Week 3-Problems

3-1 A ball is launched from the ground with a velocity of 20m/s $\hat{y}$.

i. Why does it stop rising and returns to ground?
ii. What is the acceleration at the highest point?
iii. What is the value of y at the highest point?
iv. How long will it take to return to ground?
v. What is its velocity just before it hits the ground (y=0)?

3-2 If in problem 1 you wish the ball to go three times as high before it returns by what factor would you change its initial velocity? Why?

3-3. Starting from rest a ball is thrown straight down from the top of a 20m high building. At the same time a ball is launched straight up with a velocity of 15m/s $\hat{y}$. (i) When do the balls pass by one another? (ii) What is their position at that time?

3-4. Jenny is standing on the ground while Jill is at a dormitory window 6m high. Jenny throws a set of keys and Jill catches those 3 seconds later.

i. What is the velocity with which the keys were thrown?
ii. What is the velocity when Jill catches them?

3-5. You are standing on a cliff which is 20 meters high over looking a lake. Starting from rest you throw a ball straight down. One (1) second later you throw a second ball straight down with an initial velocity if $-V\text{m/s}\,\hat{y}$. Both the balls hit the water at the same time t. Calculate t and hence V.

3-6. If in problem 1 the ball is launched from the top of a tower which is 50m high, what are the answers to the questions (i) through (v)?

3-7. You are standing next to a window which is 2m tall. A flower pot falls from the top of the house and you note that it takes 0.5 sec to fall from the top to the bottom of the window. What is the height of the house above the window?

3-8. A projectile is launched at t=0 from x=0, y=0, with an initial velocity if V_0 m/s at angle of ϑ_0 above the horizon (x-axis). Show that its y-coordinate as a function of x is given by $y = x\tan\vartheta_0 - 4{\cdot}9\left(\frac{x}{V_0\cos\vartheta_0}\right)^2$

3-9. In baseball it is quite common to have a pitch thrown horizontally with an initial velocity of 90 miles per hour. If the ball travels 18m horizontally before reaching the plate, how far will it drop? What is its velocity at that point?

3-10. A boy on a 10m high balcony throws a ball at 20m/s horizontally hoping to hit a target 40m from the base of the building. Does he hit the target? If not, by what distance does the ball miss?

3-11. Show that in projectile motion, for a given initial velocity, there are two launch angles for which it has the same range (distance along horizontal before returning to ground).

3-12. You kick a ball with an initial speed of 30 ms at an angle of 37° above the horizon. There is a 14m high wall 30m away. Will the ball clear the wall? What will its velocity be at that point?

3-13. Consider the following boat trip. The river is flowing at 500 meters per hour. You can paddle your boat at 600 meters per hour with respect to the water. Your round trip takes you between two points which are 100 meters apart along the river. With respect to the shore, what is your velocity going (i) down stream (ii) up stream and how long does it take for the entire trip?

3-14. Your aircraft is just airborne above Washington when you are informed that there is a steady wind blowing south at 50mph. You can fly at 250mph with respect to air and you want to head to Pittsburgh which is directly due west. What direction would you choose and how long will it take if the Pittsburgh to Washington distance is 200 miles?

3-15. What is an inertial observer?