Affiliated to CBSE, New Delhi (Affiliation No. 1030642)

GNPS

GOMTI NANDAN PUBLIC SCHOOL

Gandhi Ward, Bina (M.P.) 470113. | 9165 609 333. | info@mygnps.com | www.mygnps.com

CLASS X · MATHEMATICS BASIC (241) · CBSE BOARD EXAMINATION 2027

CHAPTER 4 BASIC

Quadratic Equations

Chapter Practice Booklet · Questions only · Answers in the separate Answer Booklet

6 guided method questions | 35 practice questions | 3 case studies

Basic (430 series) board question index

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STUDENT DETAILS

NAME _____

CLASS & SECTION _____

ROLL NO. _____

BOOKLET STARTED ON _____

CHAPTER TEST SCORE _____ / 20

1

READ THIS FIRST · MATHEMATICS BASIC

Chapter Notes

The whole chapter in short-note form: every definition, formula, method and model answer. Revise from here – you should not need the textbook again.

1 What is a quadratic equation?

- **Standard form:** $ax^2 + bx + c = 0$, where a, b, c are real numbers and $a \neq 0$. The highest power of x is 2.
- To check whether an equation is quadratic, **expand, bring every term to one side and simplify**. It is quadratic only if an x^2 term is left.

EXAMPLE
$(x+1)^2 = 2(x-3) \rightarrow x^2 + 2x + 1 = 2x - 6 \rightarrow x^2 + 7 = 0$: quadratic ($a = 1, b = 0, c = 7$).

EXAMPLE
$x(x+4) = x^2 - 5 \rightarrow 4x + 5 = 0$: **not** quadratic, because the x^2 terms cancel.

A **root** of $ax^2 + bx + c = 0$ is a number α for which $a\alpha^2 + b\alpha + c = 0$. A quadratic equation has **at most two** roots. The roots of the equation are the zeroes of the polynomial $ax^2 + bx + c$.

2 Checking a root · finding a constant

- To check whether a number is a root, put it in place of x. The left side must come out as 0.
- If a root is given and the equation has an unknown constant: put the root in, find the constant, then solve the equation to get the other root.

EXAMPLE
Is $x = -3$ a root of $2x^2 + 5x - 3 = 0$? $2(9) - 15 - 3 = 0$ ✓ Yes.

EXAMPLE
2 is a root of $x^2 + kx - 10 = 0$. Find k and the other root.
$4 + 2k - 10 = 0 \rightarrow k = 3$. Then $x^2 + 3x - 10 = (x+5)(x-2) = 0$, so the other root is -5.

3 Factorisation: splitting the middle term

1. Write the equation in standard form. Find the product $a \times c$.
2. Find two numbers whose **product is** ac and whose **sum is** b. Split bx into two terms using them.
3. Group in pairs, take out the common factor, and write the left side as $(\ldots)(\ldots)$.
4. Put each factor equal to 0 to get the two roots.

EXAMPLE
$6x^2 - x - 2 = 0$: $ac = -12$; the numbers are -4 and 3 (product -12, sum -1).
$6x^2 - 4x + 3x - 2 = 2x(3x-2) + 1(3x-2) = (2x+1)(3x-2) = 0 \rightarrow x = -\frac{1}{2}$ or $\frac{2}{3}$

ac **positive,** b **positive**	both numbers positive
ac **positive,** b **negative**	both numbers negative
ac **negative**	one positive, one negative; the larger one takes the sign of b

4 Special cases

- **No x term**, like $4x^2 - 9 = 0$: $x^2 = \frac{9}{4} \rightarrow x = \pm\frac{3}{2}$. Do not forget the negative root.
- **No constant term**, like $3x^2 - 12x = 0$: take x common: $3x(x-4) = 0 \rightarrow x = 0$ or 4. **Never cancel** x: you would lose the root 0.
- **Perfect square**, like $9x^2 - 12x + 4 = 0$: $(3x-2)^2 = 0 \rightarrow x = \frac{2}{3}, \frac{2}{3}$ (two equal roots).
- **Surds**, like $\sqrt{2}x^2 + 7x + 5\sqrt{2} = 0$: $ac = 10$, so split $7x = 5x + 2x$: $x(\sqrt{2}x + 5) + \sqrt{2}(\sqrt{2}x + 5) = (x + \sqrt{2})(\sqrt{2}x + 5) = 0 \rightarrow x = -\sqrt{2}$ or $-\frac{5}{\sqrt{2}} = -\frac{5\sqrt{2}}{2}$
- **Fractions**, like $x - \frac{2}{x} = 1$ ($x \neq 0$): multiply by x: $x^2 - x - 2 = 0 \rightarrow (x-2)(x+1) = 0 \rightarrow x = 2$ or -1.

