PHYSICS 121 WORKSHEET 18 11/20/2017

NAME: SECTION:

1. Consider a pendulum composed of a massless string of length l with a mass m attached to the end. Let the angular displacement from the vertical be denoted by θ.

i) Draw a free body diagram of the pendulum. What is the net force on the mass as a function of θ?

ii) Using the small angle approximation $\sin(\theta) \approx \theta$, write the force above as a restoring force of the form $F = -ks$ where $s = l\theta$ is the arc length of the pendulum swing.

iii) Noting that $w = \sqrt{\frac{k}{m}}$, what is w in terms of g and l? What is the force in terms of w, m, and l?

iv) What are the frequency f and period T of the pendulum? Is the period independent of the mass? Why or why not?

2. Consider a particle of mass m constrained to move on a circle of radius A having coordinates $x = A\cos(wt)$, $y = A\sin(wt)$.

i) What is the exact position of the particle (x, y) at times $t = 0$, $t = \frac{T}{4}$, $t = \frac{T}{2}$, and $t = T$, where $T = 2\pi/w$?

ii) What is the maximum magnitude of the velocity v_{max} of the particle? What are the velocities v_x and v_y along each direction as a function of time? What are their values at each of the times above?

iii) What is the maximum magnitude of the acceleration a_{max} of the particle? What are the accelerations a_x and a_y along each direction as a function of time? What are their values at each of the times above?

iv) What are the forces F_x and F_y on the particle?