SECTION 2

NUMBER AND OPERATIONS ON NUMBER

NUMBERS FOR EVERYDAY LIFE

Number Operations

INTRODUCTION

In this section, you will improve your problem-solving skills by working on multi-step word problems that involve the four basic operations: addition, subtraction, multiplication and division. Through the use of mental strategies, you will learn to deal with complex situations with confidence and efficiency, skills that are essential in everyday tasks such as managing time, managing your money and planning. Additionally, you will explore the use of positive and negative numbers in real-life situations, such as tracking temperature changes, managing bank accounts, etc. By performing operations on integers, you will understand how numbers interact in different ways, helping you make sense of situations where gains and losses occur. These concepts are important for developing critical thinking and mathematical reasoning, equipping you with the ability to approach real-world problems with confidence.

In this section, you will learn to;

1. Solve multi-step word problems involving the four basic operations using mental strategies.
2. Describe real-life situations using positive and negative numbers including operations on integers
3. Model and represent given fractions, naming fractions, representing quantities as a fraction

MENTAL MATHEMATICS STRATEGIES

Operation Of Numbers Up To 100 000 Using Mental Strategies

Mental strategies for addition and subtraction of large numbers (up to 100 000) involve breaking down the numbers into more manageable parts. Before we begin, let's have fun with this reinforcement activity!

Reinforcement Activities

Number Warm-Up

Objective: This activity will help you warm up your mental maths skills and get ready for learning how to perform operations on numbers up to 10 000.

Instructions:

Counting Challenge:

- Start by counting aloud in tens from 10 up to 100. For example, 10, 20, 30, etc.
- Now, try counting backwards in tens from 100 down to 10.

Quick Addition and Subtraction:

- I will say two numbers, and your task is to add or subtract them mentally as quickly as you can.
- Example:
  - "What is 45 + 36?"
  - "What is 72 - 28?"

Multiplication Drill:

- We will now do a multiplication drill with numbers under 100.
- I will give you two numbers to multiply mentally. Try to get the answer quickly!
- Example:
  - "What is 8 x 9?"
  - "What is 7 x 6?"

Rounding Practice:

- Let's practice rounding numbers to the nearest 10 or 100.
- Example:
  - "Round 57 to the nearest 10."
  - "Round 135 to the nearest 100."

Estimation Game:

- Imagine you have 67 apples and you give away 32. Without calculating exactly, estimate how many apples you have left.
- We'll share our estimates and discuss how close they are to the actual answer.

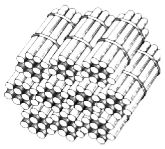
Addition Strategies

1. Using structured materials

Example 2.1:

Find the sum of 246 and 153.

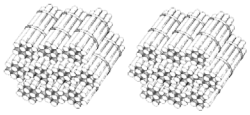
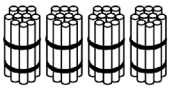
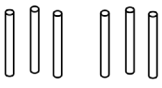
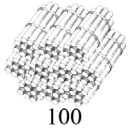
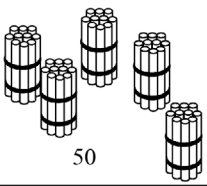
Solution



100

10

1

	Hundreds	Tens	Ones
	 200	 40	 6
+	 100	 50	 3
=	**300**	**90**	**9**

Adding all, we get 300 + 90 + 9 = **399**

2. Using the number line

Example 2.2

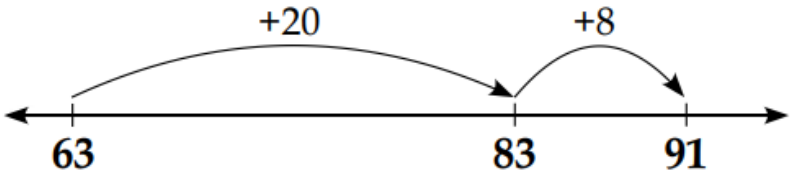
Add 63 and 28

Solution

Break the numbers up and add the parts in the order that works best for you.

63 + 20 = 83

83 8 = 91

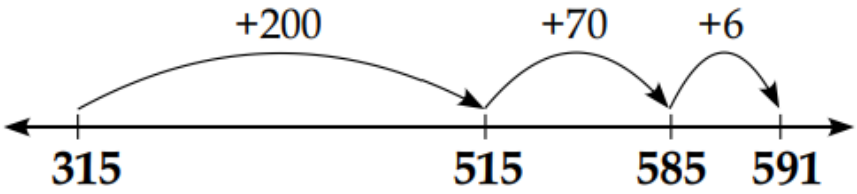


Example 2.3

Add 315 and 276

Solution

315 + 200 + 70 + 6 = 591



1. Column Addition

To add numbers with more than one digit, it is often easier to write the numbers vertically in columns.

Example 2.4

Find each sum:

1. 25 +4
2. 532 +25
3. 1446 +231

Solution

Start by adding the units column and then move on to the tens etc.

In number 1, we have 6 + 5 = 11. This is 10 + 1, so we have 1 in the units and we carry the 10 to the tens column.

1. Add	**2.** Add	**3.** Add
$2\ ^{+1}\ 5$	5 3 2	1 4 4 6
+ 6	+ 2 5	+ 2 3 1
3 1	**5 5 7**	**1 6 7 7**

4. Breaking Down into Place Values:

Example 2.5:

Add 47 653 and 23 457.

Solution

Break down each number by place value:

47 653 = 40 000 + 7 000 + 600 + 50 + 3

23 457 = 20 000 + 3 000 + 400 + 50 + 7

Add corresponding place values:

40 000 + 20 000 = 60 000

7 000 + 3 000 = 10 000

600 + 400 = 1 000

50 + 50 = 100

3 + 7 = 10

Combine the results:

60 000 + 10 000 + 1 000 + 100 + 10 = **71,110**

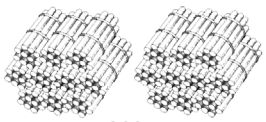
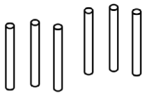
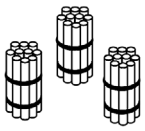
Subtraction Strategies

1. Using structured materials

Example 2.6:

Solve 246 -133.

Solution

	Hundreds	Tens	Ones
	 200	 40	 6
—	 100	 30	 3
=	**100**	**10**	**3**

Adding all, we get 100 + 10 + 3 = **113**

2. Using Number line

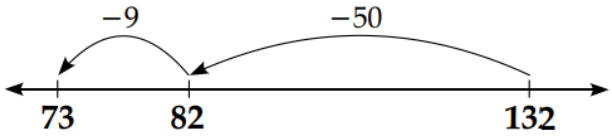
Example 2.7:

Subtract 59 from 132

Solution

132 - 50 = 82

82 - 9 = 73



3. Column Subtraction

To subtract numbers with more than one digit, it is often easier to write the numbers vertically in columns.

Example 2.8

Find:

1. 26 – 9
2. 537 – 25
3. 1446 – 231

Solution

Start by subtracting the units and then move on to the tens etc.

In number 1 we cannot take 8 from 6, so we must 'borrow' 10 from the tens column to achieve this.

1. Subtract $2^{1\,1}\,6$ $-\,9$ **1 7**	**2.** Subtract 5 3 7 $-\,2\,5$ **5 1 2**	**3.** Subtract 1 4 4 6 $-\,2\,3\,1$ **1 2 1 5**

3. Breaking Down into Place Values:

Example 2.9:

Subtract 12 345 from 78 654.

