

Algebra Fundamentals

From known Integers to calculating
the unknown

For CSE (Preliminary) Paper 2

Reading the command is the key

- '=' gives the command to find the value of the unknown 'x' such that an equality or a balance is established on either side of the symbol.
- There are always two kinds of quantities in every Equation: (a) Known or the constant indicated by an integer (0,1 ,2 ...) and an (b) unknown x, y, z.



Commands continued

Rule 1. The fundamental character of these two kinds of quantities, is to be understood first.

$$\text{Example : } Nx + a = b - mx = x = \frac{b-a}{m+n}$$

Rule 2. Always carry out the command on both sides of the Equation. (?)

Rule 3 . Rule of the thumb: isolate the unknown x , by moving known quantities to one side.

Reading the Command

- 4. The aim of the command of 'substitution' is to simplify the equation. 'Substitution' means 'Replacement of one expression' by another.'

- The replacement can be of a more complicated expression by a simple expression or a simple 'unknown quantity' by a more complicated expression. Example :

$$2 \frac{(x-4)}{3} + 3 \frac{x-4}{3} - 4 \frac{(x-4)}{3} = 9 - 2 \frac{(x-4)}{3}$$

- Here, Substitute $(x-4) / 3$ by 'n', which now becomes the new unknown. The equation now reads as

$$2n + 3n - 4n = 9 - 2n \text{ in its simplified form}$$

- One letter can be used with different suffix -
 $a_1 + a_2 + a_3 + a_4 + a_5$ OR
- Different letters can be used as in $a + b + c$.
- Here, 'a' means $1a$, but $a + a + a + b + b + c$ mean $3a + 2b + 1c$.
- Brackets mean that everything within a bracket is to be treated as one whole.
- The content of the bracket is to be worked out first to dissolve or finish the bracket.

Language of Algebra

In multiplication integers can be combined ($3 \times 4 = 12$) but letters cannot be combined or changed to a new letter, because they represent different things.

- 1) If two things are equal to a third thing, then they both must be equal to each other. This is 'self evident'.
- 2) The letters can be treated in the same way as numbers (?)
- 3) 0 (zero) is often treated as a number, but is not.
- 4) Zero only separates (+) from (-) and is symbol of nothingness in infinity

Notations

$$3a + 5b = 8c$$

$$3a + 5b = d$$

8c is equal to 'd' because both 8c and d are equal to

$$3a + 5b$$

Notations Multiplication

- Sign in the answer is (+) if number of terms is even
- Sign in the answer is (-) if terms are in odd number
- If base is the same , index numbers are added or multiplied.
- Rule of multiplication is that every term of one expression , is multiplied by each term of the other expression

$$a^n \times a^m = a^{n+m}$$

$$a^3 \times a^4 = a^{3+4} \\ = a^7$$

$$(a^n)^m = a^{nm}$$

(If two indices are multiplied by one another)

Multiply :

$$(3a+2b)(4f+g) = 12af+ 3ag + 8bf + 2bg$$

Integers can be combined ($3 \times 4 = 12$) but letters cannot be replaced by a new letter.

- An identity shows two ways of expressing the same quantity: $a + b = b + a$
- Balance in subtraction, should indicate the difference between the two.
- Division $n \times a \div a = n$. Any number divided by itself is always 1.

Notations

Subtraction and
Division

$$3a + 4b$$

subtract

$$a + 6b$$

$$= 2a - 2b$$

There is a
difference of
2b still owing
to be returned.

Steps in DIVISION

- Step 1) Carefully read the problem.
- Step 2) Re-arrange both, divisor and dividend , in ascending order or descending order.
- Step 3) Re-confirm that both the orders are matching – which means that both should be in descending or ascending order.
- If $a^3 + 11a - 6a^2 - 6$ is to be divided by $a - 2$, the dividend can be rearranged in descending order.
- From $a^3 + 11a - 6a^2 - 6$
- It will becomes $a^3 - 6a^2 + 11a - 6$

Divide : $8x^3 + 3a^3 - 2a^2x - 12ax^2$ by $(2x - a)$

1) Rearrange : $8x^3 - 12ax^2 - 2a^2x + 3a^3$

2) Now Divide :

$$\begin{array}{r} (2x - a) \overline{) 8x^3 - 12ax^2 - 2a^2x + 3a^3} \\ \underline{8x^3 - 4ax^2 \quad (Subtract)} \\ 0 - 8ax^2 - 2a^2x \\ \underline{- 8ax^2 + 4a^2x \quad (Subtract)} \\ 0 - 6a^2x + 3a^3 \\ \underline{- 6a^2x + 3a^3 \quad (Subtract)} \\ 0 \quad 0 \end{array}$$

multiply by $4x^2$
work the bracket first
(multiply by $- 4ax$)
(multiply by $- 3a^2$)

Answer is the Quotient which is $4x^2 - 4ax - 3a^2$

Graphical Method for solving Equation

- **Step 1.** Convert the equation into a function of 'x'
- **Step 2.** Give 'x' a range of values differing by equal steps and find the corresponding value of y
- **Step 3.** Plot points on the curve
- **Step 4.** Decrease near the points where curve is near the x axis

Scope of Coordinated Geometry

also see [maths video on ISRO Education Portal link in Basic Geometry](#)

- A circle is a curve of the second degree
- - problems of finding intersections of two curves
- Finding equations of 'tangent' to curves
- A function expresses a law, a physical relationship between two quantities.

- Positive numbers are closer to the viewer's eyes than the screen is.
- Negative numbers are "behind the screen";
- Larger number are farther from the screen.
- Then any point in the three-dimensional space that we live in represents the values of a trio of real numbers.
- 3D numbers can be indicated by x , y , z .

Placement of real and imaginary numbers