5 Quadratic formula

For $ax^2 + bx + c = 0$ ($a \neq 0$), with $D = b^2 - 4ac \geq 0$:

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

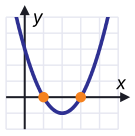
1. Write the equation in standard form. Write a, b, c **with their signs**.
2. Find D first. If D is negative, stop: there are no real roots.
3. Put the values in the formula and simplify both roots (one with $+$, one with $-$).

EXAMPLE
$2x^2 - 7x + 3 = 0$: $a = 2$, $b = -7$, $c = 3$. $D = 49 - 24 = 25$. $x = \frac{7 \pm 5}{4} \rightarrow x = 3$ or $\frac{1}{2}$.

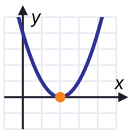
EXAMPLE
$x^2 - 2x - 4 = 0$: $D = 4 + 16 = 20$, $\sqrt{20} = 2\sqrt{5}$.
$x = \frac{2 \pm 2\sqrt{5}}{2} = 1 \pm \sqrt{5}$.

The formula always works. Factorisation is quicker when D is a perfect square. (Completing the square is not in the syllabus.)

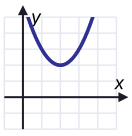
6 Discriminant and nature of roots



D > 0: two roots



D = 0: equal roots



D < 0: no real roots

$D = b^2 - 4ac > 0$	two **distinct real** roots (rational if D is a perfect square)
$D = 0$	two **equal real** roots, each $= -\frac{b}{2a}$
$D < 0$	**no real** roots

EXAMPLE
$3x^2 - 2x + 1 = 0$: $D = 4 - 12 = -8 < 0 \rightarrow$ no real roots.
$4x^2 - 12x + 9 = 0$: $D = 144 - 144 = 0 \rightarrow$ equal roots, each $\frac{12}{8} = \frac{3}{2}$.

"Real roots" means $D \geq 0$: the roots may be equal or distinct. The graph of $y = ax^2 + bx + c$ cuts the x-axis at the roots.

7 Finding k from a condition on the roots

equal roots	$D = 0$
real roots	$D \geq 0$
distinct real roots	$D > 0$
no real roots	$D < 0$

EXAMPLE
$kx^2 - 6x + 1 = 0$ has equal roots. $D = 36 - 4k = 0 \rightarrow k = 9$. Each root $= -\frac{b}{2a} = \frac{6}{18} = \frac{1}{3}$.

EXAMPLE
For what k does $x^2 + 4x + k = 0$ have real roots?
$16 - 4k \geq 0 \rightarrow k \leq 4$.

If k is in the coefficient of x^2, that coefficient cannot be 0 (else the equation is not quadratic), so reject such a value. $D = k^2 - 36 = 0$ gives $k = \pm 6$: write **both** values.

8 Word problems: how to form the equation

Consecutive numbers	x, $x + 1$; even or odd: x, $x + 2$
Number, reciprocal	x and $\frac{1}{x}$; multiply by x
Rectangle	area lb; perimeter $2(l + b)$
Right triangle	$a^2 + b^2 = c^2$ (c = hypotenuse)
Speed and time	time $= \frac{\text{distance}}{\text{speed}}$
Boat and stream	down $u + v$, up $u - v$
Taps, work	x hours for the job $\rightarrow \frac{1}{x}$ of it in 1 hour
Cost, sharing	cost of one $= \frac{\text{total}}{\text{number}}$

"1 hour less" $\rightarrow$ (slower time) $-$ (faster time) $= 1$. After solving, **reject** a root that does not fit the story (a negative speed, length or count) and write the reason.

9 Model answer: speed and time (5 marks)

A bus covers 240 km at a uniform speed. If its speed were 20 km/h more, the journey would take 1 hour less. Find its original speed.

