

Class: 8	Subject: Mathematics	Topic: Algebraic Expressions and Identities
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SUMMARY SHEET	
Learner Previous Knowledge	Know what Polynomials are (types of algebraic Expression on the basis of number of terms) -Single Terms: Monomial -Two terms : Binomial -Three terms : Trinomial -Four terms: Quadrinomials/Tetranomials. -Degree of Polynomials (Demonstrate an understanding and the use of the concept of a variable, constant and co-efficient). Like and Unlike terms. Operations on Algebraic Expressions
Target Knowledge for this Topic	<i>Revision of Algebraic Expression, terms, co-efficient, like terms, unlike terms, polynomials; Standard forms;</i> <i>Operations on Algebraic Expressions</i> Addition and subtraction of Algebraic Expression Multiplication -monomial to monomial - monomial to binomial / polynomial - binomial to binomial - binomial to trinomial / polynomial (Including rational numbers as numerical coefficients of both +ve and -ve numbers.) Introducing the identities like $(x + a)(x + b) = x^2 + (a + b)x + ab$; $(a + b)^2 = a^2 + 2ab + b^2$; $(a - b)^2 = a^2 - 2ab + b^2$; $(a + b)(a - b) = a^2 - b^2$; Using the above identities to simplify algebraic expressions and to find numerical values of mathematical expressions;
Learning Goals	
<i>More Complex Learning Goal- Students will be able to create phrases into algebraic expressions; to verify the identities using the pictorial representations.</i>	
<i>Target Learning Goal- Students will be able to solve algebraic expression problems involving addition, subtraction and multiplication; to simplify algebraic expressions and find numerical values of mathematical expressions using the identities.</i>	
<i>Simpler Learning Goal- Students will be able to describe different terms with examples like coefficients, algebraic expressions, variables, factor, monomial, binomial, trinomial etc; to identify which identity needs to be used in order to solve the particular expression.</i>	

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Period No.	Lesson Objectives	Teaching Learning Materials Required
1	- Recapitulate Algebraic Expression, terms, co-efficient, like terms, unlike terms, polynomials etc. - Recapitulate Addition and subtraction of Algebraic Expression	Pre assessment: Worksheet-1 (1 per student); - Projector (1 per class)
2 and 3 <i>Note: This lesson takes 2 days</i>	- Multiply -monomial to monomial - monomial to binomial / polynomial - binomial to binomial - binomial to trinomial / polynomial	Worksheet: Worksheet-2 (1 per student); projector (1 per class) Research work: Worksheet-3 (1 per student);
4 and 5 <i>Note: This lesson requires 2 days</i>	Apply the knowledge of addition, subtraction and multiplication of algebraic expressions in order to solve the given problems.	Worksheet: Worksheet-4 (1 per student); projector (1 Per class)
6 and 7 <i>Note: This lesson requires 2 days</i>	Arrive at the identities like $(x + a)(x + b) = x^2 + (a + b)x + ab$; $(a + b)^2 = a^2 + 2ab + b^2$; $(a - b)^2 = a^2 - 2ab + b^2$; $(a + b)(a - b) = a^2 - b^2$;	Worksheet: Worksheet-5 (1 per student);
8	Use the arrived identities to simplify algebraic expressions and to find numerical values of mathematical expressions	Worksheet: Worksheet-6 (1 per student); projector (1 per class)

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Period 1

Lesson Objectives

At the end of this lesson students will be able to:

- Recapitulate Algebraic Expression, terms, co-efficient, like terms, unlike terms, polynomials etc.
- Recapitulate addition and subtraction of Algebraic Expression

Teaching Learning Materials required

- **Pre assessment: Worksheet-1** (1 per student); Projector (1 per class)

