PHYS 102:General PhysicsI **KOÇ UNIVERSITY** **Spring Semester 2016**

College of Sciences

Section 1 **Quiz 5** **11 March 2016**

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

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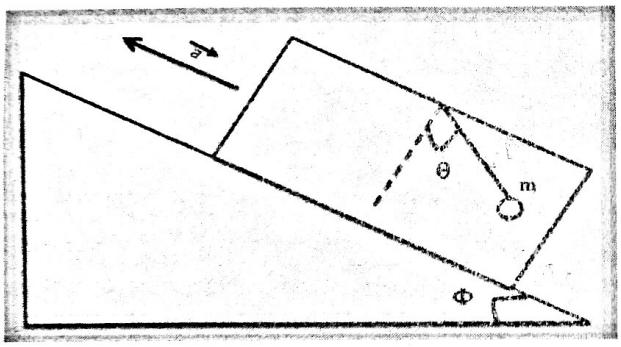
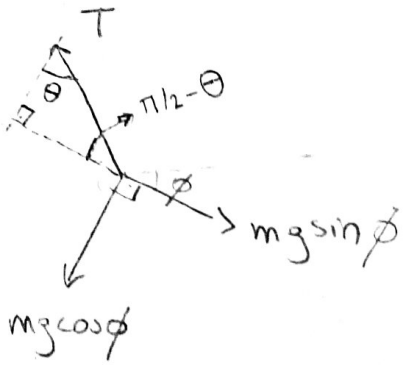
A particle of mass m is suspended from the ceiling of a hollow block by a massless cord as shown in the figure. The block is pulled up a wedge that makes an angle Φ with the horizontal at a constant accelaration a. If the cord makes a constant angle θ the perpendicular to the ceiling, what is a in terms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



Two forces act on the particle The weight of the particle and the tension on the rope.



y-dir → $T\sin\left(\frac{\pi}{2}-\theta\right) = mg\cos\phi = T\cos(\theta)$

x-dir → $T\sin\theta - mg\sin\phi = ma$ (2)

(1) → $T = \frac{mg\cos\phi}{\cos\theta}$ (3)

(3) → (2)

$$\frac{mg\cos\phi\sin\theta}{\cos\theta} - mg\sin\phi = ma \Rightarrow a = g(\tan\theta\cos\phi - \sin\phi)$$

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Section 2 **Quiz 5** **11 March 2016**

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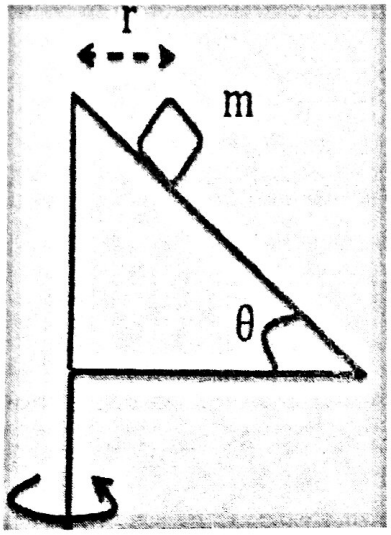
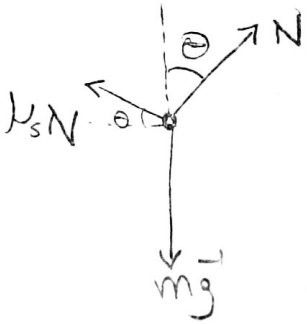
Quiz duration: 10 minutes

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 μ_s, firmly attached to a vertical rod rotating at a constant angular frequency ω. Find the condition on ω for which the particle remains at constant height.





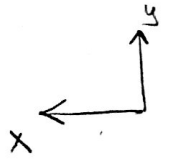
$$m\omega^2 r = \mu_s N\cos\theta - N\sin\theta$$

$$m\omega^2 r = N(\mu_s\cos\theta - \sin\theta) \quad (1)$$

$$N\cos\theta + \mu_s N\sin\theta = mg$$

$$N(\cos\theta + \mu_s\sin\theta) = mg \quad (2)$$

Centripetal acceleration in x-direction



Solve (2) for N and plug into (1)

$$m\omega^2 r = \frac{mg}{\cos\theta + \mu_s\sin\theta}(\mu_s\cos\theta - \sin\theta)$$

$$\omega = \sqrt{\frac{g}{r}\left(\frac{\mu_s\cos\theta - \sin\theta}{\mu_s\sin\theta + \cos\theta}\right)}$$

This the maximum frequency possible so

$$\omega \leq \sqrt{\frac{g}{r}\left(\frac{\mu_s\cos\theta - \sin\theta}{\mu_s\sin\theta + \cos\theta}\right)}$$

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Section 3 **Quiz 5** **11 March 2016**

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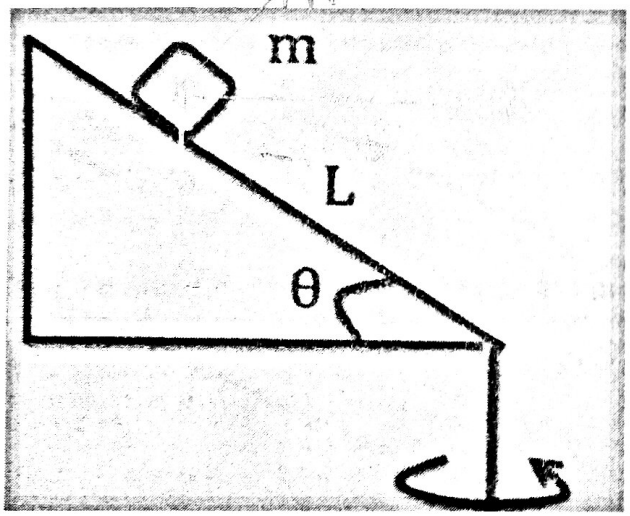
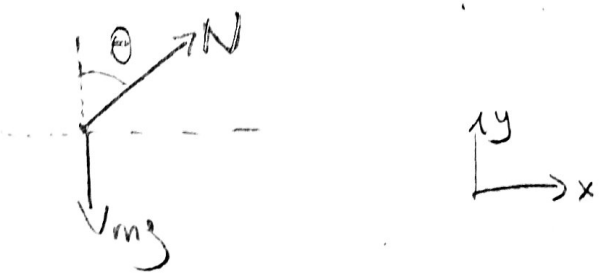
Quiz duration: 10 minutes

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.





x-dir → $m\omega^2(L\cos\theta) = N\sin\theta$ (1)

y-dir → $N\cos\theta = mg \Rightarrow N = \frac{mg}{\cos\theta}$ (2)

$$m\omega^2(L\cos\theta) = mg\tan\theta$$

$$\frac{v^2}{L\cos\theta} = g\tan\theta$$

$$v^2 = gL\sin\theta$$

$$v = \sqrt{gL\sin\theta}$$