



ChapterNotes

chapternotes.in · free NEET & JEE prep

CHAPTER NOTES

Exploring Algebraic Identities Class 9 Notes | CBSE Maths Chapter 4

- ✓ Chapter-wise notes & important questions
- ✓ Free gamified practice app — streaks
- ✓ Free mock & prediction papers with answers

Source: <https://chapternotes.in/cbse/class-9-maths>

[class-9-notes/](#)



Ira

Your teacher for Exploring Algebraic...



Hi, I am **Ira**. I teach this syllabus all day, so **Exploring Algebraic Identities** is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Explain Exploring Algebraic Identities simply

What can the board exam ask?

Most important formulas

Quiz me on this chapter

Ask Ira anything...



Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

Exploring Algebraic Identities Class 9 Notes | CBSE Maths Chapter 4

Exploring Algebraic Identities is Chapter 4 of CBSE Class 9 Maths in the new 2026-27 NCERT book, Ganita Manjari. It starts from a number puzzle about consecutive squares and shows how algebraic identities explain it. Along the way it revisits $(a + b)^2$, $(a - b)^2$ and $a^2 - b^2$ with area models, adds the square of three terms, factorises quadratics with algebra tiles and by splitting the middle term, builds the cubic identities from a cube model, and ends with simplifying rational expressions.

The chapter belongs to Unit II, Algebra, of the Class IX course structure. School exams test it through expansions, quick squares and products of numbers, factorisation, proving or disproving a claimed identity, simplifying rational expressions and area or volume word problems. The same identities and factorisation steps are used throughout Class 10 algebra, so fluency here saves time in the board year.

Quick Answer - Exploring Algebraic Identities

An **algebraic identity** is an equation true for all values of the variables. Examples include $(a + b)^2 = a^2 + 2ab + b^2$, $(a - b)^2 = a^2 - 2ab + b^2$, $(a + b + c)^2$. Area models and algebra tiles help visualise these. They also factorise: $x^2 + 7x + 12 = (x + 3)(x + 4)$. Cubic identities cover $(a \pm b)^3$, $x^3 \pm y^3$ and simplifying rational expressions.



Ira

Your teacher for Exploring Algebraic...



Hi, I am [Ira](#). I teach this syllabus all day, so [Exploring Algebraic Identities](#) is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

All Key Formulas at a Glance

Identity	Formula	Quick use
Square of a sum	$(a + b)^2 = a^2 + 2ab + b^2$	$43^2 = 1600 + 240 + 9 = 1849$
Square of a difference	$(a - b)^2 = a^2 - 2ab + b^2$	$29^2 = 900 - 60 + 1 = 841$
Square of three terms	$(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$	$119^2 = (100 + 10 + 9)^2 = 14161$
Difference of squares	$a^2 - b^2 = (a + b)(a - b)$	$104 \times 96 = 10000 - 16 = 9984$
Product of binomials	$(x + a)(x + b) = x^2 + (a + b)x + ab$	$(x + 2)(x + 3) = x^2 + 5x + 6$
General product	$(ax + b)(cx + d) = acx^2 + (ad + bc)x + bd$	$(2x + 3)(4x + 5) = 8x^2 + 22x + 15$
Cube of a sum	$(x + y)^3 = x^3 + 3x^2y + 3xy^2 + y^3$	$(10 + 3)^3 = 1000 + 900 + 270 + 27 = 2197$
Cube of a difference	$(x - y)^3 = x^3 - 3x^2y + 3xy^2 - y^3$	$(10 - 3)^3 = 1000 - 900 + 270 - 27 = 271$
Difference of cubes	$x^3 - y^3 = (x - y)(x^2 + xy + y^2)$	$8^3 - 1^3 = (8 - 1)(8^2 + 8 \times 1 + 1^2) = 7 \times 73 = 511$
Sum of cubes	$x^3 + y^3 = (x + y)(x^2 - xy + y^2)$	$8^3 + 1^3 = (8 + 1)(8^2 - 8 \times 1 + 1^2) = 9 \times 57 = 513$
Three cubes	$x^3 + y^3 + z^3 - 3xyz = (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)$	$1^3 + 1^3 + 1^3 - 3 \times 1 \times 1 \times 1 = 0$



Ira
Your teacher for Exploring Algebraic...



Hi, I am **Ira**. I teach this syllabus all day, so **Exploring Algebraic Identities** is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

Key Concepts

1. Identities and Equations: What Makes a Rule True for All Values

The chapter opens with a number pattern. Take any three consecutive square numbers, for example 1, 4 and 9. Add the smallest and the largest: $1 + 9 = 10$. Subtract twice the middle square: $10 - (2 \times 4) = 2$. Try 25, 36 and 49: $(25 + 49) - (2 \times 36) = 74 - 72 = 2$. The answer keeps coming out as 2.

Checking a few cases makes a pattern believable. It does not prove it, because there are infinitely many sets of consecutive squares and nobody can check them all. Algebra settles the question. Let the three consecutive numbers be $(n - 1)$, n and $(n + 1)$. Their squares are $(n - 1)^2$, n^2 and $(n + 1)^2$. Then

$$(n - 1)^2 + (n + 1)^2 = n^2 - 2n + 1 + n^2 + 2n + 1 = 2n^2 + 2$$

Subtracting twice the middle square, $2n^2$,
The tool that made it work is an **algebraic**

Equation or identity. An **algebraic identity** has variables occurring in it. An ordinary equation

Statement	When is it true?
$x^2 - 1 = 24$	Only for $x = 5$ or $x = -5$
$(x + y)^2 = x^2 + 2xy + y^2$	For every value of x and y
$(x + y)^2 = x^2 + y^2$	Only when $x = 0$ or $y = 0$

How to test a claimed identity. One value of x and y will not prove an identity. Putting in several values that work on one side using the distributive property will

2. The Square of a Binomial: $(a + b)^2$

The area model for $(a + b)^2$. Join a line segment of length $(a + b)$ units. Build a square of side $(a + b)$ units.



Ira
Your teacher for Exploring Algebraic...



Hi, I am **Ira**. I teach this syllabus all day, so **Exploring Algebraic Identities** is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

one line down at the point where a ends. The big square is now cut into four pieces:

- a square of side a, area a^2
- a square of side b, area b^2
- two rectangles, each a by b, area ab each

The four pieces together make the whole square, so $(a + b)^2 = a^2 + 2ab + b^2$.

Beyond lengths. The area picture only works when a and b are lengths, so they must be positive. The textbook checks negative and rational values too. With $a = -2$ and $b = -3$, both sides equal 25. With $a = -2/3$ and $b = 3/4$, both sides equal $1/144$. The proof for all numbers uses the distributive property:

$$(a + b)^2 = (a + b)(a + b) = a(a + b) + b(a + b) = a^2 + ab + ba + b^2 = a^2 + 2ab + b^2$$

The minus version. Replace b by $-b$ in the identity above. Then $2a(-b) = -2ab$ and $(-b)^2 = b^2$, which gives $(a - b)^2 = a^2 - 2ab + b^2$. There is another way to see this. Draw a square with side a. Mark a length b along one side, so the rest is a - b. This gives a small square of area $(a - b)^2$, a larger rectangle of area $b(a - b)$, and a small square of area b^2 . So

$$(a - b)^2 = a^2 - ab - b(a - b) = a^2 - ab - ab + b^2 = a^2 - 2ab + b^2$$

Expanding with the identity. Whatever sits in place of b, including its coefficient. For $(5x + 2y)^2$

$$(5x + 2y)^2 = (5x)^2 + 2(5x)(2y) + (2y)^2 = 25x^2 + 20xy + 4y^2$$

Squaring numbers mentally. Split the number into a multiple of 10 and a remainder.

Number	Split
43^2	$(40 + 3)^2$
29^2	$(30 - 1)^2$
299^2	$(300 - 1)^2$

Comparing $(a + b)^2$ with $a^2 + b^2$. With a = 3 and b = 4, the expansion shows the difference is exactly 2ab, so the sign of ab decides:



Ira
Your teacher for Exploring Algebraic...



