



Quadratic Equations — CBSE Class 10 Mathematics Chapter Test

FREE CHAPTER TEST · CLASS X · MATHEMATICS (041) · PATTERN OF THE CBSE BOARD PAPER

TIME ALLOWED	MAXIMUM MARKS	QUESTIONS	NAME / ROLL NO.
1½ hours	40	19 (A 10 · B 3 · C 2 · D 2 · E 2)	

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 19 questions. All questions are compulsory.
2. This question paper is divided into five sections: A, B, C, D and E.
3. In Section A, Questions 1 to 8 are multiple choice questions (MCQs) and Questions 9 and 10 are assertion-reason based questions of 1 mark each.
4. In Section B, Q11–13 are very short answer (VSA) type questions, carrying 2 marks each.
5. In Section C, Q14–15 are short answer (SA) type questions, carrying 3 marks each.
6. In Section D, Q16–17 are long answer (LA) type questions, carrying 5 marks each.
7. In Section E, Q18–19 are case study based questions, carrying 4 marks each, with sub-parts of the values of 1, 1 and 2 marks.
8. There is no overall choice. However, an internal choice has been provided in 1 question of Section B, 1 question of Section C, 1 question of Section D and in the 2-mark sub-part of each question of Section E.
9. Use of calculators is not allowed.
10. This chapter test follows the section structure, question types and marks per question of the CBSE Class X Mathematics (Standard, 041) board paper, at half the length of the 80-mark board paper: 40 marks in 1½ hours.
11. The answer key and the marking scheme are at the end of this booklet. Attempt the paper in 1½ hours before you look at them.

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Chapter: Quadratic Equations · **Topics:** Standard form of a quadratic equation · Solution by factorisation · Solution by the quadratic formula · Nature of roots · Situational problems

SECTION A

This section comprises 10 questions of 1 mark each: 8 multiple choice questions (MCQs) and 2 assertion-reason based questions.

1. The quadratic equation $x^2 - bx + 1 = 0$ has no real roots if and only if 1
(A) $b < -2$ or $b > 2$ (B) $-2 < b < 2$
(C) $-2 \leq b \leq 2$ (D) $b > 2$
2. The roots of the equation $a(x^2 + 1) - x(a^2 + 1) = 0$, where $a \neq 0$, are 1
(A) a and $\frac{1}{a}$ (B) $-a$ and $-\frac{1}{a}$
(C) a and $-\frac{1}{a}$ (D) $-a$ and $\frac{1}{a}$
3. The number of real roots of the equation $x^2 - 3|x| + 2 = 0$ is 1
(A) 2 (B) 1
(C) 4 (D) 3
4. The value of c for which the roots of $x^2 - 6x + c = 0$ differ by 2 is 1
(A) 9 (B) 5
(C) 6 (D) 8
5. The value of $\sqrt{6 + \sqrt{6 + \sqrt{6 + \dots}}}$ is 1
(A) 3 (B) -2
(C) 2 (D) 6
6. The quadratic equation $(x - a)(x - b) + (x - b)(x - c) + (x - c)(x - a) = 0$, where a, b and c are real, has equal roots only if 1
(A) $a + b + c = 0$ (B) $ab + bc + ca = 0$
(C) $a^2 + b^2 + c^2 = 0$ (D) $a = b = c$
7. The positive value of x that satisfies $\sqrt{3x^2 + 6} = 9$ is 1
(A) 25 (B) 5
(C) $\sqrt{5}$ (D) 3
8. The sum of a number and its square is 156. The number is 1
(A) -12 or 13 (B) 12 or 13
(C) 12 or -13 (D) -12 or -13

9. **Assertion (A):** If a , b and c are real numbers with $a \neq 0$ and $a + b + c = 0$, then $x = 1$ is a root of $ax^2 + bx + c = 0$. 1
Reason (R): Both roots of such an equation are always real.
 (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
 (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
 (C) Assertion (A) is true, but Reason (R) is false.
 (D) Assertion (A) is false, but Reason (R) is true.
10. **Assertion (A):** The equation $2x^2 - 3x + 5 = 0$ has two distinct real roots. 1
Reason (R): A quadratic equation $ax^2 + bx + c = 0$ has two distinct real roots only if $b^2 - 4ac > 0$.
 (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
 (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
 (C) Assertion (A) is true, but Reason (R) is false.
 (D) Assertion (A) is false, but Reason (R) is true.

SECTION B

This section comprises 3 very short answer (VSA) type questions of 2 marks each.

