

Stepping Stones for Signed Integers

Stepping Stones for Integers (signed integers/directed numbers)

Introducing negative numbers –

- Use slate as a bank account, use green plug as 1 rupee and red plug as a loan of 1 rupee.
 - One rupee is 'positive 1' represented as (+1) and a green plug
 - A loan of one rupee is 'negative 1' represented as (-1) and a red plug
 - If your account has one green plug and one red plug what is the net value of your account?
 - **Comparison:** Show two accounts and ask which one will they choose if they are asked to choose one of them.
 - 3 green 2 red
 - 2 green 3 red
 - 3 green 1 red 2 green 3 red
 - 2 green 2 red 3 green 3 red
 Discuss that you can make pairs, they are zeros, count remaining ones and that is the net value of your account.
 - **Making zeros :** Make a bank account having zero net value. In how many ways can we make this. Each group describes their account.
 - **Solve** the following :
 In your account you have the following, find the net value using plugs .
 - +5+3+2
 - -5-2-3
 - +5+2-3
 - +1+1+1-1-1-1-1 Discuss cancellation.
 - +2-3-2+3 Discuss cancellation.

Addition :

Add using plugs and find the answer.

- Discuss that the sign with number tells us whether that is a loan or a rupee. That should be read as negative and positive. The sign between two brackets tell us whether we are adding or subtracting. That should be read as plus or minus.
- (+2) + (+3) Read as positive two plus positive 3.
- (-2) + (-3)
- (+3) + (-2)
- (-3) +(+2)
- Arrive at rules.

- Adding two positive numbers : Sum of numbers with positive sign
- Adding two negative numbers : Sum of numbers with negative sign
- Adding one positive and one negative number : Difference of the numbers with sign of bigger number.
- Solve 5 problems using rules (take small numbers)
- Remove brackets in each case. When there is a plus sign outside the bracket you can remove the brackets by keeping the signs unchanged. You are adding either positive or negative number to your account.

Removing brackets while adding

$$\begin{aligned} +(+ &\rightarrow + \\ +(- &\rightarrow - \end{aligned}$$

Solve the following problems by removing brackets and using the rules.

- $(+2) + (+3) + (+1)$
- $(-2) + (-3) + (-1)$
- $(+4) + (+2) + (-3)$
- $(-3) + (-2) + (+5)$

Subtraction : Taking away

Solve using plugs

- $(+5) - (+2)$ Positive 5 minus positive 2.
- $(-5) - (-2)$
- $(+5) - (-2)$
- $(-5) - (+2)$
- In the last two examples, you don't have required plugs to take away. To create them without changing the value, you add those many zeros. Then take away .
- Discover the rule. Subtracting a negative number is like adding a positive number. (you become richer when your loan is taken away)
- Subtracting a positive number is like adding a negative number.
- Solve 5 problems using rules.

Removing brackets while subtracting

$$\begin{aligned} -(+ &\rightarrow - \\ -(- &\rightarrow + \end{aligned}$$

Common *RULE* for removing brackets –

When there is a + sign before the bracket, remove the sign and bracket by keeping all terms and their signs the same.

When there is a – sign before the bracket change signs of all terms inside the bracket.

- Solve the following by removing brackets :

$$(+5) - (-2)$$

$$(+3) - (+2) - (+1)$$

$$(+4) - (-1) - (-3)$$

Multiplication

- $(+2) \times (+3)$ Put positive 2 in your account 3 times.
- $(-2) \times (+3)$ Put negative 2 in your account 3 times.
- $(+2) \times (-3)$

Multiplying by a positive number is putting in the account those many times. Multiplying by a negative number is taking away from the account those many times.

Take away 3 time . What to take away ? Positive 2. So, create required number of zeros and get the answer.

- $(-2) \times (-3)$ Negative 2 is to be taken away from the account 3 Times.

Division

$(+6)/(+2)$ Take positive 6 in your account. Make 2 equal parts.

$(-6)/(+2)$ Take negative 6, Make 2 equal parts.

$(-6)/(-2)$ Take negative 6, Make portions of negative 2, You get 3 portions. Portions are always positive.

$(-6)/(+2)$ Use logic of multiplication.

Rules for multiplication and division

$$(+) \times (+) = (+) \rightarrow (+) / (+) = (+)$$

$$(+) \times (-) = (-) \rightarrow (-) / (+) = (-)$$

$$\rightarrow (-) / (-) = (+)$$

$$(-) \times (-) = (+) \rightarrow (+) / (-) = (-)$$

What is $(-2) \times (-2) \times (-2)$

What is $(-2) \times (-2) \times (+2)$

Expressions

Identify terms and solve using rules :

$$(+2) \times (-3) - 5 + (-3) \times (+2)$$

There are 3 terms.