Definition, Order and Degree

SUBJECT : (Mathematics)
CHAPTER NUMBER: 09
CHAPTER NAME : Differential equation

Website: www.odmegroup.org
Email: info@odmps.org
Toll Free: **1800 120 2316**
Sishu Vihar, Infocity Road, Patia, Bhubaneswar- 751024

What we expect to learn?

- Students will study some basic concepts related to the differential equation.
- Students will be able to learn about the general and particular solution of a differential equation.
- Students will be able to learn how to form differential equations.
- Students will be able to know some methods to solve a first order-first degree differential equation.
- Students will be able to know some applications of differential equations in different areas.

Introduction

Definition

An equation involving differentials of the variables or differential coefficients of the independent variable is called a differential equation.

Example:

- $y^2 dx + x\, dy = sinx$
- $\frac{dy}{dx} + y\, cosx = x$
- $\frac{d^2y}{dx^2} + 3\left(\frac{dy}{dx}\right)^2 - 5y = 0$
- $\frac{d^3y}{dx^3} = e^{\frac{dy}{dx}}$
- $\left(\frac{d^3y}{dx^3}\right)^2 = \sqrt{1 + y\left(\frac{dy}{dx}\right)^2}$

Order and Degree of the Differential Equation

Order of a Differential Equation:

The order of the highest order derivative of the dependent variable w. r. t. the independent variable involved in the differential equation is called the order of the differential equation.

EXP:

$\frac{dy}{dx} + y = c$ (its order is 1)

$\frac{d^2y}{dx^2} + \frac{dy}{dx} + y = 0$ (its order is 2)

Order and Degree of the Differential Equation

Degree of a Differential Equation

When a differential equation is a polynomial equation in derivatives, the highest power (positive integral index) of the highest order derivative is known as the degree of the differential equation.

For example:

$\left(\frac{dy}{dx}\right)^2 + \frac{dy}{dx} + y = c$, the highest derivative is $\frac{dy}{dx}$, its positive integral power is 2. So its degree is 2.

Example

Find the order and degree of the following differential equations

1. $\frac{d^3y}{dx^3} + 3\left(\frac{d^2y}{dx^2}\right)^4 + 4\left(\frac{dy}{dx}\right)^7 + 3y = 0$
2. $\frac{dy}{dx} - \frac{x}{\frac{dy}{dx}} + y^3 = 0.$
3. $\left(\frac{d^3y}{dx^3}\right)^2 = \sqrt{5y + \left(\frac{d^2y}{dx^2}\right)^6}$
4. $\frac{d^2y}{dx^2} = 1 + \sqrt{\frac{dy}{dx}}$
5. $\frac{dy}{dx} + \sin\left(\frac{dy}{dx}\right) = 0$

Example

i. Write the sum of the order and degree of the differential equation $\frac{d}{dx}\left\{\left(\frac{dy}{dx}\right)^3\right\} = 0.$

ii. Write the sum of the order and degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^2 + \left(\frac{dy}{dx}\right)^3 + x^4 = 0.$

Example

Write the degree of the differential equation $x\left(\frac{d^2y}{dx^2}\right)^3 + y\left(\frac{dy}{dx}\right)^4 + x^3 = 0.$

Write the degree of the differential equation $\left(\frac{dy}{dx}\right)^4 + 3y\frac{d^2y}{dx^2} = 0.$

What is the degree of the following differential equation? $5x\left(\frac{dy}{dx}\right)^2 - \frac{d^2y}{dx^2} - 6y = logx.$

Assignment

Choose the correct answer from the given options.

1. The degree of the differential equation $\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}} = \frac{d^2y}{dx^2}$

a) 4 b) $\frac{3}{2}$ c) 2 d) not defined

2. The order and degree of the differential equation $y = x\frac{dy}{dx} + \frac{2}{\frac{dy}{dx}}$ are

a) 1, 3 b) 1, 2 c) 2, 1 d) 1, 1

3. The degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^2 + \left(\frac{dy}{dx}\right)^2 = x\sin\left(\frac{dy}{dx}\right)$ is

a) 1 b) 2 c) 3 d) not defined

4. Degree of the differential equation $\left(\frac{d^3y}{dx^2}\right)^{\frac{2}{3}} = x$ is

a) 1 b) 2 c) 3 d) doesn't exist

5.The order and degree of the differential equation $\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^{\frac{1}{4}} + x^{\frac{1}{5}} = 0$ respectively, are

a) 2 and not defined b) 2 and 2 c) 2 and 3 d) 3 and 3

ODM EDUCATIONAL GROUP
Changing your Tomorrow

THANKING YOU

ODM EDUCATIONAL GROUP