11. (a) Solve for x : $4x^2 - 4a^2x + (a^4 - b^4) = 0$. 2
 OR
 (b) Solve for x by factorisation: $x^2 - (\sqrt{3} + 1)x + \sqrt{3} = 0$.
12. Show that the equation $x^2 + ax - 4 = 0$ has two distinct real roots for every real value of a . 2
13. If the equation $(1 + m^2)x^2 + 2mcx + (c^2 - a^2) = 0$ has equal roots, show that $c^2 = a^2(1 + m^2)$. 2

SECTION C

This section comprises 2 short answer (SA) type questions of 3 marks each.

14. (a) Three years ago, Meena's age (in years) was $x - 3$. The product of her age three years ago and her age five years from now is 105. Form a quadratic equation and find her present age. 3
 OR
 (b) The length of a rectangle is 3 cm more than twice its breadth, and its area is 90 cm^2 . Form a quadratic equation and find the length and the breadth of the rectangle.
15. Using the quadratic formula, solve for x : $x^2 + 5x - (a^2 + a - 6) = 0$. 3

SECTION D

This section comprises 2 long answer (LA) type questions of 5 marks each.

16. (a) From a rectangular sheet of tin 30 cm long and 20 cm wide, equal squares are cut off at the four corners, and the sides are folded up to make an open box. The area of the base of the box is 264 cm^2 . Find the side of each square cut off and the volume of the box. 5

OR

(b) A shopkeeper buys a number of identical books for ₹1200. If each book had cost ₹20 less, he would have got 10 more books for the same amount. Find the number of books he bought and the cost of each.

17. (i) Using the quadratic formula, solve for x : $\frac{1}{x-1} + \frac{2}{x-2} = \frac{6}{x}$, $x \neq 0, 1, 2$. 5
- (ii) Find the value of k for which the equation $kx^2 - 14x + 12 = 0$ has two equal roots, and find the root.

SECTION E

This section comprises 2 case study based questions of 4 marks each, with sub-parts of 1, 1 and 2 marks.

18. A school has a rectangular garden 40 m long and 30 m wide. A path of uniform width x m is to be laid inside the garden along all four sides, and flowers are to be planted on the rest.

(i) Write, in terms of x , the length and the breadth of the flower bed. [1]

(ii) If the area of the flower bed is to be 816 m^2 , show that $x^2 - 35x + 96 = 0$, and find x . [1]

(iii) Find the width of the path if the area of the flower bed is to be 704 m^2 . [2]

OR

(iii) Find the width of the path if the path and the flower bed are to have equal areas. [2]

19. A ball is thrown vertically upwards from the ground. Its height h (in metres) after t seconds is given by $h = 20t - 5t^2$.

(i) After how many seconds does the ball return to the ground? [1]

(ii) At what times is the ball at a height of 15 m? [1]

(iii) Using the discriminant, show that the ball never reaches a height of 25 m, and find the greatest height h for which the equation $20t - 5t^2 = h$ has a real solution. [2]

OR

(iii) Find the times at which the ball is at a height of 10 m, and the length of time for which it stays above 10 m. [2]

END OF THE QUESTION PAPER

ANSWER KEY — SECTION A

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
(B)	(A)	(C)	(D)	(A)	(D)	(B)	(C)	(B)	(D)

MARKING SCHEME AND WORKED SOLUTIONS

Marks for each step are shown in brackets, as in the CBSE marking scheme. Any correct alternative method earns full marks.

Q1. Answer (B). No real roots means $D = b^2 - 4 < 0$, i.e. $b^2 < 4$, i.e. $-2 < b < 2$. At $b = \pm 2$ the roots are real and equal, so the end points are excluded.

Q2. Answer (A). $ax^2 - (a^2 + 1)x + a = 0$. Split the middle term: $ax^2 - a^2x - x + a = ax(x - a) - 1(x - a) = (ax - 1)(x - a) = 0$, so $x = a$ or $x = 1/a$.

Q3. Answer (C). Since $x^2 = |x|^2$, put $y = |x| \geq 0$: $y^2 - 3y + 2 = 0$ gives $y = 1$ or $y = 2$. Then $|x| = 1$ or $|x| = 2$, so $x = \pm 1, \pm 2$: four real roots.

Q4. Answer (D). By the quadratic formula the roots are $(6 \pm \sqrt{(36 - 4c)})/2$, which differ by $\sqrt{(36 - 4c)}$. $\sqrt{(36 - 4c)} = 2$ gives $36 - 4c = 4$, $c = 8$ (the roots are 2 and 4).

Q5. Answer (A). Let x be the value; then $x = \sqrt{6 + x}$, so $x^2 = 6 + x$, $x^2 - x - 6 = 0$, $(x - 3)(x + 2) = 0$. A square root is not negative, so $x = 3$.