Details of Teaching Learning Experience

Seating Arrangement: - Individually

Lesson Beginning <u>Time:</u> 15 min <u>Purpose:</u> Activate prior knowledge Generate interest to the topic	<u>Pre-assessment</u> • Distribute a pre-assessment Worksheet-1 to each student and ask them to read & attempt the Exercise by discussing with their group members • Give them 15 minutes to complete the Exercise. <i>Note: The students can discuss with their group members but work in their individual sheets. The intent here is to assess the prior knowledge of algebraic expressions which they covered in grade 7.</i>
Lesson Middle <u>Time:</u> 20 min <u>Purpose:</u> Develop the conceptual understanding Consolidate students learning	<u>Whole Class – Discussion</u> • Project Worksheet-1. • Ask a few students at random to share the answers of all the questions. • Each time ask them to give the justification for their answers. • Build a class consensus on all the answers of the questions. <i>Note: students may come up with incorrect answers. In this case, ask other students who may have the correct answers to explain and justify. It is important to build consensus on all answers – this will help eradicate any errors. Make sure they come up with the explanation of the terms like coefficient, variables, factors, algebraic expressions. Like:</i> ○ Constant: A symbol having a fixed numerical value is called a constant.

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	○ Variable: A symbol which takes various numerical values is called a variable. ○ Algebraic expression: An expression having one or more variables is called an algebraic expression. An algebraic expression may or may not contain mathematical operators like the symbols of addition, subtraction and multiplication. The quantities in an algebraic expression - variable, constant or combinations of both, joined by plus or minus signs, are called its terms. ○ The elements whose product forms a term of an algebraic expression are called the factors of that term. The numerical factor of a term containing a variable is called the coefficient of the term. Also, make sure they will come up with the steps used in addition and subtraction of algebraic expressions vertically.
Lesson End <u>Time:</u> 5 mins <u>Purpose:</u> Finish up	• Collect the worksheet for review and feedback. • Ask the students to practice questions on Pg 140-Exercise 9.1 of NCERT Textbook at home.

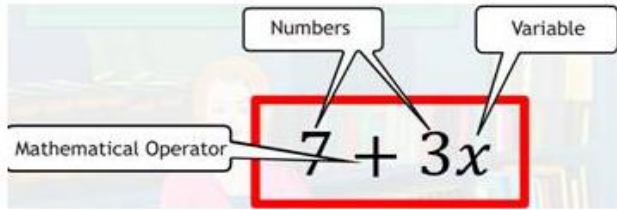
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Worksheet-1

Skill: Logical reasoning

1. Observe the image given below and then answer the questions:

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a. What is coefficient?

b. What is variable?

c. What is $7 + 3x$?

d. What is constant?

e. What do you mean by term? How many terms are there in $7+3x$?

2. Group monomials together, binomial together and trinomials together. Explain your reasoning.

$4x^{-1}$	$16x^2 + 3x$	$6x^2 + 7y$
$x^2 + y^{-2} - 2z^2$	$10xyz$	$6x^2 + 7y$

Binomial	Trinomials	Monomial

3. What are polynomials? Give two examples.

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4. Observe the given solution of addition and subtraction of algebraic expression. Explain the steps for addition and subtraction in your own words.

Steps to remember while adding and subtracting the algebraic expressions:

- To add or subtract two or more algebraic expressions arrange their terms and combine the like terms of each expression to find their sum or difference accordingly.

Example: Add $2x^2 + 6x + 5$ and $3x^2 - 2x - 1$

Start with: $2x^2 + 6x + 5 + 3x^2 - 2x - 1$

Place like terms together: $2x^2 + 3x^2 + 6x - 2x + 5 - 1$

Add the like terms: $(2+3)x^2 + (6-2)x + (5-1)$

$$= 5x^2 + 4x + 4$$

- To subtract Polynomials, first **reverse the sign of each term** we are subtracting (in other words turn "+" into "-", and "-" into "+"), **then add** as usual.