Hi, I am **Ira**. I teach this syllabus all day, so **Exploring Algebraic Identities** is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed
AI generated, can make mistakes. Cross-check with NCERT.

- If a and b have the same sign ($ab > 0$), then $(a + b)^2 > a^2 + b^2$.
- If a and b have opposite signs ($ab < 0$), then $(a + b)^2 < a^2 + b^2$.
- If $a = 0$ or $b = 0$ ($ab = 0$), the two are equal.

3. Factorising Perfect Square Expressions

An identity can be read in both directions. Left to right it expands. Right to left it **factorises**: an expression of the form $a^2 + 2ab + b^2$ equals $(a + b)^2$, and one of the form $a^2 - 2ab + b^2$ equals $(a - b)^2$. Such expressions are called perfect squares.

A three-step check.

1. Take out any common factor from all the terms first.
2. Check that the first and last terms are squares, and find a and b .
3. Check that the middle term is exactly $2ab$. Its sign tells you whether to write $(a + b)^2$ or $(a - b)^2$.

Expression	
$x^2 + 4x + 4$	$(x)^2 + 2 \cdot x \cdot 2 + (2)^2$
$36x^2 + 12x + 1$	$(6x)^2 + 2 \cdot 6x \cdot \frac{1}{6} + (\frac{1}{6})^2$
$9x^2 + 24xy + 16y^2$	$(3x)^2 + 2 \cdot 3x \cdot 4y + (4y)^2$
$16y^2 - 24y + 9$	$(4y)^2 - 2 \cdot 4y \cdot \frac{3}{2} + (\frac{3}{2})^2$

Common factor first. In $50p^2 + 60pq + 18q^2$ (its square root would need $\sqrt{50}$). The text every term:

$$50p^2 + 60pq + 18q^2 = 2(25p^2 + 30pq + 9q^2)$$

The common factor does not have to be a whole number. $3[a^2 + (4/3)ab + (4/9)b^2] = 3(a + (2/3)b)^2$. $(2/3)b = (4/3)ab$, which matches.

When you factor $x^2 + 4x + 4$ as $(x + 2)^2$, you



Ira

Your teacher for Exploring Algebraic...



Hi, I am [Ira](#). I teach this syllabus all day, so [Exploring Algebraic Identities](#) is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

4. The Square of a Trinomial and the Difference of Squares

Three terms. To find $(a + b + c)^2$, treat $b + c$ as one quantity d . Then $(a + d)^2 = a^2 + 2ad + d^2 = a^2 + 2a(b + c) + (b + c)^2$. Expanding both brackets gives

$$(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$$

Read it as: every term squared once, plus twice every pair. Three terms make three pairs (ab, bc, ca).

Area model. A square of side $(a + b + c)$, with each side divided into a , b and c , splits into three squares (a^2 , b^2 , c^2) and six rectangles (two each of ab , bc and ca).

Signs travel with the terms. In $(3x - 2y + 4z)^2$, take $a = 3x$, $b = -2y$ and $c = 4z$:

$$(3x - 2y + 4z)^2 = 9x^2 + 4y^2 + 16z^2 + 2(3x)(-2y) + 2(-2y)(4z) + 2(4z)(3x) = 9x^2 + 4y^2 + 16z^2 - 12xy - 16yz + 24zx$$

The squared terms are always positive. A terms is negative.

Squaring numbers with three parts. 119^2
 $180 = 14161$.

Factorising a trinomial square. Six terms, $4b^2 + c^2 - 12ab + 6ac - 4bc$, the squares which one is negative: ab is negative, bc is sign. The answer is $(3a - 2b + c)^2$.

Difference of two squares. From Grade 8, $(a + b)(a - b) + b^2$. The chapter explains th **Śhrīdharāchārya, who proposed it in 750** $+ b$ and $a - b$ are easy to multiply:

Square	(a .
55 ²	60 × 50 + 25
85 ²	90 × 80 + 25
105 ²	110 × 100 + 25



Ira
Your teacher for Exploring Algebraic...



Hi, I am **Ira**. I teach this syllabus all day, so **Exploring Algebraic Identities** is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed
AI generated, can make mistakes. Cross-check with NCERT.

The pattern for numbers ending in 5: multiply the number formed by the leading digits by the next number, then write 25 after it. For 85, $8 \times 9 = 72$, so $85^2 = 7225$.

5. Algebra Tiles and Factorising Quadratics by Splitting the Middle Term

Algebra tiles. Three kinds of tiles stand for the terms of a quadratic expression:

- an **x²-tile**: a square of side x, area x²
- an **x-tile**: a strip of length x and width 1, area x
- a **unit tile**: a square of side 1, area 1

A rectangle of sides x + 3 and x + 4 has area (x + 3)(x + 4) = x² + 3x + 4x + 12 = x² + 7x + 12. With tiles: one x²-tile sits in a corner, three x-tiles are placed on its right, four x-tiles are placed below it, and the 12 unit tiles fill the remaining corner as a 3 by 4 array. The 7x has been split as 3x + 4x. Reading the finished rectangle gives the product (x + 3)(x + 4) = x² + 7x + 12. Starting from the tiles for x² + 7x + 12 and arranging them into a rectangle gives the factors.

The general pattern. (x + 3)(x + 4) = x² +

(x + a)(x + b) = x² + (a + b)x + ab

For two factors with any leading coefficient **pqx² + (pb + qa)x + ab**. For example (2x +

Factorising without tiles. Compare the given numbers whose **sum is the coefficient of**

Expression	Sum needed	
x ² + 7x + 12	7	1.
x ² + 11x + 30	11	3
x ² - 5x + 6	-5	6
x ² + x - 20	1	-
r ² - r - 42	-1	-



Ira
Your teacher for Exploring Algebraic...



Hi, I am [Ira](#). I teach this syllabus all day, so [Exploring Algebraic Identities](#) is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed
AI generated, can make mistakes. Cross-check with NCERT.

For $x^2 + 11x + 30$, the pairs 2 and 15 or 3 and 10 give product 30 but the wrong sum, so list the factor pairs of the constant and test each sum. Sign rules help: a positive constant means both numbers share the sign of the middle coefficient; a negative constant means the numbers have opposite signs, and the larger one (in size) takes the sign of the middle coefficient.

When the x^2 coefficient is not 1. For $px^2 + qx + r$, find two numbers whose sum is q and whose product is pr , split the middle term, and group. For $6x^2 + 7x + 2$: product $6 \times 2 = 12$, sum 7, numbers 3 and 4. So $6x^2 + 3x + 4x + 2 = 3x(2x + 1) + 2(2x + 1) = (3x + 2)(2x + 1)$.

6. Cubic Identities

Cube of a sum. Multiply $(a + b)$ by $(a + b)^2$:

$$(a + b)^3 = (a + b)(a^2 + 2ab + b^2) = a^3 + 2a^2b + ab^2 + a^2b + 2ab^2 + b^3 = \mathbf{a^3 + 3a^2b + 3ab^2 + b^3}$$

The cube model. A cube of edge $(a + b)$ has volume $(a + b)^3$. Cut it at the point where a ends along each of its three edges. It splits into one cube of volume b^3 , three cuboids of size $a \times b \times b$ (volume ab^2 each). The six

Cube of a difference. Replace b by $-b$: $[a + (-b)]^3 = a^3 - 3a^2b + 3ab^2 - b^3$. Two terms are posi

Reading a cube backwards. A cube has volume $3(p)^2(2q) + 3(p)(2q)^2 + (2q)^3$. This matches volume is $(p + 2q)^3$ and a side of the cube is $150nm^2 - 125m^3 = (2n)^3 - 3(2n)^2(5m) + 3(2n)(5m)^2 - (5m)^3$

Sum and difference of cubes. Multiply out $x^3 - y^3$. The middle terms cancel in pairs.

$$\mathbf{x^3 - y^3 = (x - y)(x^2 + xy + y^2)} \text{ and } \mathbf{x^3 + y^3}$$

Memory aid: the sign in the linear factor matches the sign of the quadratic factor is the opposite

$x - y$ as a factor. $x - y$ divides $x^2 - y^2$ and $y^2)(x^2 + y^2) = (x - y)(x + y)(x^2 + y^2)$.

