

Concept QuickStart – Integration by Parts

Unit 7: Integrals

Subject: For CBSE Class 12 Mathematics

SECTION 2: WHAT NCERT SAYS

2.1 Key Statements

While this guide focuses on Integration by Parts, a close analysis of the NCERT text reveals a critical pedagogical strategy: before introducing this advanced technique, the curriculum ensures mastery of two foundational prerequisites—Integration by Substitution and the use of Trigonometric Identities. The textbook addresses the challenge of integrating functions not in standard form by outlining several powerful techniques. This section details how the textbook systematically builds this foundation, emphasizing that choosing the correct method is a key problem-solving skill in calculus.

Based on the introduction to advanced integration methods in the textbook, the following points are essential:

- 1. Inspection is Not Always Sufficient:** The initial method of finding an integral by simply searching for a function whose derivative matches the integrand is a useful starting point, but it is not a suitable approach for the wide range of functions encountered in calculus.
- 2. Three Prominent Methods:** To address more complex integrals, the textbook provides a roadmap by outlining three principal techniques:
 - Integration by Substitution
 - Integration using Partial Fractions
 - **Integration by Parts**
- 3. The Core of Substitution:** The method of Integration by Substitution is based on transforming an integral into a more manageable, standard form. This is achieved by changing the independent variable (e.g., from x to a new variable t) through an appropriate substitution.
- 4. Scope and Pedagogical Sequencing:** This deliberate sequencing highlights the textbook's structure: it lists the key methods, including Integration by Parts, to provide a complete roadmap, but then focuses exclusively on Substitution and Trigonometric

Identities in the provided material. This underscores their role as essential building blocks that must be mastered before proceeding to more complex methods.

The textbook uses a series of worked examples to demonstrate these foundational methods in practice.

2.2 Examples and Exercises

Worked examples are the primary tool used in the NCERT text to demonstrate the practical application of different integration methods. By analyzing how a complex problem is broken down and solved, you can learn to identify patterns and apply the correct technique. This section highlights key examples from the source material that showcase the methods of substitution and the use of trigonometric identities.

Example 5, Part (ii) (Page 236): Integration by Substitution

- **What it Shows:** This example presents the integral of $2x \sin(x^2 + 1)$. The core step is the substitution $t = x^2 + 1$. The key insight is that the derivative of $x^2 + 1$ is $2x$, which is also present as a factor in the integrand. This allows the integral to be transformed from a complex expression in x into the simple, standard integral of $\sin(t)$ with respect to t .
- **Why it's Important:** This example provides a clear strategic guide for when to use substitution. The presence of a composite function where the derivative of the "inner" function is also a factor in the integrand is the classic indicator for using the method of substitution. Recognizing this function-derivative pair is the most fundamental skill in this technique.

Example 7, Part (i) (Page 241): Integration using Trigonometric Identities

- **What it Shows:** This example tackles the integral of $\cos^2(x)$, which is not a standard integral form. The problem is solved by using the trigonometric identity $\cos^2(x) = (1 + \cos(2x))/2$. This manipulation transforms the integrand from a squared trigonometric function into a sum of simpler terms that can be integrated directly using standard formulas.
- **Why it's Important:** This example illustrates a universal principle in integration: always simplify the integrand first. It shows that proficiency with trigonometric identities is not just for trigonometry—it is a core tool for calculus, essential for converting seemingly difficult trigonometric integrals into solvable forms.

Note: The provided NCERT source text lists "Integration by Parts" as a method but does not contain any worked examples demonstrating its application. The examples above illustrate other methods discussed in the text.

The following exercise sets in the NCERT source document provide practice on the methods discussed:

- **Exercise 7.1 (Questions 1-22):** Focuses on finding anti-derivatives using the method of inspection and applying standard integration formulae.
- **Exercise 7.2 (Questions 1-39):** Provides extensive practice on applying the method of substitution to a variety of functions.
- **Exercise 7.3 (Questions 1-24):** Contains problems that require the use of trigonometric identities to simplify the integrand before integration.