Using the above information try adding and subtracting the following expressions:

a. Add:

i. $9x^2 - 5x + 4$ and $10x - 9$	ii. $2xy + 3yz - 4xz$, $5yz - 3xy + 7xz$, $6zx + 4xy - 8yz$

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Can you add them vertically? Show the solution here:

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Subtract vertically.

i. $3m(6 - m)$ and $7m^2 - 15m$	ii. $4p(5p^2 + 4p - 7)$ and $5(p^3 - 4p^2 + 3)$
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5. Frame one example each of addition and subtraction of algebraic expressions and solve them.

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Period 2 and 3

Lesson Objectives

At the end of this lesson students will be able to:

- Multiply
 - monomial to monomial
 - monomial to binomial / polynomial
 - binomial to binomial
 - binomial to trinomial / polynomial

Teaching Learning Materials required

- **Worksheet: Worksheet-2** (1 per student); projector (1 per class)
- **Research work: Worksheet-3** (1 per student); computer with net connection (1 computer per group)

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Details of Teaching Learning Experience

Seating Arrangement: - In groups of 4 to 6 at computer lab

Lesson Beginning <u>Time:</u> 30 min <u>Purpose:</u> Activate prior knowledge Generate interest to the topic Introduce the topic Develop conceptual understanding	<u>Worksheet/Groups</u> • Provide Worksheet-2 to each student of the group. • Tell them to answer the questions given in the sheet by observing the table. <i>Note: students will discuss the work in groups but solve individually in sheets. The intent here is to give exposure of multiplication of algebraic expressions in real life context.</i> <u>Whole Class - Discussion</u> • Project Worksheet-2. • Ask a few students at random to answers the given questions. • Ask the following questions: ○ What do you get by observing the patterns of the dots? ○ Where it will lead you to? ○ What expression will you get when you increased the rows and columns by 2? ○ How did you verified the expression when written in generic form i.e. $4 + n \times 2 + n$ ○ What all real life situations you were able to think of where multiplication of algebraic expressions is used? • Build a class consensus on all the solutions of the questions. • Tell them to rectify the errors done by them during the discussion. <i>Note: Students may come up with incorrect answers. In this case, ask other students who may have the correct answers to explain and justify. It is important to build consensus on all answers – this will help eradicate any errors</i>
Lesson Middle <u>Time:</u> 20 mins	<u>Exploring multiplication further/Groups</u>

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<u>Purpose:</u> Generate interest to the topic. Introduce the topic.	• Inform students that in the earlier half they have covered the situations in which multiplication of algebraic expressions can be required, where they have carried out multiplication of two or more quantities. • But, what they need to do if the quantities are given by algebraic expressions? • Make them understand that they need to find their product. This means that we should know how to obtain this product. • It's time to do the multiplication systematically and to begin with they need to know how to multiply a monomial with another monomial, multiplying a monomial with a binomial, then trinomial then polynomial. • This is the time to do research work to figure out the multiplication of the motioned expressions. • Provide a recording Worksheet-3 to each student of the group. • Give them time for the research work. <i>Note: though the students will do the research work in groups but they will record their findings individually on Worksheet-3.</i>
Lesson End <u>Time:</u> 30 min <u>Purpose:</u> Develop conceptual understanding Consolidate students learning	<u>Discussion/whole class</u> • Project worksheet-3. • At random call groups to share the process of multiplication of the mentioned cases. • Ask the following questions from the representative groups: ○ Explain the steps you researched to multiply the mentioned cases. ○ How multiplication in each of the cases is similar or different? ○ What can you conclude at the end? • Build a consensus on all the steps and questions asked above. <i>Note: Students may come up with incorrect answers. In this case, ask other students who may have the correct answers to explain and justify. It is important to build consensus on all answers – this will help eradicate any errors. Make sure through discussion they will; be able to understand the process involved in multiplication</i>

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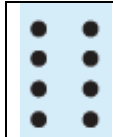
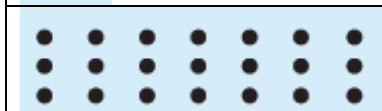
	<i>of specific cases like a monomial by another monomial, three monomials, a monomial by a binomial etc</i> <i>Also they will have to extend their knowledge of multiplication of algebraic expressions using an array model to multiply binomials.</i> <u>Home Assignment</u> Ask the students to solve questions on page 143-Exercise 9.2 of NCERT Textbook.
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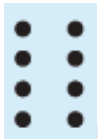
Worksheet-2

Skill: Procedural Fluency

- Observe the given pattern of dots representing an array model of multiplication (in which you multiply rows and columns). Fill in the blanks to get the expression and write your observation in the last column.

