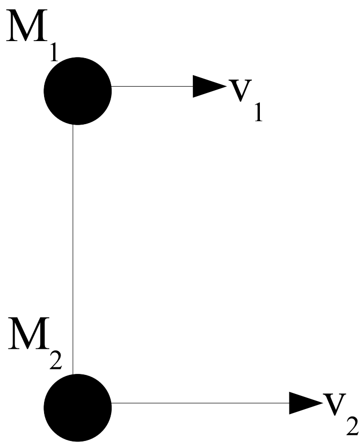
1. Two point masses, M_1 and M_2, move at parallel velocities v_1 and v_2 at $t = 0$. Their separation is r. (a.) What is their center of mass velocity? (b). If, in their center of mass frame, they orbit about each other in a circle, what is r in terms of the velocities (v_1 and v_2), masses, and gravitational constant G?



2. A Carbon nucleus has a charge of $6e$. If it has a single electron orbiting around it, how much energy is needed to ionize it? (Answer: 490 eV.)

3a.) A powerful radio station puts out about 1 megawatt (10^{13} ergs per sec) of power. At a distance of 100 km, how does the energy density in cosmic blackbody radiation compare with the energy density in the radio station's waves?

3b.) The energy density in a sound wave is $\rho\omega^2 x^2$ where ρ is mass density of the air (1.3×10^{-3}g), ω is the *angular* frequency of the sound wave, and x is the displacement of the medium caused by the wave. The human ear can hear displacements as small as 10^{-8} cm! At a frequency of 300 cycles per second, how does the energy density in a barely discernible sound wave compare with the blackbody energy density of cosmic radiation?

4. An asteroid is in a circular orbit about the sun. A rocket blasts off from its surface, instantly accelerating in the vertical direction to a velocity v equal to the original circular velocity of the asteroid. Thereafter, the rocket coasts. Ignoring the gravity of the asteroid, describe the orbit of the rocket: Is it elliptical, circular, parabolic or hyperbolic? What is the inclination of the new orbit to the old one?

5a.) Evaluate approximately the ratio of the mass of the sun to that of the earth, using only the lengths of the year and of the lunar month (27.3 days), and the radii of the earth's orbit (1.49×10^{13} cm) and of the moon's orbit (3.8×10^{10} cm). You may assume both orbits to be circular.

5b.) Suppose that the sun blew up without disturbing the earth's instantaneous velocity in orbit. What fraction of the sun's mass would have to be lost for the earth to become unbound?