Solution

Break down each number by place value:

78 654 = 70 000 + 8 000 + 600 + 50 + 4

12 345 = 10 000 + 2 000 + 300 + 40 + 5

Subtract corresponding place values:

70 000 – 10 000 = 60 000

8 000 – 2 000 = 6 000

600 - 300 = 300

50 - 40 = 10

4 - 5 = –1 (borrow from 10s place, so we have 10 -1= 9 in the next step)

Combine the results:

60 000 + 6 000 + 300 + 10 - 1 = 66 309

Activity 2.1: Exploring Addition and Subtraction Strategies

Purpose: In this activity, you will explore different strategies to solve addition and subtraction problems. You will work in groups to practise each strategy, understand how it works, and solve problems using that strategy.

Materials Needed:

- Bundles of straws or sticks (bundled into 10s and 100s)
- Number lines (printed or drawn on paper)
- Grid paper for column addition
- Place value charts
- Pencils and erasers

Instructions:

1. Using Structured Materials (Bundles of 10s and 100s)

Task 1:

- Work in groups to add or subtract using bundles of straws or sticks.
- Example Problem: "You have 4 bundles of 10 straws and 36 single straws. How many straws do you have altogether? Add another 24 straws to your total."
- Use the bundles to represent tens and the single straws for ones. Add or subtract the quantities and record your answer.

Task 2:

- Subtract using bundles.
- Example Problem: "You have 82 straws. You give away 3 bundles of 10 straws and 8 single straws. How many straws are left?"

2. Using the Number Line

Task 3:

- Use a number line to solve addition and subtraction problems.
- Example Problem: "Starting at 45 on the number line, add 28. Where do you land?"
- Draw the jumps on the number line to show your work.

Task 4:

- Subtract using the number line.
- Example Problem: "Start at 92 on the number line and subtract 36. Where do you land?"

3. Using Column Addition

Task 5:

- Practise adding numbers using column addition.
- Example Problem: "Add 365 and 478 using the column method."

- Line up the numbers by their place value (ones, tens, hundreds) and add them column by column.

Remember to carry over any extra values.

Task 6:

- Subtract using column subtraction.
- Example Problem: "Subtract 253 from 682 using the column method."

Remember to borrow from the column to the left if you do not have enough to subtract.

4. Breaking Down into Place Value

Task 7:

- Break down the numbers by their place values to add or subtract.
- Example Problem: "Add 456 and 234 by breaking them into hundreds, tens, and ones."
- Write the addition as: (400 + 200) + (50 + 30) + (6 + 4) and solve step by step.

Task 8:

- Subtract using place value breakdown.
- Example Problem: "Subtract 125 from 389 by breaking them into hundreds, tens, and ones."

5. Reflection:

After completing the tasks, discuss in your groups which strategy you found most helpful for each problem type. Share your answers and strategies with the class.

MULTIPLICATION AND DIVISION STRATEGIES

Multiplication using the vertical method

Example 2.10

$$\begin{array}{r} 635 \\ \times \quad 4 \\ \hline \end{array}$$

Solution

$600 \times 4 = 2\,400$

$30 \times 4 = 120$

$5 \times 4 = 20$

$2\,400 + 120 + 12 = 2\,540$

Example 2.11

$$\begin{array}{r} 6000 \\ \times \quad 30 \\ \hline \end{array}$$

Solution

$6\,000 \times 30 = (6 \times 1\,000) \times (3 \times 10)$

$= 6 \times 3 \times 1000 \times 10$

$= 18 \times 10\,000 = 180\,000$

Note

Annexing zeros and working with powers of ten/cutting and pasting zeros can simplify a calculation.

In multiplication and division, annexing zeros allows for quick mental computation of whole numbers that are multiples of powers of ten.

Annexing zeros for multiplication:

1. Cut all the trailing zeros for numbers being multiplied.
2. Multiply the remaining numbers.
3. Paste all the zeros back.

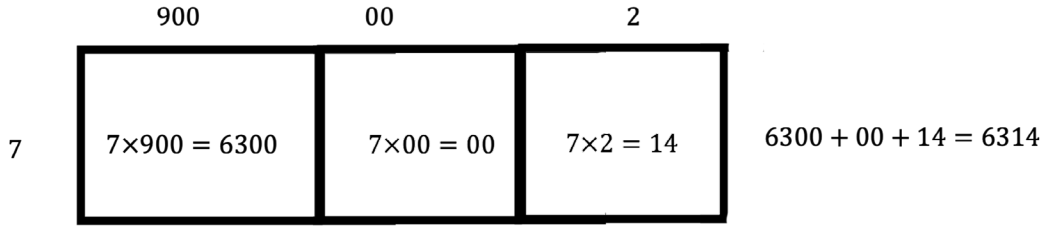
Multiplication using the expand and box method

Example 2.12

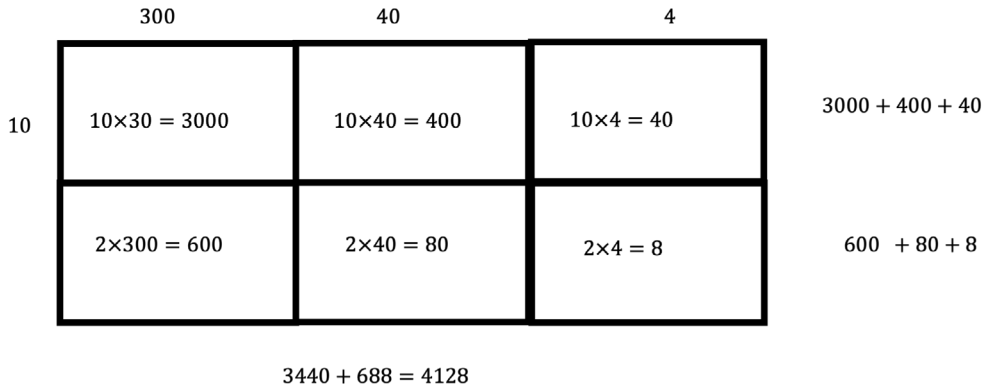
1. Multiply 902 by 7
2. Multiply 76 by 34
3. Multiply 12 by 344

Solution

1.

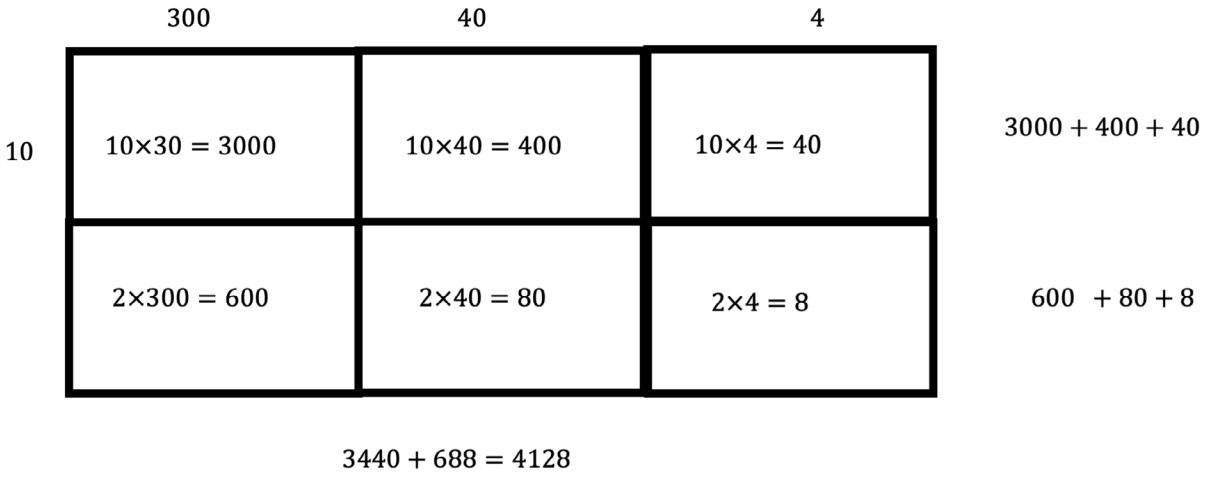


2.