Understanding how these examples and exercises are structured is key to developing an effective exam strategy.



SECTION 3: PROBLEM-SOLVING AND MEMORY

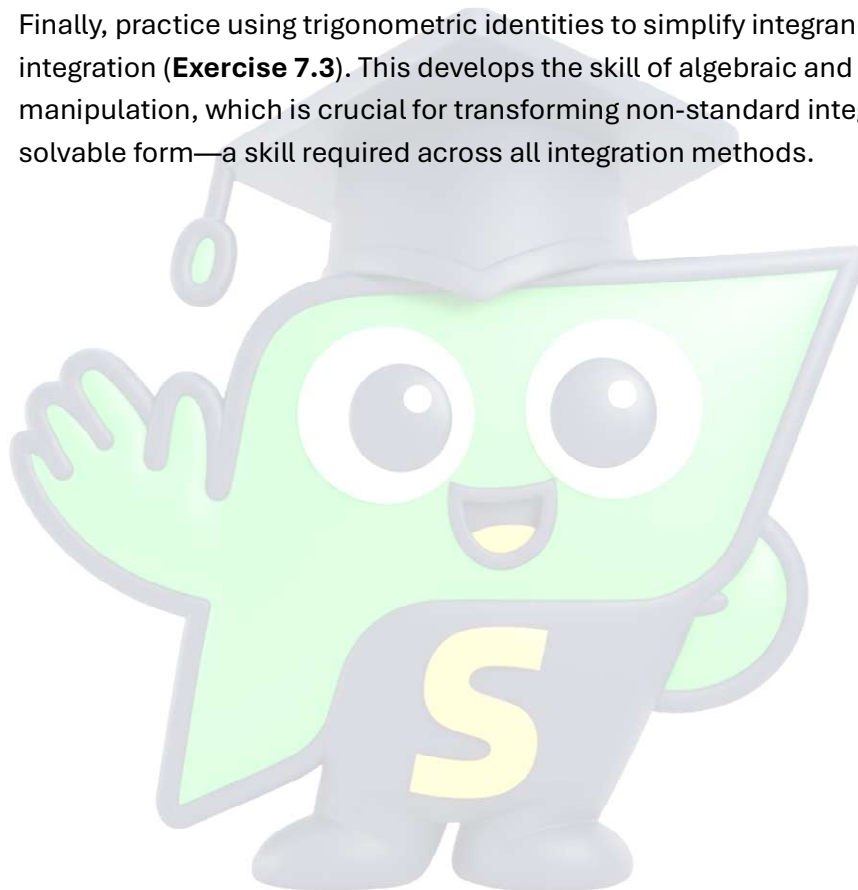
3.5 Exam Strategy

Do not treat the NCERT textbook as a random collection of problems. It is a meticulously structured learning path. To excel in the exam, you must align your study plan with the chapter's logical flow, mastering foundational skills before tackling advanced applications.

Based on the provided chapter excerpts, a strategic approach to preparation would include the following:

- **Example Range:** The worked examples covered in the source text range from **Example 1 to Example 10** (pages 231-246). These should be studied thoroughly to understand the application of concepts.
- **Exercise Sets:** The key practice sets included in the source are **Exercise 7.1, Exercise 7.2, and Exercise 7.3.**
- **Question Patterns:** This information cannot be provided as the source document for it was not available in the provided context.
- **Approach:** A logical study progression based on the chapter's structure is recommended:

1. First, master finding anti-derivatives by inspection and using standard formulae (**Exercise 7.1**). This builds the foundational knowledge required for all subsequent methods.
2. Next, gain proficiency in the method of substitution (**Exercise 7.2**). This technique is the workhorse of integration and is frequently a required first step inside more complex problems, including many Integration by Parts questions.
3. Finally, practice using trigonometric identities to simplify integrands before integration (**Exercise 7.3**). This develops the skill of algebraic and trigonometric manipulation, which is crucial for transforming non-standard integrals into a solvable form—a skill required across all integration methods.



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