Work your choice of two of the following three problems. Hand in your solutions at the end of the hour, or the start of class tomorrow morning.

Problems 1 and 3 are “trajectory” problems involving “projectile motion.” That means motion when gravity is the “only” force. Real-world problems involve air resistance and other complications.


1. A rock is thrown from the ground, with an initial angle $\theta$ with respect to the horizontal. It breaks a window in a building. The window is a horizontal distance $D$ away from the launch point, and a height $H$ above the ground. Derive an expression for the initial speed of the rock in terms of $D$, $H$, and $\theta$. Your answer may also contain constants such as $g$, $\pi$, and 4 (examples only; may or may not appear in your answer).

2. At a particular moment, you are standing in an elevator that is moving upward at speed $V$ but slowing down with an acceleration having magnitude $\frac{1}{4}g$. The acceleration of the elevator is constant. To what distance $D$ above your present position will you rise before the elevator comes to rest? Your answer must be in terms of relevant system parameters (i.e., $V$ and other constants).

3. You are playing a game of “William Tell” with your professor. Your professor is to split an apple atop your head from a distance of 27 m. The crossbow is held such that when it is aimed directly at the apple, the arrow is horizontal. At what angle must your professor aim the arrow if it is launched with an initial speed of 35 m/s?