Name: _____ Date: _____

Biology 30 – Population Ecology Worksheet

HARDY WEINBERG PROBLEMS

1. ***There are 100 students in a class. Ninety-six did well in the course whereas four blew it totally and received a grade of F. Sorry. In the highly unlikely event that these traits are genetic rather than environmental, if these traits involve dominant and recessive alleles, and if the four (4%) represent the frequency of the homozygous recessive condition, please calculate the following:***

$q^2 - 4\% = .04$

A. The frequency of the dominant allele.

$q - \sqrt{.04} = .2$

$p - 1 - .2 = .8$

.8

$p^2 -$

B. The frequency of heterozygous individuals.

$2pq - 2 \times .8 \times .2 = 0.32$

0.32

2. ***Within a population of butterflies, the color brown (B) is dominant over the color white (b). And, 40% of all butterflies are white. Given this simple information, which is something that is very likely to be on an exam, calculate the following:***

white = recessive = aa or q^2

A. The percentage of butterflies ~~in the~~ population that are heterozygous.

$q^2 - 40\% = .4$

$q - \sqrt{.4} = 0.6325$

$p - 1 - .6325 = .3675$

$p^2 - .3675^2 = .1351$

$2pq - 2 \times .6325 \times .3675 = .4649$

.4649 = 46%

B. The frequency of homozygous dominant individuals.

.1351

5. ***A rather large population of Biology instructors have 396 red-sided individuals and 557 tan-sided individuals. Assume that red is totally recessive. Please calculate the following:***

Total # = 396 + 557 = 953

A. The expected homozygous recessive frequency

396 = red = recessive = aa or q^2

557 = Aa or AA

0.4155

B. The number of heterozygous individuals that you would predict to be in this population.

we have → $q^2 \frac{396}{953} = 0.4155$

$q - \sqrt{.4155} = .6446$

$p - 1 - .6446 = .3554$

$p^2 -$

Find → $2pq - 2 \times .6446 \times .3554 = .4582$

2pq TOTAL

.4582 × 953 = 436.7 would be heterozygous

POPULATION ECOLOGY PROBLEMS

1. A survey of a coral reef by Dr. Graham identifies the presence of 25 spotted drums (fish). The plot size sampled was 100 m × 175 m. **Calculate** the density of the spotted drum population.

$D = \frac{N}{A} = \frac{25}{100 \times 175} = \frac{25}{17{,}500} = .0014 \text{ fish/m}^2$

2. Having identified an important "nurse" tree association between the palo verde tree and the saguaro cactus, Professor Burne assessed the effect of palo verde tree presence on the survivorship of saguaro cacti. He found 96 cacti in a 36 m × 205 m plot where no palo verde were found to exist. On a second plot, which contained palo verde, Prof. Burne found 80 saguaro cacti in a 20 m × 110 m area. **Calculate** the densities of each plot.

$D = \frac{N}{A} = \frac{96}{36 \times 205} = \frac{96}{7380} = .013$

$\frac{80}{20 \times 110} = \frac{80}{2200} = .364$

3. A census of pike in the local reservoir indicates that 15 new fish were born within the reservoir. A stocking program added 37 fish to help replace the estimated number of 43 fish caught by people fishing in the reservoir. The census revealed that the pike population totaled 57 prior to the addition and removal of fish from the reservoir. **Calculate** the per capita growth rate for the pike.

$cgr = \frac{\Delta N}{N} = \frac{(15+37) - (43+0)}{57}$ (no emmigration)

$= \frac{52-43}{57} = \frac{9}{57} = .1579$

4. A study of two populations of tiger salamanders was conducted in south central Alberta. These animals have a very limited distribution in western Canada and there was some concern that recent increases in UV radiation may be causing a general population decrease. The data collected is illustrated below:

Population Parameters	Population #1	Population #2
Original population size	3861	2974
Natality	706	814
Mortality	991	523
Immigration	178	264
Emigration	211	128

Pop 1 −318 Pop 2 427

(a) For each population, calculate:
- **i.** change in population size
- **ii.** per capita population growth rate

