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

CHAPTER 4 BASIC

Quadratic Equations

Answer Booklet · Full worked solutions with CBSE-style step marks

Every question of the Basic booklet | Step marks shown line by line | MCQ keys with working

INSIDE THIS BOOKLET

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HOW TO USE THE ANSWERS

1. Solve the question in your notebook **first**. Open this booklet only to check.
2. The orange number beside each line is the **step mark** an examiner gives for that line, as in the CBSE marking scheme.
3. Give yourself marks line by line. A right final answer without the working can lose step marks.
4. Check every root by putting it back into the equation. In a word problem, check the answer against the story too.
5. Copy every wrong answer to the My Mistakes page of your booklet.

READ THIS FIRST

Marking Guide

Full worked solutions to every question in the chapter booklet, set out the way a CBSE examiner marks them.

HOW MARKS ARE GIVEN IN QUADRATIC EQUATIONS ANSWERS

1. **1-mark MCQ / assertion–reason:** only the correct option scores. The working here is for your understanding.
2. **Solve by factorisation (2 marks):** correct splitting and factors 1 · both roots 1.
3. **Quadratic formula (2 marks):** value of D 1 · both roots 1.
4. **Equal roots / find k (2–3 marks):** D written and put equal to 0 1 · value(s) of k 1 · roots, if asked, 1.
5. **Word problem (5 marks):** "let" and expressions 1 · the equation 1 · standard form 1 · solving 1 · the answer, with the rejected root, 1.
6. Lines with no number are working that earns no separate mark but must be shown.

A

PART A · SOLUTIONS

Guided Practice – Solutions

Worked solutions with step marks for every question in Part A.

Standard form and factorisation

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

(i) $x^2 + 2x - 3 = x^2 + 5 \rightarrow 2x - 8 = 0$: not quadratic — 1

(ii) $x^2 - 4x + 4 + 1 = 2x - 3 \rightarrow x^2 - 6x + 8 = 0$: quadratic — 1

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

$ac = 4$; numbers -4 and -1: $2x^2 - 4x - x + 2 = 2x(x - 2) - 1(x - 2)$ — 1

$(2x - 1)(x - 2) = 0 \rightarrow x = \frac{1}{2}$ or 2 — 1

Discriminant and formula

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

Row 2: $D = 16 - 16 = 0 \rightarrow$ two equal real roots — 1

Row 3: $D = 9 - 40 = -31 \rightarrow$ no real roots — 1

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

$a = 2, b = 5, c = -3$; $D = 25 + 24 = 49$ — 1

$x = \dfrac{-5 \pm 7}{4} \rightarrow x = \frac{1}{2}$ or -3 — 1

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

$D = k^2 - 36 = 0$ 1

$k = 6$ or $k = -6$ 1

Word problem

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

$x(x+1) = 132 \rightarrow x^2 + x - 132 = 0$ 1

$(x+12)(x-11) = 0 \rightarrow x = 11$ or -12 1

-12 is not positive, so the integers are 11 and 12 1

B

PART B · SOLUTIONS

NCERT Practice – Solutions

Worked solutions with step marks for every question in Part B.

Is it a quadratic equation?

B1. Check whether each equation is a quadratic equation: **(i)** $(x+2)^2 = 3(x-1)$ **(ii)** $x(2x+3) = 2x^2 + 5$ **(iii)** $(x-1)^3 = x^3 + 2$ [3]

(i) $x^2 + 4x + 4 = 3x - 3 \rightarrow x^2 + x + 7 = 0$: **quadratic** 1

(ii) $2x^2 + 3x = 2x^2 + 5 \rightarrow 3x - 5 = 0$: **not quadratic** 1

(iii) $x^3 - 3x^2 + 3x - 1 = x^3 + 2 \rightarrow -3x^2 + 3x - 3 = 0$, i.e. $x^2 - x + 1 = 0$: **quadratic** 1

