PHYS 101: General Physics 1 **KOÇ UNIVERSITY** **Fall Semester 2011**

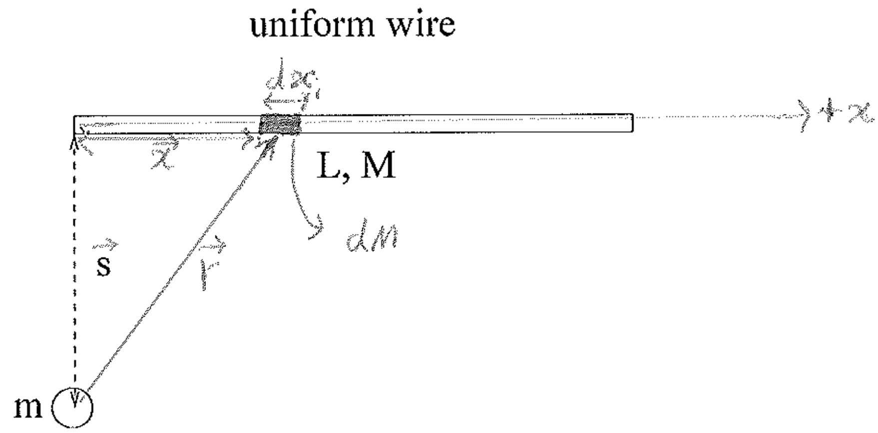
College of Arts and Sciences

Section 4 **Quiz 8** **24 November 2011**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

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

Find the potential energy between the uniform rod (length L and mass M) and the point mass m. (You don't have to evaluate the resultant integrals.)



dV: potential energy between m and dM

length	mass
L	M
dx	dM

$\Rightarrow$ $dM = \frac{M}{L} dx$

$$dV = -G \frac{m\,dM}{r} = -G \frac{m\left(\frac{M}{L}\right)dx}{\sqrt{s^2+x^2}}$$

$$\Rightarrow V = \int dV = \int_0^L \frac{-GmM\,dx}{L\sqrt{s^2+x^2}} = -\frac{GmM}{L}\int_0^L \frac{dx}{\sqrt{s^2+x^2}}$$

PHYS 101: General Physics 1 KOÇ UNIVERSITY Fall Semester 2011

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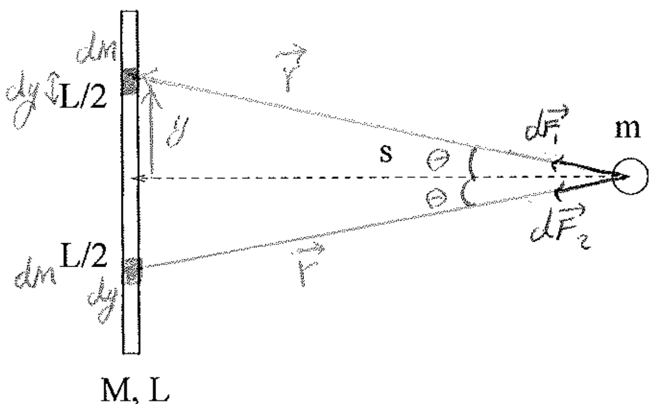
Section 5 Quiz 8 24 November 2011

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

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

Find the force between the uniform rod (length L and mass M) and the point mass m.
(You don't have to evaluate the resultant integrals.)

uniform rod



Due to symmetry $d\vec{F}_1 = d\vec{F}_2$

$$d\vec{F} = d\vec{F}_1 + d\vec{F}_2 \Longrightarrow dF = 2\,dF_1 \cos\theta \quad , \quad dm = \frac{M}{L}\,dy$$

$$dF_1 = G\,\frac{m\,dm}{r^2} = G\,\frac{m \cdot \frac{M}{L}\,dy}{y^2+s^2} = \frac{GmM}{L}\,\frac{dy}{s^2+y^2}$$

$$\Rightarrow \quad dF = 2\,dF_1\cos\theta = \frac{2GmM}{L}\,\frac{\cos\theta\,dy}{s^2+y^2} \quad , \quad \cos\theta = \frac{s}{r} = \frac{s}{\sqrt{s^2+y^2}}$$

$$\Rightarrow \quad dF = \frac{2GmM}{L}\,\frac{s\,dy}{(s^2+y^2)^{3/2}}$$

$$\Rightarrow \quad F = \int dF = \frac{2GmMs}{L}\int_0^{\frac{L}{2}} \frac{dy}{(s^2+y^2)^{3/2}}$$

To students: why not $\int_{-L/2}^{L/2}$?

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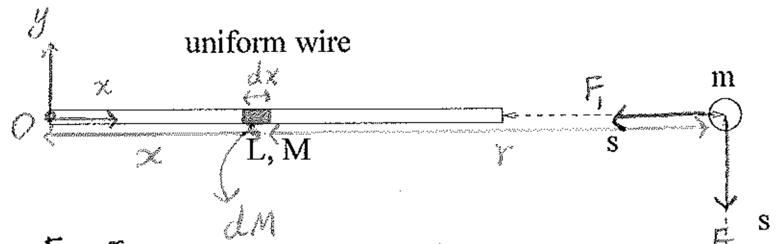
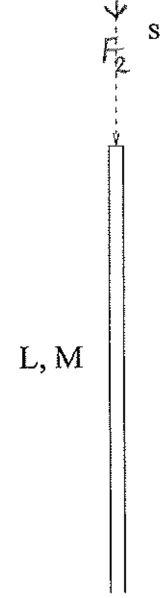
Section 2 **Quiz 8** **24 November 2011**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

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

Find the force between the uniform rod (length L and mass M) and the point mass m.
(You don't have to evaluate the resultant integrals.)





