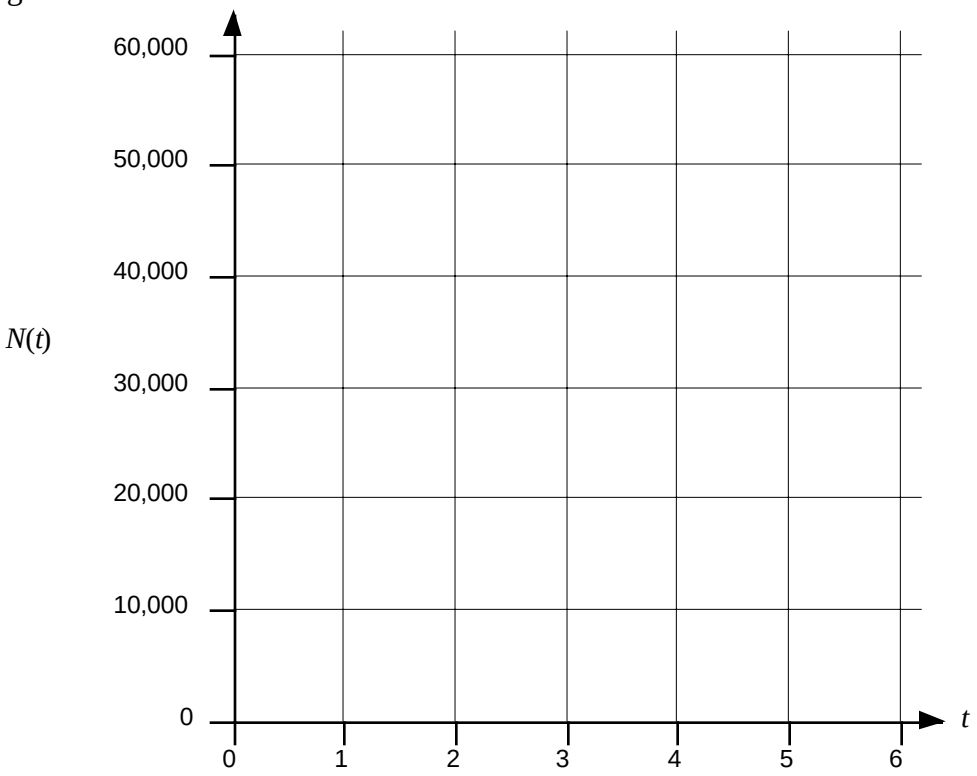
Homework Assignment 2: Due at the beginning of class 2/8/02

In 1991, the number[1] of high school seniors who had used any kind of illicit drug[2] was about 29,400[3]. If we let T represent the number of years since 1990 and $N(T)$ represent the number of high school seniors who have used some illicit drug, then the derivative is given by the equation[4]:

$$N'(T) = -0.65 \cdot \big(N(T) - 43{,}200\big).$$

Questions 1, 2 and 3 will focus on this equation.

1. Use the axes provided below to draw a slope field using the equation for $N'(t)$ given above.



NOTE: You should submit a copy of this page (with the slope field drawn on it) as part of your completed homework assignment.

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[1] Remember (from assignment 1) that here the "number of illicit drug users" means: If you took a random sample of 100,000 high school seniors from across the United States, the number of seniors in this group who had used illicit drugs at some point in their lives would be the "number of illicit drug users."

[2] This includes marijuana/hashish, inhalants, nitrites, LSD, hallucinogens other than LSD, PCP, Ecstasy, Cocaine (powder and crack), heroin, amphetamines, barbituates, tranquilizers, rohypnol, GHB, ketamine, but **excludes** alcohol, tobacco and steroids.

[3] Source: US Department of Health and Human Services, National Institute on Drug Abuse, Monitoring the Future Study, 2001.

[4] The equation for the derivative is obtained from data recorded in the Monitoring the Future Study, 2001.

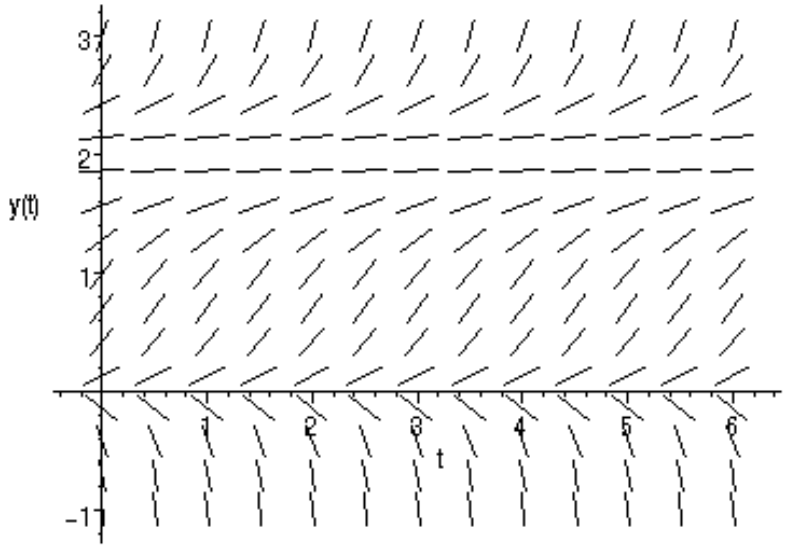
2. According to the U.S. Department of Health and Human Services[5], in 1991 there were about 29,400 high school seniors who had used some kind of illicit drug during their lives. Use this information (together with your slope field from Question 1) to sketch a graph showing the number of illicit drug-using high school seniors as a function of time.

