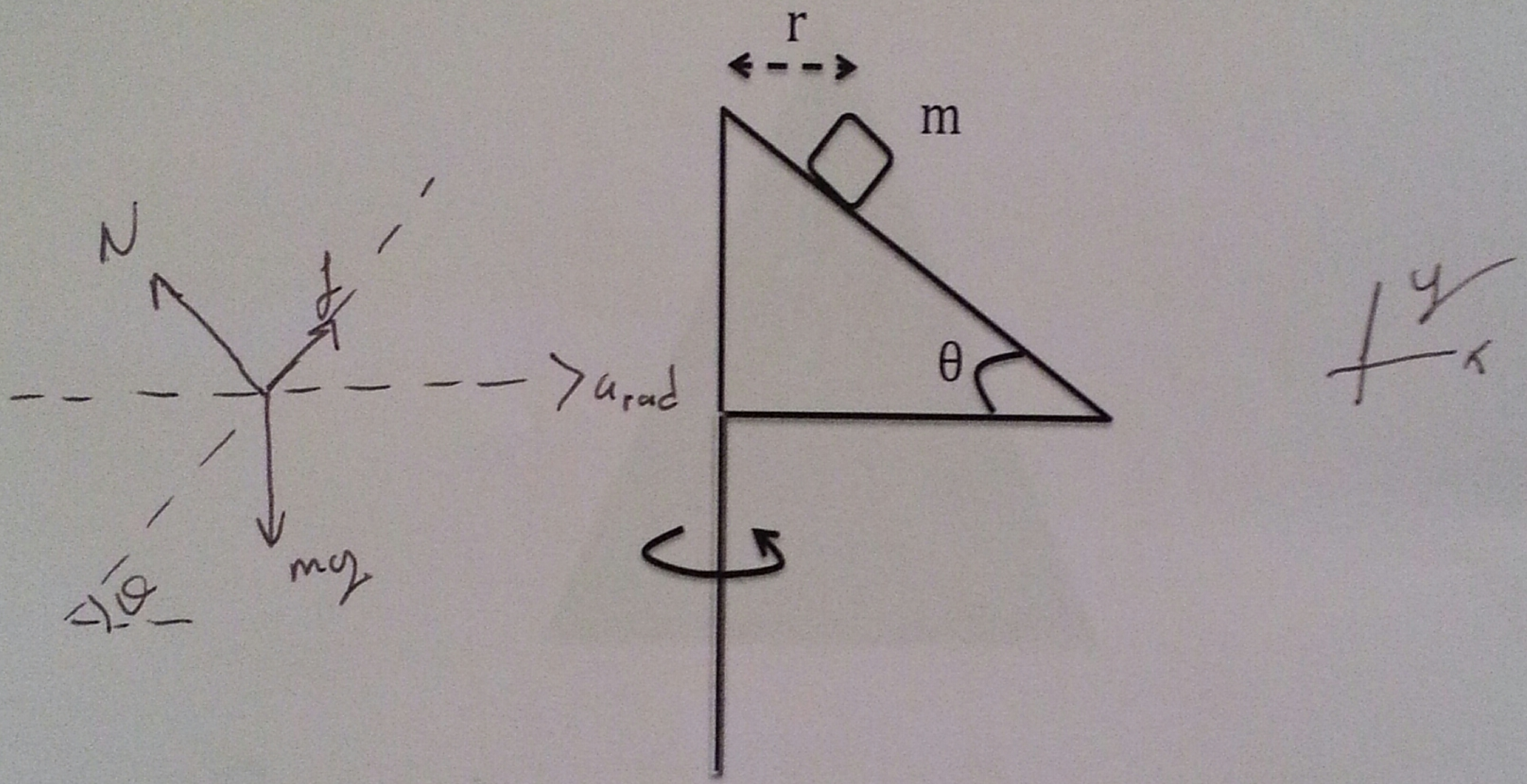
Section 3 Quiz 5 1 November 2012

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

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

A particle of mass m rotates, at a constant speed on a circle of radius r, on a wedge with static friction coefficient $\mu_s$, firmly attached to a vertical rod rotating at a constant angular frequency $\omega$. Find the condition on $\omega$ for which the particle remains at constant height.




$$\left.\begin{aligned} f\cos\theta - N\sin\theta &= m\omega^2 r \\ -mg + N\cos\theta + f\sin\theta &= 0 \end{aligned}\right\} \Rightarrow \begin{aligned} -f\cos\theta\sin\theta + N\sin^2\theta &= -m\omega^2 r\sin\theta \\ N\cos^2\theta + f\sin\theta\cos\theta &= mg\cos\theta \end{aligned}$$

$$+$$

$$f \leq \mu_s N \qquad N = mg\cos\theta - m\omega^2 r\sin\theta$$

$$\Rightarrow f\cos\theta = mg\cos\theta\sin\theta - m\omega^2 r\sin^2\theta + m\omega^2 r$$

$$\Rightarrow f = mg\sin\theta + m\omega^2 r\cos\theta$$

$$\Rightarrow g\sin\theta + \omega^2 r\cos\theta \leq \mu_s(g\cos\theta - \omega^2 r\sin\theta) \Rightarrow \omega^2 \leq \frac{g}{r}\,\frac{\mu_s\cos\theta - \sin\theta}{\mu_s\sin\theta + \cos\theta}$$

