

MATHEMATICS · JEE MAIN

# Quadratic Equations & Polynomial Inequalities

Chapter-wise previous year questions, with answer key

**68**

PYQS

**2020–2025**

PAPERS

**6**

TOPICS

Nature of Roots

Relation Between Roots and Coefficients

Transformation of Equations

Common Roots

Location of Roots

Wavy Curve Method

- 1 Attempt each question on paper first — they're grouped by topic, newest papers first.
- 2 Check yourself against the answer key at the end.
- 3 Got one wrong? Tap “Step-by-step solution” under it for the full working.

## Stuck on a question?

Every question has a free step-by-step solution on PrepWiser — tap “Step-by-step solution” under it.

Practise this chapter online with instant answer checking: [prepwisser.in/learn](https://prepwisser.in/learn) · No signup needed to browse

## Nature of Roots · 22 PYQs

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**Q1** JEE Main 2025 · 4 Apr · Shift 1

Consider the equation  $x^2 + 4x - n = 0$ , where  $n \in [20, 100]$  is a natural number. Then the number of all distinct values of  $n$ , for which the given equation has integral roots, is equal to

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

Step-by-step solution ► [prepwisser.in/questions/EqXkj5pf-i](https://www.prepwisser.in/questions/EqXkj5pf-i)

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**Q2** JEE Main 2025 · 29 Jan · Shift 2

If the set of all  $a \in \mathbf{R}$ , for which the equation  $2x^2 + (a - 5)x + 15 = 3a$  has no real root, is the interval  $(\alpha, \beta)$ , and  $X = \{x \in \mathbf{Z}; \alpha < x < \beta\}$ , then  $\sum_{x \in X} x^2$  is equal to:

- (A) 2139  
(B) 2119  
(C) 2109  
(D) 2129

Step-by-step solution ► [prepwisser.in/questions/U3\\_HMF1Go5](https://www.prepwisser.in/questions/U3_HMF1Go5)

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**Q3** JEE Main 2025 · 28 Jan · Shift 1

The sum, of the squares of all the roots of the equation  $x^2 + |2x - 3| - 4 = 0$ , is

- (A)  $6(2 - \sqrt{2})$  (B)  $3(3 - \sqrt{2})$   
(C)  $3(2 - \sqrt{2})$  (D)  $6(3 - \sqrt{2})$

Step-by-step solution ► [prepwisser.in/questions/IBBbxzkzoe](https://www.prepwisser.in/questions/IBBbxzkzoe)

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**Q4** JEE Main 2025 · 23 Jan · Shift 1

If the equation  $a(b - c)x^2 + b(c - a)x + c(a - b) = 0$  has equal roots, where  $a + c = 15$  and  $b = \frac{36}{5}$ , then  $a^2 + c^2$  is equal to \_\_\_\_\_

Numerical answer — enter the value.

Step-by-step solution ► [prepwisser.in/questions/Md3HAr0Hlx](https://www.prepwisser.in/questions/Md3HAr0Hlx)

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**Q5** JEE Main 2025 · 23 Jan · Shift 2

Let  $\alpha, \beta$  be the roots of the equation  $x^2 - ax - b = 0$  with  $\text{Im}(\alpha) < \text{Im}(\beta)$ . Let  $P_n = \alpha^n - \beta^n$ . If  $P_3 = -5\sqrt{7}i$ ,  $P_4 = -3\sqrt{7}i$ ,  $P_5 = 11\sqrt{7}i$  and  $P_6 = 45\sqrt{7}i$ , then  $|\alpha^4 + \beta^4|$  is equal to \_\_\_\_\_.

Numerical answer — enter the value.

Step-by-step solution ► [prepwisser.in/questions/vmTUds53nk](https://www.prepwisser.in/questions/vmTUds53nk)

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**Q6** JEE Main 2024 · 4 Apr · Shift 2

Let

$$S = \{\sin^2 2\theta : (\sin^4 \theta + \cos^4 \theta) x^2 + (\sin 2\theta)x + (\sin^6 \theta + \cos^6 \theta) = 0$$

has real roots  $\}$ . If  $\alpha$  and  $\beta$  be the smallest and largest elements of the set  $S$ , respectively, then  $3((\alpha - 2)^2 + (\beta - 1)^2)$  equals \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/XpVFsiHo2o](https://www.prepwiser.in/questions/XpVFsiHo2o)

**Q7** JEE Main 2024 · 31 Jan · Shift 2

Let  $a, b, c$  be the lengths of three sides of a triangle satisfying the condition  $(a^2 + b^2)x^2 - 2b(a + c)x + (b^2 + c^2) = 0$ . If the set of all possible values of  $x$  is the interval  $(\alpha, \beta)$ , then  $12(\alpha^2 + \beta^2)$  is equal to \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/8s6CiI22am](https://www.prepwiser.in/questions/8s6CiI22am)

