

Problem 2.13

Two objects having different masses are propelled vertically from the surface of Earth, each with the same initial velocities. Assuming the objects are acted upon only by the force of gravity, show that they reach zero velocity at the same height.

KNOWN: Two objects are propelled upward from the surface of Earth with the same initial velocities and are acted upon only by the force of gravity.

FIND: Show that they reach zero velocity at the same height.

SCHEMATIC AND GIVEN DATA:

ENGINEERING MODEL: (1) Each object is a closed system. (2) The acceleration of gravity is constant. (3) The only force acting is the force of gravity.

ANALYSIS: For an object moving vertically under the influence of gravity only, Eq. 2.11 applies

$$\frac{1}{2}mg(V_2^2 - V_1^2) + mg(z_2 - z_1) = 0$$

For $V_2 = 0$ and $z_1 = 0$

$$-\frac{1}{2}mV_1^2 + mgz_2 = 0$$

Thus

$$z_2 = V_1^2/2g$$

Since the final height doesn't depend on mass, both objects will reach zero velocity at the same final height.

