Class 12 Maths Chapter 9: Differential Equations - Notes, Important Questions and MCQs (2026-27)

Free PDF notes from Nextoper.in | Session 2026-27 | Read online:
https://nextoper.in/class-12-maths-chapter-9-pdf-notes/

These Class 12 Maths Chapter 9 notes cover “Differential Equations” from the NCERT Mathematics Part II textbook (2026-27): order and degree, general and particular solutions, and methods of solving first-order, first-degree equations – variable separable, homogeneous and linear equations using the integrating factor – with a method table, solved examples, Q&A, 10 MCQs and a free PDF.

Use the table of contents below to jump to the part you need, or read top to bottom for a complete revision of the chapter.

Table of Contents

- Chapter Overview
- Important Topics and Concepts
- Solved Examples
- Methods at a Glance
- Important Definitions and Terms
- Short Answer Questions
- Long Answer Questions
- MCQs with Answers
- Quick Revision Points
- Chapter Summary
- Exam Tips and PYQ Pattern
- Frequently Asked Questions
- Conclusion

Want notes for every chapter? Explore the full Class 12 Maths notes on Nextoper, arranged book-wise and chapter-wise.

Chapter Overview

A differential equation is an equation involving derivatives of a dependent variable with respect to an independent variable. Its order is the order of the highest derivative present and its degree (when defined) is the power of that highest-order derivative, once the equation is a polynomial in derivatives.

A function satisfying the equation is a solution. A general solution contains arbitrary constants equal in number to the order; a particular solution is obtained by giving those constants specific values using initial conditions.

Important Topics and Concepts

Order and Degree

- Order: highest order derivative present.
- Degree: highest power of the highest order derivative, when the equation is polynomial in derivatives.
- Example: $(d^2y/dx^2)^3 + (dy/dx)^2 + y = 0$ has order 2, degree 3.
- Degree is not defined for $y''' + \sin(y'') = 0$ (not polynomial in derivatives).
- Order and degree (if defined) are always positive integers.

General and Particular Solutions

- General solution has as many arbitrary constants as the order.
- Particular solution: constants fixed by given conditions.
- Verify a solution by substituting it and its derivatives into the equation.
- Example: $y = A \cos x + B \sin x$ is the general solution of $y'' + y = 0$.

Variable Separable Method

- Form: $dy/dx = F(x)\,G(y)$.
- Rewrite: $dy/G(y) = F(x)\,dx$.
- Integrate both sides: $\int dy/G(y) = \int F(x)\,dx + C$.
- Example: $dy/dx = (1 + y^2)/(1 + x^2) \Rightarrow \tan^{-1}y = \tan^{-1}x + C$.

Homogeneous Equations

- $F(x, y)$ is homogeneous of degree zero if $F(\lambda x, \lambda y) = F(x, y)$.
- Form: $dy/dx = F(x, y) = g(y/x)$.
- Substitute $y = vx \Rightarrow dy/dx = v + x\,dv/dx$, then separate variables.
- For $dx/dy = h(x/y)$, substitute $x = vy$.

Linear Differential Equations

- Form 1: $dy/dx + Py = Q$ (P, Q functions of x).
- Integrating factor $IF = e^{\int P\,dx}$.
- Solution: $y \times IF = \int (Q \times IF)\,dx + C$.
- Form 2: $dx/dy + P_1x = Q_1$ (functions of y): $x \times IF = \int (Q_1 \times IF)\,dy + C$ with $IF = e^{\int P_1\,dy}$.

Solved Examples

Board-pattern practice.

- Order and degree of $(dy/dx)^4 + 3y\,d^2y/dx^2 = 0$. Order 2, degree 1.
- Solve $dy/dx = e^{(x + y)}$. $e^{(-y)}\,dy = e^x\,dx \Rightarrow -e^{(-y)} = e^x + C$.
- Solve $dy/dx + 2y = \sin x$. $IF = e^{(2x)}$; $y\,e^{(2x)} = \int e^{(2x)} \sin x\,dx = e^{(2x)}(2 \sin x - \cos x)/5 + C$.
- Solve $(x - y)\,dy/dx = x + 2y$. Homogeneous; put $y = vx$ and separate variables.
- Solve $x\,dy/dx + 2y = x^2$, $x \neq 0$. $dy/dx + (2/x)y = x$; $IF = x^2$; $y\,x^2 = x^4/4 + C$.

Methods at a Glance

Type	Standard form	Method
Variable separable	dy/dx = F(x)G(y)	Separate and integrate
Homogeneous	dy/dx = g(y/x)	Put y = vx
Linear in y	dy/dx + Py = Q	IF = e^(∫P dx)
Linear in x	dx/dy + P_1x = Q_1	IF = e^(∫P_1 dy)

Important Definitions and Terms

Term	Meaning
Differential equation	Equation with derivatives
Order	Highest derivative order
Degree	Power of highest-order derivative
General solution	Contains arbitrary constants
Particular solution	Constants determined
Variable separable	Variables can be separated
Homogeneous function	F(λx, λy) = λ^nF(x, y)
Linear DE	dy/dx + Py = Q
Integrating factor	e^(∫P dx)
Initial condition	Given value to find constants

Short Answer Questions

Q1. Define the order of a differential equation.

The order of the highest derivative occurring in it.

Q2. Find order and degree of $d^2y/dx^2 + (dy/dx)^3 = 0$.

Order 2, degree 1.

