1. The usual equation of velocity for a falling object does not take air resistance into account. If we include air resistance, the velocity $v(t)$ of a falling object at time t ends up taking the form

$$v(t) = \alpha \frac{e^{\beta t} - e^{-\beta t}}{e^{\beta t} + e^{-\beta t}}.$$

Here, positive velocity indicates downward motion, and $\alpha > 0$ and $\beta > 0$ are positive constants.

(a) If the velocity $v(t)$ of an object is modelled by the above equation, is the object's velocity *increasing* or *decreasing* at $t = 3$?

(b) Under the same assumption, is the the object's **acceleration** increasing or decreasing at $t = 3$?

To start, do **NOT** try to solve the problem. Instead:

- Give variable names to all of the quantities in the problem.
- Write down an equation or equations relating the different quantities in the problem.
- Translate the key parts of the question, word by word, into mathematical statements and questions.

After you have done all of those steps, **THEN** solve the problem.

2. Under the logistic model of the spread of a rumor, the proportion of people $p(t)$ in a given population who have heard a rumor at time t days can be modelled by

$$p(t) = 1 - \frac{1}{1 + Ae^{kt}}.$$

(a) Under the above model, if 10% of the people in the United States have heard of a given rumor at time $t = 0$ days, what is the constant A?

(b) If we also know that at $t = 0$ days, the rumor is spreading at an instantaneous rate of 3% of the population per day, what is the constant k?

To start, do **NOT** try to solve the problem. Instead:

- Give variable names to all of the quantities in the problem.
- Write down an equation or equations relating the different quantities in the problem.
- Translate the key parts of the question, word by word, into mathematical statements and questions.

After you have done all of those steps, **THEN** solve the problem.

3. Spamstung is making a brand new smartphone, the Explosion 7. They determine that if they manufacture x smartphones, it will cost them

$$C(x) = x(150 + 0.00001(x - 10000)^2)$$

dollars, and they will make

$$R(x) = x(600 - 0.01x)$$

dollars in revenue. (Note that revenue does not account for costs.)

(a) Suppose that Spamstung makes 10000 Explosion 7's. How much money will Spamstung make or lose?

(b) Suppose Spamstung is currently planning to make 10000 Explosion 7's and they are wondering if they should instead make more phones or fewer phones. Are they better off making a few more phones or a few less?

To start, do **NOT** try to solve the problem. Instead:

- Give variable names to all of the quantities in the problem.
- Write down an equation or equations relating the different quantities in the problem.
- Translate the key parts of the question, word by word, into mathematical statements and questions.

After you have done all of those steps, **THEN** solve the problem.