**Q8** JEE Main 2024 · 30 Jan · Shift 1

If  $2\sin^3 x + \sin 2x \cos x + 4\sin x - 4 = 0$  has exactly 3 solutions in the interval  $[0, \frac{n\pi}{2}]$ ,  $n \in \mathbb{N}$ , then the roots of the equation  $x^2 + nx + (n - 3) = 0$  belong to :

(A)  $(0, \infty)$

(B)  $\mathbb{Z}$

(C)  $(-\frac{\sqrt{17}}{2}, \frac{\sqrt{17}}{2})$

(D)  $(-\infty, 0)$

[Step-by-step solution ► prepwiser.in/questions/dXMuAaOeFD](https://www.prepwiser.in/questions/dXMuAaOeFD)

**Q9** JEE Main 2023 · 12 Apr · Shift 1

Let  $\alpha, \beta$  be the roots of the quadratic equation  $x^2 + \sqrt{6}x + 3 = 0$ . Then

$$\frac{\alpha^{23} + \beta^{23} + \alpha^{14} + \beta^{14}}{\alpha^{15} + \beta^{15} + \alpha^{10} + \beta^{10}}$$

is equal to :

(A) 72

(B) 9

(C) 729

(D) 81

[Step-by-step solution ► prepwiser.in/questions/tP-RBNAZzl](https://www.prepwiser.in/questions/tP-RBNAZzl)

**Q10** JEE Main 2023 · 8 Apr · Shift 2

Let  $m$  and  $n$  be the numbers of real roots of the quadratic equations  $x^2 - 12x + [x] + 31 = 0$  and  $x^2 - 5|x + 2| - 4 = 0$  respectively, where  $[x]$  denotes the greatest integer  $\leq x$ . Then  $m^2 + mn + n^2$  is equal to \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/saIMAMP1eb](https://www.prepwiser.in/questions/saIMAMP1eb)

**Q11** JEE Main 2023 · 24 Jan · Shift 2

The number of real solutions of the equation

$$3\left(x^2 + \frac{1}{x^2}\right) - 2\left(x + \frac{1}{x}\right) + 5 = 0$$

, is

(A) 3

(B) 4

(C) 0

(D) 2

[Step-by-step solution ► prepwiser.in/questions/ELXPYQmQ1-](#)

**Q12** JEE Main 2023 · 24 Jan · Shift 1

Let  $\lambda \in \mathbb{R}$  and let the equation E be  $|x|^2 - 2|x| + |\lambda - 3| = 0$ . Then the largest element in the set  $S = \{x + \lambda : x \text{ is an integer solution of E}\}$  is \_\_\_\_\_

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/o69qjpYMUa](#)

**Q13** JEE Main 2022 · 28 Jul · Shift 1

For  $p, q \in \mathbb{R}$ , consider the real valued function  $f(x) = (x - p)^2 - q, x \in \mathbb{R}$  and  $q > 0$ . Let  $a_1, a_2, a_3$  and  $a_4$  be in an arithmetic progression with mean  $p$  and positive common difference. If  $|f(a_i)| = 500$  for all  $i = 1, 2, 3, 4$ , then the absolute difference between the roots of  $f(x) = 0$  is \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/XAy9BcBzhE](#)

**Q14** JEE Main 2022 · 28 Jul · Shift 1

The sum of all real values of  $x$  for which  $\frac{3x^2 - 9x + 17}{x^2 + 3x + 10} = \frac{5x^2 - 7x + 19}{3x^2 + 5x + 12}$  is equal to \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/YjibYajlOG](#)

**Q15** JEE Main 2021 · 1 Sep · Shift 2

The numbers of pairs  $(a, b)$  of real numbers, such that whenever  $\alpha$  is a root of the equation  $x^2 + ax + b = 0$ ,  $\alpha^2 - 2$  is also a root of this equation, is :

(A) 6

(B) 2

(C) 4

(D) 8

[Step-by-step solution ► prepwiser.in/questions/E-ihEv048c](#)

**Q16** JEE Main 2021 · 26 Aug · Shift 1

The sum of all integral values of  $k$  ( $k \neq 0$ ) for which the equation  $\frac{2}{x-1} - \frac{1}{x-2} = \frac{2}{k}$  in  $x$  has no real roots, is \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/GTNvutSwPU](#)

**Q17** JEE Main 2021 · 25 Jul · Shift 2

The number of real solutions of the equation,  $x^2 - |x| - 12 = 0$  is :

- (A) 2 (B) 3  
(C) 1 (D) 4

[Step-by-step solution ► prepwiser.in/questions/\\_MysNs4T6n](https://www.prepwiser.in/questions/_MysNs4T6n)

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**Q18** JEE Main 2021 · 20 Jul · Shift 1

The probability of selecting integers  $a \in [-5, 30]$  such that  $x^2 + 2(a + 4)x - 5a + 64 > 0$ , for all  $x \in \mathbb{R}$ , is :

- (A)  $\frac{7}{36}$  (B)  $\frac{2}{9}$   
(C)  $\frac{1}{6}$  (D)  $\frac{1}{4}$

[Step-by-step solution ► prepwiser.in/questions/g49PUHkVFp](https://www.prepwiser.in/questions/g49PUHkVFp)

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**Q19** JEE Main 2021 · 25 Feb · Shift 1

The integer 'k', for which the inequality  $x^2 - 2(3k - 1)x + 8k^2 - 7 > 0$  is valid for every  $x$  in  $\mathbb{R}$ , is :

- (A) 4 (B) 2  
(C) 3 (D) 0

[Step-by-step solution ► prepwiser.in/questions/NtMhjQqeRW](https://www.prepwiser.in/questions/NtMhjQqeRW)

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**Q20** JEE Main 2021 · 24 Feb · Shift 2

The number of the real roots of the equation  $(x + 1)^2 + |x - 5| = \frac{27}{4}$  is \_\_\_\_\_.

