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UNDERSTANDING HOW TO SOLVE ALGEBRAIC EQUATIONS IS FUNDAMENTAL IN MATHEMATICS, ESPECIALLY WHEN DEALING WITH POLYNOMIAL EXPRESSIONS. ONE SUCH PROBLEM THAT OFTEN CHALLENGES STUDENTS IS SOLVING EQUATIONS OF THE FORM:

$$[2x(3x+5)+3(3x+5)=ax^2+bx+c]$$

IN THIS ARTICLE, WE WILL EXPLORE STEP-BY-STEP HOW TO APPROACH AND SOLVE THIS EQUATION, UNDERSTAND THE RELATIONSHIP BETWEEN THE COEFFICIENTS, AND APPLY ALGEBRAIC PRINCIPLES TO FIND THE VALUES OF (a) , (b) , AND (c) . THIS COMPREHENSIVE GUIDE IS DESIGNED TO ENHANCE YOUR ALGEBRA SKILLS AND IMPROVE YOUR PROBLEM-SOLVING TECHNIQUES.

UNDERSTANDING THE EQUATION STRUCTURE

BEFORE DIVING INTO SOLVING, IT'S CRUCIAL TO ANALYZE THE STRUCTURE OF THE GIVEN EQUATION:

$$[2x(3x+5)+3(3x+5)=ax^2+bx+c]$$

THIS EQUATION CONSISTS OF TWO TERMS ON THE LEFT SIDE, BOTH CONTAINING THE BINOMIAL $(3x + 5)$, MULTIPLIED BY DIFFERENT COEFFICIENTS:

- THE FIRST TERM: $(2x(3x + 5))$
- THE SECOND TERM: $(3(3x + 5))$

THE RIGHT SIDE IS A QUADRATIC EXPRESSION WITH UNKNOWN COEFFICIENTS (a) , (b) , AND (c) :

$$[ax^2+bx+c]$$

OUR GOAL IS TO SIMPLIFY THE LEFT SIDE AND COMPARE IT TO THE RIGHT SIDE TO IDENTIFY THE COEFFICIENTS (a) , (b) , AND (c) .

STEP-BY-STEP SOLUTION APPROACH

TO SOLVE THIS PROBLEM SYSTEMATICALLY, FOLLOW THESE STEPS:

1. EXPAND THE LEFT SIDE

START BY APPLYING THE DISTRIBUTIVE PROPERTY (ALSO CALLED DISTRIBUTION):

- FOR $(2x(3x+5))$:

$$[\begin{aligned} 2x \times 3x &= 6x^2 \\ 2x \times 5 &= 10x \end{aligned}]$$

- FOR $(3(3x+5))$:

$$\begin{aligned} & 3 \times 3x = 9x \\ & 3 \times 5 = 15 \end{aligned}$$

NOW, COMBINE THESE RESULTS:

$$6x^2 + 10x + 9x + 15$$

2. SIMPLIFY THE EXPRESSION

COMBINE LIKE TERMS:

$$6x^2 + (10x + 9x) + 15 = 6x^2 + 19x + 15$$

SO, THE LEFT SIDE SIMPLIFIES TO:

$$6x^2 + 19x + 15$$

3. SET THE SIMPLIFIED EXPRESSION EQUAL TO THE RIGHT SIDE

ACCORDING TO THE ORIGINAL EQUATION:

$$6x^2 + 19x + 15 = ax^2 + bx + c$$

SINCE THE TWO EXPRESSIONS ARE EQUAL FOR ALL VALUES OF (x) , THEIR CORRESPONDING COEFFICIENTS MUST BE EQUAL:

$$\begin{aligned} a &= 6 \\ b &= 19 \\ c &= 15 \end{aligned}$$

CONCLUSION: VALUES OF COEFFICIENTS

THE COEFFICIENTS (a) , (b) , AND (c) ARE:

$$\boxed{a=6, b=19, c=15}$$

\]

THIS MEANS THE QUADRATIC EXPRESSION ON THE RIGHT SIDE OF THE ORIGINAL EQUATION IS:

$$\begin{aligned} & \backslash[\\ & 6x^2 + 19x + 15 \\ & \backslash] \end{aligned}$$

ADDITIONAL INSIGHTS AND APPLICATIONS

UNDERSTANDING HOW TO EXPAND AND COMPARE POLYNOMIAL EXPRESSIONS IS ESSENTIAL FOR SOLVING MORE COMPLEX ALGEBRAIC PROBLEMS. LET'S EXPLORE SOME RELATED CONCEPTS AND APPLICATIONS.

