Topic: Quadratic Equation

Sub: Mathematics **JEE Main PYQ** Prof. Chetan Sir

Type 1: Basic

1. The number of solutions of the equation $(\frac{9}{x} - \frac{9}{\sqrt{x}} + 2)(\frac{2}{x} - \frac{7}{\sqrt{x}} + 3) = 0$ is: **[29 Jan 2025]**

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

2. The product of all the rational roots of the equation $(x^2 - 9x + 11)^2 - (x-4)(x-5) = 3$ is equal to **[24 Jan 2025]**

(A) 14 (B) 21 (C) 28 (D) 7

3. The number of real roots of the equation $\sqrt{x^2 - 4x + 3} + \sqrt{x^2 - 9} = \sqrt{4x^2 - 14x + 6}$, is: **[31 Jan 2023]**

(A) 0 (B) 1 (C) 3 (D) 2

4. If p and q are real number such that $p + q = 3$, $p^4 + q^4 = 369$ then the value of $(\frac{1}{p} + \frac{1}{q})^{-2}$ is equal to **[26 Jun 2022]**

5. 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: **[25 Jul 2021]**

6. The value of $3 + \cfrac{1}{4+\cfrac{1}{3+\cfrac{1}{4+\ldots\infty}}}$ is equal to **[18 Mar 2021]**

(A) $1.5 + \sqrt{3}$ (B) $2 + \sqrt{3}$ (C) $3 + 2\sqrt{3}$ (D) $4 + \sqrt{3}$

7. The value of $4 + \cfrac{1}{5+\cfrac{1}{4+\cfrac{1}{5+\ldots\infty}}}$ is: **[17 Mar 2021]**

(A) $2 + \frac{2}{5}\sqrt{30}$ (B) $2 + \frac{4}{\sqrt{5}}\sqrt{30}$ (C) $4 + \frac{4}{\sqrt{5}}\sqrt{30}$ (D) $5 + \frac{2}{5}\sqrt{30}$

8. 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: **[24 Feb 2021]**

(A) $x^2 - 2x + 2 = 0$ (B) $x^2 - 2x + 8 = 0$ (C) $x^2 - 2x + 136 = 0$ (D) $x^2 - 2x + 16 = 0$

9. If x is a solution of the equation, $\sqrt{2x+1} - \sqrt{2x-1} = 1, (x \geq \frac{1}{2})$, then $\sqrt{4x^2 - 1}$ is equal to: **[April 10, 2016]**

(A) $\frac{3}{4}$ (B) $\frac{1}{2}$ (C) $2\sqrt{2}$ (D) 2

10. The equation $\sqrt{3x^2 + x + 5} = x - 3$, where x is real, has: **[April 19, 2014]**

(A) no solution (B) exactly one solution
(C) exactly two solutions (D) exactly four solutions

Exponential/Logarithmic Equations

11. The sum of all the solutions of the equation $(8)^{2x} - 16 \cdot (8)^x + 48 = 0$ is: **[08 Apr 2024]**

(A) $1 + \log_8(6)$ (B) $1 + \log_6(8)$ (C) $log_8(6)$ (D) $log_8(4)$

12. Let $S = \{x \in R : (\sqrt{3} + \sqrt{2})^x + (\sqrt{3} - \sqrt{2})^x = 10\}$. Then the number of elements in S is: **[01 Feb 2024]**

(A) 4 (B) 0 (C) 2 (D) 1

13. The number of solutions, of the equation $e^{\sin x} - 2e^{-\sin x} = 2$ is **[31 Jan 2024]**

(A) 2 (B) more than 2 (C) 1 (D) 0

14. Let $S = \{x : x \in \mathbb{R} \text{ and } (\sqrt{3}+\sqrt{2})^{x^2-4} + (\sqrt{3}-\sqrt{2})^{x^2-4} = 10\}$. Then $n(S)$ is equal to **[01 Feb 2023]**

(A) 2 (B) 4 (C) 6 (D) 0

15. Let $S = \{\alpha : \log_2(9^{2\alpha-4}+13) - \log_2(\frac{5}{2}\cdot 3^{2\alpha-4}+1) = 2\}$. Then the maximum value of β for which the equation $x^2 - 2(\sum_{\alpha\in S}\alpha)^2 x + \sum_{\alpha\in S}(\alpha+1)^2\beta = 0$ has real roots, is **[25 Jan 2023]**

