MEMORIAL UNIVERSITY OF NEWFOUNDLAND

DEPARTMENT OF MATHEMATICS AND STATISTICS

SECTION 4.4 **Math 1001 Worksheet** WINTER 2025

For practice only. Not to be submitted.

1. Suppose $x(t)$ and $y(t)$ are two populations described by the system of differential equations

$$\frac{dx}{dt} = 5x - 2xy$$
$$\frac{dy}{dt} = -y + 3xy.$$

   (a) This is a predator-prey system. Which population is the predator? Which population is the prey?

   (b) Does any factor besides predation inhibit the growth of the prey population?

   (c) Determine the equilibrium points of the system. What potential long-term outcomes do they describe?

2. Suppose $x(t)$ and $y(t)$ are two populations described by the system of differential equations

$$\frac{dx}{dt} = -4x + 8xy$$
$$\frac{dy}{dt} = 3y - 6y^2 - xy.$$

   (a) This is a predator-prey system. Which population is the predator? Which population is the prey?

   (b) Does any factor other than predation inhibit the growth of the prey population?

   (c) Determine the equilibrium points of the system. What potential long-term outcomes do they describe?

3. Suppose $x(t)$ and $y(t)$ are two populations described by the system of differential equations

$$\frac{dx}{dt} = -4x + 4xy$$
$$\frac{dy}{dt} = 3y - 6y^2 + xy.$$

   (a) Does this model describe predation, co-operation or competition?

   (b) Determine the equilibrium points of the system. What potential long-term outcomes do they describe?

4. Suppose $x(t)$ and $y(t)$ are two populations described by the system of differential equations

$$\frac{dx}{dt} = 6x - 2x^2 - 5xy$$
$$\frac{dy}{dt} = 8y - 5y^2 - 4xy.$$

(a) Does this model describe predation, co-operation or competition?

(b) Determine the equilibrium points of the system. What potential long-term outcomes do they describe?