Name: _____

You may answer the questions in the space provided here, or if you prefer, on your own notebook paper.

Short Problems

$$
\begin{aligned}
v_f &= v_i + at \\
x_f &= x_i + \frac{1}{2}\left(v_i + v_f\right)t \\
x_f &= x_i + v_i t + \frac{1}{2}at^2 \\
v_f^2 &= v_i^2 + 2a\left(x_f - x_i\right)
\end{aligned}
$$

1. [2 points] An automobile is moving down a straight road and brakes with a constant acceleration (remember that acceleration in physics can be positive [speeding up] or negative [slowing down] but we use the same term–acceleration). The initial velocity is $v_i = 35$ and it slows to $v_f = 15$ in 7.0seconds,

   (a) what was the average acceleration?

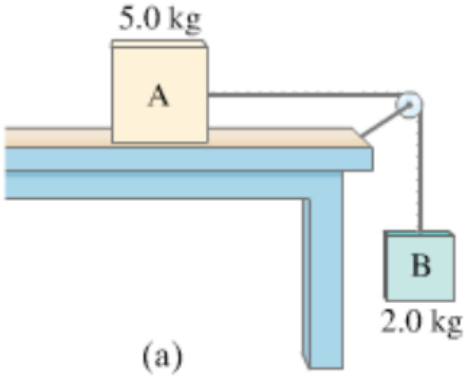
   (b) How far did it travel?

2. [4 points] An small airplane has to reach a speed of $27.8\frac{\text{m}}{\text{s}}$ to takeoff. It can accelerate at $2.00\frac{\text{m}}{\text{s}^2}$. What is the minimal length of runway that would allow for a safe takeoff?

3. [4 points] You throw a ball up into the air. How fast should you throw it up to ensure that it will return to your hand in 2 seconds?

4. [8 points] There is an evil pig 200 meters from you. You wish to hit the pig with a cannon ball. Assume the cannon ball is launched at $y = 0$ and the pig is also at $y = 0$ on the ground. Find a combination of initial launch velocity and angle that will enable you to hit the pig. *Hint: you can pick any angle, but pick a reasonable angle.* **Bonus: What angle would allow you to hit the pig faster than any other angle and why?**

5. 8 points In the figure below, two boxes are attached via rope and pulley. One box is on a *frictionless* table and the other is hanging from the rope.



(a) Draw the free body diagram for each block.

(b) Write the Newton's 2nd Law equation ($\sum F = ma$) for both boxes.

(c) Find the acceleration of the boxes.

(d) **Bonus:** If box B is 1 meter off the ground, how long will it take for it to hit the ground?