Q6. Answer (D). Expanding: $3x^2 - 2(a + b + c)x + (ab + bc + ca) = 0$. $D = 4(a + b + c)^2 - 12(ab + bc + ca) = 4(a^2 + b^2 + c^2 - ab - bc - ca) = 2[(a - b)^2 + (b - c)^2 + (c - a)^2]$. This is zero only when $a = b = c$.

Q7. Answer (B). Squaring, $3x^2 + 6 = 81$, so $x^2 = 25$ and $x = \pm 5$. Both satisfy the original equation (the square root of 81 is 9); the positive value is 5. 25 is x^2 , not x .

Q8. Answer (C). $x^2 + x - 156 = 0$ gives $(x + 13)(x - 12) = 0$, so $x = 12$ or $x = -13$. (Both satisfy the condition: $144 + 12 = 156$ and $169 - 13 = 156$.)

Q9. Answer (B). $a(1)^2 + b(1) + c = a + b + c = 0$, so $x = 1$ is a root: A is true. The roots are 1 and c/a (their product is c/a), both real: R is true. But R does not explain why 1 is a root; the substitution does. Answer (B).

Q10. Answer (D). For $2x^2 - 3x + 5 = 0$, $D = 9 - 40 = -31 < 0$, so it has no real roots: A is false. R is true (two distinct real roots $\Leftrightarrow D > 0$). Answer (D).

Q11. (2 marks) Answer: (a) $x = (a^2 + b^2)/2$, $(a^2 - b^2)/2$; (b) $x = 1, \sqrt{3}$.

(a) $a^4 - b^4 = (a^2 + b^2)(a^2 - b^2)$, and $(a^2 + b^2) + (a^2 - b^2) = 2a^2$. So $4x^2 - 4a^2x + (a^4 - b^4) = [2x - (a^2 + b^2)][2x - (a^2 - b^2)]$. [1]
 $x = (a^2 + b^2)/2$ or $x = (a^2 - b^2)/2$. [1]

OR (b) $x^2 - \sqrt{3}x - x + \sqrt{3} = x(x - \sqrt{3}) - 1(x - \sqrt{3}) = (x - 1)(x - \sqrt{3})$. [1]
 $x = 1$ or $x = \sqrt{3}$. [1]

Q12. (2 marks) Answer: $D = a^2 + 16 > 0$.

$D = a^2 - 4(1)(-4) = a^2 + 16$. [1]

$a^2 \geq 0$ for every real a , so $D \geq 16 > 0$, and the equation always has two distinct real roots. [1]

Q13. (2 marks) Answer: proved.

Equal roots: $D = (2mc)^2 - 4(1 + m^2)(c^2 - a^2) = 0$. [½]

$4[m^2c^2 - c^2 + a^2 - m^2c^2 + a^2m^2] = 0$, i.e. $4[a^2(1 + m^2) - c^2] = 0$. [1]

Hence $c^2 = a^2(1 + m^2)$. [½]

Q14. (3 marks) Answer: (a) 10 years; (b) length 15 cm, breadth 6 cm.

(a) Let her present age be x years: $(x - 3)(x + 5) = 105$, so $x^2 + 2x - 15 = 105$, i.e. $x^2 + 2x - 120 = 0$. [1]

$(x + 12)(x - 10) = 0$, so $x = 10$ or $x = -12$. [1]

Age cannot be negative, so her present age is 10 years. (Check: $7 \times 15 = 105$.) [1]

OR (b) Breadth b cm, length $(2b + 3)$ cm: $b(2b + 3) = 90$, i.e. $2b^2 + 3b - 90 = 0$. [1]

$(2b + 15)(b - 6) = 0$, so $b = 6$ or $b = -15/2$. [1]

$b = 6$ cm (a length is positive), and the length is 15 cm. (Check: $6 \times 15 = 90$.) [1]

Q15. (3 marks) Answer: $x = a - 2$, $-(a + 3)$.

$D = 25 + 4(a^2 + a - 6) = 4a^2 + 4a + 1 = (2a + 1)^2$. [1]

$x = [-5 \pm (2a + 1)]/2$. [1]

$x = (2a - 4)/2 = a - 2$ or $x = (-2a - 6)/2 = -(a + 3)$. [1]

Q16. (5 marks) Answer: (a) 4 cm, 1056 cm^3 ; (b) 20 books, ₹60 each.

