

*You must show your work to get full credit.*

Ponds in Minnesota are the homes of a meta-population of dragon flies. The probability of a pond with a population having them ~~be~~<sup>ages</sup> extinct in the next year is  $p_e = .3$ . The probability that a pond with no dragon flies being colonized the next year is  $p_i = .5$ .

1. Let  $f = f(t)$  be the fraction (that is the proportion) of the ponds that are populated at an given time  $t$ . Write a rate equation for  $f$ . (As reminder a "rate equation" will be an equation, that is have an equal sign, and have a rate, that is  $\frac{df}{dt}$ .)

$$\frac{df}{dt} = p_i(1-f) - p_e f$$

$$\text{i.e. } \frac{df}{dt} = .5(1-f) - .3f$$

2. Find the equilibrium point. Equilibrium point is .625

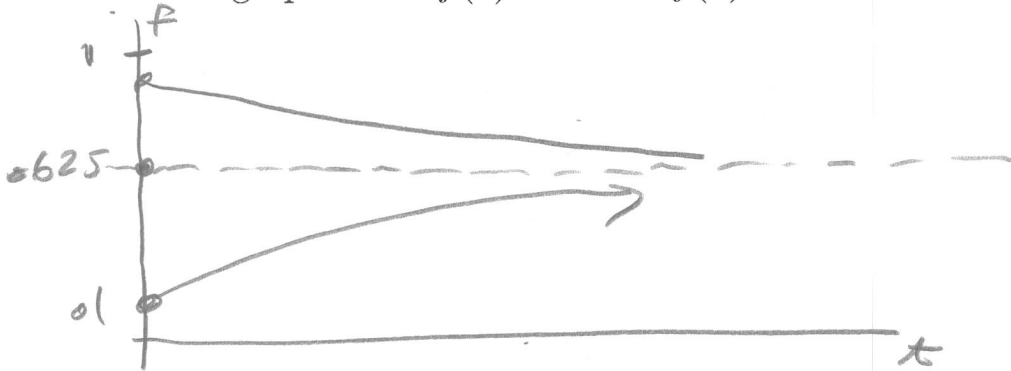
$$\text{solve } \frac{df}{dt} = .5(1-f) - .3f = 0$$

$$.5 - .5f - .3f = 0$$

$$-.8f = -.5$$

$$f = \frac{.5}{.8} = .625$$

3. Draw the graphs with  $f(0) = .1$  and  $f(0) = .9$ .



4. In the long run what proportion of the ponds do you expect to be populated with dragon flies?

Proportion of the ponds that are populated. .625  
(or 62.5%)