1. Let the original speed be x km/h. ½
2. Time at this speed $= \dfrac{240}{x}$ h; at the higher speed $= \dfrac{240}{x+20}$ h. 1
3. $\dfrac{240}{x} - \dfrac{240}{x+20} = 1 \rightarrow \dfrac{240 \times 20}{x(x+20)} = 1$ 1
4. $x^2 + 20x - 4800 = 0$ 1
5. $(x+80)(x-60) = 0 \rightarrow x = 60$ or $x = -80$ 1
6. Speed cannot be negative, so the original speed is 60 km/h. ½

10 Model answer: right triangle (3 marks)

The two shorter sides of a right triangle differ by 7 cm and the hypotenuse is 17 cm. Find the two sides.

1. Let the shorter side be x cm; the other is $(x+7)$ cm. ½
2. $x^2 + (x+7)^2 = 17^2 \rightarrow 2x^2 + 14x - 240 = 0 \rightarrow x^2 + 7x - 120 = 0$ 1
3. $(x+15)(x-8) = 0 \rightarrow x = 8$ or $x = -15$ 1
4. A length cannot be negative, so the sides are 8 cm and 15 cm. ½

11 Checks that save marks

- Write the equation in standard form **before** reading a, b, c: in $x^2 = 3x - 2$, $b = -3$ and $c = 2$.
- Put each root back into the equation. It takes a few seconds and catches sign slips.
- In a word problem, write which root you reject and why.
- For "equal roots, find k", give every value of k (often $\pm$).
- If $D < 0$, write "no real roots".

Exam snapshot

What the board asks, and how to prepare

SYLLABUS 2026–27

- Standard form of a quadratic equation $ax^2 + bx + c = 0$, $a \neq 0$.
- Solutions (real roots only) by **factorisation** and by the **quadratic formula**.
- Relationship between the discriminant and the nature of roots.
- Situational problems from day-to-day life.

Not asked: completing the square, and equations reducible to quadratic equations (both deleted).

BOARD WEIGHTAGE

20 / 80

Unit II Algebra together. Basic papers give one or two 1-mark questions (standard form, discriminant) and a 5-mark question (a word problem, or equal roots with k) from this chapter.

MOST ASKED IN BASIC BOARD PAPERS + SAMPLE PAPER 2026–27 (3 PAPERS CHECKED)

How often	Question type	Marks	Papers
★★★	Discriminant, equal roots (find k), relation between the coefficients	1–5	3 of 3
★★☆	Word problem: numbers, speed and time, sharing	5	2 of 3
★★☆	Is it a quadratic equation? Writing it in standard form	1	2 of 3

MISTAKES THAT COST MARKS

- Sign slips in $D = b^2 - 4ac$ when c is negative: $-4ac$ becomes positive.
- Splitting the middle term with two numbers whose product is not ac.
- Dividing only $\sqrt{D}$ by $2a$ in the formula. The whole $-b \pm \sqrt{D}$ is divided by $2a$.
- Taking b as 5 in $x^2 - 5x + 6 = 0$. The sign goes with the number: $b = -5$.
- Not putting the roots back into the equation to check them.
- Leaving out the units, or the negative root that should be rejected, in a word problem.

HOW TO USE THIS BOOKLET

1. **Day 1:** Notes, then Part A (guided methods) – fill every blank.
2. **Day 2:** Part B (NCERT practice). Do every MUST DO question first.
3. **Day 3:** Part C (board pattern), Part D (case studies) and the real board questions in Part E.
4. **Wed 16 Dec: zero-period chapter test – 20 marks in 40 minutes, without the booklet.**
5. Check every answer in the Answer Booklet. Write each mistake on the My Mistakes page.

RULES AT A GLANCE

Standard form	$ax^2 + bx + c = 0,\ a \neq 0$
Discriminant	$D = b^2 - 4ac$
Roots	$x = \dfrac{-b \pm \sqrt{D}}{2a}$
$D > 0$ / $D = 0$ / $D < 0$	distinct real / equal real / no real roots
Equal roots	each $= -\dfrac{b}{2a}$
Speed	time $= \dfrac{\text{distance}}{\text{speed}}$

PART A · LEARN THE METHODS

A Guided Practice

Fill in the blanks to learn each board method step by step. Then use the same steps on your own in Part B.

