

Problem set 7 (due April 17)

1. Consider an object of mass m attached to a spring with spring constant k in a viscous fluid. The system is subject to linear drag with damping factor b . The parameters are such that it oscillates around equilibrium with period T . After one period, you find that the amplitude decreases by a multiplicative factor x that is less than one.
 - (a) (2pts) What are the damping factor and the period as functions of x ?
 - (b) (1pts) Describe the behavior of the system in the limit $x \rightarrow 0$.
2. Consider two spheres with radius R and masses m and $2m$ in empty space (far away from any other forces). The spheres are released from rest with their centers a distance d apart. They accelerate towards each other due to their gravitational attraction.
 - (a) (1pt) Explain why the linear momentum is conserved.
 - (b) (2pts) Compute the relative velocities between the spheres when they collide (note that the sphere have radii R).
 - (c) (2pts) How far from the location of first sphere (of mass m) do the spheres collide?
3. (2pts) Consider a spacecraft of mass m on the surface of a planet of mass M and radius R . How much work must the spacecraft engines perform to move the spacecraft to a circular orbit a distance R from the surface of the planet?