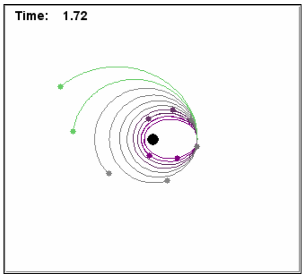
# *Worksheet for Exploration 12.1: Different $x_o$ or $v_o$ for Planetary Orbits*




This Exploration shows 10 identical planets orbiting a star. (*In parts a-d*) The initial position of the planets can be set at t = 0 time units when the planets are on the x axis. The difference in orbital trajectory, therefore, is due to the planets' initial velocities (**in this animation GM = 1000**).

a. As you vary the initial positions of the planets, how do the orbital trajectories change?

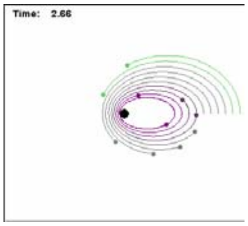
b. Find a planet with circular motion. What is the period for this motion?

   i. Use r = 10.

   ii. Measure the period and the velocity. See if you can predict the period using GM as given, r, and the appropriate laws of physics. Note distances are in arbitrary units.

c. What happens to the orbit when $x_o$ gets really small?

d. What happens to the orbit when $x_o$ gets really large?




This part of the Exploration shows 10 identical planets orbiting a star. The initial velocity of the planets can be set at t = 0 time units when the planets are on the x axis.

e. As you vary the initial velocities of the planets, how do the orbital trajectories change?

f. Find a planet with circular motion. What is the period for this motion?

  i. Use $v_o = 10$ to find a circular orbit. That circular orbit should be centered on the black star.

  ii.

g. What happens to the orbit when v gets really small (magnitude)?

h. What happens to the orbit when v gets really large (magnitude)?

i. For the given value of GM derive a formula for the escape velocity and discuss what this means. How does this compare to the speed required to yield a circular orbit?