

Read carefully. Work accurately and efficiently. Some useful equations:

$N_t = N_0 \lambda^t$	$dR/dt = rR - cRP$	$dN_1/dt = r_1 N_1 (K_1 - N_1 - \alpha_{12} N_2) / K_1$
$N_t = N_0 e^{rt}$	$dP/dt = acRP - dP$	$dN_2/dt = r_2 N_2 (K_2 - N_2 - \alpha_{21} N_1) / K_2$
$H' = - \sum [p_i * \ln(p_i)]$	$dN/dt = rN(1-N/K)$	$dU/dt = L_0 V^* E + e^c * O \lambda O^* G^y$
SIR model: $dS/dt = -B SI - dS$;	$dI/dt = B SI - dI - \alpha I - \nu I$	$dR/dt = \nu I - dR$

Mandatory Question

1. What are the four, easily observed characteristics of natural selection? (5 pts, -2 for the first missing characteristic)
- a. _____
 - b. _____
 - c. _____
 - d. _____

Multiple alternatives. Circle the **best** answer (5 pts each, 15 pts total)

1. If p = the proportion of the A_1 alleles in a one-locus, two-allele system, which of the following is p if the number of individuals that are $A_1A_1 = 25$, $A_1A_2 = 50$, and $A_2A_2 = 75$?
- a. 0.25
 - b. 0.33
 - c. 0.4
 - d. 0.5
 - e. 0.75
2. Herbivores
- a. consume very little primary productivity.
 - b. consume moderate levels of primary productivity.
 - c. consume large amounts of primary productivity.
 - d. all of the above.
 - e. none of the above.
3. Data that would be consistent with Phyllis Coley's Resource Availability Hypothesis would show which of the following relationships?
- a. a decreasing function of defense investment versus plant growth rate.
 - b. an increasing function of defense investment versus plant growth rate.
 - c. a peaked function of defense investment versus growth rate, with the maximum investment and intermediate plant growth rates.
 - d. all of the above.
 - e. none of the above.

Short Answer Questions. Answer four of six. (5 pts each)

1. Explain why the sequestration of milkweed's cyanogenic glycoside in the exoskeleton of a monarch butterfly is likely an example of an "exaptation."
2. Provide a graph of the herbivore optimization hypothesis. Also, describe a real example.
3. Why should we be more interested in asymmetry rather than the response to competition resulting from the interaction of two species? (This probably requires two definitions.)
4. Compare and contrast the terms "coevolution" and "mutualism."
5. Describe "by-product mutualism" and provide an example (without using one discussed in class).
6. Draw the survivorship curve(s) for humans. Label everything in your graph. Provide a brief explanation for your result.

Medium-Length Answer Questions. Answer one of two. (10 pts)

1. From the equations for the SIR model, derive the expression for the threshold population size (N_T) that just supports an infection. (6 pts)

Based on the equations in this model provide two reasonable recommendations that health care providers could take to reduce infections. (2 pts ea.)

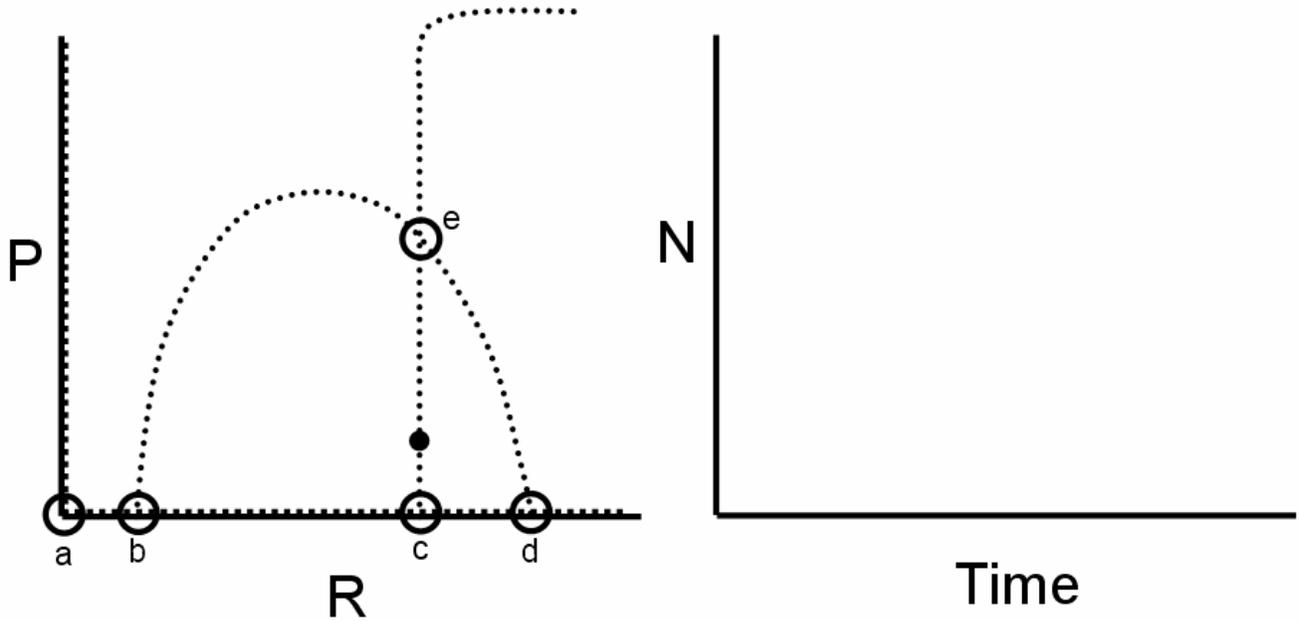
- a. _____
b. _____

2. The predator-prey model has two differential equations, one for prey (dR/dt) and one for predators (dP/dt) with two terms (variables that are multiplied together to express a relationship, separate by addition/subtraction) in each of the equations. Provide those terms below and describe, in words, what they represent (or mean) and provide one assumption that's being made for each term. (2.5 pts ea.)