(a) Let the side of each square be x cm. The base of the box is $(30 - 2x)$ cm by $(20 - 2x)$ cm. [1]

$(30 - 2x)(20 - 2x) = 264 \Rightarrow 600 - 100x + 4x^2 = 264 \Rightarrow 4x^2 - 100x + 336 = 0 \Rightarrow x^2 - 25x + 84 = 0$. [1]

$(x - 4)(x - 21) = 0$, so $x = 4$ or $x = 21$. [1]

$x = 21$ would make $20 - 2x$ negative, so $x = 4$ cm. [1]

The base is $22 \text{ cm} \times 12 \text{ cm} = 264 \text{ cm}^2$ and the height is 4 cm, so the volume is $264 \times 4 = 1056 \text{ cm}^3$. [1]

OR (b) Let the number of books be x ; each costs ₹1200/ x . [1]

$1200/x - 1200/(x + 10) = 20$. [1]

$1200 \times 10 = 20x(x + 10) \Rightarrow x^2 + 10x - 600 = 0$. [1]

$(x + 30)(x - 20) = 0$, so $x = 20$ ($x = -30$ is not possible). [1]

He bought 20 books at ₹60 each. (Check: 30 books at ₹40 also cost ₹1200.) [1]

Q17. (5 marks) Answer: (i) $x = (7 + \sqrt{13})/3$, $(7 - \sqrt{13})/3$; (ii) $k = 49/12$, root $12/7$.

(i) Multiply by $x(x - 1)(x - 2)$: $x(x - 2) + 2x(x - 1) = 6(x - 1)(x - 2)$. [1]

$3x^2 - 4x = 6x^2 - 18x + 12$, i.e. $3x^2 - 14x + 12 = 0$. [1]

$D = 196 - 144 = 52$, so $x = (14 \pm \sqrt{52})/6 = (7 \pm \sqrt{13})/3$; neither is 0, 1 or 2. [1]

(ii) Equal roots: $D = 196 - 48k = 0$, so $k = 49/12$. [1]

The root is $-b/2a = 14/(2 \times 49/12) = 12/7$. [1]

Q18. (4 marks) Answer: (i) $(40 - 2x)$ m, $(30 - 2x)$ m; (ii) 3 m; (iii)(a) 4 m; (b) 5 m.

(i) Length $(40 - 2x)$ m and breadth $(30 - 2x)$ m. [1]

(ii) $(40 - 2x)(30 - 2x) = 816 \Rightarrow 4x^2 - 140x + 384 = 0 \Rightarrow x^2 - 35x + 96 = 0 \Rightarrow (x - 3)(x - 32) = 0$; $x = 32$ makes $30 - 2x$ negative, so $x = 3$ m. [1]

(iii)(a) $(40 - 2x)(30 - 2x) = 704 \Rightarrow x^2 - 35x + 124 = 0$. [1]

$D = 1225 - 496 = 729$, $x = (35 \pm 27)/2 = 31$ or 4 ; 31 is not possible, so the path is 4 m wide. [1]

OR (iii)(b) Equal areas: the bed is half of 1200 m^2 , i.e. 600 m^2 . $(40 - 2x)(30 - 2x) = 600 \Rightarrow x^2 - 35x + 150 = 0$. [1]

$(x - 5)(x - 30) = 0$; $x = 30$ is not possible, so the path is 5 m wide. [1]

Q19. (4 marks) Answer: (i) 4 s; (ii) 1 s and 3 s; (iii)(a) greatest height 20 m; (b) $2 \pm \sqrt{2}$ s, for $2\sqrt{2}$ s.

(i) $h = 0$: $5t(4 - t) = 0$, so $t = 0$ (the throw) or $t = 4$ s. [1]

(ii) $20t - 5t^2 = 15 \Rightarrow t^2 - 4t + 3 = 0 \Rightarrow (t - 1)(t - 3) = 0$: at $t = 1$ s (going up) and $t = 3$ s (coming down). [1]

(iii)(a) $20t - 5t^2 = 25 \Rightarrow t^2 - 4t + 5 = 0$, $D = 16 - 20 = -4 < 0$: no real t , so the ball never reaches 25 m. [1]

$20t - 5t^2 = h \Rightarrow 5t^2 - 20t + h = 0$ has a real solution when $D = 400 - 20h \geq 0$, i.e. $h \leq 20$. The greatest height is 20 m. [1]

OR (iii)(b) $20t - 5t^2 = 10 \Rightarrow t^2 - 4t + 2 = 0 \Rightarrow t = (4 \pm \sqrt{8})/2 = 2 \pm \sqrt{2}$ s. [1]

It is above 10 m between these times, for $(2 + \sqrt{2}) - (2 - \sqrt{2}) = 2\sqrt{2}$ s. [1]

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