

CLASS 12 MATHEMATICS — FORMULA SHEET

Chapter 9 : Differential Equations (NCERT)

9.1 Basic Concepts

Concept	Detail
Differential equation	Equation involving derivatives of a dependent variable
Order	Order of the highest derivative present
Degree	Power of the highest-order derivative (after removing radicals/fractions)
Degree condition	Defined only when equation is a polynomial in derivatives
Linear DE	Dependent variable & derivatives appear to first degree only
General solution	Contains arbitrary constants (= order of the DE)
Particular solution	Constants fixed by initial/boundary conditions

9.2 Formation of a Differential Equation

Step	Action
Step 1	Count the arbitrary constants in the given family
Step 2	Differentiate that many times
Step 3	Eliminate the constants using the equations
Result	DE order = number of arbitrary constants

9.3 Variable Separable Method

Concept	Formula
Separable form	$dy/dx = f(x) g(y)$
Separate variables	$dy/g(y) = f(x) dx$
Solution	$\int dy/g(y) = \int f(x) dx + C$
Simplest case	$dy/dx = f(x) \rightarrow y = \int f(x) dx + C$

9.4 Homogeneous Differential Equations

Concept	Detail
Homogeneous form	$dy/dx = F(y/x)$ (function of y/x only)
Substitution	Put $y = vx \Rightarrow dy/dx = v + x(dv/dx)$
After substitution	Becomes variable separable in v and x
Alternative (x as function of y)	Put $x = vy$ when easier
Then integrate	Separate and integrate, then replace $v = y/x$

9.5 Linear Differential Equations

Concept	Formula
Standard form (in y)	$dy/dx + P(x) y = Q(x)$
Integrating factor (IF)	$IF = e^{\int P dx}$
Solution	$y \cdot (IF) = \int Q \cdot (IF) dx + C$
Standard form (in x)	$dx/dy + P(y) x = Q(y)$
IF (for x form)	$IF = e^{\int P dy}$
Solution (x form)	$x \cdot (IF) = \int Q \cdot (IF) dy + C$

9.6 Quick Reference — Methods by Form

If the equation looks like...	Use this method
$dy/dx = f(x) g(y)$	Variable separable
$dy/dx = F(y/x)$	Homogeneous (put $y = vx$)
$dy/dx + Py = Q$	Linear (find $IF = e^{\int P dx}$)
$dx/dy + Px = Q$	Linear in x (find $IF = e^{\int P dy}$)
Just $dy/dx = f(x)$	Direct integration

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Order vs degree	Order = highest derivative ; degree = its power (only when polynomial in derivatives).
Constants = order	Number of arbitrary constants equals the order of the DE.
Separable	Get all y-terms with dy on one side, all x-terms with dx on the other, then integrate.
Homogeneous	$F(y/x)$ form $\rightarrow$ substitute $y = vx$, then it becomes separable.
Linear IF	$IF = e^{\int P dx}$. Solution: $y \cdot IF = \int Q \cdot IF dx + C$.
Spot the form	Identify separable / homogeneous / linear FIRST — that picks the method.
x as variable	If P, Q depend on y, write $dx/dy + Px = Q$ and use IF in y.
Always + C	General solution always carries the arbitrary constant(s).