

1. A Civil War cannon is located on a low plain; there is a high cliff at the edge of the plain (the distance from cannon to cliff is larger than the cliff height). A cannonball is fired so that it is coming down when it lands somewhere atop the cliff.
  - a. Show the cannonball's motion from the instant it leaves the cannon until the instant before it hits the ground. Draw a complete motion diagram with labeled velocity and acceleration vectors. Show the horizontal and vertical components of velocity. Try to have at least 7 dots, with one of the dots located at the high point of the trajectory.



- b. In your motion diagram, suppose the launch speed  $v_0$ , the cliff height  $h$ , and the time of flight  $\Delta t$  are known. All other parameters of the flight, such as the launch angle  $\theta$ , are unknown. Write the velocity ( $v_y(t)$ ) and position ( $y(t)$ ) equations for the vertical motion and the position equation ( $x(t)$ ) for the horizontal motion. Then write a strategy for finding launch angle, maximum altitude, and range of flight (horizontal distance from launch to landing).