	_____ × _____	
	_____ × _____	

- Extend the visual representation when each row and column has been increased by 2



- Write the algebraic expression you get after adding 2 rows and 2 columns

- Add both the expressions here:

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5. Suppose we don't know by how much number the rows and columns have been increased. In this case you will get the following expression:

$$(4 + n) \times (2 + n)$$

Solve this expression and find out what you will get further using the distributive property of addition.

6. Now, place the value of $n = 2$ in the expression you got and verify.

7. Can you now think of similar other situations in which two algebraic expressions have to be multiplied? When the initial given length is increased by 5 and the breadth is decreased by 3

Hint: Area of rectangle and volume

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Worksheet-3

Skill: Logical Reasoning

Do a research work and find out how to multiply:

- two monomials
- three or more monomials
- a monomial by a binomial
- a monomial by a trinomial

Make sure to find out the process of multiplication along with justifiable examples. Record, for all 6 situations.

Use the array model and distributive property to multiply a binomial with another binomial

- a binomial by a binomial
- a binomial by a trinomial

Period 4 and 5

Lesson Objectives

At the end of this lesson students will be able to:

- Apply the knowledge of addition, subtraction and multiplication of algebraic expressions in order to solve the given problems.

Teaching Learning Materials required

- **Worksheet: Worksheet-4** (1 per student); projector (1 Per class)

Details of Teaching Learning Experience

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Seating Arrangement: - In groups of 4 to 6

Lesson Beginning <u>Time:</u> 20 min <u>Purpose:</u> Activate prior knowledge	<u>Worksheet/Groups</u> • Provide the Worksheet-4 to each student of the group. • Tell them to solve the questions given in the sheet while discussing in groups. <i>Note: Let students discuss the work in groups but solve in individual sheets. The intent here is to give a practice exercise to solve the algebraic expressions involving addition, subtraction and multiplication.</i>
Lesson Middle <u>Time:</u> 20 min <u>Purpose:</u> Develop the conceptual understanding Consolidate students learning	<u>Whole Class - Discussion</u> • Project Worksheet-4. • Ask a few students at random to share the answers of the given questions. • Ask the following questions: ○ How did you get the answer of the questions? ○ Explain the steps used by you and give justification. • Build a class consensus on all the solutions of the questions. • Tell them to rectify the errors done by them during the discussion. <i>Note: Students may come up with incorrect answers. In this case, ask other students who may have the correct answers to explain and justify. It is important to build consensus on all answers – this will help eradicate any errors.</i>
Lesson End <u>Time:</u> 30 min <u>Purpose:</u> Consolidate students learning	<u>Practice exercise</u> • Discuss Exercise 9.3-Pg 146 of NCERT Textbook. • Ask 2 or 3 students to solve some parts on board. • Simultaneously tell them to solve these questions in the notebook. <i>Note: Students may come up with incorrect answers. In this case, ask other students who have the correct answers to explain and justify. It is important to build consensus on all answers – this will help eradicate any errors.</i> <u>Home Assignment</u> Tell students to practice questions on Page 148-Exercise 9.4 of NCERT Textbook.

