Quadratic Practice Problems for Math 101

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*** Indicates extra credit**

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1. ***Aberforth and his Goats:** Suppose the wizard Aberforth has 81 goats. He would like to contain his goats in a rectangular enclosure one side of which runs along his pub (and so that side doesn't need any fencing). If a goat requires 2 square meters of space for itself, what is the minimum length of fencing that Aberforth can conjure up in order to build a proper enclosure?

2. ****Generalizing the Goat Problem:** Suppose now that Aberforth has k goats and that each goat requires p square meters to itself. He still wants to build an enclosure as in the previous problem. What is the minimum length of fencing that Aberforth can conjure up in order to build a proper enclosure? (Assume that his pub can magically be a long as it needs to be in order to be the side of an arbitrarily long goat pen).

3. **Kongs vs K. Rool:** Donkey Kong and his crew need to shut down the Blast-O-Matic before K. Rool can use it to destroy Donkey Kong Island. The blueprints for the Blast-O-Matic are scattered around the island, but for each piece the Kongs are able to retrieve, Snide the Weasel Technician, will be able to give them more time to disable the Blast-O-Matic generator once they are inside K. Rool's Lair.

   a) Use the following table to find a quadratic function that models the amount of time the Kongs will have in K. Rool's lair as a function of how many blueprints they brought Snide.

Blueprints	6	13	29	32
Time (Minutes)	21.1	31.775	46.975	48.4

   b) If the Kongs have 25 blueprints, how much time will they have inside K. Rool's Lair?

   c) The function you get from running a regression is a parabola, but it does not make sense for our model to ever be decreasing (since this would give the Kongs less time for bringing Snide more blueprints). Find the interval where the parabola is increasing and use this information to determine how many blueprints exist, and how much time the Kongs will have if they collect all of the blueprints.

4. ****All That Glitters is not Precious:** Oh no! A couple of short dudes with hairy feet just threw something very "precious" to Smeagol off a 200 ft cliff into a pit of lava. The height of the precious, t seconds after it was thrown is given by

$$p(t) = -16t^2 + 2t + 200.$$

   (In general if an object starts at a height h_0 ft with initial upward velocity of v_0 ft/s, then its height, t seconds later is given by $h(t) = -16t^2 + v_0t + h_0$. Also, note that negative upward velocity means going downwards.)

   a) Suppose Smeagol jumps with upward velocity, v ft/s, exactly one second after the "Precious" is thrown. Write a function, $s(t)$, that gives Smeagol's height, t seconds after the "Precious" is thrown.

   b) Using your function $s(t)$ from part a, figure out the value of v that will allow Smeagol to catch up to his "Precious" just as they both hit the lava and meet their fiery doom.