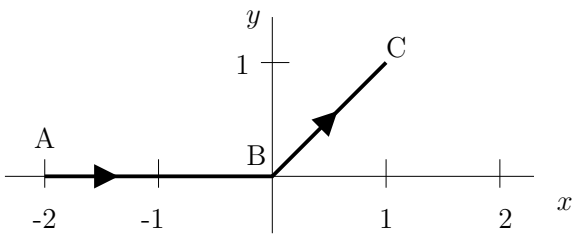
PHYS 331 — Exam #1
Friday September 15, 2017

1. Consider a particle with mass m moving horizontally to the right that starts at the origin with initial speed v_0. The particle is acted on by drag force with *magnitude* $f_{\text{drag}} = bv^2$. Determine the particle's velocity, $v(t)$, and position, $x(t)$, at later times.

2. A vector force is given by

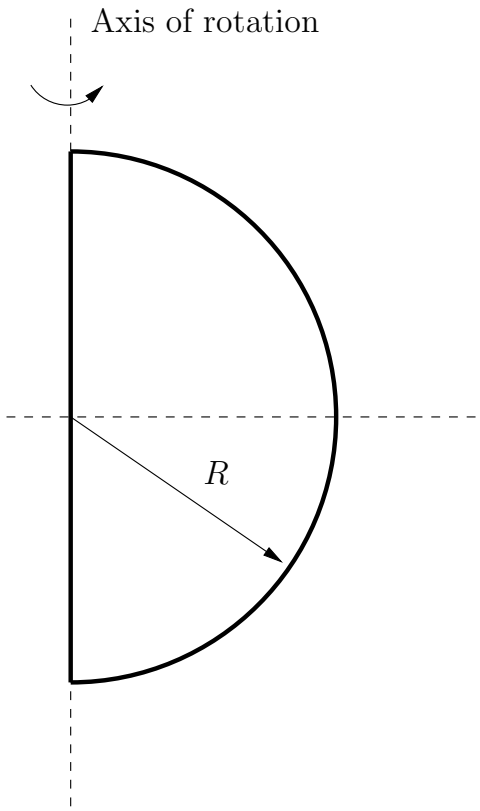
$$\mathbf{F} = 2y\,\hat{x} + x\,\hat{y}.$$



(a) Evaluate the work done by this force on the illustrated path ABC in the x-y plane.

(b) Is $\mathbf{F}$ a conservative force? Explain. (There is more than one way to justify an answer to this question.)

3. Determine an integral expression for the moment of inertia I for the illustrated uniform half disk of mass M and radius R about an axis along the vertical diameter of the half disk. You may assume that the disk is infinitesimally thin. **You do not need to perform the integration** (but enough information should be given that it would be straightforward for a computer to evaluate the integral).



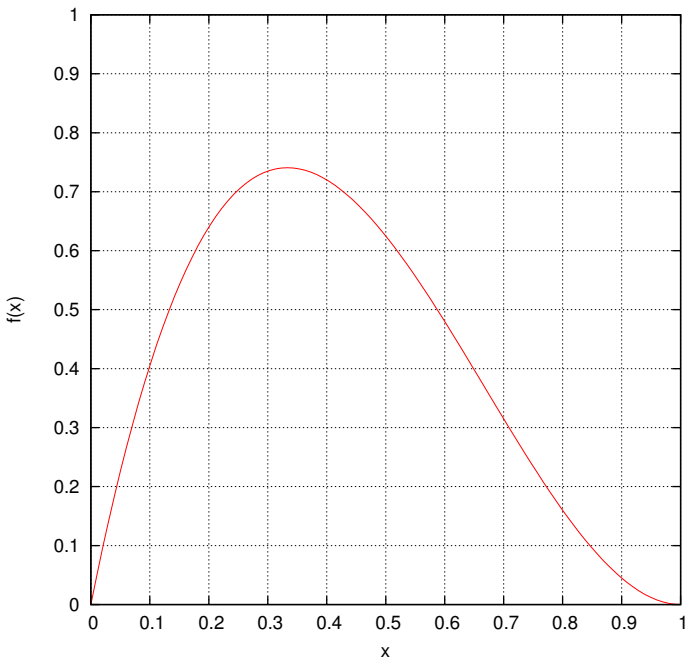
4. You have previously studied the discrete logistic map and the discrete sine map. In this problem you will investigate the *Marty Map* given by the function

$$f(x) = rx(1-x)^2$$

so that

$$x_{t+1} = f(x_t) = rx_t(1-x_t)^2,$$

where $0 < r < 6\frac{3}{4}$. Here's what the function $f(x)$ looks like for $r = 5$:



Discuss the fixed points of this map.

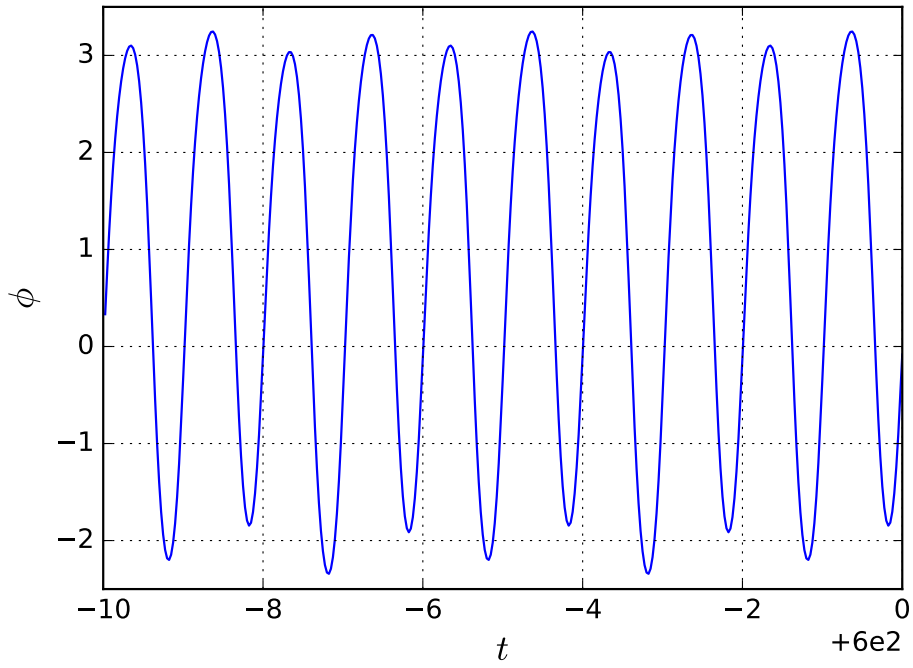
(a) Show that the map has either one or two fixed points, depending on the value of r.

(b) What are the values of the fixed points (in terms of r)?

(c) At what value of r does the transition between one and two fixed points occur?

(d) Are the fixed points for $r = 5$ stable or unstable. (There are many ways to justify your answer.)

5. Below is a graph of ϕ vs. t for a damped oscillator being driven with an angular frequency $\omega = 2\pi$.



(a) Sketch a Poincaré section for this system.

(b) Sketch a qualitative state-space (phase-space) trajectory for this system.

Useful Information