3. Locate any equilibrium solutions of the equation:

$$N'(T) = -0.65 \cdot \big(N(T) - 43{,}200\big).$$

Classify the equilibrium solution(s) as stable, unstable or semi-stable.

4. In this question, you are presented with one slope field:



and four different equations:

(a) $y'(t) = y(t) \cdot \big[y(t) - 2\big]$ **(b)** $y'(t) = y(t)^2 \cdot \big[y(t) - 2\big]$

(c) $y'(t) = y(t) \cdot \big[y(t) - 2\big]^2$ **(d)** $y'(t) = -y(t) \cdot \big[y(t) - 2\big]$

Determine which of the equations ((a), (b), (c) or (d)) corresponds to the slope field.

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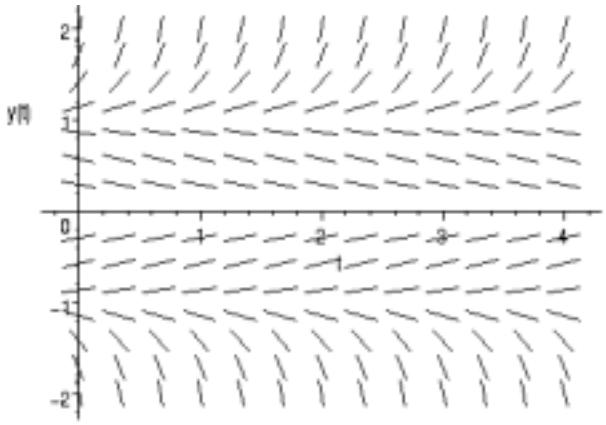
[5] Source: US Department of Health and Human Services, National Institute on Drug Abuse, Monitoring the Future Study, 2001.

5. In this question, you are presented with one equation for a derivative:

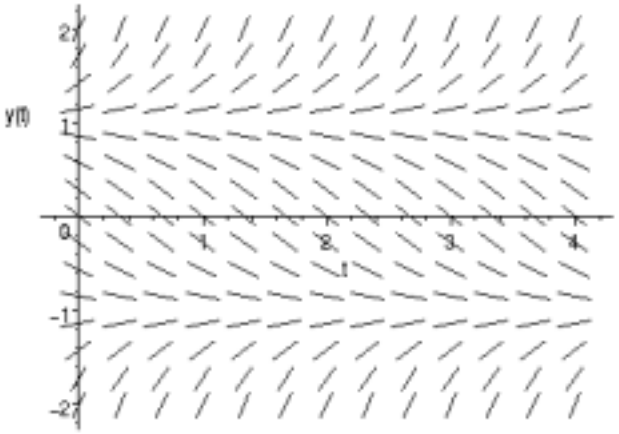
$$y'(t) = y(t) \cdot \left[y(t)^2 - 1 \right]$$

and four different slope fields:

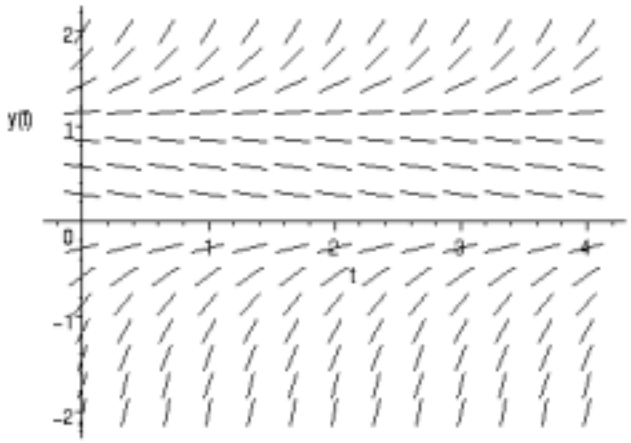
(I)



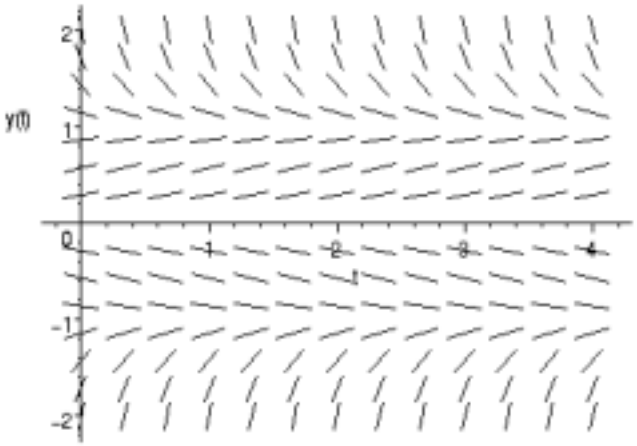
(II)



(III)



(IV)



Determine which of the slope fields (I, II, III or IV) corresponds to the equation for the derivative.