

## Orbits of binary systems.

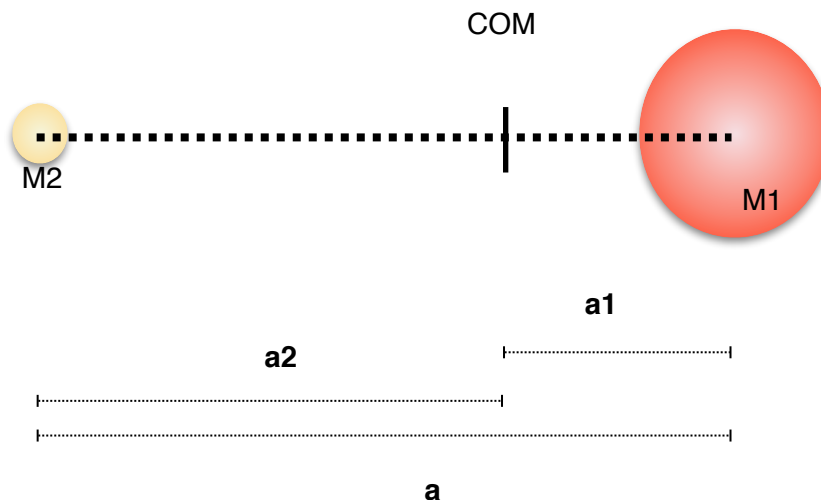
Our task is to make animations as we see in the two associated gif files (source:wikipedia). We are assuming the simplest form of orbits (circular).

Let us first see how to go about getting the orbits. Let us consider a binary system (it could be two stars, a star and a planet, or a planet and its satellite), with component masses  $M_1$  and  $M_2$ , and orbital separation  $a$ , orbiting around the common center of mass (COM) in circular orbits. It can be easily shown that in a coordinate system with origin at the center of mass of the system,

$$M_1 a_1 = M_2 a_2 \quad \text{---(1),}$$

$$a = a_1 + a_2 \quad \text{---(2),}$$

where  $a_1$  and  $a_2$  are the distances of the component masses from the center of mass. See the figure.



All that we need to do is to let both components do circular motion around the center of mass with respective orbits (as you can see in the animation).

Let us produce the animation for (i)  $M_1=M_2$  (ii)  $M_1 = 10 M_2$  and (iii)  $M_1 = 10^6 M$

You can see that the numerical value of  $a$  is your choice. As a first step you can get the orbits, and then go ahead to

make the animation. As seen in the gif files, mark the position of the COM; and make the sizes of the binary components proportional to their masses.

Assignment:- Do the same for elliptical orbits.