2. A dumbbell-shaped satellite consists of two "point" masses, m, separated by a massless rod of length $2L$. It is in a circular orbit around the Earth with the center of the dumbbell at a radius R_c from the center of the Earth. [Use M for the mass of the Earth and G for the graviational constant and assume $m \ll M$.]

   (a) What is the angular velocity ω of the satellite (in terms of m, R_c, G, ...)?

   (b) A motor in the satellite is used to pull the masses together. Calculate the work that it must do to pull them together. Assume the dumbbell maintains a radial orientation as shown.

   (c) Which if the following remain constant during this maneuver? (Circle all that remain constant.)

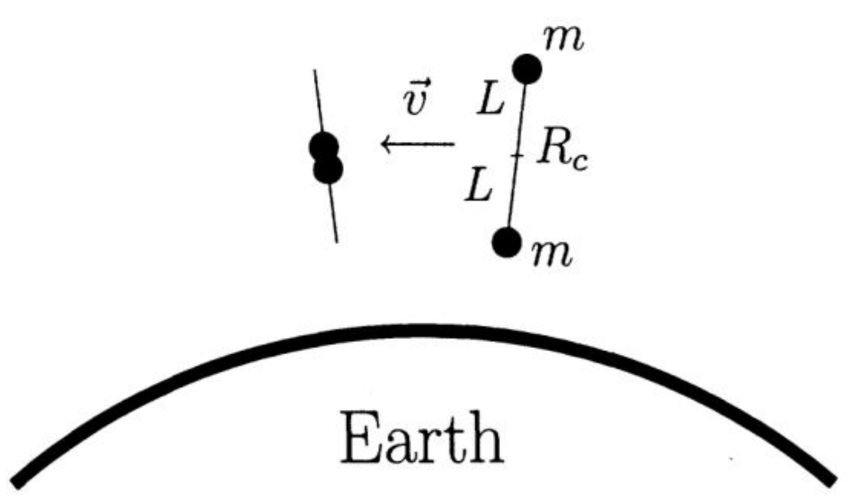
      i. Total mechanical energy of the satellite (*i.e.*, kinetic plus gravitational potential)?

      ii. Total angular momentum of the Earth-satellite system?

      iii. Total mechanical energy of th Earth-satellite system (kinetic plus gravitational potential)?

      iv. The radius of the center-of-mass of the satellite?

      v. The circular shape of the orbit?



[There is space on the next page to write out solution.]