Extra Credit Writing 4 (Deadline March 18, 11:59 PM)

This extra credit assignment is worth at most 5 extra credit points.

Prompt. I am about to launch a t-shirt using a t-shirt cannon. I know that the t-shirt in the cannon will exit at a velocity of 30 meters per second. At what *angle* should I launch the t-shirt to maximize the horizontal distance that the t-shirt travels when the t-shirt hits the ground? Indicate your answer as an exact number—not a decimal approximation. So you are allowed to have things like arcsin, sin, square roots, et cetera.

Give an answer that *depends* on the initial height y_0 of the t-shirt cannon. Your answer will be easiest when the initial height is zero.

It may help to think about velocity as follows:

The velocity of the t-shirt will have a vertical component v_y (how fast the t shirt is moving up or down) and a horizontal component v_x. And if s represents the speed of the t-shirt at time t, we'll have that

$$s(t) = \sqrt{v_x(t)^2 + v_y(t)^2}.$$

Finally, if an object has a horizontal speed of v_x, you can keep track of its horizontal coordinate as follows:

$$x(t) = v_x \cdot t.$$

If an object has an initial vertical speed of v_t, you can track its vertical coordinate as follows:

$$y(t) = y_0 + v_y t - 4.9t^2.$$

(This is an equation you'd learn in a physics class, or a mechanics class.)

Do what you can. If you can only find an answer when $y_0 = 0$, that's okay; you'll get partial credit.

Miscellaneous guidelines. Usual formatting guidelines. Upload on Canvas in **PDF format** by the above indicated deadline.

Hint. You should use calculus.