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Worksheet-4

Skill: Problem Solving

1. Find the product.

(i) $(a^2) \times (2a^{12}) \times (5a^{20})$

(ii) $\left(\frac{12}{7} xy\right) \times \left(\frac{-9}{5} x^2 y^2\right)$

(iii) $\left(-\frac{18}{4} pq^3\right) \times \left(\frac{6}{15} p^3 q\right)$

2. Simplify $2x(4x - 5) + 3$ and find its values for (i) $x = 2$ (ii) $x = \frac{1}{3}$

3. Add $(3x-2y)$, $(3x^2-2y)$, $(4y-2x^2+x)$

4. Solve $(x^2 - 2x + 2) - (x^2 - 2x - 3)$

5. Find the product

a. $(7 - 2x)(5 + x)$

b. $(3p^2 - 2q^2)(2p + 3q)$

c. $(1.5l - 0.3m)$ and $(1.5l + 0.3m)$

6. Simplify.

i. $(x^2 - 6)(x + 6) + 36$

ii. $(x^2 + 5)(x^2 - 6) + 30$

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Seating Arrangement: - Individually

Lesson Beginning <u>Time:</u> 10mins <u>Purpose:</u> Activate prior knowledge Generate interest to the topic Introduce the topic	<u>Recapitulation/Whole class</u> • Give the word identity to students while writing it on the board. • Ask, what they mean by this word. • Students may come up with the literal meaning written in the dictionary. • Ask, what do they mean in mathematics? • Tell them today we are going to discover the identities, which we use in math. • For this, you have to figure out how to make left hand side equals to right hand side in the equation. • Suppose, the identity is $(a + b)^2 = a^2 + 2ab + b^2$
Lesson Middle <u>Time:</u> 25mins <u>Purpose:</u> Develop the conceptual understanding Consolidate students learning	<u>Worksheet/Groups</u> • Provide a reading text Worksheet-5 to each student of the group. • Give sufficient unit cubes of red and green to each group. • Instruct the students to follow the given instructions and figure out the identity which needs to be driven out. • Also, how the R.H.S is equals to L.H.S. • Give them some time to explore the relation between the cubes and the identity. <u>Whole Class – Discussion</u> • Project Worksheet-5. • Ask the following questions: ○ How did they use the given information to derive the identity? ○ How did they use the cubes? ○ What all images of cubes they were able to draw using the given information? ○ Why do they think 2 different colored cubes were given?

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	○ Were they able to prove R.H.S. = L.H.S of the identity. ○ What were they able to understand with identity in math now? <i>Note: Students may share incorrect answers. In this case, ask other students who may have the correct answers to explain and justify. It is important to build consensus on all answers – this will help eradicate any errors. Through discussion make sure to come up with the identity of:</i> ○ $(a + b)^2 = a^2 + 2ab + b^2$ ○ We have figured out the values of both sides of the equality for some value of a and b. ○ Such equality, true for every value of the variable in it, is called an identity. ○ The identity we have just discovered can be obtained by multiplying a binomial by another binomial.
Lesson End <u>Time:</u> 35mins <u>Purpose:</u> Develop conceptual understanding Consolidate students learning	<u>Deriving the other two identities/Groups</u> ○ Provide more 2 colored unit cubes to the groups and tell them to derive the two other identities. ○ One is the same as $(a + b)^2$ i. e. $(a - b)^2$ and the other one is $(a + b)(a - b)$ ○ Tell them to use unit cubes and make note and record the steps they will use to arrive at the identities. <i>Note: The intent here is to provide an opportunity to students to arrive at the other two identities and prove the R.H.S equals to the L.H.S. using the unit cubes. This will help them visualize the model and build the concept of identities in a more consolidated way. In case students face problem while working in the groups ask probing questions like:</i> ○ <i>Observe the initial part of an equation provided to you?</i> ○ <i>How can you use the cubes in relation with the given part of the equation and arrive at another part of the equation?</i> ○ <i>What values they need to denote it to the variables of L.H.S to make it true for R.H.S</i>

Whole Class – Discussion

- At random ask students to share the identities they have arrived at along with the steps evolved steps.
- Ask the following questions:
 - What are the other 2 identities they have arrived at?
 - How did they use the given parts of expression to derive the complete identity?
 - How did they use the cubes?
 - Were they able to prove R.H.S. = L.H.S of the identity.

