Test 2
Phys 111, Fall 2009, Section 1

Name: _____

By writing my name above, I affirm that this test represents my work only, without aid from outside sources. In all aspects of this course I perform with honor and integrity.

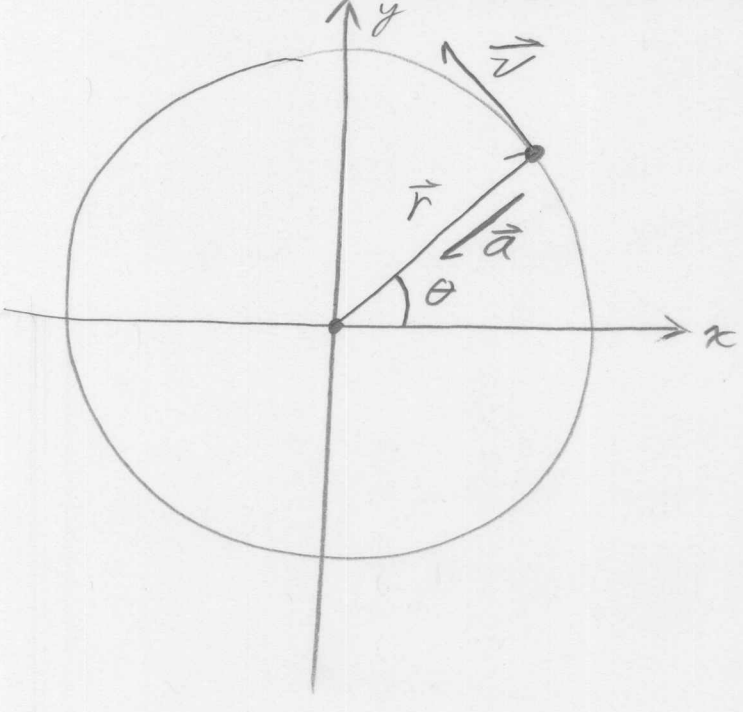
SHOW YOUR WORK ON ALL OF THE PROBLEMS. YOUR APPROACH TO THE PROBLEM IS AS IMPORTANT AS, IF NOT MORE IMPORTANT THAN, YOUR ANSWER. DRAW **CLEAR AND NEAT PICTURES** SHOWING COORDINATE SYSTEMS AND ALL OF THE RELEVANT PROBLEM VARIABLES. ALSO, **EXPLICITLY** SHOW THE **BASIC EQUATIONS** YOU ARE USING. BE NEAT AND THOROUGH. THE EASIER IT IS FOR ME TO UNDERSTAND WHAT YOU ARE DOING, THE BETTER YOUR GRADE WILL BE.

1) Derivations

a) Starting with the unit vector expression for the position, r, of a particle constrained to move in a circle, derive an expression for the magnitude of the velocity vector and the magnitude of the acceleration vector assuming that the particle is moving in **uniform circular motion.**

Include a picture with the position vector, r, the velocity vector, v, the acceleration vector, a, and the position angle, θ, clearly marked.

Clearly state any assumptions required by the proof.



assume: $|\vec{r}|$ is constant

$|\vec{v}|$ is constant

$$\vec{r} = r(\cos\theta\,\hat{x} + \sin\theta\,\hat{y})$$

$$\vec{v} = \frac{d\vec{r}}{dt} = r\left(-\frac{d\theta}{dt}\sin\theta\,\hat{x} + \frac{d\theta}{dt}\cos\theta\,\hat{y}\right)$$

$$\boxed{\vec{v} = r\omega(-\sin\theta\,\hat{x} + \cos\theta\,\hat{y})}$$

$$\boxed{|\vec{v}| = r\omega}$$

$$\vec{a} = \frac{d\vec{v}}{dt} = r\omega\left(-\frac{d\theta}{dt}\cos\theta\,\hat{x} - \frac{d\theta}{dt}\sin\theta\,\hat{y}\right)$$

$$\boxed{\vec{a} = -r\omega^2(\cos\theta\,\hat{x} + \sin\theta\,\hat{y})}$$

$$\boxed{|\vec{a}| = r\omega^2}$$