1. Some object is found to have constant acceleration. Choose the x direction as being the direction of that constant acceleration, and write the constant acceleration as a_{x0}.

a. Since by definition $a_x(t) \equiv dv_x(t)/dt$, therefore $v_x(t) = \int a_x(t)dt + C$. Do the necessary integration to produce the x-velocity equation; let the x-velocity at time zero be v_{x0}.

b. Since by definition $v_x(t) \equiv dx(t)/dt$, therefore $x(t) = \int v_x(t)dt + C$. Do the necessary integration to produce the x-position equation; let the x-position at time zero be x_0.

c. Solve for time in equation (a); use that to eliminate time from (b), and solve for displacement $\Delta x \equiv x_f - x_i = x(t) - x_0$. Simplify as much as possible.

d. Average x-velocity is defined by $\bar{v}_x \equiv \Delta x/\Delta t$. If we choose $t_i = 0$, then $\Delta t = t$. Use (b) to solve for $\bar{v}_x$ and use (a) to eliminate $a_{x0}t$ from the resulting expression. Interpret your result.

2. 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 Δt are known. All other parameters of the flight, such as the launch angle θ, 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).