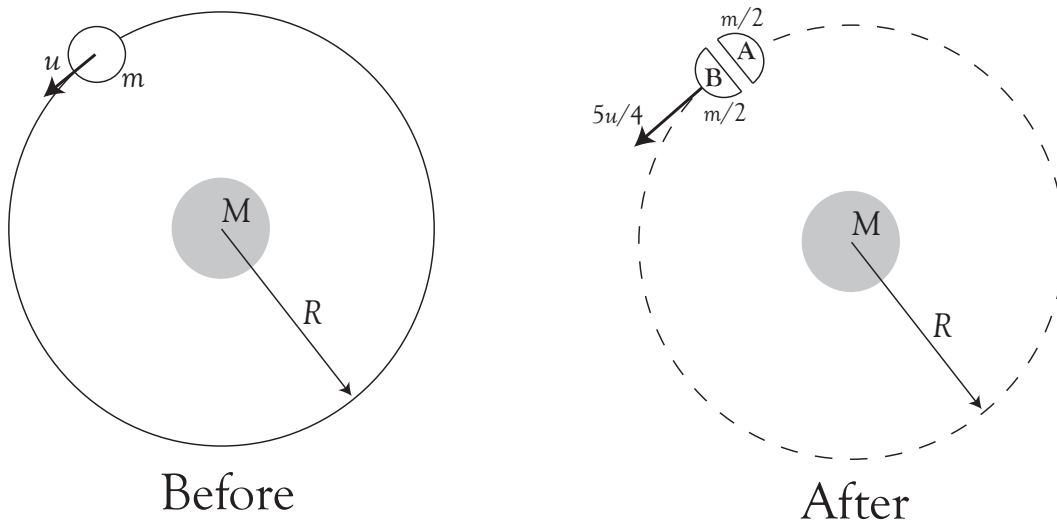


FP18

Problem 4 (10 points) - Exploding Satellite

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 shows the system immediately before and immediately after the satellite's explosion.



- (3 points)** What is the speed u , angular momentum L , and total energy E (kinetic plus gravitational 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 .
- (2 points)** What are the angular momenta L_A and L_B and the total energies E_A and E_B of parts **A** and **B** for times $t > 0$? You may leave your answer in terms of u if you did not complete part **(a)**.
- (2 points)** How much mechanical work was done by the explosion that broke the satellite apart?
- (1 point)** Find the length of the semimajor axes a_A and a_B for the orbits of the pieces **A** and **B** for $t > 0$.
- (2 points)** Sketch the orbits of pieces **A** and **B** for $t > 0$. Clearly label the point at which the explosion occurred.