



Welcome to Dhronas' ultimate resource for mastering basic algebra in preparation for the WBCS Prelims Exam. Algebra is a fundamental mathematical concept that plays a crucial role in various competitive exams, including the WBCS. In this carefully curated collection, we provide you with a comprehensive understanding of basic algebraic principles, equations, and problem-solving techniques.

Our theory and practice questions are designed to help you build a strong foundation in algebra, ensuring that you're well-prepared to tackle algebra-related questions in the WBCS Prelims Exam. Get ready to enhance your algebraic skills and boost your confidence as you embark on this learning journey with us.

Topics covered in Basic Algebra

Algebra is an important subject for the WBCS Prelims Exam, as it is covered in the General Studies section. The General Studies section covers a wide range of topics, including current events, history, geography, economics, civics, and science and technology. However, algebra is one of the few topics that is specifically mentioned in the syllabus for the General Studies section.

The following are some of the basic algebra topics that are covered in the WBCS Prelims Exam:

- Linear equations and inequalities
- Sets and relations
- Functions
- Quadratic equations and inequalities
- Arithmetic progressions and geometric progressions
- Matrices and determinants
- Probability and statistics

So in this blog, we will discuss the Linear Equations. Let's try to learn what the equation is first and its Components and then we will discuss the Linear Equation.

Equations and its Types

A statement of equality which involves variables and number(s) is called an equation.

E.g. $4x = 12$, $7 - 2z^3 = 5$ etc.

Equations are of three types:

1. Linear Equations
2. Quadratic Equations
3. Polynomials



So, let's discuss linear equation first.

Linear Equations Theory and Examples

An equation in which the highest power of the variables involved is one, is called a linear equation.

E.g. $x/3 = 8$, $x + y = 10$ etc.

- **Linear equation in one variable:** An equation containing only one variable with the highest power one. (Represent point in the number line).
E.g. $16x = 56$, $78z = 81$
- **Linear equation in two variables:** An equation containing only two variables with the highest power one. A graph of linear equations $ax + by = c$ is a straight line.
E.g. $3x + 2y = 34$, $3 = x / (5 - t)$ etc.
- **Linear equation in three variables:** A linear equation in which numbers of unknown variables are three, is known as the linear equation in three variables. (Represents a place in 3 dimensions).
E.g. $4x + 6y + 7z = 20$, $x + y + 2z = 5$ etc.

We learned about the different types of equations but what are the uses of these equations? How to solve these equations? What is consistency in equations? We will learn all these in this blog

Let's start by studying the consistency of the system.

Consistency of Linear Equation

A set of linear equations is said to be consistent if there exists at least one solution for these equations, otherwise, the equation is inconsistent.

Let us consider a system of two linear equations as shown, $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$

Consistent System: If the system has at least one solution exists then there would be two possibilities.

- Independent Equation: System has a unique solution or $a_1/a_2 \neq b_1/b_2$, it represents a pair of intersecting lines.
- Dependent Equation: System has infinite solution or $a_1/a_2 = b_1/b_2 = c_1/c_2$, it represents a pair of parallel lines.

Inconsistent System: If system of equations has no solution then,

$$a_1/a_2 = b_1/b_2 \neq c_1/c_2$$

E.g. Check whether the given system is consistent or not. If yes, then find the solution.

$$x - 2y = 0$$

$$3x + 4y - 20 = 0$$

Sol: Here, $a_1 = 1$, $a_2 = 3$

$$b_1 = -2, b_2 = 4$$

$$c_1 = 0, c_2 = -20$$

$$a_1 / a_2 = 1/3,$$

$$b_1 / b_2 = (-2) / 4 = (-1) / 2,$$

$$c_1 / c_2 = 0$$

here, $a_1/a_2 \neq b_1/b_2$

We don't know how to find solution so let's try to learn how to find out first.

Methods to Solve Linear Equations

- Substitution Method
- Elimination Method
- Cross Multiplication Method

Substitution method: In this method, first the value of one variable must be represented in the form of another variable and put this value in another equation and solve it. Thus, the value of one variable is obtained and this value is used to find the value of another variable.

E.g. Solve the following equations with the substitution method.

$$2x - y = 3, 4x - y = 5$$

Sol: $2x - y = 3$... (i)

$$\Rightarrow y = 2x - 3$$

$$\Rightarrow 4x - y = 5$$
 ... (ii)

Putting the value of y in equation (ii)

$$\Rightarrow 4x - (2x - 3) = 5 \Rightarrow 2x + 3 = 5 \Rightarrow 2x = 2 \Rightarrow x = 1$$

Now putting the value of x in (i)

$$\Rightarrow 4(1) - y = 5 \Rightarrow 4 - y = 5 \Rightarrow y = -1$$

Hence $x = 1$ and $y = -1$



Theory and Questions on Basic Algebra for WBCS Prelims Exam

Elimination method: In this method, the coefficient of one of the variables of each equation become equal to the coefficient of other equation by multiplying by a proper multiple. By solving these equations and by which we get the value of another variable and thus with the help of this value, we can find the value of another variable.

