Exercise 9.1

Question 1:

Determine order and degree(if defined) of differential equation $\dfrac{d^4y}{dx^4}+\sin\left(y'''\right)=0$

Answer

$$\dfrac{d^4y}{dx^4}+\sin\left(y'''\right)=0$$

$$\Rightarrow y''''+\sin\left(y'''\right)=0$$

The highest order derivative present in the differential equation is y''''. Therefore, its order is four.

The given differential equation is not a polynomial equation in its derivatives. Hence, its degree is not defined.

Question 2:

Determine order and degree(if defined) of differential equation $y'+5y=0$

Answer

The given differential equation is:

$$y'+5y=0$$

The highest order derivative present in the differential equation is y'. Therefore, its order is one.

It is a polynomial equation in y'. The highest power raised to y' is 1. Hence, its degree is one.

Question 3:

Determine order and degree(if defined) of differential equation $\left(\dfrac{ds}{dt}\right)^4+3s\dfrac{d^2s}{dt^2}=0$

Answer

$$\left(\dfrac{ds}{dt}\right)^4+3\dfrac{d^2s}{dt^2}=0$$

The highest order derivative present in the given differential equation is $\dfrac{d^2s}{dt^2}$. Therefore, its order is two.

It is a polynomial equation in $\dfrac{d^2s}{dt^2}$ and $\dfrac{ds}{dt}$. The power raised to $\dfrac{d^2s}{dt^2}$ is 1. Hence, its degree is one.

Question 4:

Determine order and degree(if defined) of differential equation $\left(\dfrac{d^2y}{dx^2}\right)^2 + \cos\left(\dfrac{dy}{dx}\right) = 0$

Answer

$$\left(\dfrac{d^2y}{dx^2}\right)^2 + \cos\left(\dfrac{dy}{dx}\right) = 0$$

The highest order derivative present in the given differential equation is $\dfrac{d^2y}{dx^2}$. Therefore, its order is 2.

The given differential equation is not a polynomial equation in its derivatives. Hence, its degree is not defined.

Question 5:

Determine order and degree(if defined) of differential equation $\dfrac{d^2y}{dx^2} = \cos 3x + \sin 3x$

Answer

$$\dfrac{d^2y}{dx^2} = \cos 3x + \sin 3x$$

$$\Rightarrow \dfrac{d^2y}{dx^2} - \cos 3x - \sin 3x = 0$$

The highest order derivative present in the differential equation is $\dfrac{d^2y}{dx^2}$. Therefore, its order is two.

It is a polynomial equation in $\dfrac{d^2y}{dx^2}$ and the power raised to $\dfrac{d^2y}{dx^2}$ is 1.

Hence, its degree is one.

Question 6:

Determine order and degree(if defined) of differential equation

$$\left(y'''\right)^2 + \left(y''\right)^3 + \left(y'\right)^4 + y^5 = 0$$

Answer

$$\left(y'''\right)^2 + \left(y''\right)^3 + \left(y'\right) + y^5 = 0$$

The highest order derivative present in the differential equation is y'''. Therefore, its order is three.

The given differential equation is a polynomial equation in $y''', y'', \text{and } y'$.

The highest power raised to y''' is 2. Hence, its degree is 2.

Question 7:

Determine order and degree(if defined) of differential equation $y''' + 2y'' + y' = 0$

Answer

$$y''' + 2y'' + y' = 0$$

The highest order derivative present in the differential equation is y'''. Therefore, its order is three.

It is a polynomial equation in $y''', y'' \text{ and } y'$. The highest power raised to y''' is 1. Hence, its degree is 1.

Question 8:

Determine order and degree(if defined) of differential equation $y' + y = e^x$

Answer

$$y' + y = e^x$$
$$\Rightarrow y' + y - e^x = 0$$

The highest order derivative present in the differential equation is y'. Therefore, its order is one.

The given differential equation is a polynomial equation in y' and the highest power raised to y' is one. Hence, its degree is one.

Question 9:

Determine order and degree(if defined) of differential equation $y'' + (y')^2 + 2y = 0$

Answer

$$y'' + (y')^2 + 2y = 0$$

The highest order derivative present in the differential equation is y''. Therefore, its order is two.

The given differential equation is a polynomial equation in y'' and y' and the highest power raised to y'' is one.
Hence, its degree is one.

Question 10:

Determine order and degree(if defined) of differential equation $y'' + 2y' + \sin y = 0$

Answer

$$y'' + 2y' + \sin y = 0$$

The highest order derivative present in the differential equation is y''. Therefore, its order is two.

This is a polynomial equation in y'' and y' and the highest power raised to y'' is one. Hence, its degree is one.

Question 11:

The degree of the differential equation

$$\left(\frac{d^2 y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^2 + \sin\left(\frac{dy}{dx}\right) + 1 = 0$$

is (A) 3 (B) 2 (C) 1 (D) not defined

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Answer

$$\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^2 + \sin\left(\frac{dy}{dx}\right) + 1 = 0$$

The given differential equation is not a polynomial equation in its derivatives. Therefore, its degree is not defined.

Hence, the correct answer is D.

Question 12:

The order of the differential equation

$$2x^2 \frac{d^2y}{dx^2} - 3\frac{dy}{dx} + y = 0$$
is

(A) 2 (B) 1 (C) 0 (D) not defined

Answer

$$2x^2 \frac{d^2y}{dx^2} - 3\frac{dy}{dx} + y = 0$$

The highest order derivative present in the given differential equation is $\frac{d^2y}{dx^2}$. Therefore, its order is two.

Hence, the correct answer is A.

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