*Numerical answer — enter the value.*

[Step-by-step solution ► prepwiser.in/questions/\\_ixj\\_QaylX](https://www.prepwiser.in/questions/_ixj_QaylX)

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**Q21** JEE Main 2020 · 6 Sep · Shift 1

Let  $a, b, c, d$  and  $p$  be any non zero distinct real numbers such that

$(a^2 + b^2 + c^2)p^2 - 2(ab + bc + cd)p + (b^2 + c^2 + d^2) = 0$ . Then :

- (A)  $a, c, p$  are in G.P. (B)  $a, b, c, d$  are in G.P.  
(C)  $a, b, c, d$  are in A.P. (D)  $a, c, p$  are in A.P.

[Step-by-step solution ► prepwiser.in/questions/LmByL5dAhA](https://www.prepwiser.in/questions/LmByL5dAhA)

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**Q22** JEE Main 2020 · 8 Jan · Shift 1

The least positive value of 'a' for which the equation

$2x^2 + (a - 10)x + \frac{33}{2} = 2a$  has real roots is

*Numerical answer — enter the value.*

[Step-by-step solution ► prepwiser.in/questions/IgREIP2Meu](https://www.prepwiser.in/questions/IgREIP2Meu)

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## Relation Between Roots and Coefficients · 31 PYQs

**Q23** JEE Main 2025 · 2 Apr · Shift 1

Let  $P_n = \alpha^n + \beta^n$ ,  $n \in \mathbb{N}$ . If  $P_{10} = 123$ ,  $P_9 = 76$ ,  $P_8 = 47$  and  $P_1 = 1$ , then the quadratic equation having roots  $\frac{1}{\alpha}$  and  $\frac{1}{\beta}$  is :

(A)  $x^2 + x - 1 = 0$

(B)  $x^2 - x + 1 = 0$

(C)  $x^2 + x + 1 = 0$

(D)  $x^2 - x - 1 = 0$

[Step-by-step solution ► prepwisar.in/questions/-lsyMrHfYB](https://www.prepwisar.in/questions/-lsyMrHfYB)

**Q24** JEE Main 2025 · 23 Jan · Shift 2

The roots of the quadratic equation  $3x^2 - px + q = 0$  are  $10^{\text{th}}$  and  $11^{\text{th}}$  terms of an arithmetic progression with common difference  $\frac{3}{2}$ . If the sum of the first 11 terms of this arithmetic progression is 88, then  $q - 2p$  is equal to \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwisar.in/questions/C\\_BvRsqHkS](https://www.prepwisar.in/questions/C_BvRsqHkS)

**Q25** JEE Main 2025 · 22 Jan · Shift 2

Let  $\alpha_\theta$  and  $\beta_\theta$  be the distinct roots of  $2x^2 + (\cos \theta)x - 1 = 0$ ,  $\theta \in (0, 2\pi)$ . If  $m$  and  $M$  are the minimum and the maximum values of  $\alpha_\theta^4 + \beta_\theta^4$ , then  $16(M + m)$  equals :

(A) 27

(B) 17

(C) 25

(D) 24

[Step-by-step solution ► prepwisar.in/questions/PEza7m3X8o](https://www.prepwisar.in/questions/PEza7m3X8o)

**Q26** JEE Main 2024 · 9 Apr · Shift 1

Let  $\alpha, \beta$  be the roots of the equation  $x^2 + 2\sqrt{2}x - 1 = 0$ . The quadratic equation, whose roots are  $\alpha^4 + \beta^4$  and  $\frac{1}{10}(\alpha^6 + \beta^6)$ , is:

(A)  $x^2 - 180x + 9506 = 0$

(B)  $x^2 - 195x + 9506 = 0$

(C)  $x^2 - 190x + 9466 = 0$

(D)  $x^2 - 195x + 9466 = 0$

[Step-by-step solution ► prepwisar.in/questions/GA2lvrZONo](https://www.prepwisar.in/questions/GA2lvrZONo)

**Q27** JEE Main 2024 · 4 Apr · Shift 1

If 2 and 6 are the roots of the equation  $ax^2 + bx + 1 = 0$ , then the quadratic equation, whose roots are  $\frac{1}{2a+b}$  and  $\frac{1}{6a+b}$ , is :

