- Arithmetic Expressions
- Comparing Expressions
- Brackets in Expressions
- Terms in Expressions
- Swapping and Grouping
- Removing Brackets

Arithmetic Expressions

Arithmetic expressions are mathematical phrases involving numbers and operations such as addition, subtraction, multiplication, and division. They represent calculations that yield a value. For example, the expression $13 + 5$ represents the sum of 13 and 5.

Formula Derivation

Expressions can be formed by combining numbers and operations. For example, the total amount spent by Mallika on lunch for 5 days, spending ₹25 each day, is expressed as:

$$25 \times 5$$

Evaluating this gives:

$$25 \times 5 = 125$$

Worked Illustration

Example: Mallika spends ₹25 every day for lunch from Monday to Friday. Write the expression for the total amount spent and find its value.

Solution: Number of days = 5

Expression: 25×5

Value: 125

Practice Set

- **Level 1 – Easy:** Write an expression for the total cost if a book costs ₹40 and you buy 3 books.
- **Level 2 – Moderate:** If a pen costs ₹12 and a notebook costs ₹25, write an expression for the total cost of 4 pens and 2 notebooks.
- **Level 3 – Challenging:** A shopkeeper sells 5 packets of sugar, each weighing 2 kg, and 3 packets of rice, each weighing 4 kg. Write an expression for the total weight of sugar and rice.

Answer Key

- Level 1: $40 \times 3 = 120$
- Level 2: $4 \times 12 + 2 \times 25 = 48 + 50 = 98$
- Level 3: $5 \times 2 + 3 \times 4 = 10 + 12 = 22$ kg

Quick Reference

- Arithmetic expressions combine numbers and operations.

- Use multiplication for repeated addition.
- Evaluate expressions step-by-step.

Glossary

- **Expression:** A mathematical phrase combining numbers and operations.
- **Term:** Parts of an expression separated by + or - signs.
- **Value:** The result obtained after evaluating an expression.

Comparing Expressions

Expressions can be compared using relational signs such as '=', '<', and '>'. To compare, evaluate each expression and then compare their values.

Formula Derivation

Given two expressions E_1 and E_2, compare their values V_1 and V_2:

If $V_1 = V_2$, then $E_1 = E_2$.

If $V_1 > V_2$, then $E_1 > E_2$.

If $V_1 < V_2$, then $E_1 < E_2$.

Worked Illustration

Example: Compare $1023 + 125$ and $1022 + 128$.

Solution:

Evaluate each:

$$1023 + 125 = 1148$$

$$1022 + 128 = 1150$$

Since $1148 < 1150$, we conclude:

$$1023 + 125 < 1022 + 128$$

Practice Set

- **Level 1 – Easy:** Which is greater: $15 + 10$ or $20 + 4$?
- **Level 2 – Moderate:** Compare $50 - 15$ and $40 + 5$.
- **Level 3 – Challenging:** Compare $3 \times 7 + 4$ and $2 \times 10 + 9$.

Answer Key

- Level 1: $15 + 10 = 25$, $20 + 4 = 24$, so $15 + 10 > 20 + 4$.
- Level 2: $50 - 15 = 35$, $40 + 5 = 45$, so $50 - 15 < 40 + 5$.
- Level 3: $3 \times 7 + 4 = 21 + 4 = 25$, $2 \times 10 + 9 = 20 + 9 = 29$, so $3 \times 7 + 4 < 2 \times 10 + 9$.

Quick Reference

- Evaluate expressions fully before comparing.
- Use relational signs to express comparison.

Glossary

- **Relational Signs:** Symbols '=', '<', '>' used to compare values.
- **Evaluate:** Calculate the value of an expression.

Brackets in Expressions

Brackets are used to group parts of an expression to indicate the order in which operations should be performed. The order of operations is governed by the BODMAS rule:

- Brackets
- Orders (powers and roots)
- Division
- Multiplication
- Addition
- Subtraction

Operations inside brackets are performed first, regardless of their type.

Formula Derivation

For an expression $a + (b + c)$, evaluate inside the brackets first:

$$a + (b + c) = a + d \quad \text{where} \quad d = b + c$$

Similarly, for $a - (b + c)$, removing brackets preceded by a minus sign changes the signs inside:

$$a - (b + c) = a - b - c$$

Worked Illustration

Example: Evaluate $100 - (25 + 61)$.

Solution:

First, evaluate inside the brackets:

$$25 + 61 = 86$$

Then subtract:

$$100 - 86 = 14$$

Practice Set

- **Level 1 – Easy:** Evaluate $50 + (20 - 5)$.
- **Level 2 – Moderate:** Simplify $80 - (30 + 10)$.
- **Level 3 – Challenging:** Simplify $150 - (40 - 20 + 10)$.

