

Problem 1

In the last worksheet, you were given a Chemical Reaction between CH_3Cl and NaOH , which combined in such a way that initial amount of CH_3Cl was α and the initial amount of NaOH is β for chemical. These two compounds combined to form an X amount of CH_3OH with some amount of NaCl . You were asked to write the mathematical model of differential equation for $X(t)$.



Recall the differential equation for $X(t)$. Is the differential equation linear or non-linear? Also state the reason for your answer.

Problem 2

Verify that the function y is a solution of the associated differential equation. Assume an appropriate interval of definition for each solution:

(a) $2y' + y = 0$; $y = e^{-\frac{x}{2}}$.

(b) $y' = 2xy^2$; $y = \frac{1}{4-x^2}$.

Problem 3

Answer the following for the differential equations in parts (a) to (d):

- Identify the independent and dependent variables
- Identify the order of differential equations, and state the reason.
- Write the differential equation in general form
- Write the differential equation in normal form
- Identify if the differential equation is linear or non-linear and state the reason.

(a) $(1-x)y'' - 4xy' + 5y = \cos x$

(b) $x \frac{d^3y}{dx^3} - \left(\frac{dy}{dx}\right)^4 + y = 0$

(c) $\frac{d^2y}{dx^2} = \sqrt{1 + \left(\frac{dy}{dx}\right)^2}$;

(d) $\sin \theta y''' - \cos \theta y' = 2$

Problem 4

Consider the differential equation $y' = \sqrt{y^2 - 9}$. Determine whether the existence of unique solution theorem guarantees a unique solution through the given points:

- (a) $(1, 4)$
 - (b) $(5, 3)$
 - (c) $(2, -3)$
 - (d) $(-1, 1)$
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