- worksheet: `positron.hep.upenn.edu/p8/files/ws11.pdf`
- 3 problems (2D projectile motion), problem 3 is challenging!
- I am splitting ch10 into 3 videos, & schedule will slip 1 more day. If need be, we can cover a little bit less — no worries.
- Short ch10/part2 video will appear asap, w/flexible deadline.
- Then ch10/part3 video due Monday. (Or skim ch10 book.)
- This Wednesday: a fun projectile-motion hands-on exercise, a chance to try out the "ecologist" / Mr Bill demo if you like, and a **short** worksheet. Enjoy fall break!
- Email **in advance** & file a CAR if you need to miss class.

$$x_f = x_i + v_{xi} t \qquad v_{xf} = v_{xi} \qquad v_{xi} = v_i \cos(\theta_{\rm launch})$$

$$y_f = y_i + v_{yi} t - \frac{1}{2} g t^2 \qquad v_{yf} = v_{yi} - g t \qquad v_{yi} = v_i \sin(\theta_{\rm launch})$$

$$v_f = \sqrt{v_{xf}^2 + v_{yf}^2} \qquad \theta_f = \arctan\left(\frac{v_{yf}}{v_{xf}}\right)$$

Be careful with degrees vs radians on your calculator.

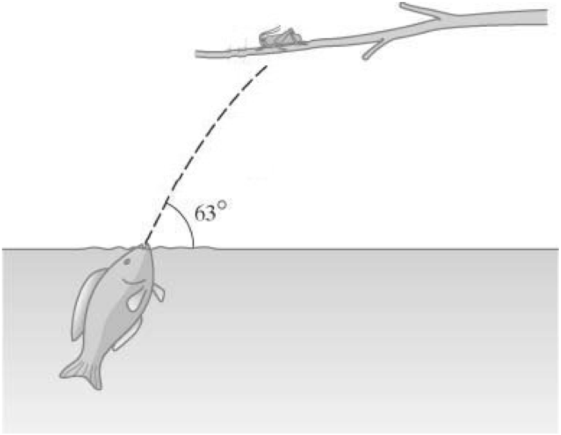
Physics 8, Fall 2021, Worksheet #11.

Upload PDF (smartphone scan or tablet edit) to Canvas at or shortly after end of class on Mon, Oct 11, 2021.

Problems marked with (*) must include your own drawing or graph representing the problem and at least one complete sentence describing your reasoning.

Discuss each problem with your teammates (usually groups of 3), then write up your own solution. Be sure to compare final results with your teammates, as a way to catch mistakes. It can also be very interesting when you and a teammate use different methods to arrive at a result! Do not hesitate to ask for help from other students, from Melina, or from Bill.

1. The archer fish shown in the figure, peering from just below the surface of the water, spits a drop of water at the grasshopper and knocks it into the water. The grasshopper's initial position is 0.45 m above the water surface and 0.25 m horizontally away from the fish's mouth. If the launch angle of the drop of water is 63° with respect to the horizontal water surface, how fast is the drop moving when it leaves the fish's mouth?



2. A package is dropped from an airplane traveling at 100 m/s at an altitude of 200 m, but the parachute attached to the package fails to open. (a) How long does it take for the package to reach the ground? (b) How far does the package travel horizontally before it lands? (c) What is the velocity of the package just before it lands? Give the velocity both in rectangular coordinates (v_x, v_y) and in polar coordinates (i.e. speed $|\vec{v}|$ and angle θ w.r.t. horizontal).

3*. *(This problem is longer, so it counts double: 8 points instead of 4 points.)* The figure below shows a friend standing on the flat roof of a building that is 51.8 m tall. The roof is square and measures 20 m on a side. You want to launch a water balloon so that it lands on the roof and startles your friend, using a spring-loaded device that shoots water balloons at a launch speed of 42 m/s. The only problem is a slim billboard 67.5 m high between you and the roof, 20 m in front of the building. You are sitting somewhere in front of the billboard such that when you launch the water balloon it just barely gets over the billboard at the highest point in its trajectory. (The figure shows you standing, but let's say that you are sitting, so that your own height can be neglected.) (a) At what angle above the horizontal do you need to aim the balloon to clear the billboard? (b) What is your horizontal distance from the billboard? (c) How long does the water balloon take to move from the highest point in its trajectory to the height of the roof? (d) Does it strike the roof? (e) What is the speed of the balloon when it strikes?

(a) At what angle above the horizontal do you need to aim the balloon to clear the billboard? (b) What is your horizontal distance from the billboard? (c) How long does the water balloon take to move from the highest point in its trajectory to the height of the roof? (d) Does it strike the roof? (e) What is the speed of the balloon when it strikes?