(A)  $x^2 + 8x + 12 = 0$

(B)  $2x^2 + 11x + 12 = 0$

(C)  $4x^2 + 14x + 12 = 0$

(D)  $x^2 + 10x + 16 = 0$

[Step-by-step solution ► prepwisar.in/questions/\\_WWDvB-m\\_K](https://www.prepwisar.in/questions/_WWDvB-m_K)

**Q28** JEE Main 2024 · 1 Feb · Shift 2

Let  $\alpha$  and  $\beta$  be the roots of the equation  $px^2 + qx - r = 0$ , where  $p \neq 0$ . If  $p, q$  and  $r$  be the consecutive terms of a non constant G.P. and  $\frac{1}{\alpha} + \frac{1}{\beta} = \frac{3}{4}$ , then the value of  $(\alpha - \beta)^2$  is :

(A) 8

(B) 9

(C)  $\frac{20}{3}$

(D)  $\frac{80}{9}$

[Step-by-step solution ► prepwisar.in/questions/aLUV2P2P7p](https://www.prepwisar.in/questions/aLUV2P2P7p)

**Q29** JEE Main 2024 · 30 Jan · Shift 1

Let  $\alpha, \beta \in \mathbb{N}$  be roots of the equation  $x^2 - 70x + \lambda = 0$ , where  $\frac{\lambda}{2}, \frac{\lambda}{3} \notin \mathbb{N}$ . If  $\lambda$  assumes the minimum possible value, then  $\frac{(\sqrt{\alpha-1} + \sqrt{\beta-1})(\lambda+35)}{|\alpha-\beta|}$  is equal to :

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/-GCUCLMVUs](https://www.prepwiser.in/questions/-GCUCLMVUs)

**Q30** JEE Main 2023 · 8 Apr · Shift 1

Let  $\alpha, \beta, \gamma$  be the three roots of the equation  $x^3 + bx + c = 0$ . If  $\beta\gamma = 1 = -\alpha$ , then  $b^3 + 2c^3 - 3\alpha^3 - 6\beta^3 - 8\gamma^3$  is equal to :

(A) 21

(B) 19

(C)  $\frac{169}{8}$

(D)  $\frac{155}{8}$

[Step-by-step solution ► prepwiser.in/questions/5m\\_vB930fg](https://www.prepwiser.in/questions/5m_vB930fg)

**Q31** JEE Main 2023 · 29 Jan · Shift 2

Let  $\alpha_1, \alpha_2, \dots, \alpha_7$  be the roots of the equation  $x^7 + 3x^5 - 13x^3 - 15x = 0$  and  $|\alpha_1| \geq |\alpha_2| \geq \dots \geq |\alpha_7|$ . Then  $\alpha_1\alpha_2 - \alpha_3\alpha_4 + \alpha_5\alpha_6$  is equal to \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/31hAd4sh4X](https://www.prepwiser.in/questions/31hAd4sh4X)

**Q32** JEE Main 2023 · 25 Jan · Shift 2

Let  $\alpha \in \mathbb{R}$  and let  $\alpha, \beta$  be the roots of the equation  $x^2 + 60^{\frac{1}{4}}x + a = 0$ . If  $\alpha^4 + \beta^4 = -30$ , then the product of all possible values of  $a$  is \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/uvqxhJNkR6](https://www.prepwiser.in/questions/uvqxhJNkR6)

**Q33** JEE Main 2022 · 29 Jul · Shift 2

Let  $\alpha, \beta (\alpha > \beta)$  be the roots of the quadratic equation  $x^2 - x - 4 = 0$ . If  $P_n = \alpha^n - \beta^n, n \in \mathbb{N}$ , then  $\frac{P_{15}P_{16} - P_{14}P_{16} - P_{15}^2 + P_{14}P_{15}}{P_{13}P_{14}}$  is equal to \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/aQ59lZqm3F](https://www.prepwiser.in/questions/aQ59lZqm3F)

**Q34** JEE Main 2022 · 28 Jul · Shift 2

Let  $\alpha, \beta$  be the roots of the equation  $x^2 - \sqrt{2}x + \sqrt{6} = 0$  and  $\frac{1}{\alpha^2} + 1, \frac{1}{\beta^2} + 1$  be the roots of the equation  $x^2 + ax + b = 0$ . Then the roots of the equation  $x^2 - (a+b-2)x + (a+b+2) = 0$  are :

(A) non-real complex numbers

(B) real and both negative

(C) real and both positive

(D) real and exactly one of them is positive

[Step-by-step solution ► prepwiser.in/questions/rKhv9wY2SW](https://www.prepwiser.in/questions/rKhv9wY2SW)

**Q35** JEE Main 2022 · 28 Jun · Shift 2

Let  $f(x)$  be a quadratic polynomial such that  $f(-2) + f(3) = 0$ . If one of the roots of  $f(x) = 0$  is  $-1$ , then the sum of the roots of  $f(x) = 0$  is equal to :

(A)  $\frac{11}{3}$

(B)  $\frac{7}{3}$

(C)  $\frac{13}{3}$

(D)  $\frac{14}{3}$

[Step-by-step solution ► prepwiser.in/questions/g4uAoE6oDM](https://www.prepwiser.in/questions/g4uAoE6oDM)

