

King Fahd University of Petroleum & Minerals
 Department of Physics
 Physics 301
 Term 051
 Quiz #4

Dr. A. Mekki

Name: Key Id#: _____

Consider a thin uniform disk of mass M and radius R.

- (a) Find the gravitational potential at point P due to this mass distribution.
 (b) What is the gravitational force on a mass m located at point P?

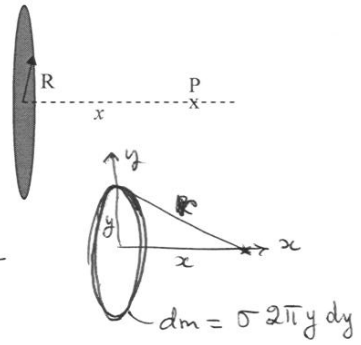
$$a) \quad d\phi = - \frac{G \, dm}{r}$$

$$= - \frac{G \, \sigma \, 2\pi y \, dy}{\sqrt{x^2 + y^2}}$$

$$\phi = \int_0^R d\phi = - G \sigma 2\pi \int_0^R \frac{y \, dy}{\sqrt{x^2 + y^2}}$$

$$= - G \sigma 2\pi \sqrt{x^2 + y^2} \Big|_0^R$$

$$\boxed{\phi = - G M 2\pi^2 R^2 \left(\sqrt{x^2 + R^2} - x \right)} \quad ; \quad \sigma = \frac{M}{\pi R^2}$$



$$b) \quad \vec{F} = - \nabla U = - m \nabla \phi$$

One dimension $F_x = - m \frac{\partial \phi}{\partial x}$

$$\boxed{F_x = + G m \cdot 2\pi^2 R^2 \left(\frac{x}{\sqrt{x^2 + R^2}} - 1 \right)}$$