Linear DE HW

D = deer pop. in thousands

a. $\frac{dD}{dt} = .04D - 4.5$

b. $\frac{dD}{dt} = .04(D - 112.5)$

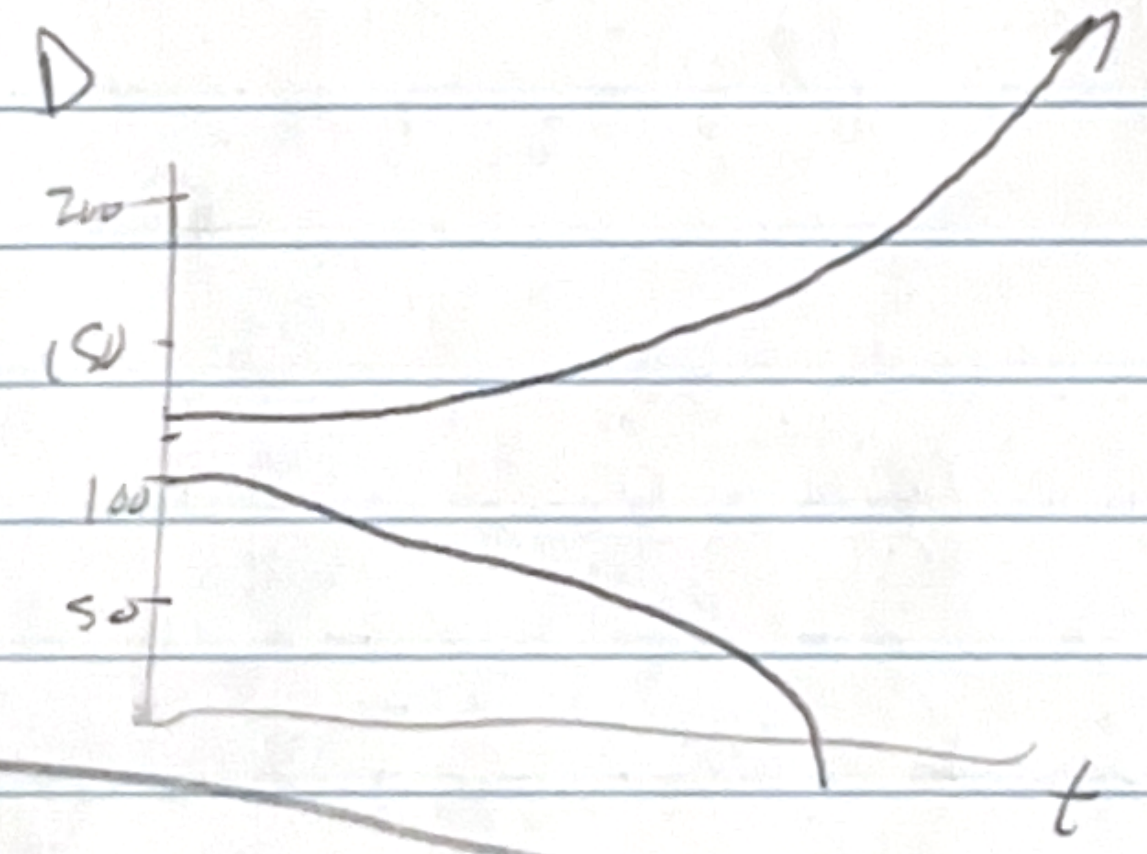
$\int \frac{1}{D-112.5} \cdot \frac{dD}{dt}\, dt = \int .04\, dt$

$\ln|D - 112.5| = .04t + C$

$\boxed{D = Ae^{.04t} + 112.5}$

c. IC_1: (0, 100) ← deer → $D = 112.5 - 12.5e^{.04t}$
IC_2: (0, 120) → $D = 112.5 + 7.5e^{.04t}$

d.



e. No b/c this is an unstable equilibrium, setting a constant 4,500 permits won't control the deer b/c they will reproduce differently. A constant 4500 will lead to 0 or infinite deer, unless 112,500 deer reproduce exactly 4% annually & zero change in pop