**Q36** JEE Main 2022 · 27 Jun · Shift 1

If the sum of all the roots of the equation

$$e^{2x} - 11e^x - 45e^{-x} + \frac{81}{2} = 0 \text{ is } \log_e p, \text{ then } p \text{ is equal to } \underline{\hspace{2cm}}.$$

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/KafbZ2Bmsk](https://www.prepwiser.in/questions/KafbZ2Bmsk)

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**Q37** JEE Main 2022 · 26 Jun · Shift 1

The sum of the cubes of all the roots of the equation

$$x^4 - 3x^3 - 2x^2 + 3x + 1 = 0 \text{ is } \underline{\hspace{2cm}}.$$

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/PW2ih045Cr](https://www.prepwiser.in/questions/PW2ih045Cr)

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**Q38** JEE Main 2022 · 26 Jun · Shift 2

Let  $p$  and  $q$  be two real numbers such that  $p + q = 3$  and  $p^4 + q^4 = 369$ . Then  $\left(\frac{1}{p} + \frac{1}{q}\right)^{-2}$  is equal to   
  $\underline{\hspace{2cm}}.$

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/VWG5tMiRc9](https://www.prepwiser.in/questions/VWG5tMiRc9)

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**Q39** JEE Main 2022 · 25 Jun · Shift 2

Let  $a, b \in \mathbb{R}$  be such that the equation  $ax^2 - 2bx + 15 = 0$  has a repeated root  $\alpha$ . If  $\alpha$  and  $\beta$  are the roots of the equation  $x^2 - 2bx + 21 = 0$ , then  $\alpha^2 + \beta^2$  is equal to :

- |        |        |
|--------|--------|
| (A) 37 | (B) 58 |
| (C) 68 | (D) 92 |

[Step-by-step solution ► prepwiser.in/questions/cFMLkwZ-A2](https://www.prepwiser.in/questions/cFMLkwZ-A2)

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**Q40** JEE Main 2022 · 24 Jun · Shift 1

If the sum of the squares of the reciprocals of the roots  $\alpha$  and  $\beta$  of

the equation  $3x^2 + \lambda x - 1 = 0$  is 15, then  $6(\alpha^3 + \beta^3)^2$  is equal to :

- |        |        |
|--------|--------|
| (A) 18 | (B) 24 |
| (C) 36 | (D) 96 |

[Step-by-step solution ► prepwiser.in/questions/Eerab4GT7e](https://www.prepwiser.in/questions/Eerab4GT7e)

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**Q41** JEE Main 2021 · 27 Jul · Shift 1

Let  $\alpha, \beta$  be two roots of the

equation  $x^2 + (20)^{1/4}x + (5)^{1/2} = 0$ . Then  $\alpha^8 + \beta^8$  is equal to

- |        |         |
|--------|---------|
| (A) 10 | (B) 100 |
| (C) 50 | (D) 160 |

[Step-by-step solution ► prepwiser.in/questions/9-AEUgNBEY](https://www.prepwiser.in/questions/9-AEUgNBEY)

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**Q42** JEE Main 2021 · 25 Jul · Shift 1

If  $\alpha, \beta$  are roots of the equation  $x^2 + 5(\sqrt{2})x + 10 = 0$ ,  $\alpha > \beta$  and  $P_n = \alpha^n - \beta^n$  for each positive integer  $n$ , then the value of

$$\left( \frac{P_{17}P_{20} + 5\sqrt{2}P_{17}P_{19}}{P_{18}P_{19} + 5\sqrt{2}P_{18}^2} \right)$$

is equal to \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/OCr7pb597\\_](https://www.prepwiser.in/questions/OCr7pb597_)

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**Q43** JEE Main 2021 · 25 Jul · Shift 2

If  $a + b + c = 1$ ,  $ab + bc + ca = 2$  and  $abc = 3$ , then the value of  $a^4 + b^4 + c^4$  is equal to \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/bFe5YcLr-M](https://www.prepwiser.in/questions/bFe5YcLr-M)

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**Q44** JEE Main 2021 · 20 Jul · Shift 1

If  $\alpha$  and  $\beta$  are the distinct roots of the equation  $x^2 + (3)^{1/4}x + 3^{1/2} = 0$ , then the value of  $\alpha^{96}(\alpha^{12} - 1) + \beta^{96}(\beta^{12} - 1)$  is equal to :

(A)  $56 \times 3^{25}$

(B)  $56 \times 3^{24}$

(C)  $52 \times 3^{24}$

(D)  $28 \times 3^{25}$

[Step-by-step solution ► prepwiser.in/questions/SHGU3E2BIq](https://www.prepwiser.in/questions/SHGU3E2BIq)

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**Q45** JEE Main 2021 · 24 Feb · Shift 1

Let  $p$  and  $q$  be two positive numbers such that  $p + q = 2$  and  $p^4 + q^4 = 272$ . Then  $p$  and  $q$  are roots of the equation :