E.g. Solve the following equations with the elimination method.

$$2x - y = 3, 4x - y = 5$$

Sol: $2x - y = 3$ (i) $4x - y = 5$ (ii)

Subtracting (ii) from (i)

$$\Rightarrow -2x = -2$$

$$\Rightarrow x = 1$$

By putting the value of x in (i)

$$\Rightarrow 2(1) - y = 3$$

$$\Rightarrow 2 - y = 3$$

$$\Rightarrow y = -1$$



We got the same answer by both methods, let's try the cross multiplication method.

Cross multiplication method: Cross multiplication method is a technique used to solve linear equations that involve fractions. This method is used to simplify the equation by multiplying both sides of the equation by the denominators of the fractions, eliminating the fractions altogether.

Let,

$$a_1x + b_1y + c_1 = 0$$

$$a_2x + b_2y + c_2 = 0$$

Are two equations, by cross-multiplication method

$$\Rightarrow x / (b_1 c_2 - b_2 c_1) = y / (c_1 a_2 - c_2 a_1) = 1 / (a_1 b_2 - a_2 b_1)$$

E.g. Solve the following equations with a cross-multiplication method.

$$2x - y - 3 = 0 \text{ and } 4x - y - 5 = 0$$

Sol: By putting the value of a_1, b_1, c_1, a_2, b_2 and c_2 in formula

$$x / (b_1 c_2 - b_2 c_1) = y / (c_1 a_2 - c_2 a_1) = 1 / (a_1 b_2 - a_2 b_1)$$

$$\Rightarrow x / [-1 \times (-5) - (-1) \times (-3)] = y / [(-3) \times 4 - (-5) \times 2] = 1 / [2 \times (-1) - 4 \times (-1)]$$

$$\Rightarrow x / (5 - 3) = y / (-12 + 10) = 1 / (-2 + 4)$$

$$\Rightarrow x / 2 = y / (-2) = 1 / 2$$

$$\Rightarrow x = 1, y = -1$$

Now, we will solve some word problem questions using the concepts we learn in this blog.

Basic Algebra Questions

E.g. The sum of four numbers is 96. When 10 and 2 are added to the first two, and 6 and 14 are subtracted from the 3rd and 4th, all the four numbers will be equal. What are the numbers?

Sol: Let four numbers be a, b, c and d $a + b + c + d = 96 \dots(1)$

$$a + 10 = b + 2 = c - 6 = d - 14 = M \text{ (let)}$$

$$a = M - 10, b = M - 2, c = M + 6, d = M + 14$$

From equation (1)

$$M - 10 + M - 2 + M + 6 + M + 14 = 96 \quad 4M + 8 = 96$$

$$4M = 96 - 8 = 88 \quad M = 88/4 = 22$$

$$\Rightarrow a = M - 10 = 22 - 10 = 12$$

$$\Rightarrow b = M - 2 = 22 - 2 = 20$$

$$\Rightarrow c = M + 6 = 22 + 6 = 28$$

$$\Rightarrow d = M + 14 = 22 + 14 = 36$$

Now, let's solve another linear algebra word problem using the concept of elimination method.

E.g. In the zoo, there are some ducks and some tigers. If the head is counted there are 120 heads, while the legs are counted are 400 legs. What is the number of tigers in the zoo?

Sol: Total number of heads = 120

Total number of legs = 400

Ducks and tigers have one head but different number of legs Let the number of tigers be x and ducks be y.

Ducks have 2 legs and tigers have 4 legs.

$$\Rightarrow \text{ducks legs} + \text{tigers legs} = \text{Total number of legs}$$

$$\Rightarrow 4x + 2y = 400 \quad \text{--- (1)}$$

$$\Rightarrow x + y = 120 \quad \text{--- (2)}$$

Multiplying equation (2) by 2 and subtracting from equation (1),

We get, $2x = 160$

$$\Rightarrow x = 80$$

We will solve a bit complicated problem using the same set of principles that we learn in this blog.

E.g. Box A, B, C, D, E have mangoes. If 60 mangoes are drawn from box B and filled in box A then box B will have as many mangoes as box E has and if 60 mangoes are drawn from box A and filled in box B then box B will have as many mangoes as box D has. Boxes A and B together have 200 mangoes more than boxes D and E together have. If box B has 40 mangoes more than box C has and the total number of mangoes that they have is 2660, how many mangoes does box B have?

Sol: $B - 60 = E \dots(1)$

$$B + 60 = D \dots(2)$$

$$A + B = D + E + 200 \dots(3) \quad B = C + 40 \dots(4)$$

$$A + B + C + D + E = 2660 \dots(5)$$

From (1) and (2)

$$2B = D + E \dots(6)$$

From (3) and (6)

$$A = 2B + 200 \dots(7)$$

Using (4), (6) and (7) in (5)

$$\Rightarrow (B + 200) + B + (B - 40) + 2(B) = 2660$$

$$\Rightarrow 5B = 2500$$

$$\Rightarrow B = 500$$

In this example, every time different number of mangoes were taken out in different boxes. First, we converted every statement in linear equation form and by solving by linear equations, we obtained the required answer.

During our initial learning phase, we were exposed to different types of equations and the concept of consistency in a system. Upon determining consistency, we then evaluated if the equation had a unique solution. Subsequently, we applied these concepts to solve practical problems that involved the use of linear algebra. These skills are highly beneficial in addressing related questions that may appear in the WBCS Prelims Exam.



So, this is all for linear equations. In our next blog of Basic Algebra, we will discuss the **Quadratic Equations**. Till then, stay tuned!!