1. FACTORIZATION

ONCE YOU HAVE THE QUADRATIC EXPRESSION, YOU MIGHT WANT TO FACTOR IT:

$$\begin{aligned} & \backslash[\\ & 6x^2 + 19x + 15 \\ & \backslash] \end{aligned}$$

TO FACTOR, LOOK FOR TWO NUMBERS THAT MULTIPLY TO $(6 \times 15 = 90)$ AND ADD TO 19:

- FACTORS OF 90: 1 AND 90, 2 AND 45, 3 AND 30, 5 AND 18, 6 AND 15, 9 AND 10

AMONG THESE, 9 AND 10 SUM TO 19, WHICH SUGGESTS REWRITING THE MIDDLE TERM:

$$\begin{aligned} & \backslash[\\ & 6x^2 + 9x + 10x + 15 \\ & \backslash] \end{aligned}$$

GROUP TERMS:

$$\begin{aligned} & \backslash[\\ & (6x^2 + 9x) + (10x + 15) \\ & \backslash] \end{aligned}$$

FACTOR EACH GROUP:

$$\begin{aligned} & \backslash[\\ & 3x(2x + 3) + 5(2x + 3) \\ & \backslash] \end{aligned}$$

FACTOR OUT THE COMMON BINOMIAL:

$$\begin{aligned} & \backslash[\\ & (2x + 3)(3x + 5) \\ & \backslash] \end{aligned}$$

THUS, THE QUADRATIC FACTORS AS:

$$\begin{aligned} & \backslash[\\ & (2x + 3)(3x + 5) \\ & \backslash] \end{aligned}$$

2. SOLVING FOR ROOTS

SET THE FACTORED FORM EQUAL TO ZERO:

$$\begin{aligned} & \backslash[\\ & (2x + 3)(3x + 5) = 0 \\ & \backslash] \end{aligned}$$

SOLVE EACH FACTOR:

$$\begin{aligned} & \backslash[\\ & 2x + 3 = 0 \rightarrow x = -\frac{3}{2} \\ & \backslash] \\ & \backslash[\\ & 3x + 5 = 0 \rightarrow x = -\frac{5}{3} \\ & \backslash] \end{aligned}$$

THESE ARE THE ROOTS OF THE QUADRATIC EXPRESSION.

3. REAL-WORLD APPLICATIONS

UNDERSTANDING QUADRATIC EXPRESSIONS AND THEIR COEFFICIENTS HAS PRACTICAL APPLICATIONS IN VARIOUS FIELDS:

- PHYSICS: CALCULATING PROJECTILE TRAJECTORIES
- ENGINEERING: DESIGNING PARABOLIC STRUCTURES
- ECONOMICS: MODELING PROFIT FUNCTIONS
- BIOLOGY: POPULATION GROWTH MODELS

THE ABILITY TO MANIPULATE AND INTERPRET QUADRATIC EQUATIONS IS CRUCIAL IN THESE DOMAINS.

COMMON MISTAKES TO AVOID

WHEN SOLVING SIMILAR EQUATIONS, WATCH OUT FOR THESE PITFALLS:

- INCORRECT EXPANSION: ENSURE EACH TERM IS CORRECTLY DISTRIBUTED.
- NEGLECTING LIKE TERMS: ALWAYS COMBINE LIKE TERMS AFTER EXPANSION.
- SIGN ERRORS: BE CAUTIOUS WITH POSITIVE AND NEGATIVE SIGNS DURING EXPANSION AND SOLVING.
- ASSUMING COEFFICIENTS ARE ZERO: REMEMBER THAT COEFFICIENTS $\backslash(a\backslash)$, $\backslash(b\backslash)$, AND $\backslash(c\backslash)$ ARE VARIABLES TO BE DETERMINED, NOT ASSUMED TO BE ZERO UNLESS INDICATED.

