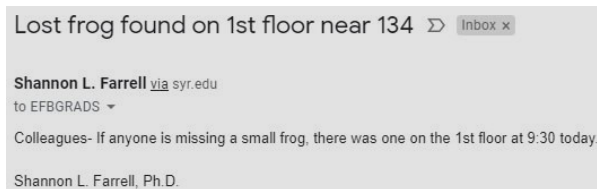# Homework 3, due Tuesday, 4 February

Your homework is due before the exam. You may either submit it to your TA's mailbox in front of the main office, or you may bring it to the exam and turn it in as you enter the room.

1. In recitation, you encountered a problem where a hiker was trying to throw her boot across a stream 12 meters wide. She accidentally threw it at an angle $65°$ above the horizontal when she meant to throw it at $35°$ above the horizontal. You may assume that she throws it from ground level.

   (a) At what speed would she need to throw the boot to get it across the stream when throwing it at $65°$ above the horizontal?

   (b) How high above the water would it travel in the process?

2. A car drives off of a cliff 60 meters above sea level and splashes into the ocean 150 meters out to sea.

   (a) What was the car's speed when it left the cliff?

   (b) What was the car's speed when it struck the water?

   (c) In what direction was the car traveling when it struck the water? (Give your answer in a physically meaningful way: "X degrees below the horizontal" or similar.

3. An escaped frog was found in Illick Hall on January 2^1 – presumably belonging to an Environmental Forest Biology student.

   This frog likely escaped because of its excellent jumping ability. Suppose that it is able to jump a meter straight up in the air, pushing itself off the ground with enough velocity to jump 1m high.

   Lost frog found on 1st floor near 134 ⟫ Inbox ×

   Shannon L. Farrell via syr.edu
   to EFBGRADS ▾

   Colleagues- If anyone is missing a small frog, there was one on the 1st floor at 9:30 today.

   Shannon L. Farrell, Ph.D.

   (a) With what velocity must the frog leave the ground to do this?

   (b) How long will the frog be in the air before she lands?

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[1] As reported by the "Leafy Memes for Forestry Teens" facebook page

4. Suppose our heroic frog wanders away from the Environmental Forest Biology students. She hops down the hall and into the elevator, which is miraculously working today. The elevator has been broken for weeks and nobody has used it, so spiders have built webs in it. While the elevator is accelerating upward at $\alpha = 2\,\text{m/s}^2$, she sees a tasty spider in its web at a height $h = 85$ cm above the floor of the elevator. (If the floor of the elevator moves, then the spider will move too.) This is the same frog, so it is capable of jumping with an initial velocity equal to the value you found in the previous problem.

Suppose that the frog jumps as high as she can to try to catch the spider, pushing off the ground with the same initial velocity as before.

(a) Sketch position vs. time graphs for the frog, the elevator floor, and the spider on one set of axes. Do this twice: once for the situation where the frog catches the spider, and one where the frog barely misses the spider because she can't jump high enough.

(b) If the frog jumps as high as she can, will she catch the spider?

Hint: Think very carefully about your coordinate system, and all of the consequences of the accelerating elevator. You may need the quadratic formula for this problem.

5. A hiker is standing on top of a mountain. The mountain slopes downward in front of her at an angle of 45°.

She kicks a stone off of the top. The stone's initial velocity is 4 m/s directed horizontally. The rock will fly through the air, curving downward until it comes back in contact with the slope. Where will the rock land back on the mountainside?