Note: Students may share incorrect answers. In this case, ask other students who may have the correct answers to explain and justify. It is important to build consensus on all answers – this will help eradicate any errors. Through discussion make sure to come up with the given identities:

- $(a - b)^2 = a^2 - 2ab - b^2$
- $(a + b)(a - b) = a^2 - b^2$
- $(x + a)(x + b) = x^2 + (a + b)x + ab$
- Also they need to give the following explanation:
- Let $a = 1, b = 1; 2ab = 2 \times 1 \times 1$
- $1^2 - 2 \times 1 \times 1 - b^2 = a^2 - 2ab - b^2$
- $(a - b)^2 = (1 - 1)^2 = 0^2 = 0$
- For another identity $(a + b)(a - b)$
- Let the $a = 1$ and $b = 1$
- $(1 + 1)(1 - 1) = 1^2 - 1^2$
- So, $(a + b)(a - b) = a^2 - b^2$
- Ask the students to solve questions on Pg 149- Try these of NCERT Textbook at home.

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Worksheet-5

Skill: Logical Reasoning

Directions: Follow the given instructions and try doing the same with unit cubes. Draw the images for each step and then figure out the identity. Figure out how the L.H.S = R.H.S of the identity.

1. Take $a = 1$ unit and make a cube of dimensions 1^2 i.e. 1×1 using 1-unit cube.
2. Take $b = 1$ unit and make a cube of dimensions b^2 i.e. 1×1 using 1-unit cube.
3. Make a cuboid of dimensions $2ab$ i.e. $2 \times 1 \times 1 = 2$. Add the cubes.
4. The total number of cubes will be 4.

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Period 8

Lesson Objectives

At the end of this lesson students will be able to:

- Use the arrived identities to simplify algebraic expressions and to find numerical values of mathematical expressions

Teaching Learning Materials required

- **Worksheet: Worksheet-6** (1 per student); projector (1 per class)

Details of Teaching Learning Experience

Seating Arrangement: - In groups of 4 to 6

Lesson Beginning <u>Time:</u> 15mins <u>Purpose:</u> Activate prior knowledge Generate interest to the topic Introduce the topic	<u>Worksheet/Groups</u> • Provide Worksheet-6 to each student of the group. • Tell them to solve the given algebraic expressions using the arrived identities. • They will have to figure out which identity needs to be used in order to solve the given expressions. <i>Note: Let students discuss the work in pairs but solve in individual sheets. The intent here is to provide an opportunity to students to use the identities in order to solve the mathematical expressions.</i>
Lesson Middle <u>Time:</u> 20 mins <u>Purpose:</u> Activate prior knowledge Develop conceptual understanding Consolidate students learning	<u>Whole Class - Discussion</u> • Project Worksheet-6. • Ask a few students at random to share the answers of the given questions. • Ask the following questions: ○ How did you arrive at an answer? ○ Which identity you used to solve the expressions? ○ Explain your choice as well. • Build a class consensus on all the solutions of the questions. • Tell them to rectify the errors done by them during the discussion.

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	<i>Note: Students may come up with incorrect answers. In this case, ask other students who may have the correct answers to explain and justify. It is important to build consensus on all answers – this will help eradicate any errors. Make sure to encourage the students to explain the steps and identity used to solve the expressions..</i>
Lesson End <u>Time:</u> 5 min <u>Purpose:</u> Finish up	<u>Home Assignment</u> Ask the students to practice questions on Pg 151-Exercise 9.5 of NCERT Textbook at home.

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Worksheet-6

Skill: Problem Solving

You know the following identities:

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

Find out which identity you need to use to solve the given equations. Explain your choice.

i. $(5x + 4y)^2$

ii. $(104)^2$

iii. $(9.9)^2$

iv. $\left(\frac{5}{2}m + \frac{2}{5}n\right)\left(\frac{5}{2}m - \frac{2}{5}n\right)$