Q3. Is degree defined for y″ + cos(y′) = 0?

No, it is not a polynomial in derivatives.

Q4. How many arbitrary constants are in the general solution of a 3rd order equation?

Three.

Q5. What substitution is used for homogeneous equations?

y = vx.

Q6. Write the integrating factor of dy/dx + Py = Q.

e^(∫P dx).

Q7. Find IF for dy/dx – y/x = x.

e^(–log x) = 1/x.

$y = x^2/2 + C$.

Long Answer Questions

Q1. Solve $dy/dx + y \cot x = 2x + x^2 \cot x$.

Linear: $P = \cot x$, $Q = 2x + x^2 \cot x$.

IF = e^(∫cot x dx) = sin x.

$y \sin x = \int (2x \sin x + x^2 \cos x)\, dx$.

RHS = $x^2 \sin x + C$.

$y = x^2 + C \operatorname{cosec} x$.

Q2. Solve the homogeneous equation $x^2 dy/dx = x^2 - 2y^2 + xy$.

$dy/dx = 1 - 2(y/x)^2 + y/x$.

Put $y = vx$: $v + x\, dv/dx = 1 - 2v^2 + v$.

$dv/(1 - 2v^2) = dx/x$.

Integrate: $(1/(2\sqrt{2}))$ log $|(1 + \sqrt{2}v)/(1 - \sqrt{2}v)| = \log |x| + C$.

Replace $v = y/x$.

Q3. Find the particular solution of $dy/dx = (1 + y^2)/(1 + x^2)$, $y = 1$ when $x = 0$.

Separate: $dy/(1 + y^2) = dx/(1 + x^2)$.

$\tan^{-1}y = \tan^{-1}x + C$.

At $x = 0$, $y = 1$: $\pi/4 = C$.

$\tan^{-1}y = \tan^{-1}x + \pi/4$.

$y = (1 + x)/(1 - x)$.

MCQs with Answers

1. Order of $y'' + 3y' = 0$(a) 1 (b) 2 (c) 3 (d) 0Answer: (b) 2

2. Degree of $(y'')^2 + y' = 0$(a) 1 (b) 2 (c) 3 (d) not definedAnswer: (b) 2

3. IF of $dy/dx + 2y = x$(a) e^(2x) (b) e^(x²) (c) 2x (d) e^xAnswer: (a) e^(2x)

4. Number of constants in general solution of order 2(a) 1 (b) 2 (c) 3 (d) 0Answer: (b) 2

5. Substitution for homogeneous DE(a) $y = x + v$ (b) $y = vx$ (c) $x = v + y$ (d) $y = v/x$Answer: (b) $y = vx$

6. $dy/dx = y$ gives(a) $y = Ce^x$ (b) $y = x + C$ (c) $y = Cx$ (d) $y = \log x$Answer: (a) $y = Ce^x$

7. Degree of $y''' + \sin y'' = 0$(a) 1 (b) 3 (c) not defined (d) 0Answer: (c) not defined

8. IF of $dy/dx + y/x = x^2$(a) x (b) 1/x (c) e^x (d) log xAnswer: (a) x

9. Solution of $dy/dx = 2x$(a) $x^2 + C$ (b) $2x^2 + C$ (c) $x + C$ (d) $2 + C$Answer: (a) $x^2 + C$

10. Linear DE form(a) $dy/dx + Py = Q$ (b) $dy/dx = y^2$ (c) $dy/dx = g(y/x)$ (d) $y'' + y = 0$ onlyAnswer: (a) $dy/dx + Py = Q$

Quick Revision Points

- Order and degree; degree may be undefined.
- General vs particular solution.
- Variable separable.
- Homogeneous: y = vx.
- Linear: IF = e^(∫P dx).
- Linear in x form.

Chapter Summary

A differential equation involves derivatives; its order is the highest derivative present and its degree the power of that derivative when the equation is polynomial in derivatives. The general solution has as many constants as the order, and initial conditions give particular solutions.

First-order equations are solved by separating variables, by y = vx for homogeneous equations, or by the integrating factor e^(∫P dx) for linear equations dy/dx + Py = Q.

Exam Tips and PYQ Pattern

- Identify the type before solving.
- Check homogeneity with F(λx, λy).
- Simplify IF using e^(log f) = f.
- Apply initial conditions at the end.
- Practise both linear forms.

Frequently Asked Questions

Is this chapter in the 2026-27 CBSE syllabus?

Yes. It is part of the NCERT Class 12 Mathematics Part II textbook, prescribed in the CBSE 2026-27 syllabus.

Can I download these notes as a PDF?

Yes. Use the free PDF link at the top of this page – no signup needed.

How do you solve a linear differential equation?

Write it as dy/dx + Py = Q, find IF = e^(∫P dx) and use y × IF = ∫ Q × IF dx + C.

When is the degree of a differential equation not defined?

When the equation is not a polynomial in its derivatives, e.g. y‴ + sin(y″) = 0.

Conclusion

Differential Equations is a dependable 5-mark chapter. Master the three methods here and save the free PDF.

More Notes: Class 12 Maths Chapter 8: Application of Integrals notes | Class 12 Maths Chapter 10: Vector Algebra notes | All Class 12 Maths notes

Freshness Note: These notes follow the NCERT Class 12 Maths textbook, Mathematics Part II (NCERT reprint 2026-27, rationalised syllabus), and the CBSE syllabus for the 2026-27 session. Last checked on 26 November 2026.