Mathematics 172 Homework, January 31, 2019.

Water hyacinth (Eichhornia crassipes) is an extremely fast growing float-ing aquatic plant[1] which is grown to feed live stock in some parts of the world.

1. A population of water hyacinth is growing logistically in a large pond with intrinsic growth rate $r = .2$ (lbs/lb)/week and a carrying capacity of $K = 10{,}000$ lbs. What is the maximum rate that the water hyacinth can be harvested before killing off the population in the pond? *Solution:* Let $P(t)$

be the number of lbs of water hyacinth in the pond in the week t. Then, as it grows logistically

$$\frac{dP}{dt} = .2P\left(1 - \frac{P}{10{,}000}\right)$$

If H is the rate it is being harvested, then the new rate equation is

$$\frac{dP}{dt} = .2P\left(1 - \frac{P}{10{,}000}\right) - H.$$

One H is so large that the right hand side of this is always negative, then the population will die off. We graph dP/dt as a function of P, which on the calculator is
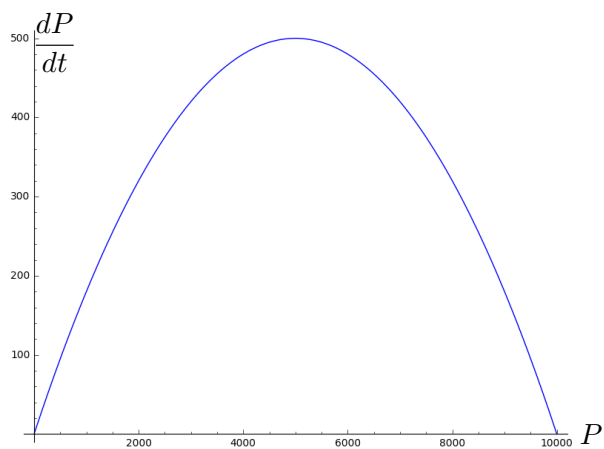
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\Y1 = .2X(1-X/10000)
Xmin = 0
Xmax = 10000
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The graph is

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[1]It is classified as an invasive species here in South Carolina.

$$\frac{dP}{dt}$$

You can now use the calculator to find that the maximum is 500. So the maximum rate of harvesting is 500 lbs/week.

2. If

$$N_{t+1} = N_t + 1.3 N_t \left(1 - \frac{N_t}{500}\right) \quad \text{and} \quad N_0 = 412.$$

find N_1, N_2, N_3, and N_4.

Solution:

$$N_1 = 506.265600000000$$
$$N_2 = 498.018249867264$$
$$N_3 = 500.584313972490$$
$$N_4 = 499.823818108925$$