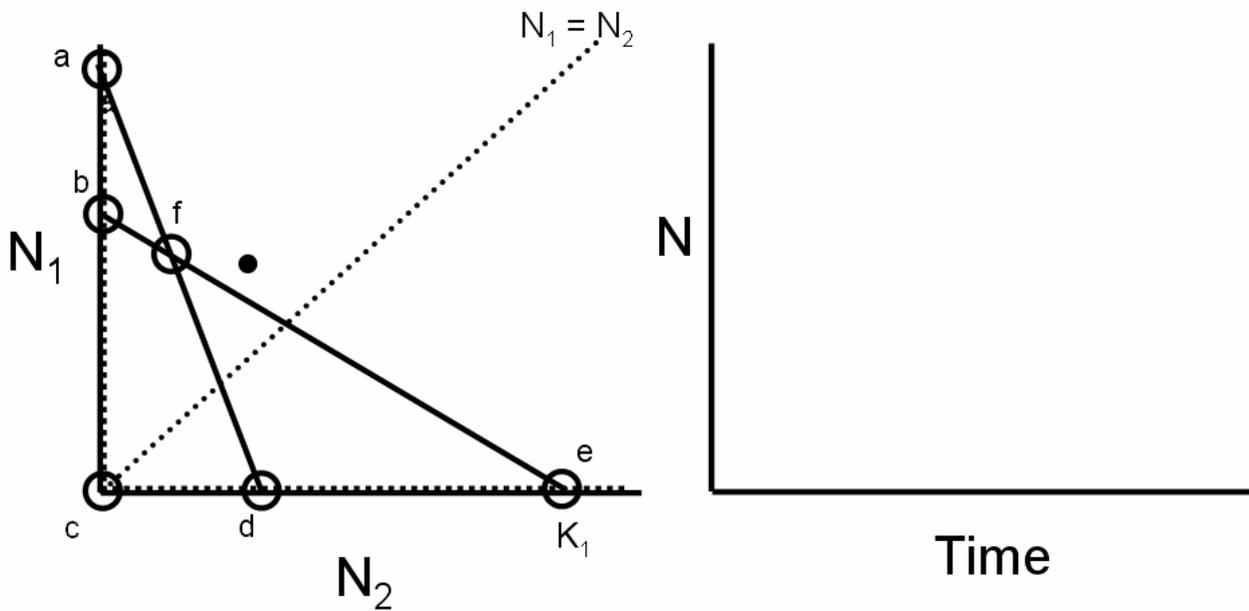
	Term	Meaning	Assumption
a.	_____	_____	_____
	_____	_____	_____
b.	_____	_____	_____
	_____	_____	_____
c.	_____	_____	_____
	_____	_____	_____
d.	_____	_____	_____
	_____	_____	_____

Long Answer Questions. Answer both (25 pts ea., 50 pts total)

- 1a. Identify the model in the left graph by name: (1 pt) _____.
- 1b. We bent the horizontal line down on the left (to point “b”) and on the right (to point “d”).
- What does this line represent? (2 pts) _____
 - What ecological principle is represented by the downward bend on the left? (2 pts) _____
 - What ecological principle is represented by the downward bend on the right? (2 pts) _____
- 1c. Analyze the graph on the left. Consider these points in particular: (2 pts ea. for 10 pts)
- _____
 - _____
 - _____
 - _____
 - _____
- 1d. The dark dot represents an initial condition (starting place). On the left graph draw the trajectory until it reaches an equilibrium. (3 pts)
- 1e. Draw this trajectory from start to finish on the graph on the right. (5 pts)

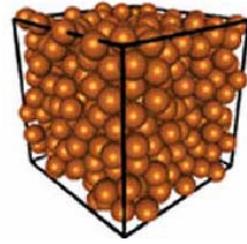


- 2a. Identify the model in the left graph below by name: (1 pt) _____.
- 2b. What does the line connecting points a and d represent? (2 pts) _____
- 2c. Analyze the graph on the left. Consider these points in particular: (2 pts ea. for 12 pts)
- a. _____
 - b. _____
 - c. _____
 - d. _____
 - e. _____
 - f. _____
- 2d. The dark dot represents the initial condition. On the left graph draw the trajectory until it reaches an equilibrium. (5 pts)
- 2e. Draw this trajectory on the graph on the right. (5 pts)



Extra Credit (≤ 7 pts)

1. We saw this interesting diagram in a “what’s new?” segment. What was the new finding specifically (1 pt) and what’s its significance for ecological/biological systems (1 pt) ?



2. SARS is a deadly respiratory disease that quickly spread to just a few places around the world. What whacky explanation (1 pt) did we discuss that suggested how that happened and what was the more parsimonious (less outrageous) explanation (1 pt) for this spread?
3. This graph, from your textbook presents three types of selection. For each provide the name of the type of selection above and an example below. (1 pt for each completed, ≤ 3 pts total).

