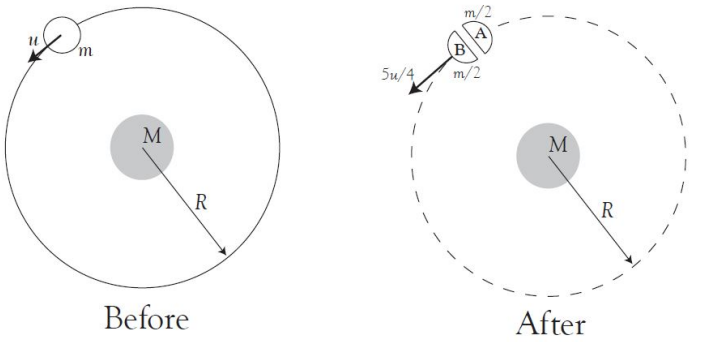
FP18

A small spherical satellite of mass m orbits a planet of much larger mass M at a speed u on a circular orbit of radius R. At a time $t = 0$, an internal explosion breaks the satellite into two equal hemispheres A and B, each of mass $m/2$. Immediately after the explosion, the speed of piece B is $5u/4$, and it is moving along the same direction as it was before the explosion. The figures show the system immediately before and immediate after the satellite's explosion.



a) (3 points) What is the speed u, angular momentum L, and total energy E (kinetic plus graviatational potential) of the satellite just before the explosion? Choose your energy scale so that a stationary object infinitely far away from the planet will have zero energy. Express your answers in terms of G, m, M, and R.

b) (2 points) What are the angular momenta L_A and L_B and the total energies E_A and E_B for parts A and B for times $t > 0$? You may leave your answer in terms of u if you did not complete part (a).

c) (2 points) How much mechanical work was done by the explosion that broke the satellite apart?

d) (1 point) Find the length of the semimajor axes a_A and a_B for the orbits of the pieces A and B for $t > 0$.

e) (2 points) Sketch the orbits of pieces A and B for $t > 0$. Clearly label the point at which the explosion occurred.