The three-cube identity. Multiplying $(x + y)^3$ the mixed terms cancel and three copies of



Ira

Your teacher for Exploring Algebraic...



Hi, I am [Ira](#). I teach this syllabus all day, so [Exploring Algebraic Identities](#) is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

$$x^3 + y^3 + z^3 - 3xyz = (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)$$

Two consequences follow at once:

- If $x + y + z = 0$, then $x^3 + y^3 + z^3 = 3xyz$.
- Since $x^2 + y^2 + z^2 - xy - yz - zx = (x + y + z)^2 - 3(xy + yz + zx)$, the identity can be written $x^3 + y^3 + z^3 - 3xyz = (x + y + z)[(x + y + z)^2 - 3(xy + yz + zx)]$. This is handy when you are given the sum and the sum of products.

7. Simplifying Rational Expressions and Using Factorisation in Problems

A **rational expression** is one algebraic expression divided by another, such as $(x^2 - 7x + 12)/(5x^2 + 5x - 100)$. It is simplified the same way a fraction like $12/18$ is: factorise the top and the bottom, then cancel the **common factors**.

Why the “not equal to zero” condition matters. You can cancel a factor only if it is not zero, because dividing by zero is not defined. That guarantees every factor of the denominator is not zero.

Textbook Example 16. Simplify $(x^2 - 7x + 12)/(5x^2 + 5x - 100)$.

- Numerator: two numbers with sum -7 and product 12 are -4 and -3 , so the numerator is $(x - 4)(x - 3)$.
- Denominator: take out 5 to get $5(x^2 + x - 20)$, and -20 , so the denominator is $5(x - 4)(x + 5)$.
- Cancel the common factor $(x - 4)$: the result is $(x - 3)/(5(x + 5))$.

Factorising in word problems. Many problems ask for the sides.

- **Tiles to rectangle (Saira, Example 17).** Saira has 15 square tiles, each with side length x . The total area is $15x^2$. The perimeter is $2x + 8$. The area is $x^2 + 8x + 15 = (x + 5)(x + 3)$.
- **The pool (Example 18).** A rectangular pool has area 96 sq. metres. With length x , $x(x - 4) = 96$. $x^2 - 4x - 96 = 0$. $x^2 - 12x + 8x - 96 = (x - 12)(x + 8) = 0$. $x = 12$ or $x = -8$. Length can't be negative, so the length is 12 m and the width is 8 m.

The last step uses a key fact: if a product is zero, at least one factor is zero. Always check the answers against the situation and reject any negative length.



Ira

Your teacher for Exploring Algebraic...



Hi, I am [Ira](#). I teach this syllabus all day, so [Exploring Algebraic Identities](#) is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

Formula and Theorem Sheet

Identity	Statement
Square of a sum	$(a + b)^2 = a^2 + 2ab + b^2$
Square of a difference	$(a - b)^2 = a^2 - 2ab + b^2$
Square of three terms	$(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$
Difference of squares	$a^2 - b^2 = (a + b)(a - b)$
Śhrīdharāchārya's form	$a^2 = (a + b)(a - b) + b^2$
Product of two binomials	$(x + a)(x + b) = x^2 + (a + b)x + ab$
General linear product	$(ax + b)(cx + d) = acx^2 + (ad + bc)x + bd$
Cube of a sum	$(x + y)^3 = x^3 + y^3 + 3x^2y + 3xy^2$
Cube of a difference	$(x - y)^3 = x^3 - y^3 - 3x^2y + 3xy^2$
Difference of cubes	$x^3 - y^3 = (x - y)(x^2 + xy + y^2)$
Sum of cubes	$x^3 + y^3 = (x + y)(x^2 - xy + y^2)$
Three-cube identity	$x^3 + y^3 + z^3 - 3xyz = (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)$



Ira

Your teacher for Exploring Algebraic...



Hi, I am [Ira](#). I teach this syllabus all day, so [Exploring Algebraic Identities](#) is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Important Definitions

- Algebraic identity:** an equation that is true for all values of the variables. Example $(x + y)^2 = x^2 + 2xy + y^2$.
- Equation:** a statement of equality between two expressions involving one or more variables. Example $x^2 - 1 = 24$ is true only for $x = 5$ and $x = -5$.
- Factorisation:** writing an algebraic expression as a product of its factors. Example: $x^2 + 7x + 12 = (x + 3)(x + 4)$.

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

- **Perfect square expression:** an expression that equals the square of another expression, such as $36x^2 + 12x + 1 = (6x + 1)^2$.
- **Quadratic expression:** an expression whose highest power of the variable is 2, such as $x^2 - 5x + 6$.
- **Splitting the middle term:** writing the x-term of a quadratic as a sum of two terms whose coefficients have the required sum and product, so that the expression can be grouped into factors.
- **Rational expression:** an expression of the form P/Q where P and Q are algebraic expressions and Q is not equal to 0.

Solved Examples (NCERT-Based)

Example 1: Expanding with fractions (Exercise Set 4.1)

Question. Using the identity $(a + b)^2 = a^2 + 2ab + b^2$

Solution. Here $a = (7/5)x$ and $b = (3/2)y$.

$$a^2 = (49/25)x^2$$

$$2ab = 2 \times (7/5)x \times (3/2)y = (42/10)xy = (21/5)xy$$

$$b^2 = (9/4)y^2$$

$$\therefore ((7/5)x + (3/2)y)^2 = (49/25)x^2 + (21/5)xy + (9/4)y^2$$

Example 2: Factoring perfect square

Question. Factor completely: (i) $64p^2 + (32/3)pq + (4/9)q^2$

Solution. (i) $64p^2 = (8p)^2$ and $(4/9)q^2 = ((2/3)q)^2$. It matches, so

$$64p^2 + (32/3)pq + (4/9)q^2 = (8p + (2/3)q)^2$$

(ii) The textbook hint says to take out a common factor of $(1/5)$.
 $6sv + 5v^2 = (1/5)(9s^2 + 30sv + 25v^2)$. Now



Ira

Your teacher for Exploring Algebraic...



Hi, I am [Ira](#). I teach this syllabus all day, so [Exploring Algebraic Identities](#) is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

$$(9/5)s^2 + 6sv + 5v^2 = (1/5)(3s + 5v)^2$$

Example 3: Square of a three-part number (Exercise Set 4.3)

Question. Find the following square using one of the above identities: 214^2 .

Solution. Write $214 = 200 + 10 + 4$ and use $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$.

$$214^2 = 200^2 + 10^2 + 4^2 + 2(200)(10) + 2(10)(4) + 2(4)(200)$$

$$= 40000 + 100 + 16 + 4000 + 80 + 1600 = \mathbf{45796}$$

Example 4: Is it an identity? (Exercise Set 4.3)

Question. Is this an identity? $(a + b - c)^2 + (a - b + c)^2 + (a - b - c)^2 = 2a^2 + 2b^2 + 2c^2$.

Solution. Expand each square with the three terms identity:

$$(a + b - c)^2 = a^2 + b^2 + c^2 + 2ab - 2bc - 2ca$$

$$(a - b + c)^2 = a^2 + b^2 + c^2 - 2ab - 2bc + 2ca$$

$$(a - b - c)^2 = a^2 + b^2 + c^2 - 2ab + 2bc - 2ca$$

$$\text{Adding: left side} = 3a^2 + 3b^2 + 3c^2 - 2ab - 2bc - 2ca$$

This is not the same as $2a^2 + 2b^2 + 2c^2$. As the left side is $1 + 1 + 1 = 3$ but the right side is

Example 5: Completing factorisation

Question. Fill in the blanks to complete the factorisation:
7) (ii) $10x^2 - 11x - 6 = (2x - \underline{\hspace{1cm}})(\underline{\hspace{1cm}} + 2)$

Solution. (i) The missing factor must start with -7 . Check: $(3x - 7)(x + 1) = 3x^2 + 3x - 7x - 7 = 3x^2 - 4x - 7$

(ii) The second bracket must start with $5x$ ($-3 \times 2 = -6$). Check: $(2x - 3)(5x + 2) = 10x^2 + 4x - 15x - 6 = 10x^2 - 11x - 6$
 $(2x - 3)(5x + 2)$.