(A)  $x^2 - 2x + 8 = 0$

(B)  $x^2 - 2x + 136 = 0$

(C)  $x^2 - 2x + 16 = 0$

(D)  $x^2 - 2x + 2 = 0$

[Step-by-step solution ► prepwiser.in/questions/ZlvCVOsYdn](https://www.prepwiser.in/questions/ZlvCVOsYdn)

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**Q46** JEE Main 2020 · 6 Sep · Shift 1

If  $\alpha$  and  $\beta$  be two roots of the equation  $x^2 - 64x + 256 = 0$ . Then the value of

$$\left(\frac{\alpha^3}{\beta^5}\right)^{1/8} + \left(\frac{\beta^3}{\alpha^5}\right)^{1/8}$$

is :

- (A) 1 (B) 3  
(C) 2 (D) 4

[Step-by-step solution ► prepwiser.in/questions/odjN9KHeQr](https://www.prepwiser.in/questions/odjN9KHeQr)

**Q47** JEE Main 2020 · 6 Sep · Shift 2

If  $\alpha$  and  $\beta$  are the roots of the equation  $2x(2x + 1) = 1$ , then  $\beta$  is equal to :

- (A)  $-2\alpha(\alpha + 1)$  (B)  $2\alpha(\alpha + 1)$   
(C)  $2\alpha^2$  (D)  $2\alpha(\alpha - 1)$

[Step-by-step solution ► prepwiser.in/questions/2NCfkrVDMY](https://www.prepwiser.in/questions/2NCfkrVDMY)

**Q48** JEE Main 2020 · 5 Sep · Shift 2

If  $\alpha$  and  $\beta$  are the roots of the equation,

$7x^2 - 3x - 2 = 0$ , then the value of

$\frac{\alpha}{1-\alpha^2} + \frac{\beta}{1-\beta^2}$  is equal to :

- (A)  $\frac{1}{24}$  (B)  $\frac{27}{32}$   
(C)  $\frac{27}{16}$  (D)  $\frac{3}{8}$

[Step-by-step solution ► prepwiser.in/questions/PL3bu8WYPN](https://www.prepwiser.in/questions/PL3bu8WYPN)

**Q49** JEE Main 2020 · 5 Sep · Shift 1

The product of the roots of the equation  $9x^2 - 18|x| + 5 = 0$  is :

- (A)  $\frac{5}{9}$  (B)  $\frac{5}{27}$   
(C)  $\frac{25}{81}$  (D)  $\frac{25}{9}$

[Step-by-step solution ► prepwiser.in/questions/oTCwkfHrxz](https://www.prepwiser.in/questions/oTCwkfHrxz)

**Q50** JEE Main 2020 · 4 Sep · Shift 1

Let  $\alpha$  and  $\beta$  be the roots of  $x^2 - 3x + p = 0$  and  $\gamma$  and  $\delta$  be the roots of  $x^2 - 6x + q = 0$ . If  $\alpha, \beta, \gamma, \delta$  form a geometric progression. Then ratio  $(2q + p) : (2q - p)$  is:

- (A) 9 : 7 (B) 5 : 3  
(C) 3 : 1 (D) 33 : 31

[Step-by-step solution ► prepwiser.in/questions/A60II2kR0z](https://www.prepwiser.in/questions/A60II2kR0z)

**Q51** JEE Main 2020 · 3 Sep · Shift 1

If  $\alpha$  and  $\beta$  are the roots of the equation

$x^2 + px + 2 = 0$  and  $\frac{1}{\alpha}$  and  $\frac{1}{\beta}$  are the roots of the equation  $2x^2 + 2qx + 1 = 0$ , then

$$\left(\alpha - \frac{1}{\alpha}\right) \left(\beta - \frac{1}{\beta}\right) \left(\alpha + \frac{1}{\beta}\right) \left(\beta + \frac{1}{\alpha}\right)$$

is equal to :

(A)  $\frac{9}{4} (9 - q^2)$

(B)  $\frac{9}{4} (9 + q^2)$

(C)  $\frac{9}{4} (9 - p^2)$

(D)  $\frac{9}{4} (9 + p^2)$

[Step-by-step solution ► prepwisar.in/questions/o7fvvhbQC](https://www.prepwisar.in/questions/o7fvvhbQC)

**Q52** JEE Main 2020 · 2 Sep · Shift 2

Let  $f(x)$  be a quadratic polynomial such that

$f(-1) + f(2) = 0$ . If one of the roots of  $f(x) = 0$

is 3, then its other root lies in :

(A)  $(-3, -1)$

(B)  $(1, 3)$

(C)  $(-1, 0)$

(D)  $(0, 1)$

[Step-by-step solution ► prepwisar.in/questions/P61cqxi7dZ](https://www.prepwisar.in/questions/P61cqxi7dZ)

**Q53** JEE Main 2020 · 9 Jan · Shift 2

Let  $a, b \in \mathbb{R}$ ,  $a \neq 0$  be such that the equation,  $ax^2 - 2bx + 5 = 0$  has a repeated root  $\alpha$ , which is also a root of the equation,  $x^2 - 2bx - 10 = 0$ . If  $\beta$  is the other root of this equation, then  $\alpha^2 + \beta^2$  is equal to :