Therefore, 76 × 34 = 2 584.

3.



Therefore, $12 \times 344 = 4128$

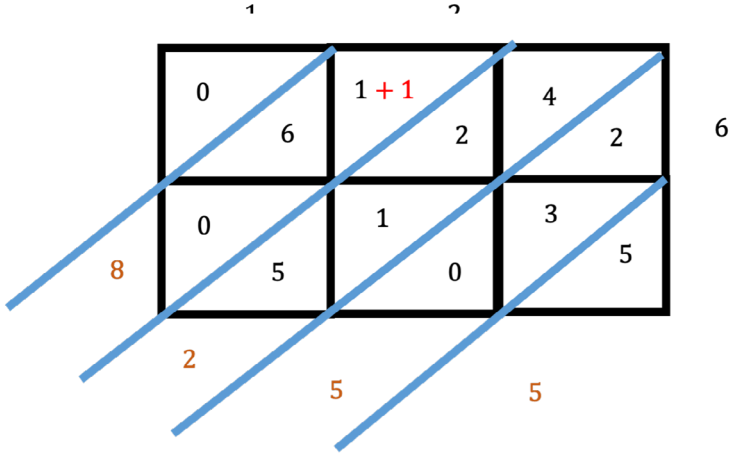
Multiplication using the lattice method

Here's how to multiply 127 by 65 using the lattice method:

Step-by-Step Solution:

1. **Set Up the Grid**:
   - Draw a grid with 3 columns (since 127 has 3 digits) and 2 rows (since 65 has 2 digits).
   - Write the digits of 127 across the top of the grid.
   - Write the digits of 65 along the right side of the grid.
2. **Draw Diagonals**:
   - Draw diagonal lines from the top right to the bottom left of each cell in the grid, extending outside the grid.
3. **Fill in the Products**:
   - Multiply each digit of 127 by each digit of 65, and write the products in the corresponding cells, with the tens digit above the diagonal and the ones digit below the diagonal.
4. **Sum Along the Diagonals**:
   - Add the numbers along each diagonal, starting from the bottom right.
5. **Write the Final Answer**:
   - Read the sum of the diagonals from left to right to get the final product.

$\therefore 127 \times 65$ using the lattice grid method



Set up the grid and fill in the Products:

- Multiply 6 by 1, 2, and 7:
  - $6 \times 1 = 06$
  - $6 \times 2 = 12$
  - $6 \times 7 = 42$
- Multiply 5 by 1, 2, and 7:
  - $5 \times 1 = 05$
  - $5 \times 2 = 10$
  - $5 \times 7 = 35$

Sum Along the Diagonals

Starting from the bottom right:

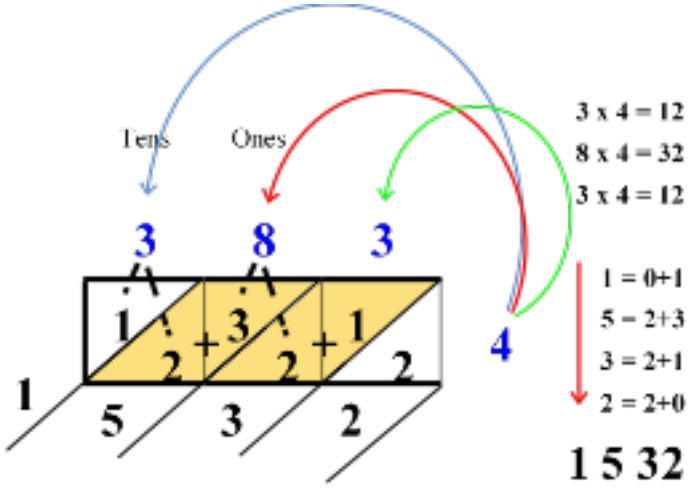
- 5 (from the bottom cell)
- $3 + 2 = 5$
- $4 + 2 + 1 + 5 = 12 = 2$, and carry the tens to the next diagonal with a $+ 1$
- $1 + 1 + 6 = 8$
- 0 (from the top cell)

Read the sum of the diagonals from left to right: The final product is 8 255

Example 2.13

1. $383 \times 4 =$

Solution



Therefore, 383 ×4 = 1 532

Division Strategies

Using the "Big 7 strategy" for division

Example 2.12

318 ÷ 3

Solution

3		1	8	
	3			
	–	0	0	100
	3			
		1	8	
	–	1	8	6
			0	106

100 + 6 =

So, 318 ÷3 = 106

Example 2.14:

156 ÷12 =

Solution

12	1	5	6	
	–			
	1	2	0	10
		3	6	+
	–	3	6	3
			0	**13**

So, $156 \div 12 = 13$

Use "repeated subtraction" to solve division problems.

Example 2.15

$144 \div 24 = 5$

Solution

$144 - 24 = 120$	①
$120 - 24 = 96$	②
$96 - 24 = 72$	③
$72 - 24 = 48$	④
$48 - 24 = 24$	⑤
$24 - 24 = 0$	**6**

So, $144 \div 24 = 6$

Example 2.16:

A class teacher shared 165 exercise books equally among 15 pupils. How many did each pupil get?

Solution

Repeated subtraction

165 – 15 = 150	1
150 – 15 = 135	2
135 – 15 = 120	3
120 – 15 = 105	4
105 – 15 = 90	5
90 – 15 = 75	6
75 – 15 = 60	7
60 – 15 = 45	8
45 – 15 = 30	9
30 – 15 = 15	10
15 – 15 = 0	11

165 ÷ 15 =

"Big 7" strategy

15	1	6	5	
	–	5	0	10
	1			
		1	5	+
	–	1	5	1
			0	11

Activity 2.2

Purpose: In this activity, you will apply the multiplication and division strategies you've learned (Expand and Box, Annexing Zeros, Lattice Method, Big 7 Strategy, Repeated Subtraction) to solve problems in a fun, competitive relay format. The goal is to reinforce your understanding of these strategies through teamwork and friendly competition.

Materials Needed:

- Large sheets of paper or whiteboards
- Markers
- A set of multiplication and division problems for each team (printed or written on cards)
- Timers

Instructions:

1. **Form Teams:**
   - Divide the class into small teams (3-4 learners per team).
   - Each team will need a space to work together on solving problems.

2. **Set Up Problem Stations:**
   - Set up different stations around the classroom, each representing a different strategy:
     - **Station 1:** Expand and Box Method (Multiplication)
     - **Station 2:** Annexing Zeros (Multiplication)
     - **Station 3:** Lattice Method (Multiplication)
     - **Station 4:** Big 7 Strategy (Division)
     - **Station 5:** Repeated Subtraction (Division)
     - **Station 6:** Open Station (Choose your favorite strategy to solve a problem)

3. **Relay Instructions:**
   - Each team will start at a different station. They will have 5 minutes to solve the problem at their station using the strategy assigned to that station.
   - Once they finish, they move to the next station in the rotation.
   - Teams must rotate stations until they've completed all the strategies.
   - As they move, they must show their work on the large sheets of paper or whiteboards provided.

4. **Solve Problems:**
   - **Example Problems**
     - **Expand and Box Method:** Multiply 23 by 47 using the Expand and Box method.
     - **Annexing Zeros:** Multiply 400 by 30 using the Annexing Zeros strategy.
     - **Lattice Method:** Multiply 56 by 78 using the Lattice Method.
     - **Big 7 Strategy:** Divide 184 by 7 using the Big 7 Strategy.
     - **Repeated Subtraction:** Divide 150 by 5 using Repeated Subtraction.
     - **Open Station:** Use any method you choose to solve a multiplication or division problem provided at this station.