PRACTICE PROBLEMS

TO REINFORCE YOUR UNDERSTANDING, TRY SOLVING THESE RELATED PROBLEMS:

1. SIMPLIFY AND FIND THE COEFFICIENTS: $\backslash(4x(2x + 3) + 5(2x + 3) = ax^2 + bx + c\backslash)$
2. FACTOR THE QUADRATIC EXPRESSION: $\backslash(3x^2 + 7x + 2\backslash)$
3. SOLVE FOR $\backslash(x\backslash)$: $\backslash((x + 4)(x - 2) = 0\backslash)$

SUMMARY

IN SUMMARY, SOLVING THE EQUATION $(2x(3x+5)+3(3x+5)=ax^2 + bx + c)$ INVOLVES:

- EXPANDING THE LEFT SIDE USING DISTRIBUTIVE PROPERTY
- COMBINING LIKE TERMS
- RECOGNIZING THE QUADRATIC FORM
- EQUATING COEFFICIENTS TO DETERMINE (a) , (b) , AND (c)

BY MASTERING THESE STEPS, YOU ARE BETTER EQUIPPED TO HANDLE SIMILAR ALGEBRAIC PROBLEMS, ENHANCE YOUR PROBLEM-SOLVING SKILLS, AND UNDERSTAND THE UNDERLYING STRUCTURE OF POLYNOMIAL EXPRESSIONS.

FINAL THOUGHTS

ALGEBRA FORMS THE FOUNDATION OF HIGHER MATHEMATICS AND NUMEROUS SCIENTIFIC DISCIPLINES. THE PROCESS OF EXPANDING, SIMPLIFYING, AND COMPARING POLYNOMIAL EXPRESSIONS IS A VITAL SKILL. WITH PRACTICE AND ATTENTION TO DETAIL, SOLVING EQUATIONS LIKE THIS BECOMES INTUITIVE, PAVING THE WAY FOR TACKLING MORE ADVANCED TOPICS SUCH AS QUADRATIC FUNCTIONS, POLYNOMIALS, AND CALCULUS.

REMEMBER, THE KEY TO SUCCESS IN ALGEBRA IS PRACTICE, UNDERSTANDING EACH STEP, AND APPLYING THE CONCEPTS SYSTEMATICALLY. KEEP PRACTICING SIMILAR PROBLEMS, AND YOU'LL DEVELOP CONFIDENCE IN SOLVING COMPLEX ALGEBRAIC EQUATIONS WITH EASE.

FREQUENTLY ASKED QUESTIONS

HOW DO I EXPAND THE EXPRESSION $2x(3x+5) + 3(3x+5)$ BEFORE SOLVING FOR A, B, AND C?

FIRST, DISTRIBUTE $2x$ OVER $(3x+5)$: $2x \cdot 3x = 6x^2$ AND $2x \cdot 5 = 10x$. THEN DISTRIBUTE 3 OVER $(3x+5)$: $3 \cdot 3x = 9x$ AND $3 \cdot 5 = 15$. COMBINE LIKE TERMS TO GET $6x^2 + (10x + 9x) + 15 = 6x^2 + 19x + 15$.

WHAT IS THE GENERAL FORM OF THE QUADRATIC EXPRESSION OBTAINED AFTER EXPANDING $2x(3x+5) + 3(3x+5)$?

THE EXPANDED FORM IS A QUADRATIC IN STANDARD FORM: $6x^2 + 19x + 15$.

HOW CAN I IDENTIFY THE COEFFICIENTS A, B, AND C FROM THE EXPRESSION $6x^2 + 19x + 15$?

IN THE QUADRATIC EXPRESSION $6x^2 + 19x + 15$, THE COEFFICIENT A IS 6, B IS 19, AND C IS 15.

IS THE EXPRESSION $2x(3x+5) + 3(3x+5)$ ALWAYS EQUAL TO $6x^2 + 19x + 15$?

YES, WHEN YOU EXPAND AND SIMPLIFY $2x(3x+5) + 3(3x+5)$, THE RESULT IS ALWAYS $6x^2 + 19x + 15$.