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

(i) Smaller integer x: $x(x+2) = 143 \rightarrow x^2 + 2x - 143 = 0$ 1

(ii) Breadth x m, length $(2x+3)$ m: $x(2x+3) = 230 \rightarrow 2x^2 + 3x - 230 = 0$ 1

Solving by factorisation

B3. Find the roots by factorisation: **(i)** $x^2 - 5x - 14 = 0$ **(ii)** $3x^2 - x - 10 = 0$ **(iii)** $4x^2 - 12x + 9 = 0$ [3]

(i) $(x-7)(x+2) = 0 \rightarrow x = 7$ or -2 1

(ii) $ac = -30$: $3x^2 - 6x + 5x - 10 = 3x(x-2) + 5(x-2) = (3x+5)(x-2) = 0 \rightarrow x = 2$ or $-\frac{5}{3}$ 1

(iii) $(2x-3)^2 = 0 \rightarrow x = \frac{3}{2}, \frac{3}{2}$ 1

B4. Solve by factorisation: **(i)** $25x^2 - 30x + 9 = 0$ **(ii)** $x^2 - (1+\sqrt{3})x + \sqrt{3} = 0$ [2]

(i) $(5x-3)^2 = 0 \rightarrow x = \frac{3}{5}, \frac{3}{5}$ 1

(ii) $x^2 - x - \sqrt{3}x + \sqrt{3} = x(x-1) - \sqrt{3}(x-1) = (x-1)(x-\sqrt{3}) = 0 \rightarrow x = 1$ or $\sqrt{3}$ 1

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

Let one number be x; the other is $31 - x$. $x(31 - x) = 234 \rightarrow x^2 - 31x + 234 = 0$ 1

$(x - 13)(x - 18) = 0 \rightarrow x = 13$ or 18 1

The numbers are 13 and 18 1

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

Let them be x and $x + 1$: $x^2 + (x + 1)^2 = 481 \rightarrow 2x^2 + 2x - 480 = 0 \rightarrow x^2 + x - 240 = 0$ 1

$(x + 16)(x - 15) = 0 \rightarrow x = 15$ (reject -16, not positive) 1

The integers are 15 and 16 1

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

Let the sides be x and $x + 1$: $x^2 + (x + 1)^2 = 29^2 \rightarrow x^2 + x - 420 = 0$ 1

$(x + 21)(x - 20) = 0 \rightarrow x = 20$ (a side cannot be -21) 1

The sides are 20 cm and 21 cm 1

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]**

Let x baskets be made; cost of each $= ₹(2x + 3)$. $x(2x + 3) = 90 \rightarrow 2x^2 + 3x - 90 = 0$ 1

$ac = -180$: $2x^2 + 15x - 12x - 90 = x(2x + 15) - 6(2x + 15) = (x - 6)(2x + 15) = 0 \rightarrow x = 6$ 1

6 baskets, ₹15 each (reject $x = -7.5$) 1

Quadratic formula and nature of roots

B9. Find the nature of the roots. If real roots exist, find them: **(i)** $2x^2 - 3x + 5 = 0$ **(ii)** $3x^2 - 4\sqrt{3}x + 4 = 0$ **(iii)** $2x^2 - 6x + 3 = 0$ **[3]**

(i) $D = 9 - 40 = -31 < 0$: **no real roots** 1

(ii) $D = 48 - 48 = 0$: equal roots, each $\dfrac{4\sqrt{3}}{6} = \dfrac{2}{\sqrt{3}}$ 1

(iii) $D = 36 - 24 = 12$: distinct real roots, $x = \dfrac{6 \pm 2\sqrt{3}}{4} = \dfrac{3 \pm \sqrt{3}}{2}$ 1

B10. Find the value(s) of k for which each equation has two equal roots: **(i)** $3x^2 + kx + 12 = 0$ **(ii)** $kx(x - 3) + 9 = 0$ **[2]**

(i) $D = k^2 - 144 = 0 \rightarrow k = \pm 12$ 1

(ii) $kx^2 - 3kx + 9 = 0$: $D = 9k^2 - 36k = 9k(k - 4) = 0 \rightarrow k = 4$ ($k = 0$ is rejected: the equation would not be quadratic) 1

