

This last quiz will be a take-home. It is due in class after Thanksgiving. For full credit you must show sufficient work to justify your answers. **You may not consult with anyone else**, but you may use notes, text, worksheet solutions, etc.

1. A predator exhibits a type II (Michaelis-Menton) functional response to prey abundance  $V$  (measured in thousands) by having a per capita kill rate

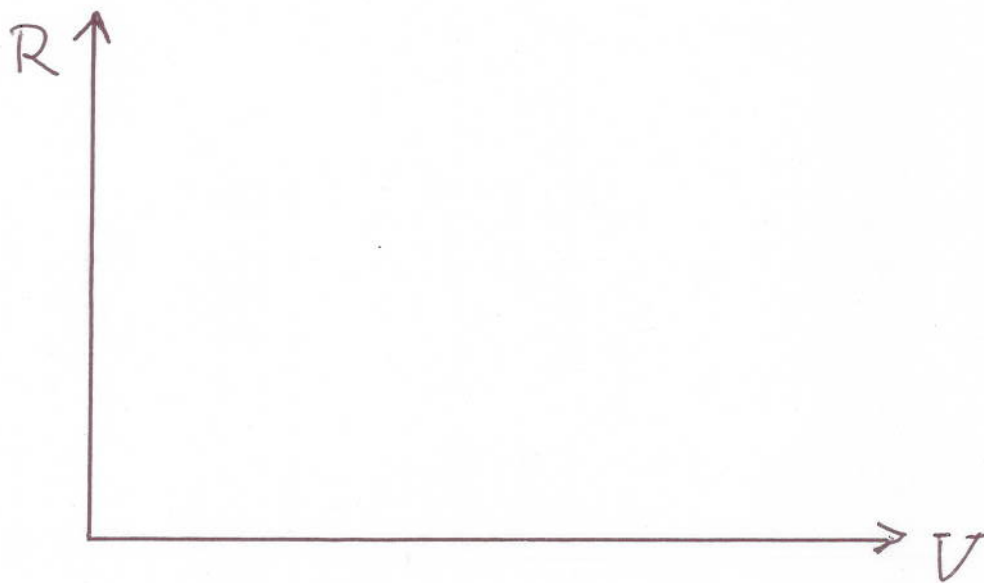
$$R = \frac{12V}{4 + V}.$$

- a. What is a good approximation of  $R$  if  $V$  is very small?

- b. What is a good approximation of  $R$  if  $V$  is very large?

- c. At what value of  $V$  is  $R$  one half of the maximum kill rate? What is the maximum kill rate?

- d. Plot  $R$  as a function of  $V$ , exhibiting the features of a., b., c.



2. This was a problem from your test, which we will extend just a bit here. We had the following continuous model of a predator-prey system (hares and lynxes, let's say).

$$\frac{dH}{dt} = 0.5H\left(1 - \frac{H}{250}\right) - 0.02HL = H\left(0.5\left(1 - \frac{H}{250}\right) - 0.02L\right)$$

$$\frac{dL}{dt} = -0.8L + 0.004HL = L(-0.8 + 0.004H)$$

You will recall that I asked you to mark the coordinates of the equilibrium pts (heavy dots), and place the predator population arrows (up or down), victim population arrows (left or right), and net population change arrows at the open dots. What you will do now is actually compute the population phase portrait trajectories. Convert these equations to discrete equations, and use Euler's method. So, for example you will have  $H_{n+1} = H_n + \Delta H$  where  $\Delta H \approx (\Delta t)\frac{dH}{dt}$ . You may use  $\Delta t = 0.25$ , and of course  $\frac{dH}{dt} = H_n\left(0.5\left(1 - \frac{H_n}{250}\right) - 0.02L_n\right)$ . You will have to do something similar for  $L$ , and then turn these into  $u$  and  $v$  for the calculator. Pick two different starting coordinates  $(H_0, L_0)$ , corresponding to two of the open dots in the picture, and run  $n$  long enough so that you can determine if the equilibrium marked E is stable, unstable, or neutral. Give tables of values or graphs to illustrate your conclusion. *(Use extra sheets if necessary.)*

