PHYS 101: General Physics 1 **KOÇ UNIVERSITY** **Spring Semester 2015**

College of Arts and Sciences

Section **Quiz 6-1** **March 2015**

Closed book. No calculators are to be used for this quiz.

Quiz duration: 10 minutes

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

As seen in figure, **varying horizontal force F** is pushing the object very slowly from **α = 0 to $\pi/2$** and in a swing, it remains in equilibrium through the process.

a) Calculate F as a function of angle α ✓

b) What is the total work done by the force F ✓

c) What is the total work done by the gravitational force (**mg**) ✓

d) What is the total work done by the tension **T** in the rope

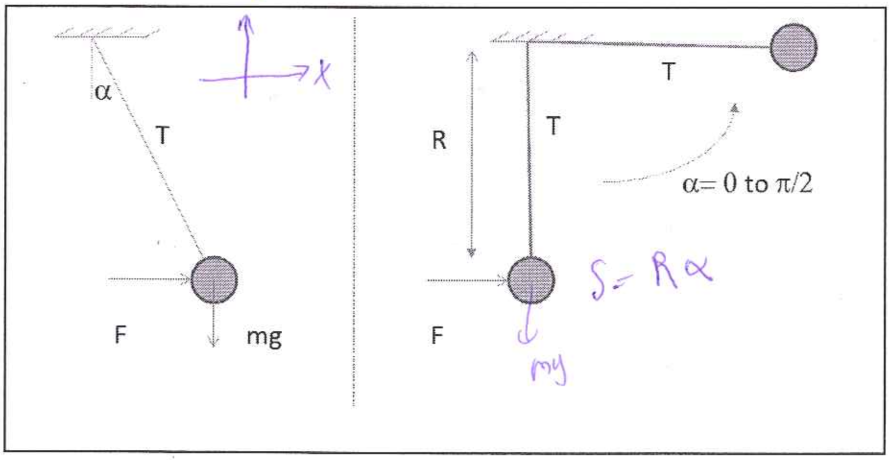
a) applying Newton's Law

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

projection on x-axis gives

$F_x + T\sin\alpha = 0$ ①

$\Rightarrow$ $T = -\dfrac{F_x}{\sin\alpha}$ ①′



on y-axis : $T\cos\alpha - mg = 0$ ②

from ①′, ② when Find $F_x = F = mg\tan\alpha = w\tan\alpha$; $w = mg$

b) $W = \int_0^{\alpha} \vec{F}\cdot d\vec{l} = \int_0^{\alpha} F\cos\alpha\, ds = \int_0^{\alpha} w\sin\alpha\, R\, d\alpha = wR\int_0^{\alpha}\sin\alpha\, d\alpha$

$= wR\,(1-\cos\alpha)\Big|_0^{\pi/2}$

$W_{(\alpha=\pi/2)} = mgR$ ✓

(c) $W = \int \vec{w} \cdot \vec{dl} = \int (-mg \sin\alpha) R \, d\alpha = -mgR \int_0^{\alpha} \sin\alpha \, d\alpha = -mgR(1-\cos\alpha)$

$W(0 \to \pi/2) = -mgR$ (For gravity)

(d) $\vec{T} \cdot \vec{dl} = (-T \sin\alpha)(ds \cos\alpha) + (T\cos\alpha)(ds \sin\alpha) = 0$

there is no obvious Work done by tension.

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Section | Quiz 6-2 | March 2015

Closed book. No calculators are to be used for this quiz.

Quiz duration: 10 minutes

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

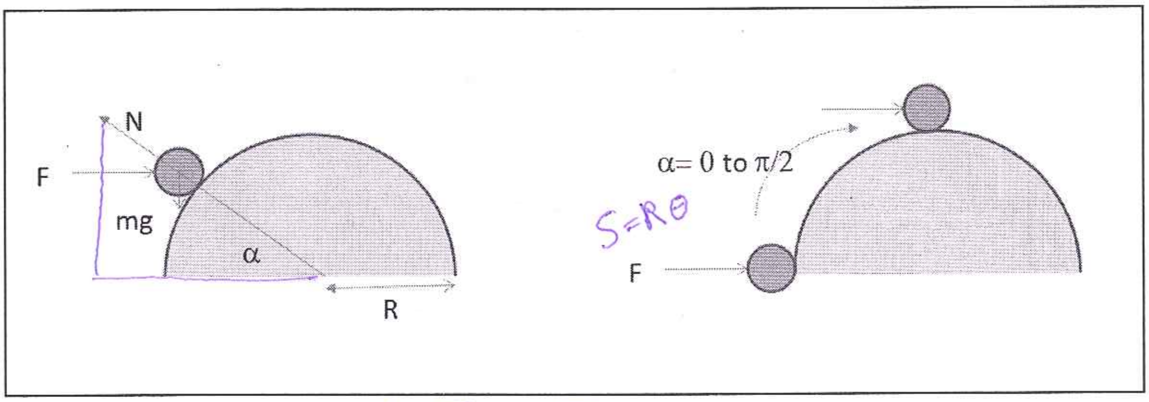
As seen in figure, **varying horizontal force F** is pushing the object very slowly from **α = 0 to $\pi/2$** and it remains in equilibrium through the process.