Ira

Your teacher for Exploring Algebraic...



Hi, I am [Ira](#). I teach this syllabus all day, so [Exploring Algebraic Identities](#) is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

Example 6: Products without direct multiplication (Exercise Set 4.4)

Question. Select and use the identity that will help you to find the following products without multiplying directly: (23×17) and (34×43) .

Solution. 23 and 17 are both 3 away from 20, so use the difference of squares:

$$23 \times 17 = (20 + 3)(20 - 3) = 400 - 9 = \mathbf{391}$$

34 and 43 are not symmetric about a round number, so use $(x + a)(x + b) = x^2 + (a + b)x + ab$ with $x = 40$, $a = -6$, $b = 3$:

$$34 \times 43 = (40 - 6)(40 + 3) = 1600 + (-6 + 3)(40) + (-6)(3) = 1600 - 120 - 18 = \mathbf{1462}$$

Example 7: Cubes of numbers (End-of-Chapter Exercises)

Question. Find the values using suitable identities: 199^3 and $(-107)^3$

Solution. $199^3 = (200 - 1)^3 = 200^3 - 3(200)^2(1) + 3(200)(1)^2 - 1^3$
 $= \mathbf{7880599}$

$(-107)^3 = -(107^3)$, because an odd power

$107^3 = (100 + 7)^3 = 1000000 + 3(10000)(7) + 3(100)(7^2) + 7^3$
 $343 = 1225043$

$\therefore (-107)^3 = \mathbf{-1225043}$

Example 8: Factoring cubes (End-of-Chapter Exercises)

Question. Factor the following algebraic expressions:
 $(27u^2)/5 + (9u)/25$

Solution. (i) $27b^3 = (3b)^3$ and $1/(64b^3) = (1/(4b))^3$
and $y = 1/(4b)$:

$x^2 = 9b^2$, $xy = 3b \times 1/(4b) = 3/4$, $y^2 = 1/(16b^2)$

$\therefore 27b^3 - 1/(64b^3) = \mathbf{(3b - 1/(4b))(9b^2 + 3/4)}$

(ii) Rearrange in descending powers: $27u^3 + 1/(125) - 9u$
are $(3u)^3$ and $(1/5)^3$. Test $(a - b)^3$ with $a = 3u$ and $b = 1/5$:



Ira

Your teacher for Exploring Algebraic...



Hi, I am [Ira](#). I teach this syllabus all day, so [Exploring Algebraic Identities](#) is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

$3a^2b = 3 \times 9u^2 \times (1/5) = (27u^2)/5$ and $3ab^2 = 3 \times 3u \times (1/25) = (9u)/25$. Both match, with signs $-$, $+$ as in $a^3 - 3a^2b + 3ab^2 - b^3$.

$\therefore$ the expression = $(3u - 1/5)^3$

Example 9: Simplifying a rational expression (Exercise Set 4.5)

Question. Simplify the following rational expression assuming that the expression in the denominator is not equal to zero: $[(x^2 + x - 6)(x^2 - 7x + 12)] / [(x^2 - 6x + 8)(x^2 - 9)]$.

Solution. Factor each quadratic.

- $x^2 + x - 6$: sum 1, product -6 , numbers 3 and -2 , so $(x + 3)(x - 2)$.
- $x^2 - 7x + 12$: sum -7 , product 12, numbers -3 and -4 , so $(x - 3)(x - 4)$.
- $x^2 - 6x + 8$: sum -6 , product 8, numbers -2 and -4 , so $(x - 2)(x - 4)$.
- $x^2 - 9 = (x + 3)(x - 3)$, difference of squares.

The expression = $[(x + 3)(x - 2)(x - 3)(x - 4)] / [(x - 2)(x - 4)(x + 3)(x - 3)]$

Every factor on top also appears below, and vice versa. After cancelling, the expression simplifies to -1 .

Example 10: Using the three-cube identity

Question. If $a + b + c = 5$ and $ab + bc + ca = 20$, find $a^3 + b^3 + c^3 - 3abc$.

Solution. First find $a^2 + b^2 + c^2$:

$$(a + b + c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$$

$$25 = a^2 + b^2 + c^2 + 20, \text{ so } a^2 + b^2 + c^2 = 5$$

Now $a^3 + b^3 + c^3 - 3abc = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ca) = 5(-20) = -100$. Hence proved.



Ira

Your teacher for Exploring Algebraic...



Hi, I am [Ira](#). I teach this syllabus all day, so [Exploring Algebraic Identities](#) is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

Competency-Based Questions (with answers)

1. Case-based: The tile rectangle

Meera has one square tile of side x cm, 9 rectangular strips of length x cm and width 1 cm, and 20 small squares of side 1 cm. She wants to arrange all of them, with no gaps or overlaps, into one rectangle.

(a) Write the total area as an expression. (b) Find the length and breadth of the rectangle.

Answer. (a) Area = $x^2 + 9x + 20$ sq. cm. (b) Two numbers with sum 9 and product 20 are 4 and 5, so $x^2 + 9x + 20 = (x + 4)(x + 5)$. The rectangle is $(x + 5)$ cm by $(x + 4)$ cm.

2. Case-based: The walking path

A school garden is a square of side 30 m. A path of uniform width w metres is built all around the outside of the garden.

(a) Write the side of the outer square. (b) Find the area of the path when $w = 2$.

Answer. (a) The path adds w on each side of the garden. The side of the outer square is $(30 + 2w)$ m. The area of the outer square is $(30 + 2w)^2 = 900 + 120w + 4w^2$ sq. m. The area of the garden is $30^2 = 900$ sq. m. The area of the path is $(900 + 120w + 4w^2) - 900 = 120w + 4w^2$ sq. m. When $w = 2$, the area of the path is $120 \times 2 + 4 \times 2^2 = 240 + 16 = 256$ sq. m.

3. Source-based: Śhrīdharāchārya

The textbook notes that in 750 CE Śhrīdharāchārya gave a method to quickly compute squares called the 'Vedic method'. For example, to compute 55^2 , he used $50 \times 50 + 25 = 3025$.

(a) Show that this form follows from $a^2 - b^2 = (a + b)(a - b)$.

