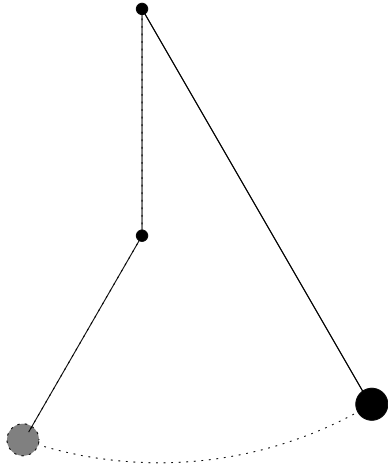


Math 142 Practice problems for final exam

1. Hinged pendulum



Consider the pendulum shown above. Sketch the potential energy curve and the phase plane diagram for this pendulum.

2. Earth oscillator

Imagine we drill a hole through the center of the earth from one side to the other. The force of gravity inside the earth is given by

$$F(r) = -\frac{GmM(r)}{r^2}$$

where $M(r)$ is the mass of the sphere of radius r within the earth. (Assume the density of the earth is uniform.)

If we drop a ball from the surface of the earth, how long does it take to return.

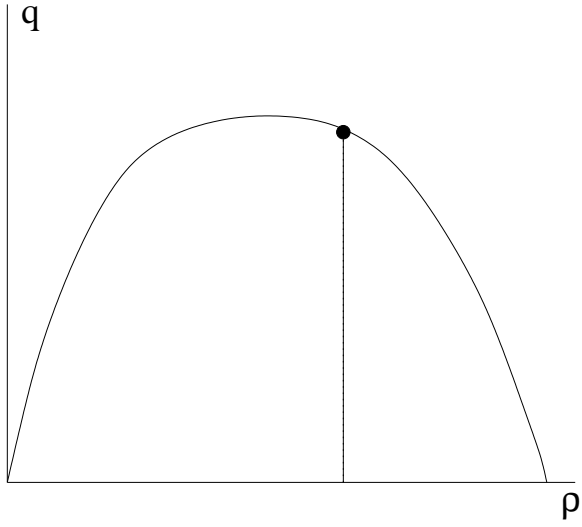
3. Mafia dynamics

Suppose there are two mob families in the same area. Each member of family x recruits new members at a rate γ , and each member of family y recruits at a rate σ . Also, each member of family x kills off members of family y at a rate a , and vice versa at a rate b .

Can these two families coexist in equilibrium? If so, what is required for them to coexist?

4. Traffic flow diagram

Consider the point marked on the traffic flow diagram;



Draw a line with slope equal to the car velocity at this density. Also draw a line with slope equal to the density wave velocity.