a) Calculate F as a function of angle α

b) What is the total work done by the force **F**

c) What is the total work done by the gravitational force (**mg**)

d) What is the total work done by the normal force **N**



a) using Newton's Second Law $\sum \vec{F} = m\vec{a} = 0$; $ds = R\,d\theta$

projection on x-axis $F_x + N\cos\alpha = 0$ (1)

$$N = -\frac{F_x}{\cos\alpha} \quad (1)$$

projection on y-axis : $N\sin\alpha - mg = 0$ (2)

solving (1) and (2) we find $\boxed{F_x = F = mg\cot\alpha}$

b) $W = \int_0^{\frac{\pi}{2}} \vec{F} \cdot \vec{dl} = \int_0^{\frac{\pi}{2}} mg \cos\alpha \, R \, d\alpha = mgR$

c) Work done by gravity $W = -\int_0^{\frac{\pi}{2}} mg \cos\alpha \, R \, d\alpha = -mgR \sin\alpha \Big|_0^{\frac{\pi}{2}}$

$= -mgR$

d) the work done by normal force $\vec{N}$ is zero.

$\vec{N} \cdot \vec{dl} = (-N \sin\alpha)(R \cos\alpha \, d\alpha) + (N \cos\alpha) R \sin\alpha \, d\alpha = 0$

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Section | **Quiz 6-3** | **March 2015**

Closed book. No calculators are to be used for this quiz.

Quiz duration: 10 minutes

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

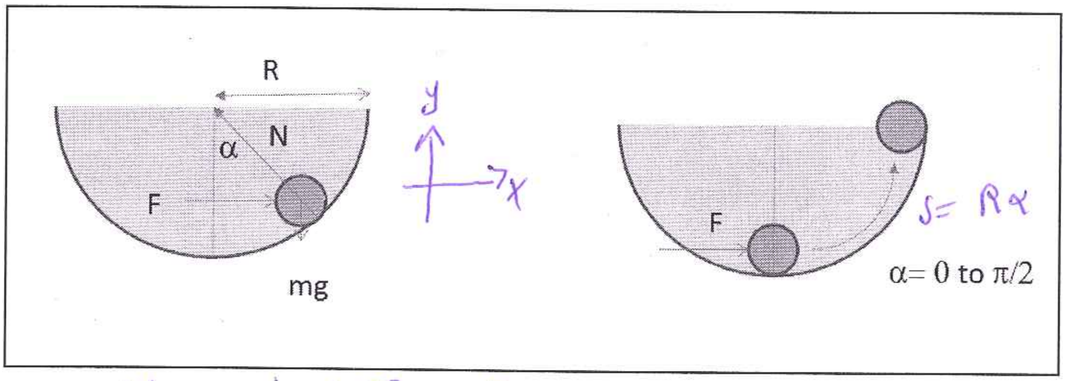
As seen in figure, **varying horizontal force F** is pushing the object very slowly from α **= 0 to** $\pi/2$ and it remains in equilibrium through the process.

a) Calculate F as a function of angle α

b) What is the total work done by the force **F**

c) What is the total work done by the gravitational force (**mg**)

d) What is the total work done by the normal force **N**



a) using Newton's second law $\sum \vec{F} = m\vec{a}$

projection on X-axis: $F_x + N\sin\alpha = 0$ ①

$$N = -\frac{F_x}{\sin\alpha} \quad ①'$$

projection on y-axis: $N\cos\alpha - mg = 0$ ②

From ①', ② we find the Force $F_x = mg\tan\alpha$

Since $F_y = 0 \Rightarrow$ $\boxed{F = F_x = mg\tan\alpha}$

(b) $W = \int_0^{\alpha} \vec{F} \cdot d\vec{l} = \int_0^{\alpha} F\cos\alpha \, ds = \int_0^{\alpha} mg \sin\alpha \, R \, d\alpha = mgR(1 - \cos\alpha)$

The Total Work in the interval $[0, \frac{\pi}{2}]$ is $\boxed{W = mgR}$

$\boxed{ds = R\,d\alpha}$ since R is constant

(c) $W_{mg} = -\int_0^{\frac{\pi}{2}} (mg \sin\alpha) R \, d\alpha = -mgR$

Minus becaus mg towards the ground and y-axis upward

(d) $\vec{N} \cdot d\vec{l} = (-N \sin\alpha)(ds \cos\alpha) + (N \cos\alpha)(ds \sin\alpha) = 0$ Force.

No work is done by the normal Force.