5. **Team Collaboration:**
   - Teams are encouraged to work together to ensure everyone understands the strategy and participates in solving the problem.

- Teams should discuss the steps they take and check each other's work for accuracy.

6. **Final Review:**
   - After all teams have completed each station, gather together as a class to review the problems.
   - Teams will share how they solved each problem and which strategies they found most effective or challenging.
7. **Reflection:**
   - Discuss as a class which strategies were easier or harder and why.
   - Talk about when each strategy might be most useful in real-life situations.

Additional Tasks for the Activity

Station 1: Expand and Box Method (Multiplication)

1. Task: Multiply 32 by 45 using the Expand and Box method.
2. Task: Multiply 67 by 29 using the Expand and Box method.

Station 2: Annexing Zeros (Multiplication)

1. Task: Multiply 500 by 30 using the Annexing Zeros strategy.
2. Task: Multiply 6000 by 40 using the Annexing Zeros strategy.

Station 3: Lattice Method (Multiplication)

1. Task: Multiply 53 by 27 using the Lattice Method.
2. Task: Multiply 84 by 56 using the Lattice Method.

Station 4: Big 7 Strategy (Division)

1. Task: Divide 196 by 4 using the Big 7 Strategy.
2. Task: Divide 321 by 3 using the Big 7 Strategy.

Station 5: Repeated Subtraction (Division)

1. Task: Divide 180 by 9 using Repeated Subtraction.
2. Task: Divide 144 by 6 using Repeated Subtraction.

Station 6: Open Station (Choose Your Favorite Strategy)

1. Task: Multiply 76 by 43 using any method of your choice.
2. Task: Divide 225 by 5 using any method of your choice.

MINI- PROJECTS: APPLICATIONS OF ADDITION, SUBTRACTION, MULTIPLICATION AND DIVISION IN EVERYDAY LIFE

Mathematics in the Market

Activity: Budgeting and Purchasing

- **Scenario**: You are given a budget of 1000 cedis to buy items from a local market. The items include fruits, vegetables, grains and other essentials.
- **Task**: Create a shopping list with prices for each item. Calculate the total cost, determine how much money is left after purchasing the items and decide if you can buy additional items within your budget.
- **Operations**: Addition (adding the cost of items), subtraction (calculating remaining budget), multiplication (buying multiple quantities of an item), and division (splitting costs among different items).




Mathematics in the Kitchen

Activity: Recipe Adjustments

- **Scenario**: You have a recipe for a mix-fruits drink that serves 40 people.

Item	Quantity	Cost (GH¢)
Pineapple	15	55
Beet root	35	70
Sugar	2 cups	30
Bottles	40	60

- **Task**: Double the quantities of each ingredient in the recipe to serve 80 people and calculate how much it will cost.

  Then, if you need to serve only 20 people, how much will it cost?
- **Operations**: Multiplication (doubling the ingredients), division (halving the ingredients), and addition (combining ingredients).

Mathematics in Sports

Activity: Scoring and Statistics

- **Scenario**: You are a coach tracking the performance of your team over several games. You need to calculate total points scored, average points per game, and compare performances with other teams.

  Sample Football League Table - Ghana Football Clubs

  Here's a sample football league table showing 4 Ghana football clubs. The table includes the number of matches played, goals scored, matches won, drawn and lost.

Position	Club	Matches Played	Matches Won		Matches Drawn	Matches Lost	Goals Scored	Points
1	Hearts of Oak	12	8		2	2	24	-
2	Asante Kotoko	12	7		3	2	21	-
3	Ashanti Gold	12	6		4	2	18	-
4	Accra Lions	12	5		3	4	15	-

Explanation of the Table:

- **Matches Played:** Total number of matches each club has played so far.
- **Matches Won:** Number of matches each club has won.
- **Matches Drawn:** Number of matches each club has drawn.
- **Matches Lost:** Number of matches each club has lost.

- **Goals Scored:** Total number of goals scored by the club in the 12 matches.
- **Points:** Points earned by the clubs. (Win = 3 points, Draw = 1 point, Loss = 0 points)

Tasks:

- **Task 1:** Calculate the total points for each team.
- **Task 2:** Find the average number of goals scored per match for each team.
- **Task 3:** Predict what will happen to the league positions if each team wins their next match.
- **Task 4:** Determine how many matches each team needs to win to overtake the team above them on the table.
- **Task 5:** If Asante Kotoko win their next match and Hearts of Oak lose, how will the points and position change?

Mathematics in Tailoring

Activity 2.3: Fabric Measurement and Cutting

Scenario: As a tailor, you are making a set of uniforms for 300 learners. You need to measure and cut fabric of 1 ½ yard each precisely to ensure each uniform is the right size for each learner.

Task:

- If there are 475 yards of the fabric, find the number of yards of the fabric which is required to sew the uniforms for all the learners.
- How much of the fabric is left?
- Assuming you want to use the rest of the fabric to sew other uniforms that requires 2 yards each, how may uniforms can you sew?

POSITIVE AND NEGATIVE WHOLE NUMBERS

Concept of Positive and Negative Whole Numbers [Integers]

Imagine you're watching the news, and the weather report mentions that the temperature in a certain city has dropped to -5°C, while in another city, it's as high as 30°C. You might also hear about how a bank account can have a positive balance, like 500 cedis, or a negative balance, like -200 cedis, when someone owes money. These situations require an understanding of positive and negative whole numbers, known as integers.

Positive and negative numbers are all around us, whether it's temperatures below zero, bank accounts that go into debt, or even sea levels where some places are above and others below sea level. Understanding integers helps us make sense of these real-world situations. By learning how to work with positive and negative numbers, you can better understand and navigate scenarios involving gains and losses, temperatures, elevations, and more. Before we go deeper into the concept, let's have fun with these activities!

Reinforcement Activities

Purpose: To help learners grasp the concept of opposites, which is fundamental for understanding positive and negative integers.

Materials Needed:

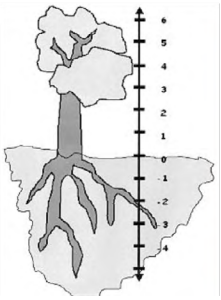
- Index cards/jotters
- Markers
- A whiteboard or chalkboard

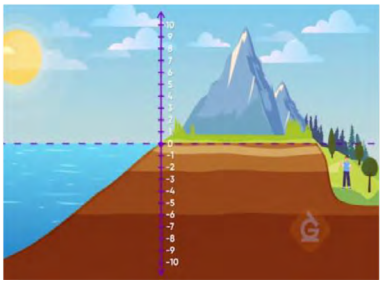
Activity Steps:

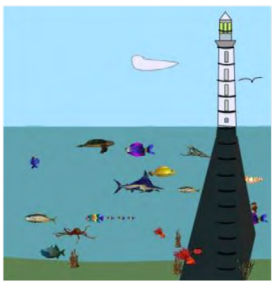
1. **Introduction to Opposites:** Begin by discussing the concept of opposites in everyday life. Give examples of opposites that you know, such as day and night, hot and cold, up and down. Write these on your cards/jotters.
2. **Pairing Opposites:** obtain a card, which has one word from an opposite pair (e.g., "Hot" on one card and "Cold" on another).

