2. *Pineapple* is an up-and-coming tech startup. Their current cost and revenue functions (in dollars) are given below.

$$R(q) = 5q - 0.003q^2$$
$$C(q) = 300 + 1.1q$$

where q is quantity and $0 \leq q \leq 1000$.

(a) What production levels give the maximum profit? What about the minimum profit?

⇨ INDICATES THAT WE SHOULD USE THE FIRST DERIVATIVE TEST (FOR PROFIT!)

RECALL: PROFIT = REVENUE - COST

$P(q) = (5q - 0.003q^2) - (300 + 1.1q)$

$= 5q - 0.003q^2 - 300 - 1.1q$ SO $P(q) = 3.9q - 0.003q^2 - 300$

STEP 1. FIND $P'(q)$.

$P'(q) = 3.9 - 0.006q$

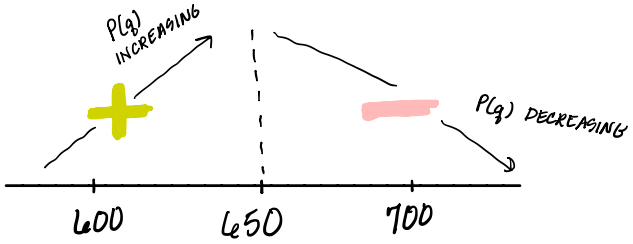
STEP 2. SET $P'(q) = 0$ AND SOLVE FOR q

$3.9 - 0.006q = 0$

$q = \frac{-3.9}{-0.006} = 650$

SO $q = 650$ IS A CRITICAL POINT.

STEP 3 USE # LINE TO CHECK IF CRIT. POINT IS MAX OR MIN



$P'(600) = 3.9 - 0.006(600) > 0$

$P'(700) = 3.9 - 0.006(700) < 0$

⇨ $q = 650$ IS A LOCAL MAX OF $P(q)$

... BUT WE ALSO NEED TO CHECK THE ENDPOINTS OF OUR INTERVAL!

$P(0) = 3.9(0) - 0.003(0) - 300 = -300$ ⟶ $q = 0$ IS A GLOBAL MINIMUM OF $P(q)$ ⇨ $q = 0$ GIVES MINIMUM PROFIT

$P(1000) = 3.9(1000) - 0.003(1000) - 300 = 600$

$P(650) = 3.9(650) - 0.003(650) - 300 = 967.5$ ⟶ $q = 650$ IS A GLOBAL MAXIMUM OF $P(q)$ ⇨ $q = 650$ GIVES MAXIMUM PROFIT

3. The company *Beets by Go* is studying the rate at which photosynthesis takes place in the leaf of a beet plant.

   For time $t \geq 0$ in days, the rate at which photosynthesis takes place, represented by the rate at which oxygen is produced, is approximated by:

$$p(t) = 100\left(e^{-0.02t} - e^{-0.1t}\right)$$

   (a) When is photosynthesis occurring fastest in the beet plants? What is that rate?

WANT: MAXIMUM!

SO: FIRST DERIVATIVE TEST

$p(t) = 100\left(e^{-0.02t} - e^{-0.1t}\right)$

STEP 1: FIND $p'(t)$

TO FIND $p'(t)$ USE CHAIN RULE (TWICE)

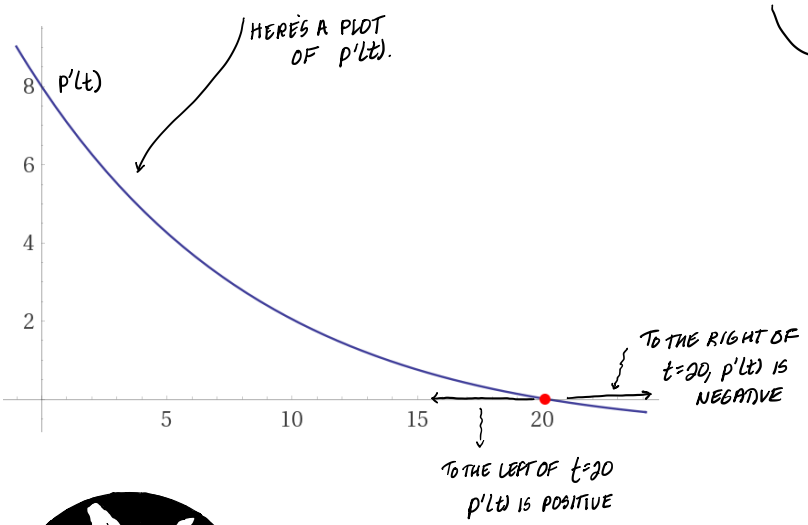
$p'(t) = -0.02e^{-0.02t} + 0.1e^{-0.1t}$

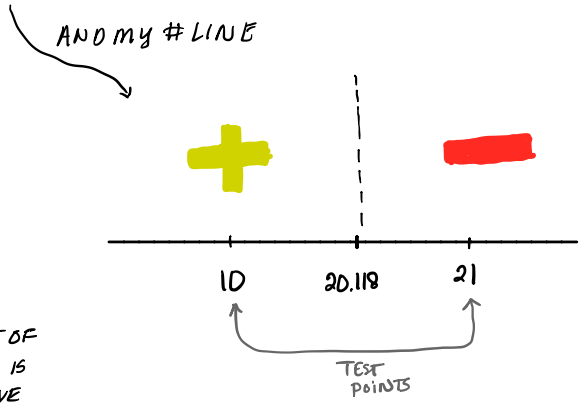
STEP 2 SET $p'(t)=0$ & SOLVE FOR t

$-0.02e^{-0.02t} + 0.1e^{-0.1t} = 0$ → TO SOLVE FOR t, I WOULD PLUG THIS INTO MY GRAPHING CALCULATOR

WHEN YOU DO THIS, YOU'LL GET $t = 20.118$ → THIS IS A CRITICAL POINT!

STEP 3: NUMBER LINE TO DETERMINE IF CRITICAL POINT IS MAX OR MIN





BY THE FIRST DERIVATIVE TEST, PHOTOSYNTHESIS IS OCCURING FASTEST AT $t = 20.118$, AT THE RATE $p(20.118)$.

beets by go