• Due to symmetry $F_1 = F_2$, so we just need to obtain either F_1 or F_2.

dF_1 : the force between m and $dM = \frac{M}{L} dx$

$$dF_1 = G \frac{m\,dM}{r^2} = G \frac{m \cdot \frac{M}{L} dx}{(L+s-x)^2}$$

$$\Rightarrow F_1 = \int dF_1 = \frac{GmM}{L} \int_0^L \frac{dx}{(L+s-x)^2}$$

$$\vec{F} = \vec{F_1} + \vec{F_2}$$

$$|\vec{F}| = 2F_1 \cos\left(\frac{90}{2}\right) = 2F_1 \cos 45 = 2F_1 \times \frac{\sqrt{2}}{2} = \sqrt{2}\, F_1$$

$$\Rightarrow |\vec{F}| = \frac{\sqrt{2}\, GmM}{L} \int_0^L \frac{dx}{(L+s-x)^2}$$

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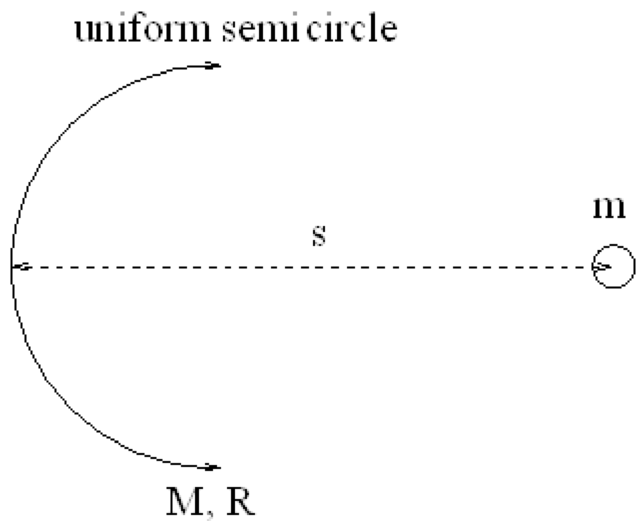
Section 1 Quiz 8 24 November 2011

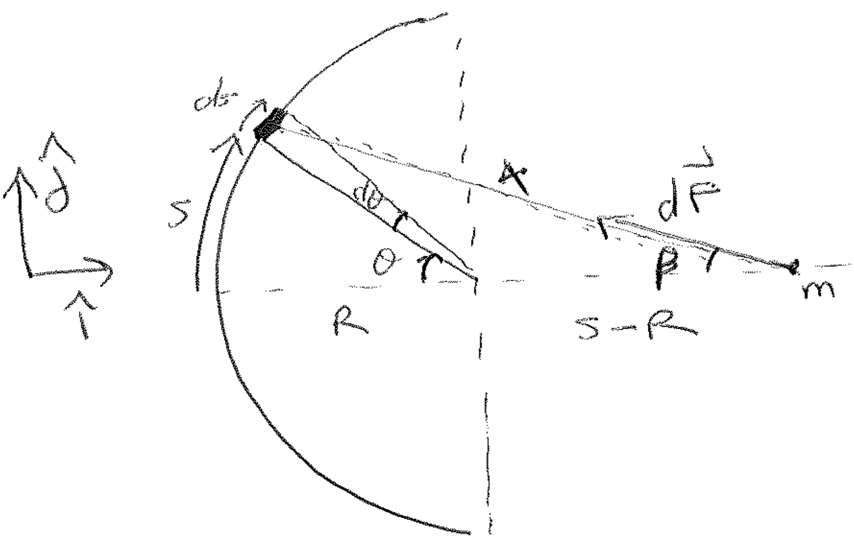
Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

Name: Student ID: Signature:

Find the force between the uniform semi-circular wire (radius R and mass M) and the point mass m. (You don't have to evaluate the resultant integrals.)



Sec 1



$s = R\theta$

$ds = R\,d\theta$

$dM = ds \cdot \left(\frac{M}{\pi R}\right)$

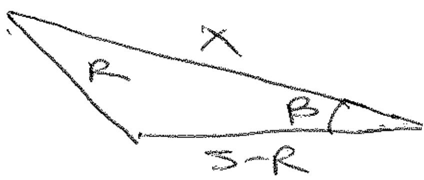
mass density

$$d\vec{F} = \frac{G m\, dM}{x^2}\left(-\cos\beta\,\hat{i} + \sin\beta\,\hat{j}\right)$$

due to symmetry $\vec{F} = F_0\,(-\hat{i})$

$$\Rightarrow F_0 = G m \frac{M}{\pi} \int_{-\pi/2}^{\pi/2} \frac{d\theta}{x^2} \cos\beta$$

$$\cos\beta = \frac{(s-R)^2 + x^2 - R^2}{2x(s-R)}$$



$$\cos(\pi - \theta) = \frac{R^2 + (s-R)^2 - x^2}{2R(s-R)}$$