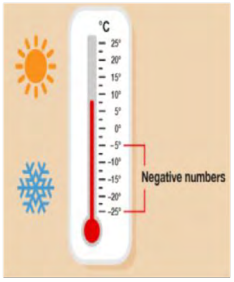
3. **Finding Your Opposite:** Move around the room and find the person who has the card that represents the opposite of the word on their card. Once you find your pair, you should stand together.
4. **Discussing the Activity:** Once all pairs have been found, each pair should share their words with the class. Discuss how these pairs of opposites relate to each other and why understanding opposites is important in everyday life.
5. **Connecting to Integers:** Explain that just like the words they paired, numbers also have opposites. For example, just as "hot" is the opposite of "cold," the number +5 has an opposite, which is -5. This concept of opposites in numbers will be the basis for learning about positive and negative integers.

In pairs, study the pictures and discuss your observations and understanding of what is depicted in each image. Then each pair should join another pair to form a square and share ideas. Then each square should join another square to discuss further.









Real Life Situations using positive and negative numbers

1.

Positive	Negative
Above	Below
Right	Left
Win	Lose
Increase	Decrease
Fast	Slow
Over	Under
More	Less
Grow	Shrink
Higher	Lower
Ascend	Descend

2. **Banking and Money**

Positive Numbers: When you put money into your bank account.

- Example: If you deposit GHS 50 into your bank account, you add GHS 50 to your balance.

Negative Numbers: When you take money out of your bank account.

- Example: If you withdraw GHS 20, you subtract GHS 20 from your balance.

3. **Temperature**

Positive Numbers: When it's warmer than 0 degrees.

- Example: A sunny day might be 25°C.

Negative Numbers: When it's colder than 0 degrees.

- Example: A very cold day might be -5°C.

4. **Elevation (Height)**

Positive Numbers: Places that are above sea level.

- Example: A mountain that is 1000 metres high.

Negative Numbers: Places that are below the ground.

- Example: A mine that is 50 metres underground is at -50 metres.

5. Sports Scores

Positive Numbers: Points that your team scores.

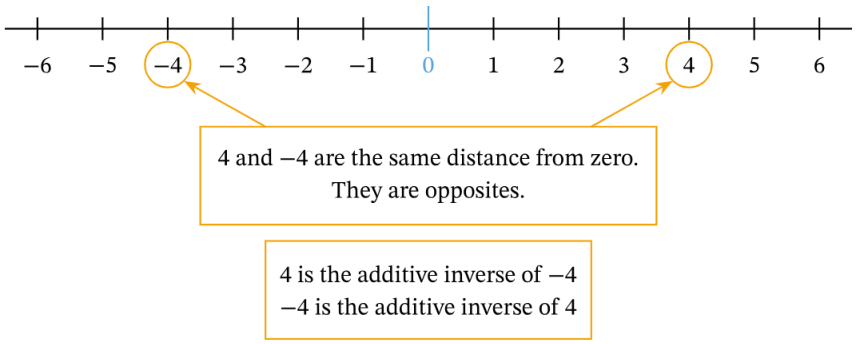
- Example: If your team scores 10 points in a game, that's +10 points.

Negative Numbers: Points taken away because of penalties.

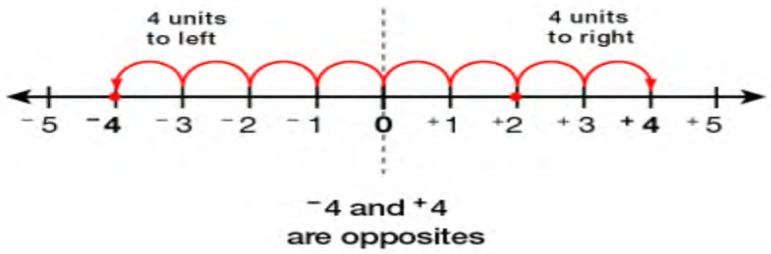
- Example: If your team loses 5 points due to a penalty, that is -5 points.

Integers

Integers are the positive counting numbers 1,2,3,4,5…, and negative numbers, −1, −2, −3, −4, −5…, and 0, which is neither positive nor negative. When we plot these numbers on a number line, 0 is in the centre, the positive numbers count up from the right of zero, and the negative numbers count down to the left of zero.



Pairs of numbers like +4 and -4 are exactly the same distance from 0, but on opposite sides, so they are called "opposites"



When we measure from zero, there are always two numbers that are the same distance away but in opposite directions. We call these numbers opposites. For example,

- 1 and −1 are opposites,
- 2 and −2 are opposites, and
- 53 and −53 are opposites.

The positive integers are more than zero and the negative integers are less than zero. Therefore, integers can be used to describe real-world situations, which represent quantities that are more or less than zero.

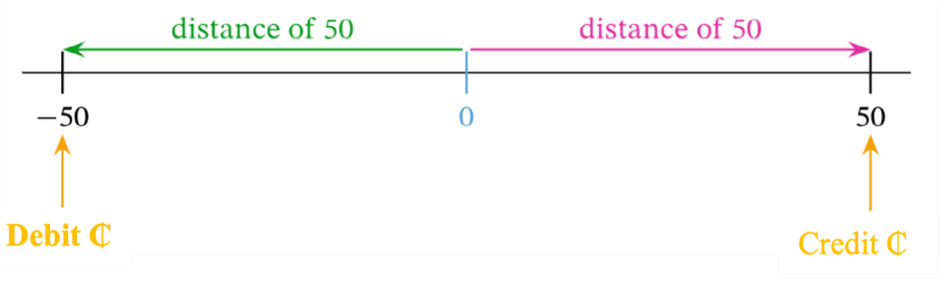
Example 2.17

Suppose that Sarah has a bank account. If the bank account contains ¢50, then Sarah has ¢50 to spend. We can represent this amount with the positive integer 50 because she has an amount that is more than zero.

However, if her account is in debt by ¢50, then she owes ¢50. To represent the balance in her account, we would use the negative integer −50.

In this situation, a positive integer represents money she has or money she has gained, and a negative number represents money she has lost or money she has to pay. When we talk about the balance in a bank account, the amount can either be more than zero (having money to spend) or less than zero (owing money).

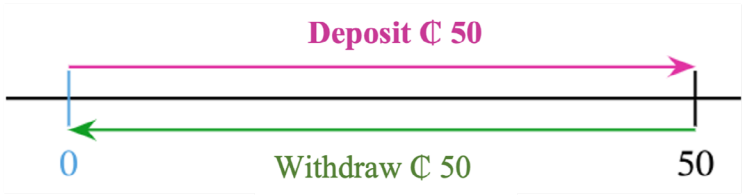
We can model this on a number line.



If the bank account is empty, the balance can be represented by 0. If she deposits ¢50 into the account when the balance is 0, this represents a gain of ¢ 50 that we represent with the positive integer 50. If instead she withdraws 50 from the account when the balance is zero, this represents a debt, or a loss, of ¢50 that we can represent with the negative integer −50.

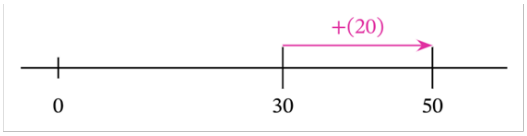
A deposit (gain) of ¢50 and a withdrawal (loss) of ¢50 are represented by integers that are the same distance from zero but in opposite directions. This is because they represent the same amount of money each time but we use either a positive or negative number to indicate whether the amount is being gained or lost.

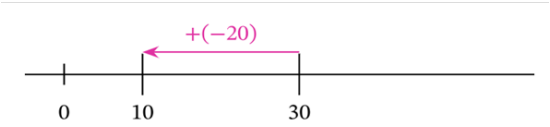
The numbers 50 and −50 are called opposites, or additive inverses, because they sum to zero. To see this, observe that a deposit of ¢50 and then a withdrawal of ¢50 takes the balance in the account back to zero. When we model this addition on a number line, we see that $50 + (-50) = 0$.



