

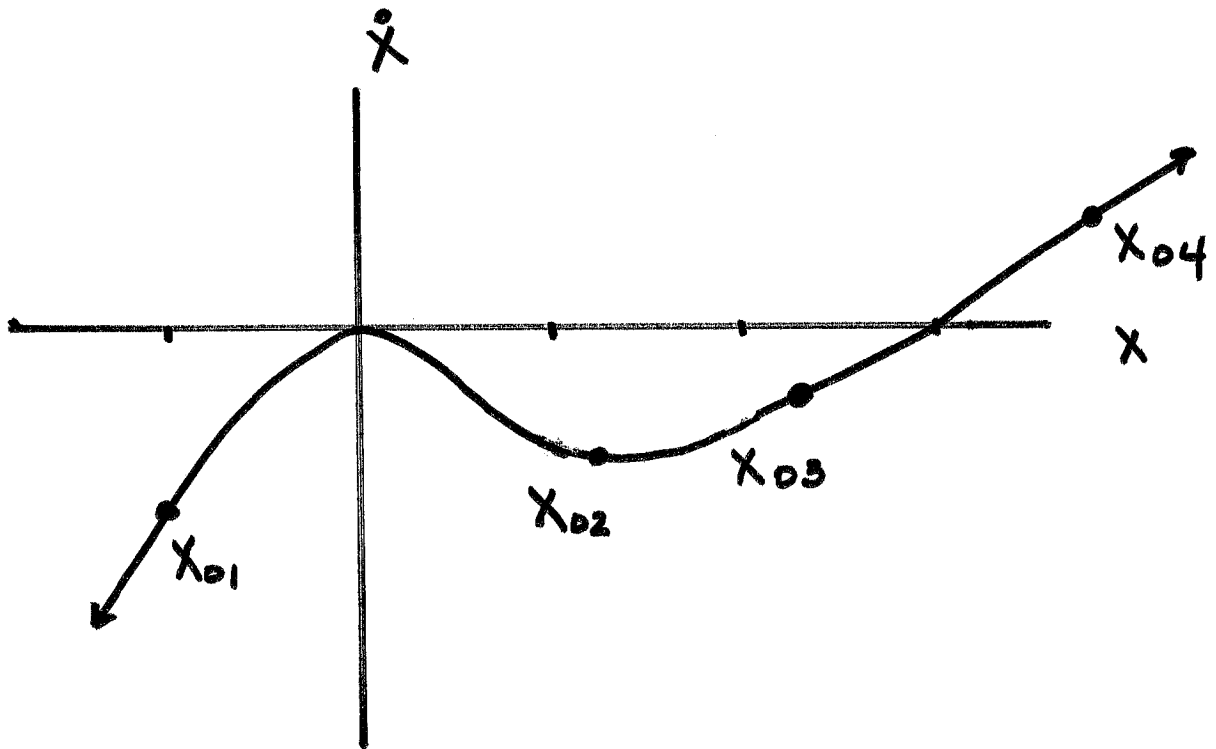
1. If $\dot{x} = \frac{dx}{dt}$

- Explain the relationship between \dot{x} and x relative to x increasing/decreasing.
 - Explain the relationship between \ddot{x} and \dot{x} relative to \dot{x} increasing/decreasing.
 - Explain the relationship between \ddot{x} and concavity, relative to x vs t .
 - Define an inflection point, how it is found and its relevance to x vs t graph and show its relevance to \dot{x} .
2. Solve by separation of variables and plot the solution of the ODE:

$$\frac{dx}{dt} = \dot{x} = \alpha_1 x - 2; t \geq 1, x(1) = \frac{3}{\alpha_1}, \alpha_1 > 2, x \geq 1.$$

3. Solve the equation: $\dot{x} = -R \ln(x), t \geq 0, x > 0, R > 0, x(0) = x_0$.
What is the asymptotic value of x as $t \rightarrow \infty$. Explain.

4. For the given graph, re-sketch a graph for x_{01} and indicate the system progress (using arrows and explain) from x_{01} as $t \rightarrow \infty$.
- Identify any critical points as stable, unstable, or semi-stable—explain.
 - Repeat for $x_{02}, x_{03},$ and x_{04} .



5. Draw and label the phase diagram \dot{x} vs x .
- Indicate the system progress using arrows and explain.
 - Identify any critical points as stable, unstable, or semi-stable and explain.
- $$\dot{x} = -\alpha_1 x + \alpha_2, \quad \alpha_1 > 0, \quad \alpha_2 > 0.$$
- Draw a family of solution curves x vs t .*
6. Draw and label the phase diagram \dot{x} vs x for $\dot{x} = 3x^2 - 9x$.
- Indicate the system progress using arrows and explain.
 - Identify any critical points as stable, unstable, or semi-stable and explain.
 - Find the x value, x_m , where \dot{x} is minimum or maximum.
 - Plot x vs t for $x(0) = x_0 > x_m$. There should be 2 different cases for $x_0 > x_m$.
7. A fish farm is allowed to reach a stable level before any fishing is allowed. R , in tons per year, is the stocking rate for the farm. The growth rate is modeled by $\dot{x} = \alpha_1 x - \alpha_2 x^2 + R$; $\alpha_1 > 0$, $\alpha_2 > 0$, $R > 0$.
- Draw the phase diagram \dot{x} vs x and label the values of the intercepts and the point of maximum \dot{x} .
 - Identify any critical points as stable, unstable, or semi-stable and explain.
 - Draw the phase diagram for $R = 0$.
 - On one coordinate system plot, draw and label the phase diagrams for different values of R : $R=0$, $R=R_{\max}$, and $0 < R_1 < R_2 < R_3 < R_{\max}$.
 - What are the units of α_1 and α_2 ?