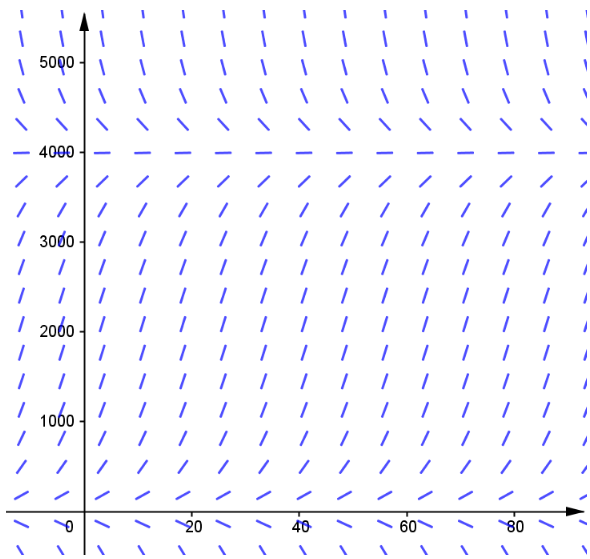
1) A state game commission releases 40 elk into a game refuge. After 5 years, the elk population is 104. The commission believes that the environment can support no more than 4000 elk. The growth rate of the elk population p is:

$$\frac{dp}{dt} = kp\left(1 - \frac{p}{4000}\right), \qquad 40 \le p \le 4000$$

where t is the number of years.

a) Write a model for the elk population in terms of t.

b) A direction field for this equation is shown below. Graph the solution that passes through the point $(0,\ 40)$.



c) Use the model to estimate the elk population after 15 years.

d) Find the limit of the model as $t \to \infty$.

2) The pacific halibut fishery has been modeled by the differential equation:

$$\frac{dy}{dt} = ky\left(1 - \frac{y}{K}\right)$$

where $y(t)$ is the biomass (the total mass of the members of the population) in kilograms at time t (measured in years), the carrying capacity is estimated to be $K = 8\times10^7$ kg, and $k = 0.71$ per year.

a) If $y(0) = 2\times10^7$ kg, find the biomass a year later.

b) How long will it take for the biomass to reach 4×10^7 kg?