Example:

1. Kwame is playing a game and starts with 30 points.
   - If, after his first turn, his score changes by +20, what is his score after the first turn?
   - If, instead, after his first turn, his score changes by -20, what is his score after the first turn?





Exploring Integers Through Temperature and Banking

Activity 2.x.1: Recording and Comparing Daily Temperatures

Purpose: Learn about positive and negative integers by recording and analysing daily temperature changes.

Materials Needed:

- Thermometers or access to a reliable weather app/website
- Notebooks or graph paper
- Pencils and rulers

Steps:

1. **Form Groups:** Divide into small groups of 3-4 learners.
2. **Record Temperatures:** Each group will record the daily high and low temperatures for a week. You can check the weather at home or use a classroom thermometer to measure it in the morning and afternoon.

3. **Create a Temperature Chart:** After collecting the data, create a chart to show the temperatures. Make sure to include positive and negative temperatures where applicable.
4. **Calculate Temperature Changes:** For each day, calculate the difference between the high and low temperatures. Discuss whether the temperature increased or decreased, and by how much.
5. **Compare Results:** Compare your group's data with other groups. Discuss how temperatures varied throughout the week and identify any trends. Discuss how temperatures below zero are represented and what that means in real life.
6. **Group Discussion:** As a class, discuss why understanding positive and negative numbers is important for interpreting temperature data.

FOCAL AREA 2: OPERATIONS ON POSITIVE AND NEGATIVE WHOLE NUMBERS (ADDITION AND SUBTRACTION)

In this focal area we will explore the basic arithmetic processes of addition and subtraction involving integers. We will delve into the rules and techniques in solving real-life problems. In order to add positive and negative integers, we will imagine that we are moving along that number line.

· When we add a positive number to another, we start at the first number mentioned and then move to the right the amount added. Positive numbers make us move to the right side of the number line.

Examples: $4 + 3 \rightarrow$ We start at 4 and go 3 units to the right. We end up at 7, so: $4 + 3 = 7$

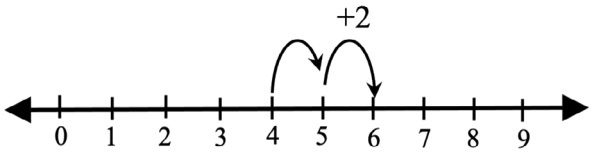
$-2 + 6 \rightarrow$ We start at -2 and go 6 units to the right. We end up at 4, so: $-2 + 6 = 4$

- When we add a negative number to another, we start at the first number mentioned and then move to the left the amount added. Negative numbers make us move to the left side of the number line. Adding a negative number is the same as subtracting a positive number.

Examples

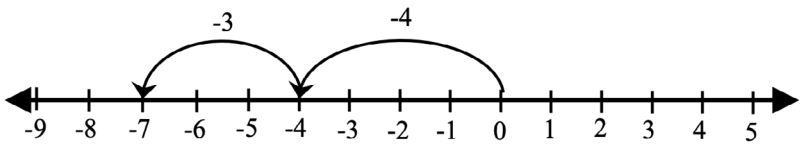
1. Kwame moved +4 steps from the starting point at 0 and then proceeded to take an additional +2 steps. What is the total number of steps he took?

$$4 + 2 = 6$$

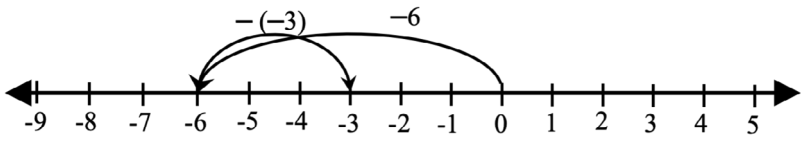


2. Alima has no money, so she borrowed *GH¢* 4.00 from her friend to buy food. She borrowed an extra *GH¢* 3.00 later, how much does she owe?

$$-4 + -3 = -7$$

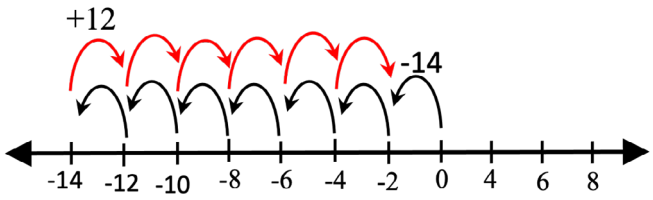


3. Mawuli borrowed GH¢ 6.00 from Esi, and later returned GH¢ 3.00. The expression (–6) + (3) models this situation.



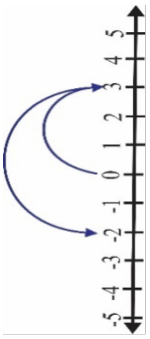
(–6) – (– 3)= –6 + 3 = – 3, so Mawuli still owes Esi GH¢ 3.00.

4. Mensima has a jar of toffees, initially, she had 14 fewer toffees than she needed for a party. Kwesi gives her an additional 12. The expression (– 14) + 12 models this situation.



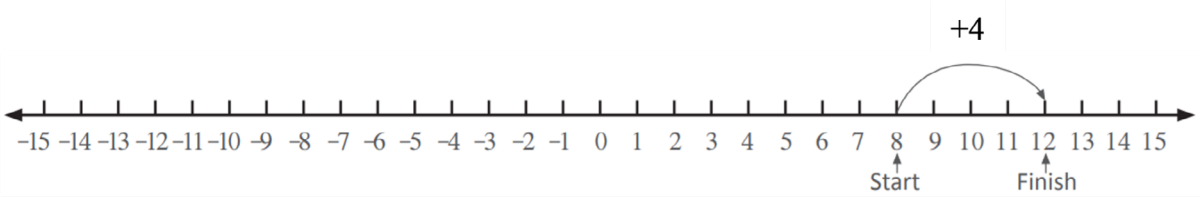
(–14) + 12 = (– 2), so Mensima is still 2 toffees short for her party.

5. Find $3 + (-5)$



$3 + (-5) = -2$

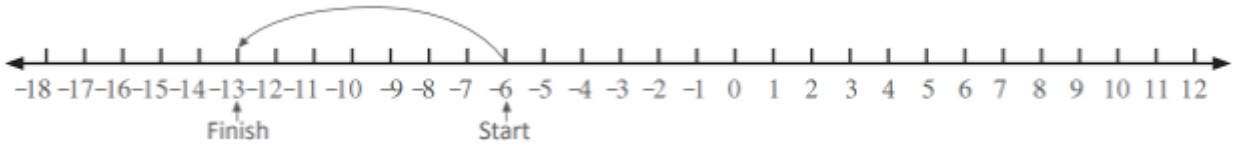
6. Find $8 + 4$



Starting at +8, 4 to the right finishes at 12 right (+ 12)

$8 + 4 = 12$

7. Find $-6 - 7$



Starting at −6, then 7 to the left finishes at 13 right (−13)

$=-6 - 7 = -13$

ACTIVITY 2.4:- Individual/Pair/Group Work

Banking and Balancing

Purpose: Understand positive and negative integers through a simulated banking scenario.

Materials Needed:

- Simulated bank account balance sheets
- Fake money or tokens
- Calculators

Steps:

1. **Set Up a Bank Account:** Each group starts with a simulated bank balance of 100 units (could be cedis, dollars, etc.).
2. **Transactions:** Over the week, groups will record various transactions:

- Deposits (positive integers) such as getting money from parents.
- Withdrawals (negative integers) such as buying snacks or supplies.