HOW CAN I VERIFY MY COEFFICIENTS A, B, AND C AFTER EXPANDING THE EXPRESSION?

YOU CAN VERIFY BY EXPANDING THE EXPRESSION STEP-BY-STEP AND COMPARING THE RESULTING COEFFICIENTS OF x^2 , x , AND THE CONSTANT TERM TO IDENTIFY A, B, AND C.

WHAT IS THE IMPORTANCE OF UNDERSTANDING THE EXPANSION IN SOLVING FOR A, B, AND C?

UNDERSTANDING EXPANSION HELPS YOU CORRECTLY IDENTIFY THE COEFFICIENTS IN THE QUADRATIC FORM, WHICH IS ESSENTIAL FOR SOLVING EQUATIONS, GRAPHING, OR APPLYING QUADRATIC FORMULAS.

CAN I FACTOR THE QUADRATIC $6x^2 + 19x + 15$ EASILY?

FACTORING $6x^2 + 19x + 15$ CAN BE CHALLENGING; IT MIGHT BE EASIER TO USE THE QUADRATIC FORMULA TO FIND ROOTS OR VERIFY FACTORS, AS IT DOES NOT FACTOR NEATLY INTO SIMPLE BINOMIALS.

HOW DOES UNDERSTANDING THIS EXPANSION HELP IN SOLVING QUADRATIC EQUATIONS IN GENERAL?

RECOGNIZING HOW TO EXPAND AND IDENTIFY COEFFICIENTS ALLOWS YOU TO SET UP AND SOLVE QUADRATIC EQUATIONS ACCURATELY, WHETHER BY FACTORING, COMPLETING THE SQUARE, OR USING THE QUADRATIC FORMULA.

ADDITIONAL RESOURCES

QUADRATIC EQUATIONS: UNLOCKING THE SECRETS OF ALGEBRAIC EXPRESSIONS

MATHEMATICS, OFTEN DUBBED THE LANGUAGE OF THE UNIVERSE, OFFERS A PLETHORA OF CHALLENGES AND BEAUTIES. AMONG THESE, QUADRATIC EQUATIONS STAND OUT AS FUNDAMENTAL YET INTRIGUING CONSTRUCTS THAT UNDERPIN VARIOUS FIELDS—FROM ENGINEERING TO ECONOMICS, PHYSICS TO COMPUTER SCIENCE. TODAY, WE DELVE INTO A CLASSIC ALGEBRAIC PROBLEM: SOLVE $2x(3x+5) + 3(3x+5) = ax^2 + bx + c$. THIS PROBLEM NOT ONLY EXEMPLIFIES ESSENTIAL ALGEBRAIC TECHNIQUES BUT ALSO UNDERSCORES THE IMPORTANCE OF UNDERSTANDING HOW TO MANIPULATE EXPRESSIONS TO REVEAL HIDDEN RELATIONSHIPS.

UNDERSTANDING THE PROBLEM: BREAKING DOWN THE EQUATION

BEFORE DIVING INTO THE SOLUTION, IT'S CRUCIAL TO INTERPRET THE GIVEN EXPRESSION PROPERLY:

EXPRESSION:

$$2x(3x + 5) + 3(3x + 5) = ax^2 + bx + c$$

THIS EXPRESSION INVOLVES TWO PARTS ON THE LEFT:

- THE PRODUCT OF $2x$ AND $(3x + 5)$
- THE PRODUCT OF 3 AND $(3x + 5)$

ON THE RIGHT, WE HAVE A QUADRATIC POLYNOMIAL WITH COEFFICIENTS A , B , AND C , WHICH ARE TO BE DETERMINED.

STEP 1: EXPAND THE LEFT SIDE

THE INITIAL STEP IN SOLVING SUCH AN EQUATION IS TO EXPAND THE EXPRESSIONS ON THE LEFT TO EXPRESS EVERYTHING AS A POLYNOMIAL IN TERMS OF x .