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]

$l + b = 30$, so $b = 30 - l$. $l(30 - l) = 200 \rightarrow l^2 - 30l + 200 = 0$ — 1

$D = 900 - 800 = 100 > 0$, so yes, it is possible — 1

$(l - 20)(l - 10) = 0$: length 20 m, breadth 10 m — 1

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]

Ages x and $18 - x$: $(x - 4)(14 - x) = 60 \rightarrow x^2 - 18x + 116 = 0$ — 1

$D = 324 - 464 = -140 < 0$: no real roots, so it is **not possible** — 1

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. [3]

Let the speed be x km/h: $\frac{180}{x} - \frac{180}{x+9} = 1 \rightarrow 180 \times 9 = x(x + 9)$ — 1

$x^2 + 9x - 1620 = 0$; $D = 81 + 6480 = 6561 = 81^2 \rightarrow x = \frac{-9 + 81}{2} = 36$ — 1

Speed 36 km/h (the other root, -45, is rejected) — 1

PART C · SOLUTIONS

C Board Pattern Practice – Solutions

Worked solutions with step marks for every question in Part C.

Standard form · is it quadratic?

Q	Answer	Working / reason
C1	**(b)** $x^3 - x^2 = (x - 1)^3$	$x^3 - x^2 = x^3 - 3x^2 + 3x - 1 \rightarrow 2x^2 - 3x + 1 = 0$. (a) is not a polynomial equation; (c) and (d) become linear.
C2	**(b)** -2	$x^2 - x - 2 = 0$: $1 - 1 - 2 = -2$.

A root is given

Q	Answer	Working / reason
C3	**(a)** 2	$12 - 14 + p = 0 \rightarrow p = 2$.

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]

$16 + 4p - 4 = 0 \rightarrow p = -3$ — 1

$x^2 - 3x + k = 0$: $D = 9 - 4k = 0 \rightarrow k = \frac{9}{4}$ — 1

Discriminant · nature of roots · find k

Q	Answer	Working / reason
C5	**(a)** 49	$D = 25 - 4(3)(-2) = 25 + 24 = 49$.

C6	**(d)** $4 - 4p^2$	$D = 2^2 - 4(p)(p) = 4 - 4p^2$.
C7	**(c)** no real roots	$D = 16 - 24 = -8 < 0$.
C8	**(d)** $k \le 4$	$D = 16 - 4k \ge 0 \to k \le 4$.
C9	**(c)** a = c	Product of the roots $= \frac{c}{a}$ (Chapter 2). For roots α and $\frac{1}{\alpha}$ the product is 1, so $c = a$.
C10	**(a)**	$D = 9 - 20 = -11 < 0$. Both are true and R explains A.

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

$D = 9k^2 - 4(9)(4) = 9k^2 - 144$ — 1

$9k^2 = 144 \to k = \pm 4$ — 1

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

$D = 25 - 24 = 1 > 0$: two distinct real roots — 1

$x = \frac{5 \pm 1}{4} \to x = \frac{3}{2}$ or 1 — 1

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

$D = k^2 - 144 = 0$ — 1

$k = 12$ or $k = -12$ — 1

$k = 12$: $(2x - 3)^2 = 0 \to x = \frac{3}{2}, \frac{3}{2}$; $k = -12$: $(2x + 3)^2 = 0 \to x = -\frac{3}{2}, -\frac{3}{2}$ — 1

Solve: factorisation or formula

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

$ac = -18$: $6x^2 - 9x + 2x - 3 = 3x(2x - 3) + 1(2x - 3) = (3x + 1)(2x - 3) = 0$ — 1