Standard form and factorisation

A1. Complete the steps to check whether each equation is quadratic. MUST DO [2]

(i) $(x + 3)(x - 1) = x^2 + 5$: _____ $= x^2 + 5 \rightarrow$ _____ $= 0 \rightarrow$ quadratic? ____

(ii) $(x - 2)^2 + 1 = 2x - 3$: _____ $= 2x - 3 \rightarrow$ _____ $= 0 \rightarrow$ quadratic? ____

A2. Complete the steps to solve $2x^2 - 5x + 2 = 0$ by splitting the middle term. MUST DO [2]

$a \times c =$ ____. Two numbers with product ___ and sum -5: ____ and ____

$2x^2 -$ ___$x -$ ___$x + 2 = 0 \rightarrow 2x($ _____ $) - 1($ _____ $) = 0$

(_____)(_____) $= 0 \rightarrow x =$ ___ or ___

Discriminant and formula

A3. Complete the table. The first row is done for you. **MUST DO** [2]

Equation	$D = b^2 - 4ac$	Nature of roots
$x^2 - 5x + 6 = 0$	$25 - 24 = 1$	two distinct real roots
$x^2 - 4x + 4 = 0$	_____	_____
$2x^2 + 3x + 5 = 0$	_____	_____

A4. Complete the steps to solve $2x^2 + 5x - 3 = 0$ by the quadratic formula. [2]

$a =$ ___, $b =$ ___, $c =$ ___. $D = b^2 - 4ac =$ _____ $-$ _____ $=$ _____

$x = \dfrac{-b \pm \sqrt{D}}{2a} = \dfrac{-5 \pm}{\quad} \rightarrow x =$ _____ or $x =$ _____

A5. Complete the steps: find k for which $x^2 - kx + 9 = 0$ has equal roots. [2]

Equal roots: $D =$ ___. Here $a = 1$, $b =$ ___, $c = 9$.

$D =$ _____ $-$ _____ $= 0 \rightarrow k^2 =$ _____ $\rightarrow k =$ _____ or _____

Word problem

A6. The product of two consecutive positive integers is 132. Complete the steps to find them. [3]
MUST DO

Let the integers be x and _____. Equation: _____ $= 132 \rightarrow$ _____ $= 0$

Factorise: $(x +$ ___ $)(x -$ ___ $) = 0 \rightarrow x =$ ___ or ___

Reject ___ because _____. The integers are ___ and ___

B

PART B · NCERT PRACTICE

NCERT Practice

The same skills as the NCERT examples and exercises, with new numbers. Basic papers are built on NCERT, so finish every question.

Is it a quadratic equation?

B1. Check whether each equation is a quadratic equation: **MUST DO** [3]

(i) $(x + 2)^2 = 3(x - 1)$ (ii) $x(2x + 3) = 2x^2 + 5$ (iii) $(x - 1)^3 = x^3 + 2$

B2. Write each situation as a quadratic equation in standard form: [2]

(i) The product of two consecutive positive odd integers is 143.

(ii) The length of a rectangular plot is 3 m more than twice its breadth, and its area is 230 m².

Solving by factorisation

B3. Find the roots by factorisation: **MUST DO** [3]

(i) $x^2 - 5x - 14 = 0$ (ii) $3x^2 - x - 10 = 0$ (iii) $4x^2 - 12x + 9 = 0$

B4. Solve by factorisation: [2]

(i) $25x^2 - 30x + 9 = 0$ (ii) $x^2 - (1+\sqrt{3})x + \sqrt{3} = 0$

B5. Find two numbers whose sum is 31 and whose product is 234. MUST DO [3]

B6. Find two consecutive positive integers the sum of whose squares is 481. [3]

B7. The two shorter sides of a right triangle differ by 1 cm and its hypotenuse is 29 cm. Find the two sides. [3]

B8. A small unit makes baskets. On one day, the cost of making each basket (in ₹) was 3 more than twice the number of baskets made, and the total cost was ₹90. Find the number of baskets made and the cost of each. [3]

Quadratic formula and nature of roots

B9. Find the nature of the roots. If real roots exist, find them: MUST DO [3]