(A) 28

(B) 24

(C) 26

(D) 25

[Step-by-step solution ► prepwisar.in/questions/EeQ77tUASg](https://www.prepwisar.in/questions/EeQ77tUASg)

## Transformation of Equations · 6 PYQs

**Q54** JEE Main 2025 · 24 Jan · Shift 1

The product of all the rational roots of the equation  $(x^2 - 9x + 11)^2 - (x - 4)(x - 5) = 3$ , is equal to

(A) 7

(B) 21

(C) 28

(D) 14

[Step-by-step solution ► prepwisar.in/questions/bz4VV9Czab](https://www.prepwisar.in/questions/bz4VV9Czab)

**Q55** JEE Main 2024 · 6 Apr · Shift 1

Let  $x_1, x_2, x_3, x_4$  be the solution of the equation  $4x^4 + 8x^3 - 17x^2 - 12x + 9 = 0$  and

$$(4 + x_1^2) (4 + x_2^2) (4 + x_3^2) (4 + x_4^2) = \frac{125}{16} m$$

. Then the value of  $m$  is \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwisar.in/questions/OB0IG1qIEt](https://www.prepwisar.in/questions/OB0IG1qIEt)

**Q56** JEE Main 2023 · 11 Apr · Shift 2

The number of points, where the curve

$$f(x) = e^{8x} - e^{6x} - 3e^{4x} - e^{2x} + 1, x \in \mathbb{R}$$

cuts  $x$ -axis, is equal to \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/4Hg0Z8vbYB](https://www.prepwiser.in/questions/4Hg0Z8vbYB)

**Q57** JEE Main 2023 · 31 Jan · Shift 2

The equation  $e^{4x} + 8e^{3x} + 13e^{2x} - 8e^x + 1 = 0, x \in \mathbb{R}$  has :

- (A) two solutions and both are negative
- (B) two solutions and only one of them is negative
- (C) four solutions two of which are negative
- (D) no solution

[Step-by-step solution ► prepwiser.in/questions/uFE4W01iVh](https://www.prepwiser.in/questions/uFE4W01iVh)

**Q58** JEE Main 2022 · 28 Jun · Shift 1

The number of real solutions of the equation  $e^{4x} + 4e^{3x} - 58e^{2x} + 4e^x + 1 = 0$  is \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/c4HjzD-NsA](https://www.prepwiser.in/questions/c4HjzD-NsA)

**Q59** JEE Main 2021 · 1 Sep · Shift 2

Let  $f(x)$  be a polynomial of degree 3 such that

$f(k) = -\frac{2}{k}$  for  $k = 2, 3, 4, 5$ . Then the value of  $52 - 10f(10)$  is equal to :

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/4gZnt4s1wk](https://www.prepwiser.in/questions/4gZnt4s1wk)

## Common Roots · 6 PYQs

**Q60** JEE Main 2023 · 30 Jan · Shift 2

If the value of real number  $a > 0$  for which  $x^2 - 5ax + 1 = 0$  and  $x^2 - ax - 5 = 0$

have a common real root is  $\frac{3}{\sqrt{2\beta}}$  then  $\beta$  is equal to \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/TP1J0ER8u-](https://www.prepwiser.in/questions/TP1J0ER8u-)

**Q61** JEE Main 2023 · 29 Jan · Shift 1

Let  $\lambda \neq 0$  be a real number. Let  $\alpha, \beta$  be the roots of the equation  $14x^2 - 31x + 3\lambda = 0$  and  $\alpha, \gamma$  be the roots of the equation  $35x^2 - 53x + 4\lambda = 0$ . Then  $\frac{3\alpha}{\beta}$  and  $\frac{4\alpha}{\gamma}$  are the roots of the equation

- (A)  $7x^2 - 245x + 250 = 0$
- (B)  $49x^2 - 245x + 250 = 0$
- (C)  $49x^2 + 245x + 250 = 0$
- (D)  $7x^2 + 245x - 250 = 0$

[Step-by-step solution ► prepwiser.in/questions/uT2L07rSe9](https://www.prepwiser.in/questions/uT2L07rSe9)

**Q62** JEE Main 2022 · 25 Jul · Shift 2

Let  $f(x)$  be a quadratic polynomial with leading coefficient 1 such that  $f(0) = p, p \neq 0$ , and  $f(1) = \frac{1}{3}$ . If the equations  $f(x) = 0$  and  $f \circ f \circ f \circ f(x) = 0$  have a common real root, then  $f(-3)$  is equal to \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwisar.in/questions/KxEPahWneM](https://www.prepwisar.in/questions/KxEPahWneM)

