Please write your homework neatly. Don’t try to cram all the problems into the minimum space. Show your work clearly; useful diagrams are always appropriate and may get extra points. You may work with others, but the paper you submit should be your own. I expect numeric answers to have a reasonable number of significant figures and proper units.

Note: WebAssign grades only on the answer; I will grade only (mostly) on the method! Make your method clear.

1. A ball is thrown at an angle of 37.0° below the horizontal from a rooftop 25.0 m above the ground. The ball hits the ground a horizontal distance of 13.0 m from where it was thrown. The ball is in ideal free fall from when it leaves the hand of the thrower until it hits the ground.
   (a) Find the time needed for the ball to hit the ground.
   (b) Find the initial speed of the ball. (I.e. the magnitude of its velocity.)
   (c) Find the components of the ball’s velocity just before it hits the ground.

2. Newton’s 3rd Law and Gravity. A thoughtful student puts forth the following argument about when Newton’s 3rd law applies.
   I understand why Newton’s 3rd law applies to contact forces, the forces objects exert on each other while touching, like when a truck hits a car. But I don’t think Newton’s 3rd law applies to gravity. When you drop a ball, the Earth exerts a gravitational force upon it, which makes the ball rush down to the Earth. But according to Newton’s 3rd law, the ball exerts just as big a force on the Earth as the Earth exerts on the ball. That can’t be right! The Earth doesn’t “rush up” to meet the ball. This goes to show that the Earth exerts a bigger force on the ball than the ball exerts on the Earth. So, Newton’s 3rd law isn’t true for gravity.

   How would you respond to the student?

3. You are moving a box along a horizontal surface, either by pushing it, or pulling it. In both cases your pull or push makes an angle θ with the horizontal. You can assume that you know the push, P, the angle, θ, and the mass of the box, m, as well as the value g. Only these may appear in your answers.
   (0) Always begin by drawing a force diagram for the block.
   (a) First consider the case of no friction acting between the box and the table.
      (i) What is the acceleration of the box in each case?
      (ii) What is the normal force in each case?
   (b) Finally, suppose that the box is moving to the left, and you are trying to stop it. What is the acceleration of the box in each case?