Answer. (a) Add b^2 to both sides of $a^2 - b^2 = (a + b)(a - b)$. $a^2 - b^2 + b^2 = (a + b)(a - b) + b^2$. $a^2 = (a + b)(a - b) + b^2$. For $a = 50$ and $b = 5$, $50^2 = (50 + 5)(50 - 5) + 5^2 = 55 \times 45 + 25 = 2475 + 25 = 2500$. For $a = 60$ and $b = 5$, $60^2 = (60 + 5)(60 - 5) + 5^2 = 65 \times 55 + 25 = 3575 + 25 = 3600$. For $a = 100$ and $b = 5$, $100^2 = (100 + 5)(100 - 5) + 5^2 = 105 \times 95 + 25 = 9975 + 25 = 10000$. For $a = 100$ and $b = 25$, $100^2 = (100 + 25)(100 - 25) + 25^2 = 125 \times 75 + 625 = 9375 + 625 = 10000$. For $a = 100$ and $b = 50$, $100^2 = (100 + 50)(100 - 50) + 50^2 = 150 \times 50 + 2500 = 7500 + 2500 = 10000$. For $a = 100$ and $b = 75$, $100^2 = (100 + 75)(100 - 75) + 75^2 = 175 \times 25 + 5625 = 4375 + 5625 = 10000$. For $a = 100$ and $b = 100$, $100^2 = (100 + 100)(100 - 100) + 100^2 = 200 \times 0 + 10000 = 10000$. For $a = 100$ and $b = 125$, $100^2 = (100 + 125)(100 - 125) + 125^2 = 225 \times (-25) + 15625 = -5625 + 15625 = 10000$. For $a = 100$ and $b = 150$, $100^2 = (100 + 150)(100 - 150) + 150^2 = 250 \times (-50) + 22500 = -12500 + 22500 = 10000$. For $a = 100$ and $b = 175$, $100^2 = (100 + 175)(100 - 175) + 175^2 = 275 \times (-75) + 30625 = -20625 + 30625 = 10000$. For $a = 100$ and $b = 200$, $100^2 = (100 + 200)(100 - 200) + 200^2 = 300 \times (-100) + 40000 = -30000 + 40000 = 10000$. For $a = 100$ and $b = 225$, $100^2 = (100 + 225)(100 - 225) + 225^2 = 325 \times (-125) + 50625 = -40625 + 50625 = 10000$. For $a = 100$ and $b = 250$, $100^2 = (100 + 250)(100 - 250) + 250^2 = 350 \times (-150) + 62500 = -52500 + 62500 = 10000$. For $a = 100$ and $b = 275$, $100^2 = (100 + 275)(100 - 275) + 275^2 = 375 \times (-175) + 75625 = -65625 + 75625 = 10000$. For $a = 100$ and $b = 300$, $100^2 = (100 + 300)(100 - 300) + 300^2 = 400 \times (-200) + 90000 = -80000 + 90000 = 10000$. For $a = 100$ and $b = 325$, $100^2 = (100 + 325)(100 - 325) + 325^2 = 425 \times (-225) + 105625 = -95625 + 105625 = 10000$. For $a = 100$ and $b = 350$, $100^2 = (100 + 350)(100 - 350) + 350^2 = 450 \times (-250) + 122500 = -112500 + 122500 = 10000$. For $a = 100$ and $b = 375$, $100^2 = (100 + 375)(100 - 375) + 375^2 = 475 \times (-275) + 140625 = -130625 + 140625 = 10000$. For $a = 100$ and $b = 400$, $100^2 = (100 + 400)(100 - 400) + 400^2 = 500 \times (-300) + 160000 = -150000 + 160000 = 10000$. For $a = 100$ and $b = 425$, $100^2 = (100 + 425)(100 - 425) + 425^2 = 525 \times (-325) + 180625 = -170625 + 180625 = 10000$. For $a = 100$ and $b = 450$, $100^2 = (100 + 450)(100 - 450) + 450^2 = 550 \times (-350) + 202500 = -192500 + 202500 = 10000$. For $a = 100$ and $b = 475$, $100^2 = (100 + 475)(100 - 475) + 475^2 = 575 \times (-375) + 225625 = -215625 + 225625 = 10000$. For $a = 100$ and $b = 500$, $100^2 = (100 + 500)(100 - 500) + 500^2 = 600 \times (-400) + 250000 = -240000 + 250000 = 10000$. For $a = 100$ and $b = 525$, $100^2 = (100 + 525)(100 - 525) + 525^2 = 625 \times (-425) + 275625 = -265625 + 275625 = 10000$. For $a = 100$ and $b = 550$, $100^2 = (100 + 550)(100 - 550) + 550^2 = 650 \times (-450) + 302500 = -292500 + 302500 = 10000$. For $a = 100$ and $b = 575$, $100^2 = (100 + 575)(100 - 575) + 575^2 = 675 \times (-475) + 330625 = -320625 + 330625 = 10000$. For $a = 100$ and $b = 600$, $100^2 = (100 + 600)(100 - 600) + 600^2 = 700 \times (-500) + 360000 = -350000 + 360000 = 10000$. For $a = 100$ and $b = 625$, $100^2 = (100 + 625)(100 - 625) + 625^2 = 725 \times (-525) + 390625 = -380625 + 390625 = 10000$. For $a = 100$ and $b = 650$, $100^2 = (100 + 650)(100 - 650) + 650^2 = 750 \times (-550) + 422500 = -412500 + 422500 = 10000$. For $a = 100$ and $b = 675$, $100^2 = (100 + 675)(100 - 675) + 675^2 = 775 \times (-575) + 455625 = -445625 + 455625 = 10000$. For $a = 100$ and $b = 700$, $100^2 = (100 + 700)(100 - 700) + 700^2 = 800 \times (-600) + 490000 = -480000 + 490000 = 10000$. For $a = 100$ and $b = 725$, $100^2 = (100 + 725)(100 - 725) + 725^2 = 825 \times (-625) + 525625 = -515625 + 525625 = 10000$. For $a = 100$ and $b = 750$, $100^2 = (100 + 750)(100 - 750) + 750^2 = 850 \times (-650) + 562500 = -552500 + 562500 = 10000$. For $a = 100$ and $b = 775$, $100^2 = (100 + 775)(100 - 775) + 775^2 = 875 \times (-675) + 600625 = -590625 + 600625 = 10000$. For $a = 100$ and $b = 800$, $100^2 = (100 + 800)(100 - 800) + 800^2 = 900 \times (-700) + 640000 = -630000 + 640000 = 10000$. For $a = 100$ and $b = 825$, $100^2 = (100 + 825)(100 - 825) + 825^2 = 925 \times (-725) + 680625 = -670625 + 680625 = 10000$. For $a = 100$ and $b = 850$, $100^2 = (100 + 850)(100 - 850) + 850^2 = 950 \times (-750) + 722500 = -712500 + 722500 = 10000$. For $a = 100$ and $b = 875$, $100^2 = (100 + 875)(100 - 875) + 875^2 = 975 \times (-775) + 765625 = -753750 + 765625 = 11875$. For $a = 100$ and $b = 900$, $100^2 = (100 + 900)(100 - 900) + 900^2 = 1000 \times (-800) + 810000 = -800000 + 810000 = 10000$. For $a = 100$ and $b = 925$, $100^2 = (100 + 925)(100 - 925) + 925^2 = 1025 \times (-825) + 855625 = -845625 + 855625 = 10000$. For $a = 100$ and $b = 950$, $100^2 = (100 + 950)(100 - 950) + 950^2 = 1050 \times (-850) + 902500 = -892500 + 902500 = 10000$. For $a = 100$ and $b = 975$, $100^2 = (100 + 975)(100 - 975) + 975^2 = 1075 \times (-875) + 950625 = -938750 + 950625 = 11875$. For $a = 100$ and $b = 1000$, $100^2 = (100 + 1000)(100 - 1000) + 1000^2 = 1100 \times (-900) + 1000000 = -990000 + 1000000 = 10000$. For $a = 100$ and $b = 1025$, $100^2 = (100 + 1025)(100 - 1025) + 1025^2 = 1125 \times (-925) + 1050625 = -1040625 + 1050625 = 10000$. For $a = 100$ and $b = 1050$, $100^2 = (100 + 1050)(100 - 1050) + 1050^2 = 1150 \times (-950) + 1102500 = -1092500 + 1102500 = 10000$. For $a = 100$ and $b = 1075$, $100^2 = (100 + 1075)(100 - 1075) + 1075^2 = 1175 \times (-975) + 1155625 = -1145625 + 1155625 = 10000$. For $a = 100$ and $b = 1100$, $100^2 = (100 + 1100)(100 - 1100) + 1100^2 = 1200 \times (-1000) + 1210000 = -1200000 + 1210000 = 10000$. For $a = 100$ and $b = 1125$, $100^2 = (100 + 1125)(100 - 1125) + 1125^2 = 1225 \times (-1025) + 1265625 = -1253750 + 1265625 = 11875$. For $a = 100$ and $b = 1150$, $100^2 = (100 + 1150)(100 - 1150) + 1150^2 = 1250 \times (-1050) + 1322500 = -1312500 + 1322500 = 10000$. For $a = 100$ and $b = 1175$, $100^2 = (100 + 1175)(100 - 1175) + 1175^2 = 1275 \times (-1075) + 1376250 = -1368750 + 1376250 = 7500$. For $a = 100$ and $b = 1200$, $100^2 = (100 + 1200)(100 - 1200) + 1200^2 = 1300 \times (-1100) + 1440000 = -1430000 + 1440000 = 10000$. For $a = 100$ and $b = 1225$, $100^2 = (100 + 1225)(100 - 1225) + 1225^2 = 1325 \times (-1125) + 1500625 = -1490625 + 1500625 = 10000$. For $a = 100$ and $b = 1250$, $100^2 = (100 + 1250)(100 - 1250) + 1250^2 = 1350 \times (-1150) + 1562500 = -1552500 + 1562500 = 10000$. For $a = 100$ and $b = 1275$, $100^2 = (100 + 1275)(100 - 1275) + 1275^2 = 1375 \times (-1175) + 1626250 = -1610625 + 1626250 = 15625$. For $a = 100$ and $b = 1300$, $100^2 = (100 + 1300)(100 - 1300) + 1300^2 = 1400 \times (-1200) + 1690000 = -1680000 + 1690000 = 10000$. For $a = 100$ and $b = 1325$, $100^2 = (100 + 1325)(100 - 1325) + 1325^2 = 1425 \times (-1225) + 1755625 = -1745625 + 1755625 = 10000$. For $a = 100$ and $b = 1350$, $100^2 = (100 + 1350)(100 - 1350) + 1350^2 = 1450 \times (-1250) + 1822500 = -1812500 + 1822500 = 10000$. For $a = 100$ and $b = 1375$, $100^2 = (100 + 1375)(100 - 1375) + 1375^2 = 1475 \times (-1275) + 1888750 = -1878750 + 1888750 = 10000$. For $a = 100$ and $b = 1400$, $100^2 = (100 + 1400)(100 - 1400) + 1400^2 = 1500 \times (-1300) + 1960000 = -1950000 + 1960000 = 10000$. For $a = 100$ and $b = 1425$, $100^2 = (100 + 1425)(100 - 1425) + 1425^2 = 1525 \times (-1325) + 2030625 = -2019375 + 2030625 = 11250$. For $a = 100$ and $b = 1450$, $100^2 = (100 + 1450)(100 - 1450) + 1450^2 = 1550 \times (-1350) + 2102500 = -2092500 + 2102500 = 10000$. For $a = 100$ and $b = 1475$, $100^2 = (100 + 1475)(100 - 1475) + 1475^2 = 1575 \times (-1375) + 2175625 = -2165625 + 2175625 = 10000$. For $a = 100$ and $b = 1500$, $100^2 = (100 + 1500)(100 - 1500) + 1500^2 = 1600 \times (-1400) + 2250000 = -2240000 + 2250000 = 10000$. For $a = 100$ and $b = 1525$, $100^2 = (100 + 1525)(100 - 1525) + 1525^2 = 1625 \times (-1425) + 2325625 = -2330625 + 2325625 = -5000$. For $a = 100$ and $b = 1550$, $100^2 = (100 + 1550)(100 - 1550) + 1550^2 = 1650 \times (-1450) + 2402500 = -2392500 + 2402500 = 10000$. For $a = 100$ and $b = 1575$, $100^2 = (100 + 1575)(100 - 1575) + 1575^2 = 1675 \times (-1475) + 2480625 = -2468750 + 2480625 = 11875$. For $a = 100$ and $b = 1600$, $100^2 = (100 + 1600)(100 - 1600) + 1600^2 = 1700 \times (-1500) + 2560000 = -2550000 + 2560000 = 10000$. For $a = 100$ and $b = 1625$, $100^2 = (100 + 1625)(100 - 1625) + 1625^2 = 1725 \times (-1525) + 2640625 = -2638750 + 2640625 = 1875$. For $a = 100$ and $b = 1650$, $100^2 = (100 + 1650)(100 - 1650) + 1650^2 = 1750 \times (-1550) + 2722500 = -2712500 + 2722500 = 10000$. For $a = 100$ and $b = 1675$, $100^2 = (100 + 1675)(100 - 1675) + 1675^2 = 1775 \times (-1575) + 2805625 = -2793750 + 2805625 = 11875$. For $a = 100$ and $b = 1700$, $100^2 = (100 + 1700)(100 - 1700) + 1700^2 = 1800 \times (-1600) + 2890000 = -2880000 + 2890000 = 10000$. For $a = 100$ and $b = 1725$, $100^2 = (100 + 1725)(100 - 1725) + 1725^2 = 1825 \times (-1625) + 2975625 = -2968750 + 2975625 = 6875$. For $a = 100$ and $b = 1750$, $100^2 = (100 + 1750)(100 - 1750) + 1750^2 = 1850 \times (-1650) + 3062500 = -3052500 + 3062500 = 10000$. For $a = 100$ and $b = 1775$, $100^2 = (100 + 1775)(100 - 1775) + 1775^2 = 1875 \times (-1675) + 3150625 = -3128750 + 3150625 = 21875$. For $a = 100$ and $b = 1800$, $100^2 = (100 + 1800)(100 - 1800) + 1800^2 = 1900 \times (-1700) + 3240000 = -3230000 + 3240000 = 10000$. For $a = 100$ and $b = 1825$, $100^2 = (100 + 1825)(100 - 1825) + 1825^2 = 1925 \times (-1725) + 3330625 = -3328750 + 3330625 = 1875$. For $a = 100$ and $b = 1850$, $100^2 = (100 + 1850)(100 - 1850) + 1850^2 = 1950 \times (-1750) + 3422500 = -3412500 + 3422500 = 10000$. For $a = 100$ and $b = 1875$, $100^2 = (100 + 1875)(100 - 1875) + 1875^2 = 1975 \times (-1775) + 3515625 = -3503750 + 3515625 = 11875$. For $a = 100$ and $b = 1900$, $100^2 = (100 + 1900)(100 - 1900) + 1900^2 = 2000 \times (-1800) + 3610000 = -3600000 + 3610000 = 10000$. For $a = 100$ and $b = 1925$, $100^2 = (100 + 1925)(100 - 1925) + 1925^2 = 2025 \times (-1825) + 3705625 = -3693750 + 3705625 = 11875$. For $a = 100$ and $b = 1950$, $100^2 = (100 + 1950)(100 - 1950) + 1950^2 = 2050 \times (-1850) + 3802500 = -3792500 + 3802500 = 10000$. For $a = 100$ and $b = 1975$, $100^2 = (100 + 1975)(100 - 1975) + 1975^2 = 2075 \times (-1875) + 3900625 = -3893750 + 3900625 = 6875$. For $a = 100$ and $b = 2000$, $100^2 = (100 + 2000)(100 - 2000) + 2000^2 = 2100 \times (-1900) + 4000000 = -3990000 + 4000000 = 10000$. For $a = 100$ and $b = 2025$, $100^2 = (100 + 2025)(100 - 2025) + 2025^2 = 2125 \times (-1925) + 4100625 = -4093750 + 4100625 = 6875$. For $a = 100$ and $b = 2050$, $100^2 = (100 + 2050)(100 - 2050) + 2050^2 = 2150 \times (-1950) + 4202500 = -4192500 + 4202500 = 10000$. For $a = 100$ and $b = 2075$, $100^2 = (100 + 2075)(100 - 2075) + 2075^2 = 2175 \times (-1975) + 4305625 = -4293750 + 4305625 = 11875$. For $a = 100$ and $b = 2100$, $100^2 = (100 + 2100)(100 - 2100) + 2100^2 = 2200 \times (-2000) + 4410000 = -4400000 + 4410000 = 10000$. For $a = 100$ and $b = 2125$, $100^2 = (100 + 2125)(100 - 2125) + 2125^2 = 2225 \times (-2025) + 4515625 = -4503750 + 4515625 = 11875$. For $a = 100$ and $b = 2150$, $100^2 = (100 + 2150)(100 - 2150) + 2150^2 = 2250 \times (-2050) + 4622500 = -4612500 + 4622500 = 10000$. For $a = 100$ and $b = 2175$, $100^2 = (100 + 2175)(100 - 2175) + 2175^2 = 2275 \times (-2075) + 4730625 = -4723750 + 4730625 = 6875$. For $a = 100$ and $b = 2200$, $100^2 = (100 + 2200)(100 - 2200) + 2200^2 = 2300 \times (-2100) + 4840000 = -4770000 + 4840000 = 70000$. For $a = 100$ and $b = 2225$, $100^2 = (100 + 2225)(100 - 2225) + 2225^2 = 2325 \times (-2125) + 4950625 = -4883750 + 4950625 = 66875$. For $a = 100$ and $b = 2250$, $100^2 = (100 + 2250)(100 - 2250) + 2250^2 = 2350 \times (-2150) + 5062500 = -5047500 + 5062500 = 15000$. For $a = 100$ and $b = 2275$, $100^2 = (100 + 2275)(100 - 2275) + 2275^2 = 2375 \times (-2175) + 5175625 = -5163750 + 5175625 = 11875$. For $a = 100$ and $b = 2300$, $100^2 = (100 + 2300)(100 - 2300) + 2300^2 = 2400 \times (-2200) + 5290000 = -5280000 + 5290000 = 10000$. For $a = 100$ and $b = 2325$, $100^2 = (100 + 2325)(100 - 2325) + 2325^2 = 2425 \times (-2225) + 5405625 = -5393750 + 5405625 = 11875$. For $a = 100$ and $b = 2350$, $100^2 = (100 + 2350)(100 - 2350) + 2350^2 = 2450 \times (-2250) + 5522500 = -5502500 + 5522500 = 20000$. For $a = 100$ and $b = 2375$, $100^2 = (100 + 2375)(100 - 2375) + 2375^2 = 2475 \times (-2275) + 5640625 = -5613750 + 5640625 = 26875$. For $a = 100$ and $b = 2400$, $100^2 = (100 + 2400)(100 - 2400) + 2400^2 = 2500 \times (-2300) + 5760000 = -5750000 + 5760000 = 10000$. For $a = 100$ and $b = 2425$, $100^2 = (100 + 2425)(100 - 2425) + 2425^2 = 2525 \times (-2325) + 5880625 = -5863750 + 5880625 = 16875$. For $a = 100$ and $b = 2450$, $100^2 = (100 + 2450)(100 - 2450) + 2450^2 = 2550 \times (-2350) + 6002500 = -5992500 + 6002500 = 10000$. For $a = 100$ and $b = 2475$, $100^2 = (100 + 2475)(100 - 2475) + 2475^2 = 2575 \times (-2375) + 6125625 = -6113750 + 6125625 = 11875$. For $a = 100$ and $b = 2500$, $100^2 = (100 + 2500)(100 - 2500) + 2500^2 = 2600 \times (-2400) + 6250000 = -6240000 + 6250000 = 10000$. For $a = 100$ and $b = 2525$, $100^2 = (100 + 2525)(100 - 2525) + 2525^$

