

RRB JE Mathematics – ALGEBRA

Exam-Oriented Study Notes | Formulas • Shortcuts • Solved Examples • Practice MCQs

How to use these notes: First memorise the identities and laws, then practise the solved examples without looking at the solution. Finally attempt the MCQs under a time limit.

1. Algebraic Expressions

Key ideas

An algebraic expression contains variables, constants and coefficients. Like terms have the same variables with the same powers.

Operations

Combine like terms for addition/subtraction. For multiplication, multiply coefficients and add powers of the same variable. For division, divide coefficients and subtract powers.

Example

Simplify: $3x + 5 - 2x + 7 = x + 12$.

2. Important Algebraic Identities

Must-memorise identities

$$a^2 + 2ab + b^2 = (a+b)^2$$

$$a^2 - 2ab + b^2 = (a-b)^2$$

$$a^2 - b^2 = (a+b)(a-b)$$

$$a^3 + b^3 = (a+b)(a^2 - ab + b^2)$$

$$a^3 - b^3 = (a-b)(a^2 + ab + b^2)$$

Cubic expansions

$$(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$$

$$(a-b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$$

Useful identity

$$(a+b+c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$$

Shortcut example

Find 99^2 . Use $(100-1)^2 = 10000 - 200 + 1 = 9801$.

3. Factorisation

Methods

Common factor; grouping; difference of squares; perfect-square trinomial; sum/difference of cubes; quadratic factorisation.

Example 1

$$x^2 - 25 = x^2 - 5^2 = (x+5)(x-5).$$

Example 2

$$x^2 + 7x + 12 = (x+3)(x+4).$$

Exam tip

For $x^2 + bx + c$, look for two numbers whose product is c and sum is b .

4. Linear Equations

Rule

Keep the variable terms on one side and constants on the other. Any operation performed on one side must also be performed on the other.

Example

$$3x - 7 = 11 \rightarrow 3x = 18 \rightarrow x = 6.$$

Fractions

Multiply the entire equation by the LCM of denominators before simplifying.

5. Simultaneous Linear Equations

Standard form

$$a_1x + b_1y = c_1 \text{ and } a_2x + b_2y = c_2.$$

Methods

Elimination, substitution and cross-multiplication.

Example

$$x + y = 10 \text{ and } x - y = 2. \text{ Adding gives } 2x = 12, \text{ so } x = 6 \text{ and } y = 4.$$

6. Quadratic Equations

Standard form

$$ax^2 + bx + c = 0, \text{ where } a \neq 0.$$

Quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Discriminant

$D = b^2 - 4ac$. $D > 0$: two distinct real roots; $D = 0$: equal real roots; $D < 0$: no real roots.

Relations between roots α, β

$$\alpha + \beta = -b/a \text{ and } \alpha\beta = c/a.$$

Example

$$x^2 - 5x + 6 = 0 \rightarrow (x - 2)(x - 3) = 0 \rightarrow \text{roots are } 2 \text{ and } 3.$$

7. Indices / Exponents

Laws

$$a^m \times a^n = a^{m+n}; a^m / a^n = a^{m-n}; (a^m)^n = a^{mn}; (ab)^n = a^n b^n; a^0 = 1 (a \neq 0); a^{-n} = 1/a^n.$$

Fractional powers

$$a^{1/n} = \sqrt[n]{a} \text{ and } a^{(m/n)} = \sqrt[n]{a^m}.$$

Example

$$2^3 \times 2^4 = 2^7 = 128.$$

8. Surds

Basic idea

A surd is an irrational root expression such as $\sqrt{2}$ or $3\sqrt{5}$.

Simplification

$$\sqrt{50} = \sqrt{(25 \times 2)} = 5\sqrt{2}.$$

Rationalisation

To rationalise $1/(\sqrt{a})$, multiply numerator and denominator by $\sqrt{a}$. For $1/(a+\sqrt{b})$, use the conjugate $a-\sqrt{b}$.

Example

$$1/\sqrt{5} = \sqrt{5}/5.$$

9. Arithmetic Progression – Algebra Basics

nth term

$$a_n = a + (n-1)d.$$

Sum of n terms

$$S_n = n/2 [2a + (n-1)d].$$

Example

For AP 3, 7, 11,..., $a=3, d=4$. The 10th term = $3+9 \times 4 = 39$.

RRB JE Algebra – Quick Formula Sheet

Topic	Formula / Result
Square	$(a \pm b)^2 = a^2 \pm 2ab + b^2$
Difference of squares	$a^2 - b^2 = (a+b)(a-b)$
Cube sum	$a^3 + b^3 = (a+b)(a^2 - ab + b^2)$
Cube difference	$a^3 - b^3 = (a-b)(a^2 + ab + b^2)$
Quadratic roots	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Discriminant	$D = b^2 - 4ac$
Root sum	$\alpha + \beta = -b/a$
Root product	$\alpha\beta = c/a$
Indices	$a^m a^n = a^{m+n}$
Negative index	$a^{-m} = 1/a^m$
AP nth term	$a_n = a + (n-1)d$
AP sum	$S_n = n/2 [2a + (n-1)d]$

RRB JE-Style Practice MCQs

1. If $x + 1/x = 5$, then $x^2 + 1/x^2$ is:

A) 21 B) 22 C) 23 D) 25

Answer: C

2. 98^2 is:

A) 9404 B) 9604 C) 9801 D) 9904

Answer: B

3. The factors of $x^2 - 9$ are:

A) $(x-9)(x+1)$ B) $(x-3)(x+3)$ C) $(x-3)^2$ D) $(x+9)(x-1)$

Answer: B

4. The roots of $x^2 - 7x + 12 = 0$ are:

A) 2, 6 B) 3, 4 C) 1, 12 D) -3, -4

Answer: B

5. If $2x + 5 = 17$, x equals:

A) 5 B) 6 C) 7 D) 8

Answer: B

6. The discriminant of $x^2 - 6x + 9 = 0$ is:

A) 0 B) 9 C) 18 D) 36

Answer: A

7. $\sqrt{72}$ simplifies to:

A) $3\sqrt{8}$ B) $6\sqrt{2}$ C) $4\sqrt{3}$ D) $2\sqrt{18}$

Answer: B

8. $2^m \times 2^3$ equals:

A) 64 B) 128 C) 256 D) 512

Answer: C

9. The 12th term of AP 5, 8, 11,... is:

A) 35 B) 36 C) 38 D) 39

Answer: C

10. If α and β are roots of $2x^2 - 5x + 3 = 0$, $\alpha\beta$ equals:

A) $\frac{2}{3}$ B) $\frac{3}{2}$ C) $\frac{5}{2}$ D) $-\frac{3}{2}$

Answer: B

Final Exam Tips

- Memorise the standard identities before attempting lengthy questions.
- Use approximation and mental calculation only when it is safe and faster.
- For quadratic equations, check factorisation before using the formula.
- For surds, first extract perfect-square factors.
- In an objective exam, avoid spending too long on one algebra problem; mark it and return if time permits.