3. **Track the Balance:** After each transaction, learners update their bank balance. Ensure that learners record both positive and negative numbers.
4. **Calculate the Final Balance:** At the end of the week, calculate the final balance. Discuss what it means if their balance goes below zero.
5. **Group Reflection:** Discuss as a class how managing money (positive and negative balances) is similar to managing temperature changes. What happens if you spend more than you have? How does this relate to negative numbers in real life?

FOCAL AREA 3: OPERATIONS ON POSITIVE AND NEGATIVE WHOLE NUMBERS (MULTIPLICATION AND DIVISION)

Multiplication of Integers

Example 1:

A box contains 8 pencils. If there are 5 boxes in all, how many pencils are all together?

5 groups of 8

$(8 \times 5) = 40$

This implies that, $8 + 8 + 8 + 8 + 8 = (8 \times 5) = 40$

Therefore, multiplication is a repeated addition.

Example 2:

Evaluate 14 x 3:

This means we have 14 + 14 +14 or 3 groups of 14 = 14 x 3 = 3 x 14 = 42

Therefore, regardless of what order the numbers are written, the product is the same.

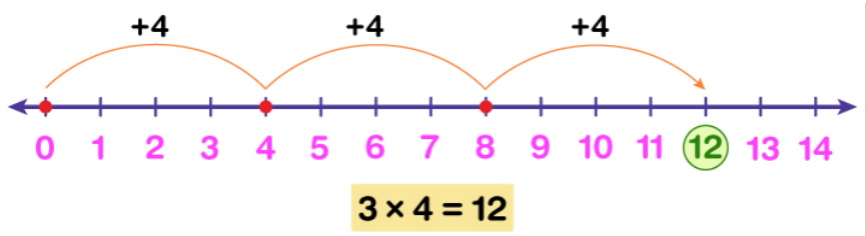
Multiplication of negative integers using number line.

Example 1:

For example, 3 × 4 represents 3 times 4 or 3 groups of 4.

Step 1: 4 being positive, we move 4 units to the right of 0.

Step 2: A total of 3 such moves are taken, i.e., we skip count forward by 4s three times to the right of 0.



Thus, we get 3 × 4 = 12 on the number line.

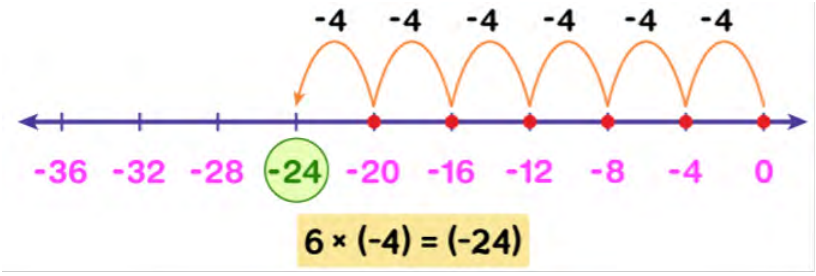
Example 2

Let us multiply 6 × (-4)

6 × (-4) means 6 times of (-4).Thus we need to add (-4) six times.

Step 1: As (-4) is negative and lies to the left of 0, a negative number line is drawn by plotting the first few negative multiples of 4 starting from 0.

Step 2: Then, we count back by 4s six times to the left, starting from 0.



Example 3

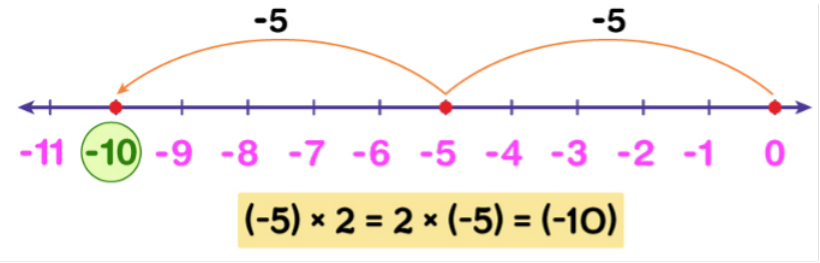
Calculate (-5) × 2 on a number line

As we know, in multiplication; we can write (-5) × 2 as 2 × (-5), which means 2 times (-5).

Here the result is obtained by adding (-5) two times, i.e., 2 × (-5) = (-5) + (-5)

Thus counting back by 5s twice to the left, starting from 0, will get us to -10.

So the product is (-5) × 2 = 2 × (-5) = (-10) is on the number line.



Note these rules of multiplication

In multiplication, the sign of the product depends on the signs of the numbers being multiplied.

- Positive x Positive = Positive (e.g., 3 x 4 = 12)
- Negative x Negative = Positive (e.g., –5 x –2 = 10)
- Positive x Negative = Negative (e.g., 2 x –7 = –14)

  Negative x Positive = Negative (e.g., −4 × 5 = −20)

Example 4

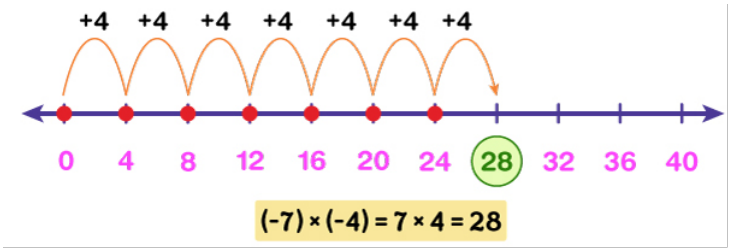
Multiplication of two negative numbers gives a positive number by the even rule of multiplying negative numbers.

For instance, to multiply (-7) × (-4), we see that the result will be positive as both the numbers are negative.

So we calculate 7 × 4 following the rule of multiplying positive numbers.

Step 1: A positive number line starting at 0 and with the first few multiples of 4 is drawn.

Step 2: As 7 × 4 denotes 7 times 4, we count forward by 4s seven times to the right starting from 0.



Example 5

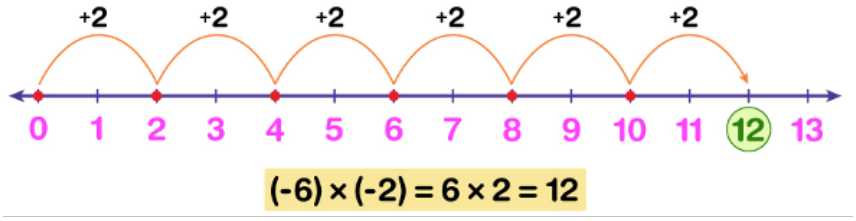
Find the product (-6) × (-2) using a number line.

This multiplication result will be positive as (-6) and (-2) are both negative numbers.

Thus (-6) × (-2) can be written as 6 × 2, i.e., 6 times 2.

To add 2 six times, we count forward by 2s six times to the right starting from 0.

We find (-6) × (-2) = 6 × 2 = 12.

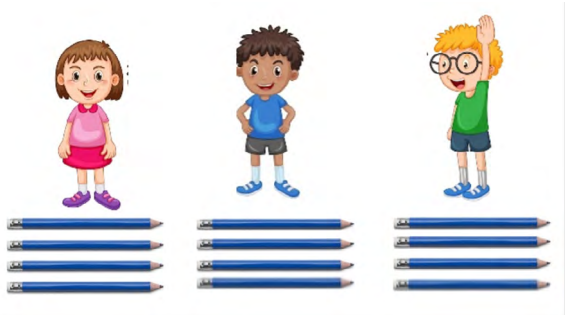


Division of Integers

Remember that division is the process of sharing or distributing quantities into smaller groups.

Examples

a. Kofi is to share 12 pencils among his three friends. How many pencils will each receive?



Solution

From the illustration, each friend receives 4 pencils. Therefore, $12 \div 3 = 4$

b. Your class is going on a field trip and the bus can hold 36 passengers There are 108 learners in your class. How many buses will be needed to transport all the learners?

