AP BIO EQUATIONS AND FORMULAS REVIEW SHEET #4

(Population Growth practice)

Formulas:

Rate	Population Growth	Exponential Growth	Logistic Growth
dY/dt	dN/dt = B – D	$\frac{dN}{dt} = r_{max} N$	$\frac{dN}{dt} = r_{max} N\left(\frac{K-N}{K}\right)$

dY = amount of change B = birth rate D = death rate N = population size

K = carrying capacity r_{max} = maximum per capita growth rate of population (decimal)

↳ per person

Notes

$\frac{dN}{dt} = \frac{\Delta N}{\Delta t} = \frac{\textit{change in population size}}{\textit{change in time}}$ = **population growth rate**

Example 1:

There are 300 falcons living in a certain forest at the beginning of 2013. Suppose that every year there are 60 falcons born and 30 falcons that die. — use exponential growth equation (No carrying capacity mentioned)

a. What is the **population growth rate** (include units)? Interpret the value.

$\frac{\Delta N}{\Delta t} = B - D = 60 - 30 =$ 30 falcons added in 1 year

1 year ← Δt

b. What is the **per capita growth rate** of the falcons over a year? Interpret the value.

r_{max}

$\frac{\Delta N}{\Delta t} = r_{max} N$

$r_{max} = 0.1$

$\frac{30}{300} = \frac{r_{max} \cdot 300}{300}$

c. Fill in the table and the construct a graph.

Year	Population
2013	300
2014	330
2015	363
2016	399.3
2017	439.23
2018	483.153

(sorry, I'm lazy!)

$\frac{\Delta N}{\Delta t} = r_{max} N$

for 2014 $\frac{\Delta N}{\Delta t} = 0.1(300) = 30$

+ 300

2013 pop. size

330

for 2015

$\frac{\Delta N}{\Delta t} = (0.1)(330)$

$= 33$

+ 330 (2014 pop size)

363

d. Find the **average rate of change** for the falcon population from 2013 to 2018 (include units). Interpret the value.

$\text{slope} = \frac{\Delta y}{\Delta x} = \frac{483 - 300}{2018 - 2013} =$ 36.6 falcons per year

over the past 5 years, the falcon population has increased by 36.6 per year on average

Example 2:
Kentwood, Michigan had a population of 49,000 in the year 2013. The infrastructure of the city allows for a carrying capacity of 60,000 people. $r_{max} = .9$ for Kentwood.

a. Is the current population above or below the carrying capacity? Will the population increase or decrease in the next year?

Below, increase

b. What will be the **population growth rate** for 2013 (include units)?

logistic growth (b/c carrying capacity mentioned)

$\frac{\Delta N}{\Delta t} = r_{max} N \left(\frac{K-N}{K}\right)$

$= 0.9\,(49{,}000)\left(\frac{60{,}000-49{,}000}{60000}\right) =$ 8085 people added during 2013

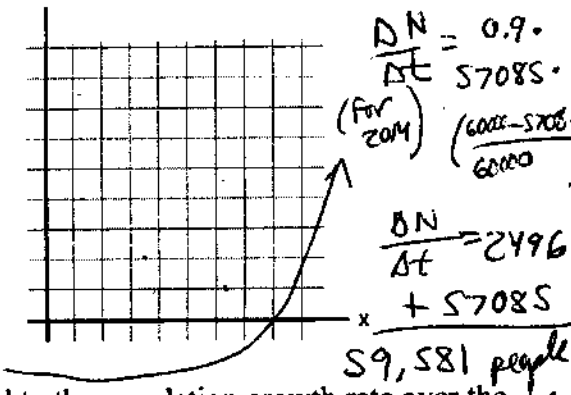
c. What will be the **population size** at the start of 2014.

$49{,}000 + 8085 =$ 57,085 people

d. Fill in the following table. Then graph year vs. population size.

Year	Population size	Population growth rate
2013	49,000	8085
2014	57085	2496.041625
2015	59581	374.4296457
2016	59955	40.04611425
2017	59996	4.039052139

$\frac{\Delta N}{\Delta t} = r_{max} N \left(\frac{K-N}{K}\right)$



e. What happened to the population size over the years? What happened to the population growth rate over the years?

It grew but the growth rate decreased

f. Explain your answer from part (e) using what you know about carrying capacity.

Rate of growth slows closer to the carrying capacity, the

g. Explain your answer from part (e) using the formula: $\frac{dN}{dt} = r_{max} N \left(\frac{K-N}{K}\right)$

as N gets closer to K, $\left(\frac{K-N}{K}\right)$ gets closer to zero → $\frac{\Delta N}{\Delta t}$ gets closer to "0"