2a) $\frac{dP}{dt} = .03P + 20 = .03(P + \frac{20}{.03})$

$P = Ae^{.03t} - \frac{20}{.03}$

b) Situation: In a town, pop is growing by 3% every year and 20,000 more people move into said town every year

3a

$$\frac{dV}{dt} = -k\sqrt{V} \qquad k>0$$

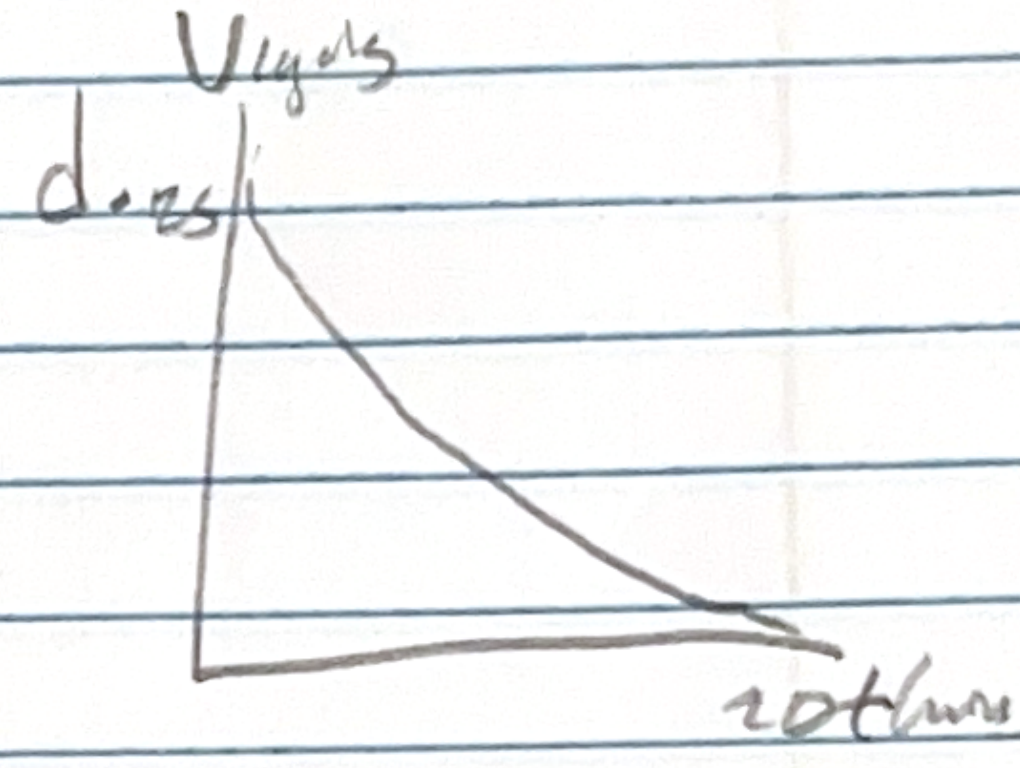
b) $\int \frac{1}{\sqrt{V}} \frac{dV}{dt} = \int -k$

$2\sqrt{V} = -kt + C$ $\qquad C = 20k$

$V = \left(\frac{-kt+c}{2}\right)^2$ $\qquad C = \pm 10 = 10$ $\qquad C - \frac{20k}{2} = 0$

$k = .5$

$(0, 25)$ c. $\boxed{V = \left(\frac{-t+20}{4}\right)^2}$
&
$(20, 0)$



c) i $\frac{dV}{dt} = \frac{-\sqrt{V}}{2} + 2$

ii) At $t=0$, still losing water $\left(\frac{-\sqrt{25}}{2} + 2 < 0\right)$ so it will keep losing water until it levels and reaches equilibrium w/ 2g in and 2g out @ same time.

iii) It's b/c $\frac{1}{\sqrt{V} - 4}$ is a much harder integral to solve