PHYS 101:General Physics1 **KOÇ UNIVERSITY** **Fall Semester 2016**

College of Sciences

Section 3 **Quiz 10** **December 16, 2016**

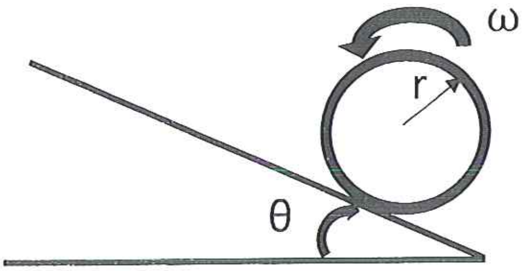
Closed book. Duration: 10 minutes

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

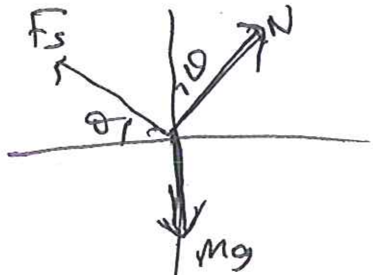
A cylinder of mass m and radius r starts moving up the inclined plane in the figure with initial angular velocity ω and no center of mass velocity. The coefficient of kinetic friction on the surface is μ. The moment of inertia of the cylinder around its center is $\frac{1}{2}mr^2$.

a) Note that the cylinder initially is not rolling without slipping. Draw the free body diagram of the cylinder while it is slipping. Be careful about the direction of the friction force, it should oppose the movement of the point of contact.

b) While it is rolling with slipping, calculate the angular acceleration of the cylinder around its center of mass, and the linear acceleration of its center of mass. Express the angular velocity and the center of mass velocity as functions of time (t=0 is the time the ball starts moving with angular velocity ω)



a)



b) $\tau = I\alpha$ $\qquad F_s = N\mu = mg\cos\theta\mu.$

$-F_s.R = I\alpha \Rightarrow -mg\cos\theta\mu.R = \frac{1}{2}mR^2\alpha$

$\alpha = -2\mu g\cos\theta/R$

$F = ma.$

$F_s = ma = mg\mu\cos\theta \Rightarrow a = g\mu\cos\theta$

$w_f - w_i = \alpha t \Rightarrow w_f = w - 2\mu g\cos\theta\, t/R$

$V_f - \cancel{V_i} = at \Rightarrow V_f = g\mu\cos\theta.t$

0

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Section 4   **Quiz 10**   **December 16, 2016**

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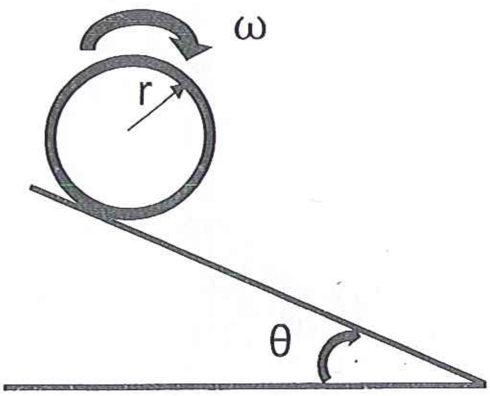
Name: **Student ID:**   **Signature:**

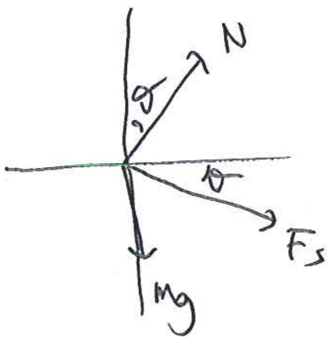
A cylinder of mass m and radius r starts moving down the inclined plane in the figure with initial angular velocity ω and no center of mass velocity. The coefficient of kinetic friction on the surface is μ. The moment of inertia of the cylinder around its center is $\frac{1}{2}mr^2$.

a) Note that the cylinder initially is not rolling without slipping. Draw the free body diagram of the cylinder while it is slipping. Be careful about the direction of the friction force, it should oppose the movement of the point of contact.

b) While it is rolling with slipping, calculate the angular acceleration of the cylinder around its center of mass, and the linear acceleration of its center of mass. Express the angular velocity and the center of mass velocity as functions of time (t=0 is the time the ball starts moving with angular velocity ω)



a)



b) $\tau = I\alpha$ $F_s = N\mu = mg\cos\theta\mu$

$-F_s.R = I.\alpha \Rightarrow -mg\cos\theta\mu.R = \frac{1}{2}mR^2\alpha$

$\alpha = -2\mu g\cos\theta/R$ //

$F = ma$.