(i) $2x^2 - 3x + 5 = 0$ (ii) $3x^2 - 4\sqrt{3}x + 4 = 0$ (iii) $2x^2 - 6x + 3 = 0$

B10. Find the value(s) of k for which each equation has two equal roots: MUST DO [2]

(i) $3x^2 + kx + 12 = 0$ (ii) $kx(x-3) + 9 = 0$

B11. Is it possible to design a rectangular park with perimeter 60 m and area 200 m²? If so, find its length and breadth. [3]

B12. Is it possible that the sum of the ages of two friends is 18 years and the product of their ages 4 years ago was 60? Justify. [2]

Speed, time and work

B13. A train travels 180 km at a uniform speed. If the speed had been 9 km/h more, it would have taken 1 hour less. Find the speed of the train. MUST DO [3]

C

PART C · BOARD PATTERN (BASIC)

Board Pattern Practice

Question types from real Mathematics Basic papers (430 series) and the 2026–27 Sample Paper. ★★★ = asked in all 3 papers checked · ★★ = 2 papers · ★ = 1 paper.

ASSERTION–REASON: HOW TO ANSWER

(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

Standard form · is it quadratic?

★★☆ 2 of 3 papers · 1 mark

C1. Which of the following is a quadratic equation? MUST DO [1]

(a) $x^2 + \dfrac{1}{x^2} = 2$ (b) $x^3 - x^2 = (x-1)^3$

(c) $x(x+3) = x^2 - 5$ (d) $(x-2)^2 = x^2 + 2x$

C2. When $x - \frac{2}{x} = 1$ $(x \neq 0)$ is written as $ax^2 + bx + c = 0$ with $a = 1$, the value of $a + b + c$ is: [1]

(a) 0 (b) -2 (c) 2 (d) -1

A root is given

C3. If $x = -2$ is a root of $3x^2 + 7x + p = 0$, then p is: MUST DO [1]

(a) 2 (b) -2 (c) 26 (d) -26

C4. If 4 is a root of $x^2 + px - 4 = 0$ and the equation $x^2 + px + k = 0$ has equal roots, find k. [2]
MUST DO

Discriminant · nature of roots · find k

★★★ 3 of 3 papers · 1–5 marks

C5. The discriminant of $3x^2 - 5x - 2 = 0$ is: MUST DO [1]

(a) 49 (b) 1 (c) 19 (d) -1

C6. The discriminant of $px^2 + 2x + p = 0$ is: [1]

(a) $4p^2 - 4$ (b) $2 - 4p^2$ (c) $4 + 4p^2$ (d) $4 - 4p^2$

C7. The equation $2x^2 - 4x + 3 = 0$ has: [1]

(a) two distinct real roots (b) two equal real roots
(c) no real roots (d) more than two real roots

C8. $kx^2 + 4x + 1 = 0$ $(k \neq 0)$ has real roots when: [1]

(a) $k \geq 4$ (b) $k = 4$ only (c) $k < 4$ only (d) $k \leq 4$

C9. If the roots of $ax^2 + bx + c = 0$ are reciprocals of each other, then: [1]

(a) $a = b$ (b) $b = c$ (c) $a = c$ (d) $a = -c$

C10. ASSERTION–REASON [1]

Assertion (A): The equation $x^2 + 3x + 5 = 0$ has no real roots.

Reason (R): A quadratic equation has no real roots when its discriminant is negative.

C11. Find the values of k for which $9x^2 + 3kx + 4 = 0$ has equal roots. MUST DO [2]

C12. Find the nature of the roots of $2x^2 - 5x + 3 = 0$. If they are real, find them. [2]

C13. Find k for which $4x^2 - kx + 9 = 0$ has equal roots. Find the roots for each value of k. MUST DO [3]

Solve: factorisation or formula

2 marks

C14. Solve by factorisation: $6x^2 - 7x - 3 = 0$. MUST DO [2]

C15. Solve using the quadratic formula: $x^2 - 4x - 1 = 0$. [2]

C16. Solve: $\frac{1}{x} - \frac{1}{x+2} = \frac{1}{4}$, $x \neq 0, -2$. [2]

