# Appendix – 1

Basic Operations in Algebra:

The four basic operations +, -, x, ÷ are used in this book in the traditional manner. However, efforts have been made to explain every step. The idea of negative numbers is not given in the usual way of 'continuum of quantities'. Instead illustrative examples are use. Thus one can see 'hole and solid' concept. This helps to explain addition, subtraction (of both +ve and –ve numbers).

When it comes to multiplication this analogy fails. In this book, we have attempted a concept, which we hope will help in teaching at school level.

Let us analyse addition of negative numbers. When we write 5 + 4 it is really +5 + 4 = +9. It is just that 5 units and 4 units of the same type (viz +ve) of numbers coming together (adding).

Similarly –5 – 4 = -9. It is just 5 units (= items) and 4 units of the same kind (viz -ve) come together. It ADDS to –9. 5 – 4 is the same as (+5 – 4). Here, for each negative unit, one positive unit annuals the effect (like repaying loan). Thus +5 – 4 = 1 i.e., 4 debtors cancelled by 4 creditors and remaining is 1 credit (i.e, + 1). Subtraction term itself is not necessary here.

Consider –5 + 4. By a similar reasoning, we get 1 debit (i.e., -1).

Multiplication is many times addition.
Thus (+3) (+n) = 3(+n) = + n + n + n = 3n
Similarly (+3) (-n) = 3(-n)
= -n – n – n
= -3n

Here the sign (+) in the multiplying factor is not the same as the + in the bracket. If we understand this we can explain (-)(-) and (-)(+) results.

The rule (-) x (-) = + appears to be strange and explanations are not convincing to a logical thinker. Teachers, I am sure, would have experienced this difficulty. More so, if they try to explain this on the basis of debtors for negative, and creditor for positive. Here is a concept.

The basic assumption of the following explanation is that in the ideal number system (continuum) both positive and negative exist; and the symbols used (+) or (-) indicate something else. More clearly, when you say (-) x (-x) the second belongs to the number continuum and therefore is the quality (or nature, or attribute or SIGN) of the number x. The first (-) is an operational symbol. Here comes our explanation. In the usual coming together (=joining, addition) of numbers (or quantities) (-) indicates subtraction or removal (of a quantity). It is quantitative and therefore requires a quantity following it.

The first (-) symbol is an operator and works on a quantity. It has no quantity on its own. The function of this operator is reversal (of sign). By the same argument (+) of some quantity means conserving (i.e, keeping as such) (of sign).

Example:
(-4) means (you) owe someone (4). Thus –4 is a quantity i.e., Dr. of 4. Now (-) (-4) means reversing the nature. i.e., Dr. becomes creditor. (This is because number has only 2 states). Thus (-) (-4) = +4.

Explanation:

(+) (+1) means conserving (=keeping the nature) + status of number 1.
Ans: +1, i.e. 1.

(-) (+) means reversing (= opposing the nature) + status of number 1.
Ans: Opposite of +1= -1

(+) (-1) means conserving the _ve nature of –1. Therefore –1.

Now,

(-1)(-1) means reversing the –ve nature of 1. That is (-1) = +1
Hence, the rule (+) x (+) = +
(+) x (-) = -
(-) x (+) = -
(-1) x (-) = +

Thus the right way of doing (-5) x (-4)
(-5) x (-4) = (-) (5) x (-4) = (-) (-20) = +20.

But in practice, any which way works.
(-5) (-4) = (-)(-) (5) (4) = +20 OK.

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## Appendix – 2

Common Conventions in Geometry:

| | |
|---|---|
| • P | Point, capital alphabet |
| ▬▬ (AB) | Line, capital alphabets |
| ├─┤ a | Length, small alphabet (no units) |
| $\angle$ Or $\angle$ Ø | Angle, Greek alphabet (small) |
| $\triangle$ | Triangle |
| $\perp$ | Perpendicular Lines |
| ○ | Circle |
| r, d | Radius, diameter (of circle) |
| A | Area (in square units of length) (Capital A) |
| V | Volume (in cubic units of length) (Capital V) |
| $x, y, z$ etc | Variables used in algebra |
| P $(x_1, y_1)$ | $x_1$ and $y_1$ - numbers. P is a point in coordinate geometry (i.e. on a graph sheet) |

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## Appendix – 3

Exponents:

$a \times a = a^2$

$a \times a \times a = a^3$

$a \times a \times a \times \ldots\ldots$ n times $= a^n$

$a^m \times a^n = (a \times \ldots\ldots$ m times$)(a_x \ldots\ldots$ n times$) = a^{(m+n)}$