Solution

This is a division problem; $108 \div 36 = 3$

c. A household owes electricity bill of GH¢450.00. This amount was shared among three members equally, how much will each tenant pay?

Solution

Since this is a debt, the amount owe will be written as – 450. Therefore, each member will pay an amount of $-450 \div 3 = -150$, which is a debt and can be written as – 150.

Rules of division

In division, the sign of the division depends on the signs of the numbers being divided.

- Positive ÷ Positive = Positive (e.g., $12 \div 4 = 3$)
- Negative ÷ Negative = Positive (e.g., $-20 \div -2 = 10$)
- Positive ÷ Negative = Negative (e.g., $28 \div -2 = -14$)
- Negative ÷ Positive = Negative (e.g., $-28 \div 2 = -14$)

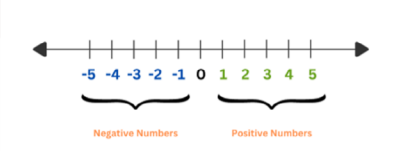
Activity 2.5: Individual/Pair/Group Work

Multiplication of Integers Using a Number Line

Objective: Learn how to multiply integers using a number line.

Materials Needed:

- Number line (drawn on paper or on the board)
- Markers or pencils



Steps:

1. **Setting Up the Number Line:**
   - Draw a number line on your paper, starting from -10 to +10.
   - Mark the zero point clearly in the middle.
2. **Multiplication with Positive and Negative Numbers:**
   - Start with a simple multiplication, like 2×3.
   - From 0, move 2 steps to the right 3 times. You should land on +6. Discuss that this is $2 \times 3=6$.
   - Now try a multiplication like -2×3
   - From 0, move 2 steps to the left 3 times. You should land on -6. Discuss that this is $-2 \times 3=-6$.
3. **Practice:**
   - Practice with different combinations, like 3×-4, -3×4, -4×-3.
   - Remember, when you multiply two negative numbers, the result is positive. For example, $-4 \times -3 = 12$, so you'll move to the right when multiplying two negative numbers.
4. **Create new Problems**
   - Write your own problems for your friends to solve.
5. **Reflection:**
   - After each problem, write down what you notice about the direction you moved and the result you got. Share with the class or your group.

Division of Integers Using Grouping

Objective: Learn how to divide integers using a grouping strategy.

Materials Needed:

- Counters or small objects (e.g., beans, coins)
- Paper and pencil

Steps:

1. **Understanding Division:**
   - Start by thinking of division as grouping. For example, $12 \div 4$ means how many groups of 4 can you make from 12.

2. **Division with Positive Integers:**
   - Take 12 counters. Group them into sets of 4. You should have 3 groups, so $12 \div 4 = 3$.
   - Now try $-12 \div 4$. If positive 12 was 12 steps to the right on a number line, then -12 would be 12 steps to the left. You're still grouping by 4, but now you're counting groups of -4. You'll find 3 groups again, but the answer is -3.
3. **Division with Negative Divisors:**
   - Try dividing with a negative divisor: $12 \div -4$.
   - Using the counters, you know that 4 groups of -3 would make -12, so $12 \div -4 = -3$.
4. **Division of Two Negative Numbers:**
   - Now try $-12 \div -4$. Since both numbers are negative, you're still grouping, but you're looking for positive groups. You should find that $-12 \div -4 = 3$.
5. **Practice:**
   - Practice with different combinations, like $16 \div -4$, $-20 \div 5$, and $-18 \div -3$.
6. **Create new Problems**:
   - Write your own problems for your friends to solve.
7. **Reflection:**
   - After each division problem, write down your findings. Discuss how the signs of the numbers affect the result.

REVIEW QUESTIONS

Review Questions 2.1

Addition (Up to 6-Digit Numbers)

1. Add: **234 + 456**
2. Add: **6 781+ 321**
3. Add: **1 234 + 7 890**
4. Add: **345 678 + 987 654**
5. Add: **567 890 + 234 567**

Subtraction (Up to 6-Digit Numbers)

6. **Subtract:** 789 - 123
7. **Subtract:** 6 543 - 456
8. **Subtract:** 9 876 - 3456
9. **Subtract:** 456 789 – 234 567
10. **Subtract:** 890 123 – 678 234

Multiplication (Up to 6-Digit Numbers)

11. Multiply: **345 × 12**
12. Multiply: **567 × 23**
13. Multiply: **789 × 35**
14. Multiply: **456 × 567**
15. Multiply: **234 567 × 678**

Division (Up to 4-Digit Numbers)

16. **Divide:** 108 ÷ 9
17. **Divide:** 12 340 ÷ 2
18. **Divide:** 67 800 ÷ 4
19. **Divide:** 8 400 ÷ 56

20. **Shopping at the Market:** Kofi bought 3 bags of rice. The first bag cost 120 cedis, the second bag cost 150 cedis, and the third bag cost 175 cedis. How much did Kofi spend in total?
21. **Building a Fence:** A farmer is adding new sections to his fence. The first section is 1 500 metres long, the second section is 1 250 metres long, and the third section is 1 750 metres long. What is the total length of the new fence sections?
22. **Money Remaining:** Ama had 500 cedis. She bought groceries for 215 cedis and some clothes for 150 cedis. How much money does Ama have left?
23. **Construction Materials:** A carpenter started with 1 000 nails. After building several pieces of furniture, he has 673 nails left. How many nails did he use?
24. **Bulk Purchase:** A store sells a pack of water bottles for 12 cedis. If a customer buys 150 packs, how much money will the customer spend?
25. **Farm Produce:** A farmer harvested 350 bags of maize. If each bag weighs 65 kilograms, what is the total weight of the maize harvested?
26. **Sharing Profits:** A group of friends made 4 800 cedis from selling handmade crafts. They want to share the profits equally among 8 friends. How much money will each friend receive?
27. **Packaging:** A factory packs 9 600 oranges into boxes. If each box holds 120 oranges, how many boxes are needed to pack all the oranges?

Review Questions 2.2

1.

a) $5+(-3) = ?$

b) $-7+9 = ?$

c) $-12+(-8) = ?$

d) $15+(-20) = ?$

e) $-4+10 = ?$

2.

a) $8-(-5) = ?$

b) $-14-6 = ?$

c) $-9-(-3) = ?$

d) $20-25 = ?$

e) $-2-7 = ?$

3.

a) $4\times(-3)=?$

b) $-5\times(-6)=?$

c) $7\times(-8)=?$

d) $-9\times3=?$

e) $-10\times(-2)=?$

4

a) $30\div(-5)=?$

b) $-42\div7=?$

c) $-36\div(-6)=?$

d) $56\div(-8)=?$

e) $-48\div4=?$

5. Sarah was playing a game where she earned points. In the first round, she lost 7 points, but in the next round, she gained 12 points. What is her total score after the two rounds?

6. The temperature in a freezer was -5∘C. The temperature outside was 10∘C warmer. What is the temperature outside?

7. A submarine is positioned at 100 metres below sea level. If it rises by 60 metres, what is its new position relative to sea level?

8. John had GH¢50, but he owed his friend GH¢30. After paying his friend, how much money does John have left?

9. A mountain climber descends 200 metres each day for 5 days. How many metres does he descend in total?

10. A company is making a loss of GH¢50 each day. How much will the company lose in 7 days?

11. A baker made 48 loaves of bread and needs to pack them equally into 6 boxes. If the baker accidentally dropped 12 loaves, how many loaves of bread will be in each box now?

12. A scuba diver descends to a depth of 45 metres. If she ascends 15 metres each minute, how many minutes will it take her to reach the surface?

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