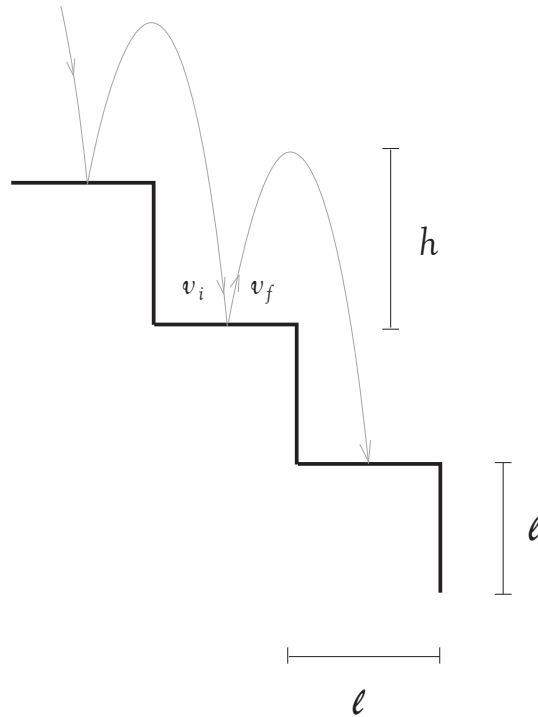


QP34

Problem 1 (6 points) - Marble Descending Staircase

A marble bounces regularly down a long flight of stairs, hitting each step with the same speed and at the same distance from the edge, and then bouncing up to the same height h above the step, as shown in the figure.



Each stair has the same height and depth l . The *horizontal* component of the marble's velocity is constant throughout, but the stairs have the property that $-v_f/v_i = e$, where v_i and v_f are the *vertical* velocity components just before and just after the bounce respectively, and e is a constant ($0 < e < 1$).

- (2 points)** Find an expression for v_i in terms of e , l , and the gravitational acceleration g .
- (2 points)** Find an expression for the time t between successive bounces, in terms of e , l , and g .
- (2 points)** Find an expression for the bounce height h in terms of e and l .