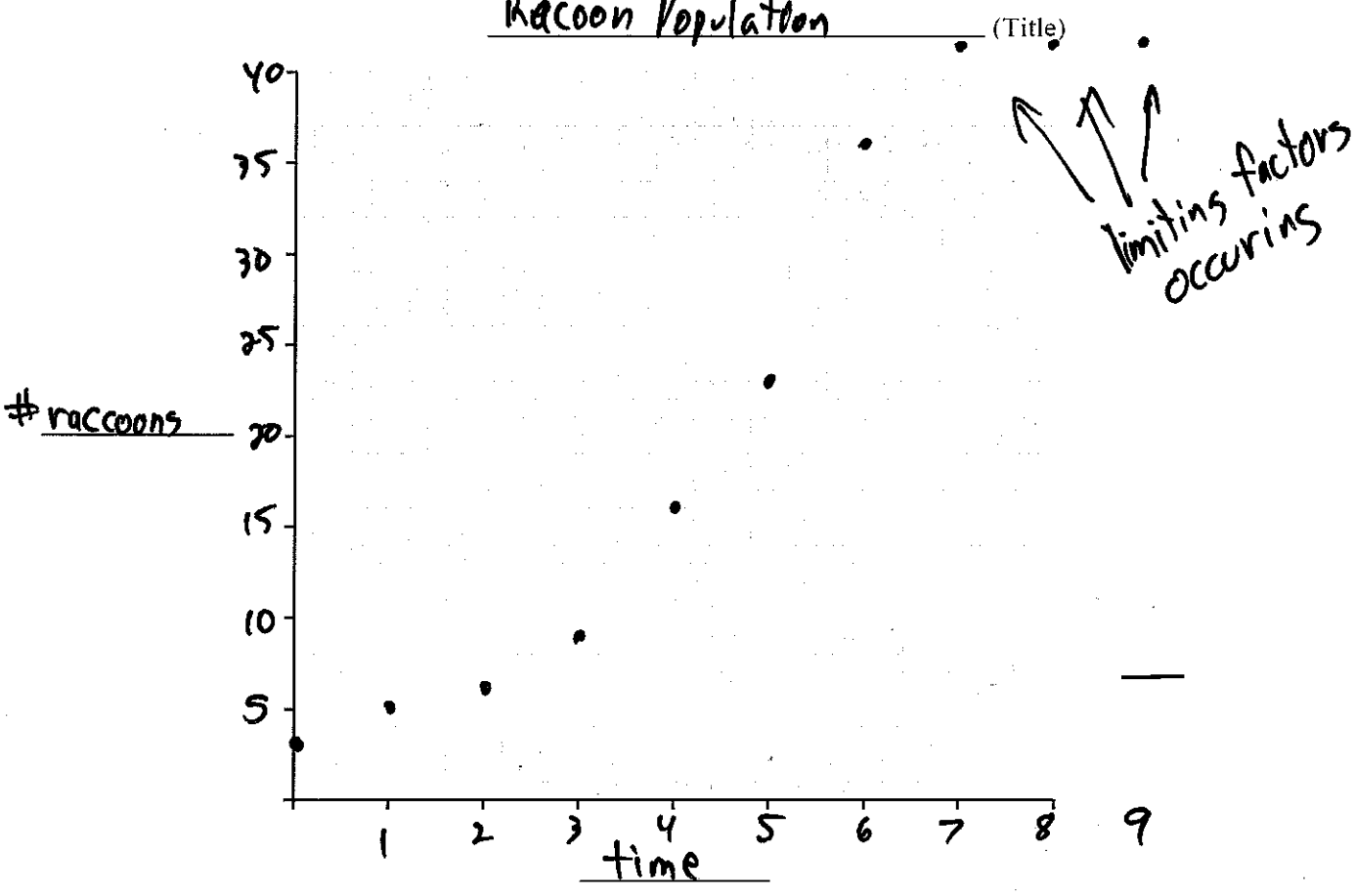
Pop 1 $\frac{(706+178)-(991+211)}{3861} = \frac{-318}{3861} = -.082$

Pop. 2 $\frac{(814+264)-(523+128)}{2974} = \frac{427}{2974} = .144$

5. Plot the following data in the grid provided.

Time (years)	Number of raccoons
0	3
1	5
2	6
3	9
4	16
5	23
6	36
7	42
8	42
9	42

(a) Identify the type of growth curve represented by this data.



(b) Label on your graph the points in the growth of the population where limiting factors are having an effect.

(Hint: There are 3 points).

(c) Determine the carrying capacity of this population. 42 raccoons

Use the following information to answer the next question.

A population of rattlesnakes contained 1000 individuals at the beginning of the year. During the year, the population changed in the following ways:

Births	106
Deaths	53
Immigration	42
Emigration	15

The population covered an area of 16 hectares.

6. (a) Calculate the rattlesnake population density at the beginning of the year.

$D = \frac{N}{A} = \frac{1000}{16} =$ 62.5 snakes/h

(b) Calculate the per capita growth rate for the rattlesnake population over the year.

$cgr = \frac{\Delta N}{N} = \frac{(106+42)-(53+15)}{1000} = \frac{80}{1000} =$ 0.08

Use the following information to answer the next question.

A swimming pool 50 m long and 20 m wide is filled with water to a depth of 3 m. The population density of people in the pool is 0.0583 people/m^3.

7. Calculate the number of people in the pool.

$D = \frac{N}{V} \Rightarrow N = A \times D$

$= (50 \times 20 \times 3) \times 0.0583$

$=$ 174.9 people.