$F_s = ma = mg\mu\cos\theta = ma$

$a = g\mu\cos\theta$ //

$\omega_f - \omega_i = \alpha t \Rightarrow \omega_f = \omega_i - \frac{2\mu g\cos\theta}{R}t$

$V_f - \cancel{V_i} = at \Rightarrow V_f = \mu g\cos\theta t$

0

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Section 1 **Quiz 10** **December 16, 2016**

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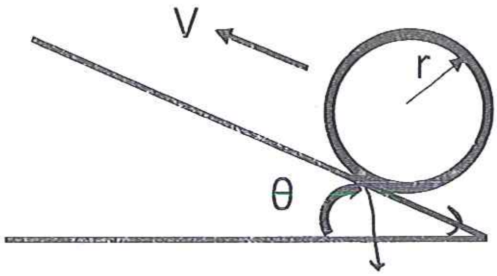
Name: **Student ID:** **Signature:**

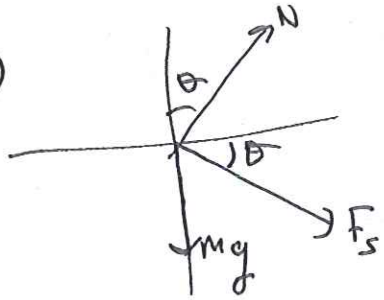
A cylinder of mass m and radius r starts moving up the inclined plane in the figure with initial center of mass velocity v and no angular velocity. The coefficient of kinetic friction on the surface is μ. The moment of inertia of the cylinder around its center is $\frac{1}{2}mr^2$.

a) Note that the cylinder initially is not rolling without slipping. Draw the free body diagram of the cylinder while it is slipping. Be careful about the direction of the friction force, it should oppose the movement of the point of contact.

b) While it is rolling with slipping, calculate the angular acceleration of the cylinder around its center of mass, and the linear acceleration of its center of mass. Express the angular velocity and the center of mass velocity as functions of time (t=0 is the time the ball starts moving with velocity v)



a)



b) rolling with slipping
so $a \neq \alpha r$ $v \neq wR$

$\tau = I\alpha$ $F_s = N\mu = mg\cos\theta\,\mu$

$F_s . R = \frac{1}{2} m R^2 \alpha \Rightarrow \alpha = \mu 2 g\cos\theta / R$

$F = ma$

$-F_s = ma$ $a = -\mu g\cos\theta$

$w_f - \cancel{w_i} = \alpha t = w_f = 2\mu g \frac{\cos\theta}{R} t$
0

$V_f - V_i = at = V_f = V - \mu g\cos\theta\, t$

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Section 2 **Quiz 10** **December 16, 2016**

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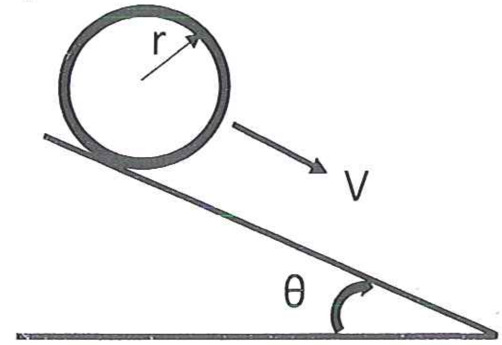
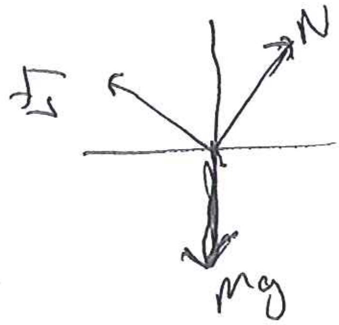
Name: **Student ID:** **Signature:**

A cylinder of mass m and radius r starts moving down the inclined plane in the figure with initial center of mass velocity v and no angular velocity. The coefficient of kinetic friction on the surface is μ. The moment of inertia of the cylinder around its center is $\frac{1}{2}mr^2$.

a) Note that the cylinder initially is not rolling without slipping. Draw the free body diagram of the cylinder while it is slipping. Be careful about the direction of the friction force, it should oppose the movement of the point of contact.

b) While it is rolling with slipping, calculate the angular acceleration of the cylinder around its center of mass, and the linear acceleration of its center of mass. Express the angular velocity and the center of mass velocity as functions of time (t=0 is the time the ball starts moving with velocity v)





$F_s = N\mu = mg\cos\theta\,\mu.$

a) $\tau = I\alpha$

$+F_s . R = I\alpha = mg\cos\theta\,\mu R = \frac{1}{2} m R^2 \alpha$

$\alpha = 2g\mu\cos\theta / R$

$F = ma$

$F_s = ma = -mg\cos\theta\,\mu = ma$

$a = -g\cos\theta\,\mu$

$\omega_f - \cancel{\omega_i} = \alpha t \Rightarrow \omega_f = \frac{2g\mu\cos\theta}{R} t$

0

$v_f - v_i = at \Rightarrow V_f = V - g\cos\theta\,\mu t$