1. EXPAND $2x(3x + 5)$

USING THE DISTRIBUTIVE PROPERTY:

$$2x \cdot 3x + 2x \cdot 5 = 6x^2 + 10x$$

2. EXPAND $3(3x + 5)$

SIMILARLY:

$$3 \cdot 3x + 3 \cdot 5 = 9x + 15$$

3. COMBINE THE EXPANDED PARTS

ADDING THESE TOGETHER:

$$(6x^2 + 10x) + (9x + 15) = 6x^2 + (10x + 9x) + 15 = 6x^2 + 19x + 15$$

RESULT OF EXPANSION:

$$6x^2 + 19x + 15$$

STEP 2: EXPRESS THE RIGHT SIDE

THE RIGHT SIDE OF THE EQUATION IS ALREADY IN POLYNOMIAL FORM:

$$Ax^2 + Bx + C$$

OUR GOAL IS TO MATCH THIS EXPRESSION WITH THE SIMPLIFIED LEFT SIDE:

$$6x^2 + 19x + 15$$

STEP 3: EQUATE COEFFICIENTS AND FIND A, B, C

SINCE THE TWO SIDES ARE EQUAL FOR ALL VALUES OF x , THEIR CORRESPONDING COEFFICIENTS MUST BE EQUAL. THIS GIVES US A SYSTEM OF EQUATIONS:

COEFFICIENT	EXPRESSION	VALUES
QUADRATIC TERM	A	6 (FROM LEFT SIDE)
LINEAR TERM	B	19 (FROM LEFT SIDE)
CONSTANT TERM	C	15 (FROM LEFT SIDE)

THEREFORE, DIRECTLY:

- $A = 6$
- $B = 19$
- $C = 15$

INTERPRETING THE RESULTS: THE ROLE OF COEFFICIENTS

THIS STRAIGHTFORWARD MATCHING REVEALS NOT ONLY THE SPECIFIC VALUES OF A, B, AND C BUT ALSO DEMONSTRATES A POWERFUL TECHNIQUE IN ALGEBRA: COMPARING COEFFICIENTS. THIS METHOD IS FUNDAMENTAL WHEN DEALING WITH POLYNOMIAL IDENTITIES, SIMPLIFYING EXPRESSIONS, OR SOLVING FOR UNKNOWN IN EQUATIONS.

DEEPER INSIGHTS: WHY IS THIS IMPORTANT?

UNDERSTANDING HOW TO EXPAND, SIMPLIFY, AND COMPARE COEFFICIENTS IN ALGEBRAIC EXPRESSIONS IS ESSENTIAL FOR SEVERAL REASONS:

- FOUNDATION FOR ADVANCED MATHEMATICS: MASTERY OF THESE TECHNIQUES PAVES THE WAY FOR CALCULUS, LINEAR ALGEBRA, AND DIFFERENTIAL EQUATIONS.
- PROBLEM SOLVING SKILLS: THEY HELP IN SOLVING REAL-WORLD PROBLEMS INVOLVING QUADRATIC RELATIONSHIPS, SUCH AS PROJECTILE MOTION, PROFIT MAXIMIZATION, AND AREA OPTIMIZATION.
- ANALYTICAL REASONING: COMPARING COEFFICIENTS FOSTERS AN ANALYTICAL APPROACH—BREAKING COMPLEX PROBLEMS INTO MANAGEABLE PARTS.

PRACTICAL APPLICATIONS OF QUADRATIC EQUATIONS

QUADRATIC EQUATIONS APPEAR ACROSS VARIOUS FIELDS. LET'S EXPLORE SOME REAL-WORLD SCENARIOS WHERE UNDERSTANDING SUCH EXPRESSIONS IS VITAL:

1. PHYSICS AND ENGINEERING

PROJECTILE MOTION, WHERE THE HEIGHT OF AN OBJECT OVER TIME IS MODELED BY QUADRATIC FUNCTIONS, RELIES ON UNDERSTANDING COEFFICIENTS SIMILAR TO A, B, AND C.

2. ECONOMICS AND BUSINESS

PROFIT FUNCTIONS OFTEN INVOLVE QUADRATIC EXPRESSIONS, ESPECIALLY WHEN CONSIDERING DIMINISHING RETURNS OR MAXIMIZING REVENUE.

