Assignment IV, PHYS 111 (General Physics I)
Fall 2018
Due Thursday, September 16th, 2021

Just as a reminder – in each homework assignment, I will list suggested homework problems out of the book. These are worth practicing – some may even appear on exams verbatim – but since they are in the text, finding answers on-line should be straightforward and these textbook problems will not be graded. I suggest you do them – many of them will be easier than the graded homework and they would be a good thing to tackle in your SI sessions to get comfortable with the content.

After the suggested book problems, I will give a list of problems that I myself wrote. *SOME* of these problems will be graded, but you won't know which ahead of time. The ones that I grade will be the same for everyone in the class.

I will supply you with an answer key to all of the problems that I wrote – even the ones that I did not grade.

As always, please legibly write (or type) your answers on separate paper. Incorrect answers with no work will earn nearly no credit, and consistent correct answers with no work are suspicious – many of these problems your professor can't do in his head, so it is unusual if you can. Please show all relevant work.

To help with this homework, you should read the associated sections of your text and watch the videos associated with the lectures on the course webpage: http://larsenml.people.cofc.edu/phys111_fall21.html.

(Ungraded) suggested textbook practice problems

(All problems are odd problems (that have answers in the back of the book) out of Halliday, Resnick, and Walker, 10th Ed.)

Chapter 4:
Questions: 5, 7, 9, 13, 17
Problems: 3, 7, 11, 15, 17, 21, 23, 27, 29, 41, 43, 47, 57, 59, 65, 87, 89, 111

(Graded problems on following page)

Graded homework problems

1. A baseball player uses a bat to launch a baseball at an angle of 32 degrees. The ball is moving at a speed of 38 m/s as it leaves the bat. For simplicity, you may assume the batter hits the ball from ground level.

   a) Assuming no air resistance and a flat/level environment, how far from the batter would this hit land? Leave your answer in feet. (You'll get an unrealistically large answer; that's because air resistance really isn't totally negligible here).

   b) The center field fence is 410 feet from home plate. The fence is twenty feet tall. Assuming no air resistance, will this baseball clear the fence for a home-run? (Support your answer with calculations.)

2. You stand on top of a tower of height 18 m and throw a stone at an angle of $+27^\circ$ with respect to the horizontal at a speed of 14 m/s.

   a) How long does it take for the stone to hit the ground?

   b) At what horizontal distance from the tower does the stone hit the ground?

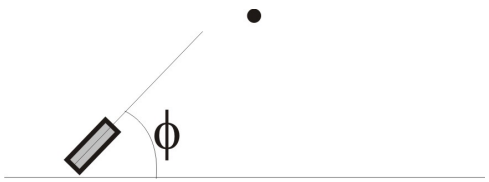
   c) What is the speed of the stone just before it hits the ground?

   d) Just before the stone hits the ground, what is the angle between the velocity of the stone and the ground?

3. A ball is thrown from level ground on Earth at some angle φ with respect to the horizontal. If the ball is originally thrown with speed $v_\circ$ and the ball is moving with speed $v_\circ/3$ at the very top of its path, what was the angle φ?

(More on following page)

4. A projectile is fired over a level surface on Earth with a speed $v_\circ$ such that it passes through two points both a distance h above the horizontal. (The first time height h is reached is on the projectile's ascent; the second time on its descent).



a) Show that if the gun is adjusted for maximum range, the horizontal distance the projectile travels between these two points is equal to:

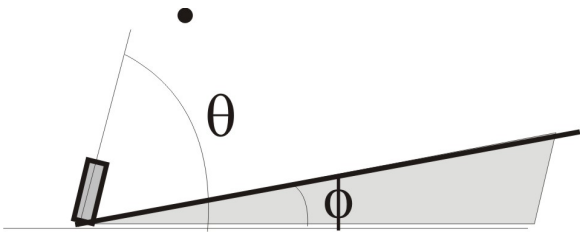
$$\frac{v_\circ}{g}\sqrt{v_\circ^2 - 4gh}$$

NOTE! When a physics problem asks you to "show ....", that does *NOT* mean "assume ...." and then show you get something that makes sense. That will NOT earn credit for problems like this. Rather, when a physics problem asks you to "show" a thing, you are being asked to start with relevant, known physical properties of a system and then manipulate them with extra physical insight to ultimately *derive* the result in question. Since you haven't been asked to do this before, I'll tell you that my first step is that – if I choose the origin for the gun's position and let x be the horizontal position of the projectile and let z be the vertical position of the projectile, I know that $x(t) = (v_\circ \cos\theta)t$ and $z(t) = (v_\circ \sin\theta)t - \frac{1}{2}gt^2$. I recommend starting from there.

b) Find an expression for the time of flight for the projectile between the points a distance h above the horizontal if the initial launch angle $\phi = \pi/6$. Your answer should be in terms of variables $v_\circ$, h, and g *only*.

(More on following page)

5. A cannon launches a projectile with initial velocity 175 m/s at an angle of 65° with respect to the horizontal (angle θ on the diagram). However, the area that the cannon is launching to is not level; in fact, the cannon is firing "up-hill" that has a steady grade of 28° with respect to the horizontal (angle ϕ in the diagram). How far "up the hill" does the projectile land? (In other words, how many meters up the slope would you have to walk in order to catch the cannonball? This is *different* than asking what is the horizontal position of the cannonball at its landing spot.)



6. Let's say that you are firing a cannon in an attempt to hit a target that is 1400 meters directly East of you. The target and the cannon are on level ground. Your cannon always fires cannonballs with an initial speed of 135 m/s.

   a) Calculate the angle of elevation needed to hit the target. [There are actually two angles; find them both.]

   b) Let's say you wanted to hit the target with two separate cannonballs at the same time. You can do this by firing the first cannonball at the larger angle computed in part (a), then adjusting the launch angle and firing another cannonball at the smaller angle computed in part (a). How long would you need to wait between firing the cannonball at the larger angle to firing the cannonball at the smaller angle so that the two cannonballs hit the target at the exact same time?