



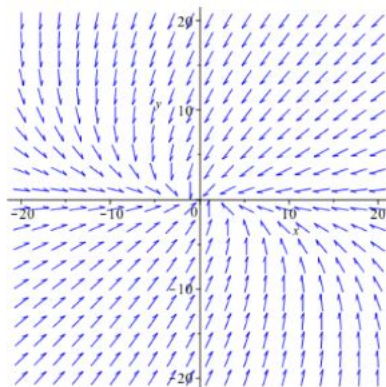
Eksamen Vår 2017 oppgave 3

(a) Find the general solution of the system of differential equations below

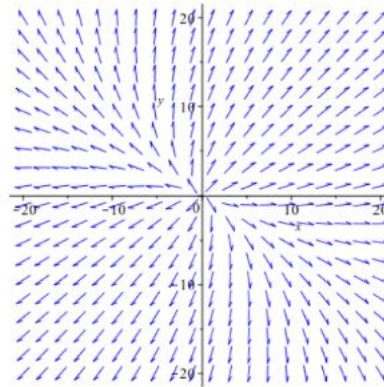
$$\frac{dx_1}{dt} = 5x_1(t) + 2x_2(t)$$

$$\frac{dx_2}{dt} = x_1(t) + 6x_2(t)$$

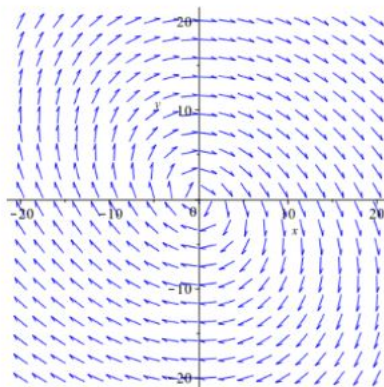
- (b) Find the special solution of the system from part a) with initial conditions  $x_1(0) = 10$  and  $x_2(0) = -8$ .
- (c) Consider the four slope fields below. Which of these corresponds to the system in part (a)? Sketch the solution curve corresponding to part (b) in the correct slope field together with the eigenvectors of the system. Also sketch the solution curve corresponding to the initial conditions  $x_1(0) = 10$  og  $x_2(0) = -8$ .



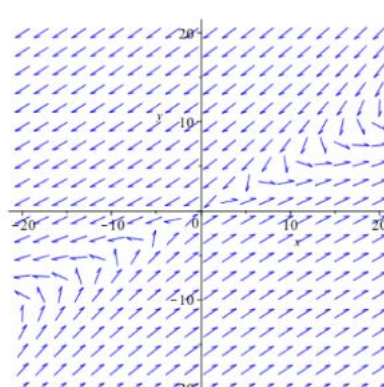
Retningsfelt 1



Retningsfelt 2



Retningsfelt 3



Retningsfelt 4

**Eksamen Vår 2018 oppgave 1** Sonja has a resting heart rate of 70 beats per minute (bpm). She does a strenuous exercise and measures her pulse to be 172 bpm as she finishes her exercise. Afterwards she stands still, and measures her pulse after 30 seconds to be 152 bpm.

- (a) Let  $S(t)$  be Sonjas heart rate as a function of time  $t$  (given in seconds) after she finishes her exercise. Find an expression  $S(t)$  when it is given that the rate of change of her heart rate is proportional to the difference between the heart rate at that time and her resting heart rate.
- (b) Calculate what Sonjas heart rate will be a minute after she finishes her exercise. Also, calculate what the rate of change of her heart rate will be at this time (remember to give your answer in units).

**Eksamen Vår 2018 oppgave 2** A special colony of bats - where we only consider female individuals - have a life span of less than three years. The individuals are divided into three age groups: 0-year-olds, 1-year-olds, 2-year-olds. 0-year olds have no offspring, every 1-year olds have an average of 2 offspring per year, and each 2-year-old have an average of 1 offspring per year. Furthermore, the survival rate of 0-year olds is 40 % and 50 % for the 1-year-olds. At the beginning the colony consists of 300 0-year-olds, 180 1-year-olds and 130 2-year olds.

- (a) Set up a Leslie-matrix representing the information given above, and find the distribution of bats in the three age groups after two years.
- (b) Show that  $\lambda = 1$  is an eigenvalue of the Leslie-matrix. Find the other eigenvalues, as well as the eigenvector corresponding to  $\lambda = 1$ .
- (c) Explain what will happen to this colony of bats in the long run if it is given that the number of 0-year-olds will stabilise at 400 individuals. Give reasons for your answer.

**Deadline:** Sunday, May 1st (digitally as a single pdf-file via Blackboard)