A projectile of mass \( m \) is fired vertically from the earth’s surface with an initial speed that is equal to the escape velocity. The radius of the earth is \( R_e \), the mass of the earth is \( M_e \), and the universal gravitational constant is \( G \). Express your answers to the questions below in terms of \( M_e, R_e, m, \) and \( G \) as needed.

a) What is the initial speed of the projectile when it is launched from the surface of the earth?

When the projectile is a distance \( 2R_e \) from the center of the earth, it collides with a satellite of mass \( m \) that is orbiting the earth in a circular orbit. After the collision the two objects stick together. Assume that the collision is instantaneous.

b) What is the speed of the projectile, just before the collision, when it is a distance \( 2R_e \) from the center of the earth?

c) What is the speed of the satellite, just before the collision, when it is in a circular orbit of radius \( 2R_e \)?

d) What is the speed of projectile and satellite immediately after the collision?