**Q63** JEE Main 2022 · 27 Jun · Shift 2

Let  $\alpha, \beta$  be the roots of the equation  $x^2 - 4\lambda x + 5 = 0$  and  $\alpha, \gamma$  be the roots of the equation  $x^2 - (3\sqrt{2} + 2\sqrt{3})x + 7 + 3\lambda\sqrt{3} = 0, \lambda > 0$ . If  $\beta + \gamma = 3\sqrt{2}$ , then  $(\alpha + 2\beta + \gamma)^2$  is equal to \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwisar.in/questions/ZDGnq4soYL](https://www.prepwisar.in/questions/ZDGnq4soYL)

**Q64** JEE Main 2021 · 26 Aug · Shift 2

Let  $\lambda \neq 0$  be in  $\mathbb{R}$ . If  $\alpha$  and  $\beta$  are the roots of the equation  $x^2 - x + 2\lambda = 0$ , and  $\alpha$  and  $\gamma$  are the roots of equation  $3x^2 - 10x + 27\lambda = 0$ , then  $\frac{\beta\gamma}{\lambda}$  is equal to \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwisar.in/questions/hUU0YJ\\_OvQ](https://www.prepwisar.in/questions/hUU0YJ_OvQ)

**Q65** JEE Main 2020 · 4 Sep · Shift 2

Let  $\lambda \neq 0$  be in  $\mathbb{R}$ . If  $\alpha$  and  $\beta$  are the roots of the equation,  $x^2 - x + 2\lambda = 0$  and  $\alpha$  and  $\gamma$  are the roots of the equation,  $3x^2 - 10x + 27\lambda = 0$ , then  $\frac{\beta\gamma}{\lambda}$  is equal to:

- |        |        |
|--------|--------|
| (A) 36 | (B) 9  |
| (C) 27 | (D) 18 |

[Step-by-step solution ► prepwisar.in/questions/2figlFFR1o](https://www.prepwisar.in/questions/2figlFFR1o)

## Location of Roots · 2 PYQs

**Q66** JEE Main 2025 · 7 Apr · Shift 1

Let the set of all values of  $p \in \mathbb{R}$ , for which both the roots of the equation  $x^2 - (p+2)x + (2p+9) = 0$  are negative real numbers, be the interval  $(\alpha, \beta]$ . Then  $\beta - 2\alpha$  is equal to

- |        |       |
|--------|-------|
| (A) 5  | (B) 0 |
| (C) 20 | (D) 9 |

[Step-by-step solution ► prepwisar.in/questions/uChmFk0vbi](https://www.prepwisar.in/questions/uChmFk0vbi)

**Q67** JEE Main 2021 · 26 Feb · Shift 2

Let  $a$  be an integer such that all the real roots of the polynomial  $2x^5 + 5x^4 + 10x^3 + 10x^2 + 10x + 10$  lie in the interval  $(a, a+1)$ . Then,  $|a|$  is equal to \_\_\_\_\_.

Numerical answer — enter the value.

[Step-by-step solution ► prepwisar.in/questions/Rk2yIWmnLj](https://www.prepwisar.in/questions/Rk2yIWmnLj)

**Q68** JEE Main 2024 · 31 Jan · Shift 1

Let  $S$  be the set of positive integral values of  $a$  for which  $\frac{ax^2+2(a+1)x+9a+4}{x^2-8x+32} < 0, \forall x \in \mathbb{R}$ . Then, the number of elements in  $S$  is :

- (A) 0 (B)  $\infty$   
(C) 3 (D) 1

[Step-by-step solution ► prepwiser.in/questions/I5y44Mv0KR](https://www.prepwiser.in/questions/I5y44Mv0KR)

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## Answer key — Quadratic Equations & Polynomial Inequalities

Numbers match the question numbers above. For full working, open the solution link under each question.

|    |    |    |   |    |    |    |     |    |    |    |    |    |     |    |     |
|----|----|----|---|----|----|----|-----|----|----|----|----|----|-----|----|-----|
| 1  | A  | 2  | A | 3  | A  | 4  | 117 | 5  | 31 | 6  | 4  | 7  | 36  | 8  | D   |
| 9  | D  | 10 | 9 | 11 | C  | 12 | 5   | 13 | 50 | 14 | 6  | 15 | A   | 16 | 66  |
| 17 | A  | 18 | B | 19 | C  | 20 | 2   | 21 | B  | 22 | 8  | 23 | A   | 24 | 474 |
| 25 | C  | 26 | B | 27 | A  | 28 | D   | 29 | 60 | 30 | B  | 31 | 9   | 32 | 45  |
| 33 | 16 | 34 | B | 35 | A  | 36 | 45  | 37 | 36 | 38 | 4  | 39 | B   | 40 | B   |
| 41 | C  | 42 | 1 | 43 | 13 | 44 | C   | 45 | C  | 46 | C  | 47 | A   | 48 | C   |
| 49 | C  | 50 | A | 51 | C  | 52 | C   | 53 | D  | 54 | D  | 55 | 221 | 56 | 2   |
| 57 | A  | 58 | 2 | 59 | 26 | 60 | 13  | 61 | B  | 62 | 25 | 63 | 98  | 64 | 18  |
| 65 | D  | 66 | A | 67 | 2  | 68 | A   |    |    |    |    |    |     |    |     |

### Want the next chapter?

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