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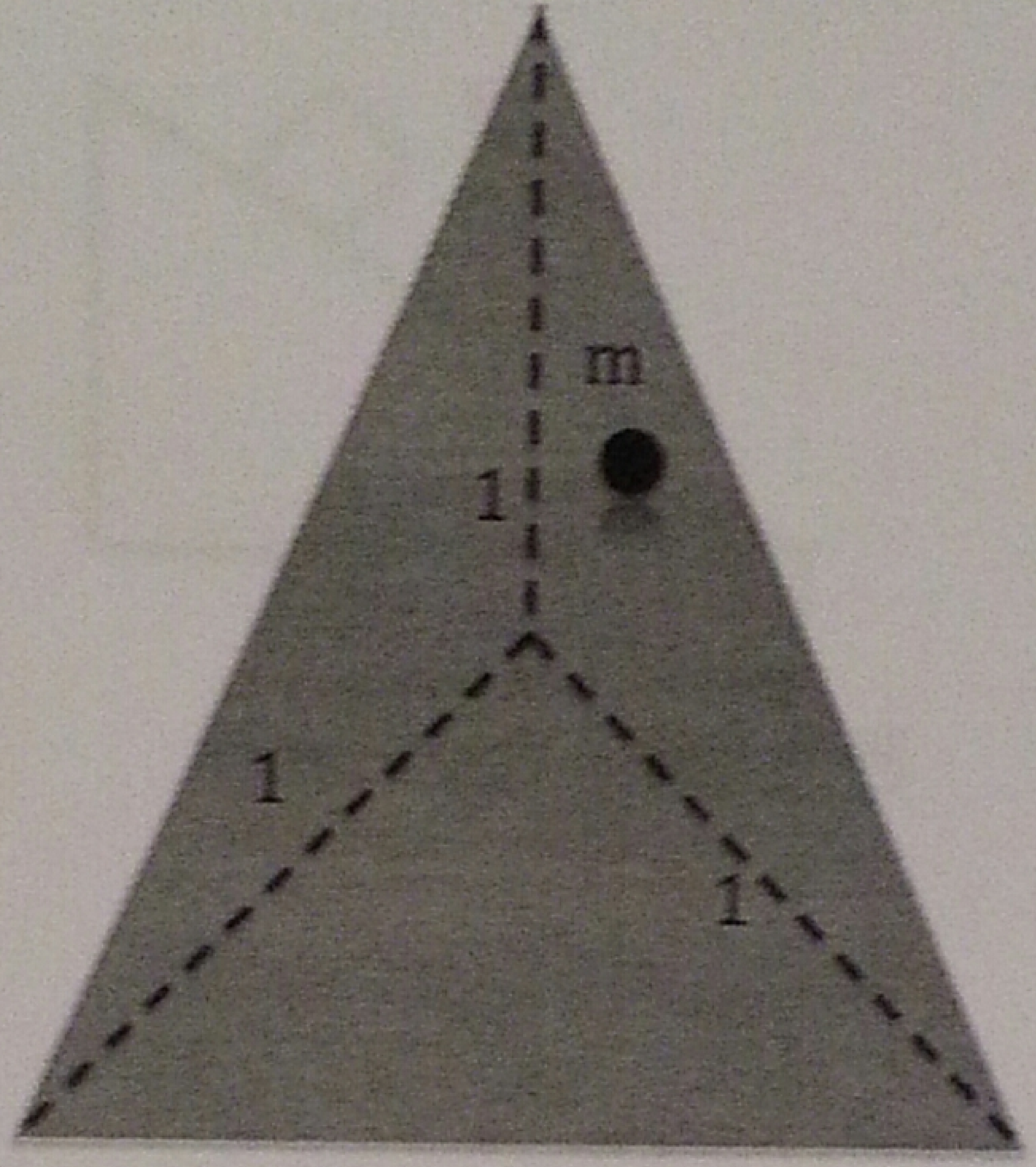
Section 1 Quiz 5 1 November 2012

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

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

A particle of mass m slides down on a frictionless triangular surface as shown in the figure. The surface is constructed by cutting a square block, of side lengths d=1 meters, diagonally from one upper corner to the opposing lower corners. . Take gravitational accelaration $g = 10\ m/s^2$ and find the magnitude of the accelaration of the particle.




$$\vec{F} = m\vec{a}$$

$$\vec{N} + m\vec{g} = m\vec{a}$$

$$N\hat{N} + m(g_{\parallel}\hat{N} + g_{\perp}\hat{\perp}) = m\vec{a}$$

$$(\underbrace{N + mg_{\parallel}}_{0})\hat{N} + mg_{\perp}\hat{\perp} = m\vec{a}$$

$$\rightarrow a = g_{\perp} ; \quad \vec{g}_{\perp} = \vec{g} - (\vec{g}\cdot\hat{N})\hat{N}$$