$x = \frac{3}{2}$ or $-\frac{1}{3}$ — 1

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

$D = 16 + 4 = 20$, $\sqrt{20} = 2\sqrt{5}$ — 1

$x = \frac{4 \pm 2\sqrt{5}}{2} = 2 \pm \sqrt{5}$ — 1

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

$\frac{2}{x(x+2)} = \frac{1}{4} \to x^2 + 2x - 8 = 0$ — 1

$(x + 4)(x - 2) = 0 \to x = 2$ or -4 — 1

Word problems

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

$x(x + 2) = 168 \to x^2 + 2x - 168 = 0 \to (x + 14)(x - 12) = 0$ — 1

$x = 12$ (positive): the integers are 12 and 14 — 1

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

Present age x: $(x-5)(x+3)=105 \to x^2-2x-120=0$ — 1

$(x-12)(x+10)=0 \to x=12$ or -10 — 1

Age cannot be negative: Ravi is 12 years old — 1

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

Smaller x, larger $x+3$: $\frac{1}{x}-\frac{1}{x+3}=\frac{1}{6} \to \frac{3}{x(x+3)}=\frac{1}{6}$ — 1

$x^2+3x-18=0 \to (x+6)(x-3)=0 \to x=3$ — 1

The numbers are 3 and 6 — 1

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

Sides a and $17-a$: $a^2+(17-a)^2=169 \to 2a^2-34a+120=0$ — 1

$a^2-17a+60=0 \to (a-5)(a-12)=0$ — 1

The sides are 5 cm and 12 cm — 1

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]**

Ria x, Sid $40-x$: $(x-4)(36-x)=240 \to x^2-40x+384=0$ — 1

$D=1600-1536=64 \to x=\frac{40\pm 8}{2}=24$ or 16 — 1

One had 24 and the other 16 stickers — 1

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. **[5]**

Let the passenger train's speed be x km/h; the express train's is $(x+10)$ km/h. — ½

Times: $\frac{300}{x}$ h and $\frac{300}{x+10}$ h — 1

$\frac{300}{x}-\frac{300}{x+10}=1 \to 3000=x(x+10)$ — 1

$x^2+10x-3000=0$ — 1

$(x+60)(x-50)=0 \to x=50$ or -60 — 1

Speeds: passenger train 50 km/h, express train 60 km/h (reject -60) — ½

PART D · SOLUTIONS

D Case-Based Questions – Solutions

Worked solutions with step marks for every question in Part D.

D1. Case Study · Diwali Mela Stall [4]

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

$₹\frac{600}{x}$ 1

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

$\frac{600}{x} - \frac{600}{x+10} = 5 \rightarrow 6000 = 5x(x+10) \rightarrow x^2 + 10x - 1200 = 0$ 1

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

$(x+40)(x-30) = 0$ 1

$x = 30$ (reject -40): she bought 30 diyas 1

OR

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

From the equation, $x = 30$; cost of one diya $= \frac{600}{30} = ₹20$ 1

Profit $= 30 \times (25 - 20) = ₹150$ 1

D2. Case Study · Ball in the Air [4]

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

$h = 20 - 5 = 15$ m 1

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

$5t^2 - 20t + 25 = 0 \rightarrow t^2 - 4t + 5 = 0$; $D = 16 - 20 < 0$: no real t, so it **cannot** reach 25 m 1

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

$5t^2 - 20t + 15 = 0 \rightarrow t^2 - 4t + 3 = 0$ 1

$(t-1)(t-3) = 0$: at $t = 1$ s (going up) and $t = 3$ s (coming down) 1

OR

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

$D = 400 - 20h = 0 \rightarrow h = 20$ 1

It is reached only once (at $t = 2$ s): 20 m is the greatest height 1

D3. Case Study · School Garden [4]

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

$x(x+4) = 96 \rightarrow x^2 + 4x - 96 = 0$ 1

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

$D = 16 + 384 = 400$ 1

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

$x = \dfrac{-4 \pm 20}{2} = 8$ (reject -12) 1

Breadth 8 m, length 12 m 1

OR

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

Garden 12 m by 8 m (from the equation); perimeter $= 2(12 + 8) = 40$ m 1

Cost $= 40 \times 50 =$ ₹2,000 1