3. COMPUTER GRAPHICS

QUADRATIC EQUATIONS ARE USED IN RENDERING CURVES, PARABOLAS, AND IN ALGORITHMS INVOLVING QUADRATIC PROGRAMMING.

4. BIOLOGY AND MEDICINE

POPULATION MODELS MAY EMPLOY QUADRATIC EQUATIONS TO PREDICT GROWTH LIMITS AND SATURATION POINTS.

EXTENDING THE CONCEPT: FROM SPECIFIC TO GENERAL

WHILE OUR SPECIFIC PROBLEM YIELDED A STRAIGHTFORWARD SOLUTION, THE APPROACH CAN BE GENERALIZED:

- GIVEN AN EXPRESSION OF THE FORM:
 $(k_1)(x)(\text{EXPRESSION}) + (k_2)(\text{EXPRESSION}) = \text{QUADRATIC POLYNOMIAL}$

- METHODOLOGY:

1. EXPAND ALL PARTS TO STANDARD POLYNOMIAL FORM.
2. EQUATE COEFFICIENTS OF CORRESPONDING POWERS OF X.
3. SOLVE THE RESULTING SYSTEM FOR UNKNOWN COEFFICIENTS.

THIS PROCESS IS A CORNERSTONE TECHNIQUE IN ALGEBRA, ENABLING STUDENTS AND PROFESSIONALS TO MANIPULATE AND INTERPRET POLYNOMIAL EXPRESSIONS EFFECTIVELY.

COMMON MISTAKES AND HOW TO AVOID THEM

AS WITH ANY MATHEMATICAL TECHNIQUE, PITFALLS EXIST. HERE ARE SOME COMMON ERRORS AND TIPS TO PREVENT THEM:

- INCORRECT EXPANSION: ENSURE TO DISTRIBUTE EACH TERM PROPERLY; DOUBLE-CHECK SIGNS AND COEFFICIENTS.
- IGNORING LIKE TERMS: ALWAYS COMBINE LIKE TERMS AFTER EXPANSION FOR CLARITY.
- MISALIGNING COEFFICIENTS: REMEMBER THAT EACH POWER OF X MUST BE MATCHED PRECISELY.
- ASSUMING COEFFICIENTS ARE EQUAL WITHOUT PROOF: ONLY EQUATE COEFFICIENTS AFTER THE EXPANSION, NOT BEFORE.

CONCLUSION: MASTERY AND BEYOND

THE PROCESS OF SOLVING $2x(3x+5) + 3(3x+5) = ax^2 + bx + c$ EXEMPLIFIES FUNDAMENTAL ALGEBRAIC PRINCIPLES: EXPANSION, SIMPLIFICATION, AND COMPARISON. MASTERING THESE TECHNIQUES ENHANCES PROBLEM-SOLVING AGILITY, BUILDS A SOLID FOUNDATION FOR ADVANCED MATHEMATICS, AND UNLOCKS THE ABILITY TO INTERPRET COMPLEX EXPRESSIONS ACROSS VARIOUS DISCIPLINES.

BY UNDERSTANDING HOW TO SYSTEMATICALLY BREAK DOWN AND ANALYZE ALGEBRAIC EXPRESSIONS, STUDENTS AND PROFESSIONALS ALIKE CAN APPROACH SIMILAR PROBLEMS WITH CONFIDENCE AND PRECISION. THE ELEGANCE OF QUADRATIC EXPRESSIONS LIES NOT JUST IN THEIR MATHEMATICAL FORM BUT IN THEIR UBIQUITY AND UTILITY—TOOLS THAT, ONCE MASTERED, OPEN DOORS TO COUNTLESS APPLICATIONS IN SCIENCE, ENGINEERING, ECONOMICS, AND BEYOND.

IN ESSENCE, MASTERING THE ART OF POLYNOMIAL COMPARISON AND EXPANSION IS AKIN TO WIELDING A VERSATILE TOOL—PRECISE, POWERFUL, AND ESSENTIAL FOR EVERY MATHEMATICIAN'S TOOLKIT.

[Solve 2x 3x 5 3 3x 5 Ax 2 Bx C](#)

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