

4. [12 points] Another farmer notices the plague of grasshoppers has spread to his crop. He also visits the pest control company and requests a cheaper pesticide. This new pesticide is capable of eliminating the grasshoppers at a rate that decreases with time. Specifically, the rate at which grasshoppers are killed is given by the function $f(t) = \frac{3}{10}(4 - t)$ in thousands of grasshoppers per week at t weeks after the pesticide application. There is no pesticide remaining after 4 weeks. Suppose there are 3000 grasshoppers at the time the pesticide is applied.

Let $Q(t)$ the population of grasshoppers (in thousands) t weeks after this cheaper pesticide is applied to the crop. Then for $0 \leq t \leq 4$, $Q(t)$ satisfies

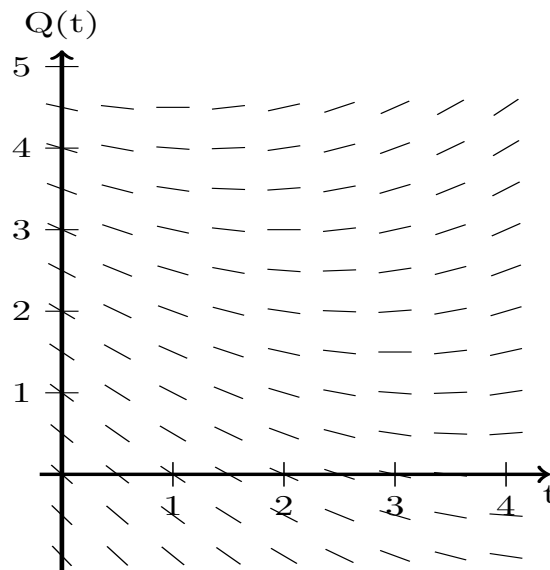
$$\frac{dQ}{dt} = \frac{Q}{5} - f(t).$$

- a. [1 point] Is this differential equation separable?
- b. [7 points] Using Euler's method, fill the table with the amount of grasshoppers (in thousands) in the crop during the first week. Show all your computations.

t	0	$\frac{1}{2}$	1
$Q(t)$			

(problem 4 continued)

Use the slope field of the differential equation satisfied by $Q(t)$ to answer the following questions.



- c. [2 points] Does this equation have any equilibrium solutions in the region shown? List each equilibrium solution and determine whether it is stable or unstable. **Justify your answer.**
- d. [2 points] If the farmer's goal is to kill all the grasshoppers in his crop, will the pesticide be effective in this case? Draw the solution $Q(t)$ on the slope field.