Therefore $a^m \times a^n = a^{(m+n)}$

$$\frac{a^m}{a^n} = \frac{(a \times a \times \ldots\ldots m \text{ times})}{(a \times a \times \ldots\ldots n \text{ times})} \quad \text{Say } m > n$$

$= (a \times a \ldots\ldots (m-n)$ times$) = a^{(m-n)}$

Therefore $\frac{a^m}{a^n} = a^{(m-n)}$

$\frac{a^m}{a^m} = a^{(m-m)} = a^0$ LHS = 1; $a^o = 1$

$(\text{Anything})^o = 1$

$\frac{1}{a} = \frac{a^0}{a} = a^{(0-1)} = a^{-1}$

$\frac{1}{a^n} = \frac{a^0}{a^n} = a^{(0-1)} = a^{-n}$

Thus $a^{-1} = \frac{1}{a}$

$a^{-n} = \frac{1}{a^n}$

$\sqrt{a} \times \sqrt{a} = a.\ a^{\frac{1}{2}} \times a^{\frac{1}{2}} = a^{\frac{1}{2}+\frac{1}{2}} = a^1 = a$

Therefore $\sqrt{a} = a^{\frac{1}{2}}$

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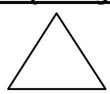
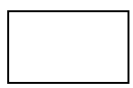
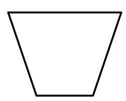
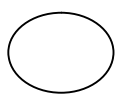
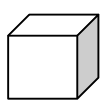
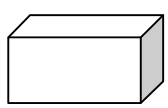
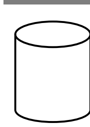
## Appendix – 4

**Collection Of Important Formulas.**

Geometrical figures:

| | Name | Shape (= diagram) | Quantity to Calculate |
|---|---|---|---|
| a. | Triangle |  | area, perimeter |
| b. | Square |  | area, perimeter |
| c. | Rectangle |  | area, perimeter |
| d. | Trapezium |  | area, perimeter |
| e. | Circle |  | area, perimeter |
| f. | Cube |  | surface area, volume |
| g. | Box |  | surface area, volume |
| h. | Sphere |  | surface area, volume |
| i. | Cylinder |  | surface area, volume |
| j. | Any others | | surface area, volume |

Let the students see some book and fill up.

## Appendix – 5

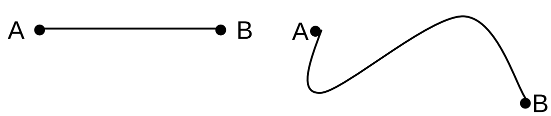
**Tips for Making Maths Easy**

1. Understand – Symbols – Use them.

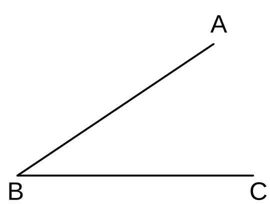
   +, -, X, ÷, =, ±, >, <, ≤, ≥, ≠, ≈

   $\therefore$ Sometimes $n$ $\sqrt{\ }$ $\sqrt[3]{\ }$ , (…..) ( )

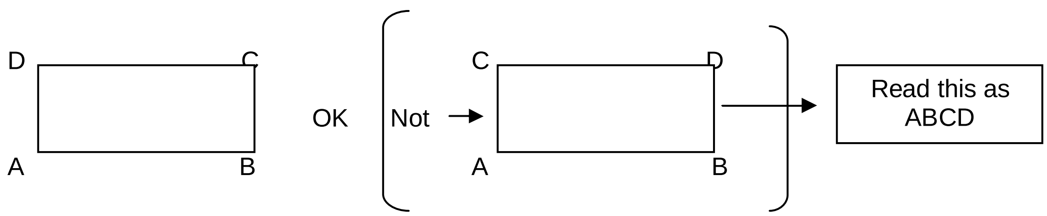
2. Learn substitution
3. Use your own notations; Use Let x be
4. Use LHS = RHS etc liberally
5. Always give names (A, P. R etc) to points (geometry)
6. Learn to give names to all geometric shapes




Lines




$\angle ABC = \angle CBA = A\hat{B}C = C\hat{B}A$……




7. Know the special like horizontal, vertical, perpendicular, right angle, parallel, annular, cone, prism, cube, parallelepiped, pipe, cylinder, segment, sector, hemisphere, hexagonal, tangential.
8. Learn to make your own graph: x axis, y axis etc. Learn how to join points or not to join.
9. Decimals, percent are very important in engineering.
10. Learn formulas along with meanings of symbols and units of the quantities.
11. Apply approximation methods to verify the order of values.