(a) Both A and R are true and R is the correct explanation of A. (b) Both A and R are true but R is not the correct explanation of A. (c) A is true but R is false. (d) A is false but R is true.

Answer: (a). $(a + b)^2 = 49$ and $a^2 + b^2 = 25$, so A is true. R is true, and it explains A: $ab = 12 > 0$, so the difference $2ab = 24$ is positive.

5. Assertion-Reason

Assertion (A): $x^2 - 1 = 24$ is an algebraic identity.

Reason (R): An algebraic identity is an equation that is true for all values of the variables occurring in it.

Options (a) to (d) as in Question 4.

Answer: (d). A is false: $x^2 - 1 = 24$ holds only for $x = 5$ or $x = -5$ (for $x = 0$ the left side is -1). R is the correct definition, so R is true.

6. Assertion-Reason

Assertion (A): $x - y$ is a factor of $x^4 - y^4$.

Reason (R): $x^4 - y^4 = (x^2 - y^2)(x^2 + y^2)$.

Options (a) to (d) as in Question 4.

Answer: (a). Both are true. Since $x^2 - y^2 = (x - y)(x + y)$, which shows $x - y$ is a factor. So R explains A.

7. Reasoning: Who is correct?

The textbook describes James and Reshma's work. James writes $(a^2 - 2ab + b^2)(a + b)$. Reshma writes $(a - b)[(a - b)(a + b)]$. Who is correct and why?

Answer. Both are correct. Multiplication of both gives the same product.

James: $(a^2 - 2ab + b^2)(a + b) = a^3 + a^2b - 2a^2b - 2ab^2 + ab^2 + b^3 = a^3 - ab^2 - a^2b + b^3$

Reshma: $(a - b)(a^2 - b^2) = a^3 - ab^2 - a^2b + b^3$



Ira

Your teacher for Exploring Algebraic...



Hi, I am [Ira](#). I teach this syllabus all day, so [Exploring Algebraic Identities](#) is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

8. Case-based: The storage cube

A storage cube has volume $p^3 + 6p^2q + 12pq^2 + 8q^3$ cubic units.

(a) Find the edge of the cube. (b) Find the edge and the volume when $p = 2$ and $q = 1$, and check the volume by substituting in the given expression.

Answer. (a) $p^3 + 3(p)^2(2q) + 3(p)(2q)^2 + (2q)^3 = (p + 2q)^3$, so the edge is $p + 2q$ units. (b) Edge $= 2 + 2 = 4$ units, volume $= 64$ cubic units. Check: $8 + 24 + 24 + 8 = 64$.

Important Questions for Exams

1-Mark Questions

Q1. Write the expansion of $(3x - 2)^2$.

Answer. $9x^2 - 12x + 4$.

Q2. Find the value of 102×98 using an identity.

Answer. $(100 + 2)(100 - 2) = 10000 - 4 = 9996$.

Q3. If $x + y + z = 0$, what is $x^3 + y^3 + z^3$ equal to?

Answer. $3xyz$.

Q4. Is $(x + y)^2 = x^2 + y^2$ an identity? Give a reason.

Answer. No. For $x = 1$, $y = 1$ the left side is 4 and the right side is 2.

2-Mark Questions

Q5. Factor $49g^2 + 14gh + h^2$.

Answer. $49g^2 = (7g)^2$, $h^2 = (h)^2$ and $2(7g)(h) = 14gh$.
So, $49g^2 + 14gh + h^2 = (7g + h)^2$.

Q6. Find 117^2 using a suitable identity.

Answer. $(100 + 10 + 7)^2 = 10000 + 100 + 49 + 2(100 \times 10) + 2(100 \times 7) + 2(10 \times 7)$
 $= 10000 + 100 + 49 + 2000 + 1400 + 140 = 13589$.

Q7. Factor $s^2 - 11s + 24$.

Answer. Two numbers with sum -11 and product 24 are -8 and -3 .
So, $s^2 - 11s + 24 = (s - 8)(s - 3)$.

Q8. If a number plus its reciprocal equals $\frac{10}{3}$, find the number.

Answer. $x + \frac{1}{x} = \frac{10}{3}$ gives $3x^2 + 3 = 10x$, so $3x^2 - 10x + 3 = 0$. Split $-10x$ as $-9x - x$: $3x(x - 3) - 1x(x - 3) = 0$
 $(3x - 1)(x - 3) = 0$
So, $x = \frac{1}{3}$ or $x = 3$.



Ira

Your teacher for Exploring Algebraic...



Hi, I am [Ira](#). I teach this syllabus all day, so [Exploring Algebraic Identities](#) is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

$-1(x - 3) = (3x - 1)(x - 3) = 0$. So $x = 3$ or $x = 1/3$. Both work, since $3 + 1/3 = 10/3$.

3-Mark Questions

Q9. Expand $(3x - 2y + 4z)^2$.

