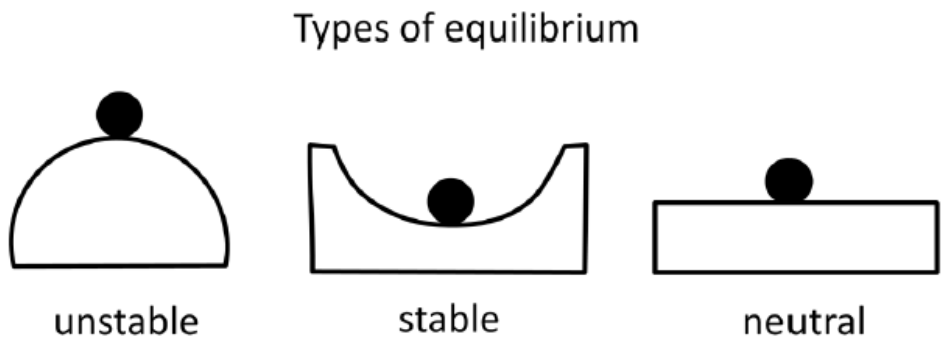
Homework 17

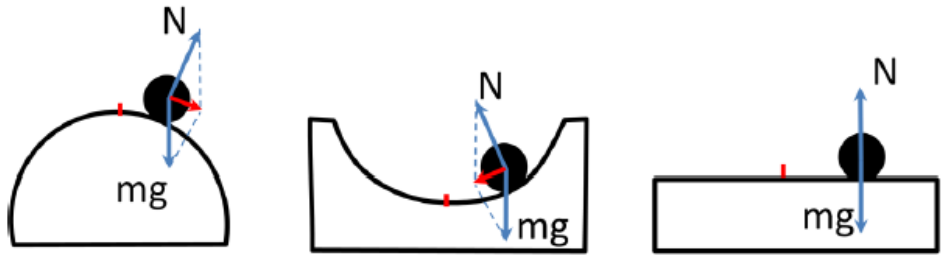
Oscillations and the types of equillibrium.

Generally, oscillation can be described as periodic (or, even more generally just repetitive) variations of a certain parameter. Heartbeat, Earth rotation, pendulum, 11-year Sun activity cycle, light – these are examples of oscillatory phenomena.

In which systems we can observe oscillatory behavior? To understand this let us consider three systems in equilibrium (see Figure below):



If we slightly displace the ball which is on top of the hill (left picture) it will roll down because the total net force will be directed from the equilibrium position. For the ball displaced from the center of the bottom of a spherical bowl the force is directed back to the equilibrium point. We will call such force as *restoring force*. In case of neutral equilibrium, no force appear and the ball just stay in new position (see Figure below).



Systems in stable equilibrium can demonstrate oscillatory behavior.

Problem:

There is a solid ball with nonuniform density, so the center of mass is shifted from geometrical center of the ball. In the figure below the center of mass is shown as a red dot. Make a force diagram and show that the ball is in stable equilibrium in fig (a) and in unstable equilibrium in

Figure (b). *Clue: take a look at the total net torque applied to the ball with respect to the point of contact with the surface.*