Word problems

★★☆ 2 of 3 papers · 5 marks

C17. The product of two consecutive positive even integers is 168. Find them. MUST DO [2]

C18. The product of Ravi's age 5 years ago and his age 3 years from now is 105. Find his present age. [3]

C19. The difference of two natural numbers is 3 and the difference of their reciprocals is $\frac{1}{6}$. Find the numbers. [3]

C20. The perimeter of a right triangle is 30 cm and its hypotenuse is 13 cm. Find the other two sides. MUST DO [3]

C21. Ria and Sid together have 40 stickers. Each loses 4 stickers, and the product of the numbers they now have is 240. How many stickers did each have at the start? [3]

C22. An express train takes 1 hour less than a passenger train to cover 300 km. The express train is 10 km/h faster. Find the speeds of the two trains. MUST DO [5]

D

PART D · SECTION E STYLE

Case-Based Questions

Each case carries 4 marks (1 + 1 + 2), as in Section E of the board paper. Underline the numbers in the passage before you start.

D1. Case Study · Diwali Mela Stall [4]

For the school Diwali mela, Neha buys x clay diyas for ₹600. She notices that if each diya had cost ₹5 less, she could have bought 10 more diyas for the same ₹600.

(i) Write the cost of one diya in terms of x. [1]

(ii) Form a quadratic equation in x in standard form. [1]

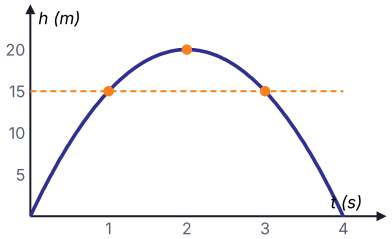
(iii) Find the number of diyas she bought. [2]

OR

(iii) She sells all the diyas at ₹25 each. Find her profit. [2]

D2. Case Study · Ball in the Air [4]

In a sports-day demonstration a ball is thrown straight up. Its height after t seconds is $h = 20t - 5t^2$ metres.



(i) Find the height of the ball after 1 second. [1]

(ii) Using the discriminant, check whether the ball can reach a height of 25 m. [1]

(iii) At what times is the ball 15 m above the ground? [2]

OR

(iii) Find the height h for which $5t^2 - 20t + h = 0$ has equal roots. What does this height mean? [2]

D3. Case Study · School Garden [4]

The eco club is laying out a rectangular garden whose length is 4 m more than its breadth. The area of the garden is to be 96 m².

(i) Taking the breadth as x m, write the quadratic equation. [1]

(ii) Find the discriminant of this equation. [1]

(iii) Find the length and breadth of the garden. [2]

OR

(iii) Fencing costs ₹50 per metre. Find the cost of fencing the garden. [2]

E

PART E · REAL BOARD QUESTIONS

Board PYQ Index (Basic)

Real questions from the Mathematics Basic (430 series) papers and the 2026–27 Sample Paper, by type. Open the official paper and solve the listed questions.

Frequency	Question type	Marks	Where asked (year: paper code, question number)	Practise here
★★★	**Discriminant, equal roots, relation between coefficients**	1–5	**2026:** 430/1/2 Q2 · **2025:** 430/1/1 Q3, Q32(b) · **SQP 2026–27:** Q5	A3, A5, B9–B12, C5–C13, D2
★★☆	**Word problems**	5	**2025:** 430/1/1 Q32(a) · **SQP 2026–27:** Q33	A6, B5–B8, B13, C17–C22, D1, D3
★★☆	**Is it quadratic? Standard form**	1	**2026:** 430/1/2 Q1 · **2025:** 430/1/1 Q4	A1, B1–B2, C1–C2

Papers checked (3): 2026 – 430/1/2 (Section A only could be read online) · 2025 – 430/1/1 · CBSE Sample Paper 2026–27 (Mathematics Basic). Sets of one code family share most questions, so they count as one paper. Download the official papers from cbse.gov.in → Previous Year Question Papers → Mathematics Basic.

F

PART F · YOUR RECORD

My Mistakes

Write down each mistake from this chapter, including the chapter test.

Every wrong answer is a free lesson. Write it here, find the rule you missed, and redo the question after three days. Bring this page to class before the next test.

Date	Part & Q No.	What went wrong	Correct rule or method	Redone ✓