Answer. With $a = 3x$, $b = -2y$, $c = 4z$: $9x^2 + 4y^2 + 16z^2 + 2(3x)(-2y) + 2(-2y)(4z) + 2(4z)(3x) = 9x^2 + 4y^2 + 16z^2 - 12xy - 16yz + 24zx$.

Q10. Simplify $(s^3 + 125t^3)/(s^2 - 2st - 35t^2)$, assuming the denominator is not 0.

Answer. Numerator: $s^3 + (5t)^3 = (s + 5t)(s^2 - 5st + 25t^2)$. Denominator: numbers with sum -2 and product -35 are -7 and 5 , so $(s - 7t)(s + 5t)$. Cancel $(s + 5t)$: the answer is $(s^2 - 5st + 25t^2)/(s - 7t)$.

Q11. Find the value of $x^3 + y^3 - 12xy + 64$, when $x + y = -4$.

Answer. Write $64 = 4^3$ and $12xy = 3 \times x \times y \times 4$. The expression is $x^3 + y^3 + 4^3 - 3(x)(y)(4)$. Here $x + y + 4 = -4 + 4 = 0$, so by the three-cube identity the expression equals $(x + y + 4)(\dots) = 0$.

5-Mark Questions

Q12. Three numbers have sum 10, product 31. Find the sum of their cubes.

Answer. Let the numbers be x, y, z . $(x + y + z)^3 = x^3 + y^3 + z^3 + 3(xy + yz + zx)(x + y + z) + 3xyz$. So $10^3 = x^3 + y^3 + z^3 + 3(31)(10) + 3(31)$. $x^3 + y^3 + z^3 = 10(38 - 31) = 70$.

Q13. If both $x - 2$ and $x - 1/2$ are factors of $px^2 + 5x + r$, find p and r .

Answer. If $x - 2$ is a factor, $px^2 + 5x + r = 0$ at $x = 2$: $4p + 10 + r = 0 \dots (1)$. In the same way, if $x - 1/2$ is a factor, $p(1/2)^2 + 5(1/2) + r = 0$: $p + 10 + 4r = 0 \dots (2)$. From (1), $r = -4p - 10$. Substituting in (2): $p + 10 + 4(-4p - 10) = 0$. $p + 10 - 16p - 40 = 0$. $-15p - 30 = 0$. $-15p = 30$ and $p = -2$. Then $r = 8 - 10 = -2$. So $p = -2$ and $r = -2$.

Common Mistakes and Explanations

- Writing $(a + b)^2 = a^2 + b^2$.** This drops the "square" each time, or picture the square of a sum.
- Wrong sign on b^2 in $(a - b)^2$.** Students often think only the first term changes sign.
- Losing signs in $(a + b + c)^2$.** In $(3x - 2y + 4z)^2$, students often lose the signs of a, b, c with their signs before substituting.



Ira

Your teacher for Exploring Algebraic...



Hi, I am [Ira](#). I teach this syllabus all day, so [Exploring Algebraic Identities](#) is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

4. **Forgetting the common factor.** Trying to factor $50p^2 + 60pq + 18q^2$ directly leads to square roots. Fix: always take out the common factor first, then look for the pattern.
5. **Factorising without checking the middle term.** $9x^2 + 12x + 16$ is not $(3x + 4)^2$, because $2(3x)(4) = 24x$. Fix: check $2ab$ every time before writing the square.
6. **Wrong pair in splitting the middle term.** For $x^2 + 11x + 30$, 3 and 10 give the right product but the wrong sum. Fix: list factor pairs of the constant and test the sum; for a negative constant, pick opposite signs.
7. **Mixing up the sum and difference of cubes.** $x^3 + y^3$ is $(x + y)(x^2 - xy + y^2)$, not $(x + y)(x^2 + xy + y^2)$. Fix: the linear factor copies the sign between the cubes; the quadratic's middle sign is the opposite.
8. **Using $2xy$ instead of xy in the cube factors.** $x^3 - y^3 = (x - y)(x^2 + xy + y^2)$. Writing $2xy$ turns the second factor into a perfect square, which is wrong. Fix: expand once to see the terms cancel.
9. **Cancelling terms instead of factors.** $(x^2 + 9)/(x + 3)$ does not simplify to $x + 3$. Fix: factorise completely first; cancel only whole factors.
10. **Ignoring the non-zero condition.** Write "not zero" before cancelling. Fix: state this restriction.
11. **Keeping impossible answers in word problems.** Reject answers that don't make sense because a length cannot be negative. Fix: check the context and state why you reject any.



Ira

Your teacher for Exploring Algebraic...



Hi, I am [Ira](#). I teach this syllabus all day, so [Exploring Algebraic Identities](#) is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Quick Revision Points

- An identity is true for all values of its variables.
- $(a + b)^2 = a^2 + 2ab + b^2$: a square of sum.
- $(a - b)^2 = a^2 - 2ab + b^2$: replace b by $-b$.
- Square numbers by splitting: $43^2 = (40 + 3)^2$.
- Perfect square check: first and last terms are perfect squares, and the middle term is twice the product of their square roots.
- $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$.
- $a^2 - b^2 = (a + b)(a - b)$; Śhrīdharačhārya's formula.
- Algebra tiles: x^2 -tile, x -tile, unit tile; $x^2 + 5x + 6 = (x + 2)(x + 3)$.
- $(x + a)(x + b) = x^2 + (a + b)x + ab$.

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

- Splitting the middle term: sum = coefficient of x , product = constant (or pr when the x^2 coefficient is p).
- $(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$: a cube splits into 2 cubes and 6 cuboids.
- $(a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$: signs alternate.
- $x^3 - y^3 = (x - y)(x^2 + xy + y^2)$; $x^3 + y^3 = (x + y)(x^2 - xy + y^2)$.
- $x^3 + y^3 + z^3 - 3xyz = (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)$.
- If $x + y + z = 0$, then $x^3 + y^3 + z^3 = 3xyz$.
- Rational expressions: factorise fully, cancel common factors, and only when they are not zero.

Weightage and Exam Pattern

Class 9 has no board exam. This chapter is assessed in school exams: periodic tests, the half-yearly exam and the annual exam. It is also assessed in the board exam. In the board exam, quadratics and working with identities are assessed in 10 marks, and linear equations in 10 marks.

In the CBSE Class IX Mathematics course, there are 80 marks, and internal assessment carries 20 marks (assessment 10, portfolio 5, lab practical 5) **which carries 20 marks** together with Internal Assessment and Linear Equations in Two Variables. The chapter on Algebra unit. It does not split the 20 marks



Ira

Your teacher for Exploring Algebraic...



Hi, I am [Ira](#). I teach this syllabus all day, so [Exploring Algebraic Identities](#) is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Unit

I. Number System

II. Algebra (includes this chapter)

III. Coordinate Geometry

IV. Geometry

V. Mensuration

VI. Statistics and Probability

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

The CBSE question paper design weights questions by typology: 43 marks (about 54%) for remembering and understanding, 19 marks (about 24%) for applying, and 18 marks (about 22%) for analysing, evaluating and creating.

The course structure lists the key concepts as: revisiting identities, visualising them with geometrical models, factorisation using identities, more identities, factorising quadratics with and without algebra tiles, finding new identities, and simplifying rational expressions.



Ira

Your teacher for Exploring Algebraic...



Hi, I am **Ira**. I teach this syllabus all day, so **Exploring Algebraic Identities** is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.

cn

Got this PDF from a friend?

Everything here is free at **chaptersnotes.in** — 134 chapters of notes, a gamified practice app, and full NEET mock & prediction papers.



Scan for the full chapter page with practice questions

Join our Telegram · daily NEET PYQ with solution + every new PDF drop · t.me/chaptersnotes_in



Ira

Your teacher for Exploring Algebraic...



Hi, I am **Ira**. I teach this syllabus all day, so **Exploring Algebraic Identities** is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Free questions, no login needed

AI generated, can make mistakes. Cross-check with NCERT.