Answer Key

- Level 1: $20 - 5 = 15$, so $50 + 15 = 65$.
- Level 2: $30 + 10 = 40$, so $80 - 40 = 40$.
- Level 3: Inside brackets: $40 - 20 + 10 = 30$, so $150 - 30 = 120$.

Quick Reference

- Always evaluate expressions inside brackets first.
- When removing brackets preceded by a minus sign, change the signs of terms inside.
- Follow BODMAS for order of operations.

Glossary

- **Brackets:** Symbols used to group parts of an expression.
- **BODMAS:** Order of operations rule.
- **Order of Operations:** The sequence in which operations are performed.

Terms in Expressions

Terms are parts of an expression separated by '+' or '-' signs. Subtraction can be expressed as addition of the inverse (negative) of a number.

Formula Derivation

For example, $83 - 14$ can be written as:

$$83 + (-14)$$

Thus, the terms are 83 and -14.

Worked Illustration

Example: Identify the terms in the expression $4 + 3 - 2$.

Solution: The terms are 4, 3, and -2.

Practice Set

- **Level 1 – Easy:** Identify terms in $7 + 5 - 3$.
- **Level 2 – Moderate:** Express $10 - 6 + 2$ as sum of terms.
- **Level 3 – Challenging:** Write terms for $15 - (4 + 3)$ after removing brackets.

Answer Key

- Level 1: Terms are 7, 5, and -3.
- Level 2: $10 - 6 + 2 = 10 + (-6) + 2$, terms are 10, -6, and 2.
- Level 3: $15 - (4 + 3) = 15 - 4 - 3 = 15 + (-4) + (-3)$, terms are 15, -4, and -3.

Quick Reference

- Terms are separated by '+' or '-' signs.
- Subtraction is addition of negative terms.

Glossary

- **Term:** A single number or variable in an expression.
- **Inverse:** The number with opposite sign.

Swapping and Grouping

Swapping refers to changing the order of terms in addition, which does not change the sum due to the commutative property. Grouping refers to changing the grouping of terms using brackets, which does not change the sum due to the associative property.

Formula Derivation

Commutative Property:

$$a + b = b + a$$

Associative Property:

$$(a + b) + c = a + (b + c)$$

Worked Illustration

Example: Simplify $3 + (-7) + 4$ by swapping and grouping.

Solution:

Swapping terms:

$$3 + (-7) + 4 = 3 + 4 + (-7)$$

Grouping terms:

$$(3 + 4) + (-7) = 7 + (-7) = 0$$

Or

$$3 + (4 + (-7)) = 3 + (-3) = 0$$

Practice Set

- **Level 1 – Easy:** Show that $5 + 3 = 3 + 5$.
- **Level 2 – Moderate:** Simplify $(2 + 6) + 4$ and $2 + (6 + 4)$.
- **Level 3 – Challenging:** Simplify $7 + (-2) + (-5)$ by grouping.

Answer Key

- Level 1: $5 + 3 = 8$, $3 + 5 = 8$, so equal.
- Level 2: $(2 + 6) + 4 = 8 + 4 = 12$, $2 + (6 + 4) = 2 + 10 = 12$.
- Level 3: Grouping $(7 + (-2)) + (-5) = 5 + (-5) = 0$.

Quick Reference

- Swapping terms does not change the sum (commutative property).
- Grouping terms differently does not change the sum (associative property).

Glossary

- **Commutative Property:** Changing order of addition does not change the sum.
- **Associative Property:** Changing grouping of addition does not change the sum.
- **Swapping:** Changing the order of terms.
- **Grouping:** Changing the way terms are grouped using brackets.

Removing Brackets

When removing brackets in expressions, the signs of the terms inside the brackets may change depending on the sign preceding the brackets.

Formula Derivation

(i) If brackets are preceded by a minus sign, change the signs of the terms inside when removing the brackets:

$$a - (b + c) = a - b - c$$

(ii) If brackets are preceded by a plus sign or no sign, the signs inside remain the same:

$$a + (b - c) = a + b - c$$

Worked Illustration

Example: Simplify $200 - (40 + 3)$.

Solution:

Removing brackets preceded by minus sign changes signs inside:

$$200 - 40 - 3 = 157$$

Practice Set

- **Level 1 – Easy:** Simplify $100 - (20 + 5)$.
- **Level 2 – Moderate:** Simplify $150 + (30 - 10)$.
- **Level 3 – Challenging:** Simplify $250 - (50 - 20 + 10)$.

Answer Key

- Level 1: $100 - 20 - 5 = 75$.
- Level 2: $150 + 30 - 10 = 170$.
- Level 3: Inside brackets: $50 - 20 + 10 = 40$, so $250 - 40 = 210$.

Quick Reference

- Remove brackets carefully considering the sign before them.
- Minus before brackets changes signs inside.
- Plus before brackets keeps signs unchanged.

Glossary

- **Removing Brackets:** Eliminating brackets by adjusting signs of terms inside.
- **Preceding Sign:** The sign immediately before the bracket.