16. If the sum of all the roots of the equation $e^{2x} - 11e^x - 45e^{-x} + \frac{81}{2} = 0$ is $\log_e P$, then P is equal to **[27 Jun 2022]**

17. The sum of all real roots of equation $(e^{2x}-4)(6e^{2x}-5e^x+1) = 0$ is **[24 Jun 2022]**

(A) $\ln 4$ (B) $\ln 2$ (C) $-\ln 3$ (D) $\ln 5$

18. The sum of all the real values of x satisfying the equation $2^{(x-1)(x^2+5x-50)} = 1$ is: **[April 9, 2017]**

(A) 16 (B) 14 (C) -4 (D) -5

19. The sum of all real values of x satisfying the equation $(x^2-5x+5)^{x^2+4x-60} = 1$ is: **[2016]**

(A) 6 (B) 5 (C) 3 (D) -4

Modulus Equations

20. The sum of the squares of the roots of $|x+2|^2 + |x-2| - 2 = 0$ and the squares of the roots of $x^2 - 2|x-3| - 5 = 0$, is **[8 April 2025]**

(A) 26 (B) 36 (C) 30 (D) 24

21. The number of real roots of the equation $x|x-2| + 3|x-3| + 1 = 0$ is: **[7 April 2025]**

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

22. The sum, of the squares of all the roots of the equation $x^2 + |2x-3| - 4 = 0$ is **[28 Jan 2025]**

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

23. The number of real solution(s) of the equation $x^2 + 3x + 2 = \min\{|x-3|, |x+2|\}$ is: **[24 Jan 2025]**

(A) 2 (B) 3 (C) 1 (D) 0

24. The number of distinct real roots of the equation $|x+1||x+3| - 4|x+2| + 5 = 0$, is **[08 Apr 2024]**

25. The number of real solutions of the equation $x|x+5| + 2|x+7| - 2 = 0$ is **[05 Apr 2024]**

26. The sum of all the roots of the equation $|x^2 - 8x + 15| - 2x + 7 = 0$ is **[27 Jan 2024]**

(A) $9-\sqrt{3}$ (B) $9+\sqrt{3}$ (C) $11-\sqrt{3}$ (D) $11+\sqrt{3}$

27. The number of real solutions of the equation $x(x^2 + 3|x| + 5|x-1| + 6|x-2|) = 0$ is **[30 Jan 2024]**

Type 2: Relation between Roots and Coefficients

28. Let α_θ and β_θ 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: **[22 Jan 2025]**

(A) 24 (B) 25 (C) 17 (D) 27

29. Let α, β 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: **[09 Apr 2024]**

(A) $x^2 - 190x + 9466 = 0$ (B) $x^2 - 180x + 9506 = 0$
(C) $x^2 - 195x + 9506 = 0$ (D) $x^2 - 195x + 9466 = 0$

30. Let α and β 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: **[01 Feb 2024]**

(A) $\frac{80}{9}$ (B) 9 (C) $\frac{20}{3}$ (D) 8

31. Let $a \in R$ and let α, β 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 **[25 Jan 2023]**

32. Let α, β 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: **[28 Jul 2022]**

(A) non-real complex numbers (B) real and both negative
(C) real and both positive (D) real and exactly one of them is positive

33. Let a, b be two non-zero real numbers. If p and r are the roots of the equation $x^2 - 8ax + 2a = 0$ and q and s are the roots of the equation $x^2 + 12bx + 6b = 0$, such that $\frac{1}{p}, \frac{1}{q}, \frac{1}{r}, \frac{1}{s}$ are in A.P., then $a^{-1} - b^{-1}$ is equal to **[25 Jul 2022]**

34. If the sum of the squares of the reciprocals of the roots α and β of the equation $3x^2 + \lambda x - 1 = 0$ is 15, then $6(\alpha^3 + \beta^3)^2$ is equal to **[24 Jun 2022]**

(A) 46 (B) 36 (C) 24 (D) 18

35. If α and β be two roots of the equation $x^2 - 64x + 256 = 0$. Then the value of $(\frac{\alpha^3}{\beta^5})^{\frac{1}{8}} + (\frac{\beta^3}{\alpha^5})^{\frac{1}{8}}$ is: **[06 Sep 2020]**

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

36. If α and β are the roots of the equation $2x(2x + 1) = 1$, then β is equal to: **[06 Sep 2020]**

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

37. If α and β 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: **[05 Sep 2020]**

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

38. If α and β 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 $(\alpha - \frac{1}{\alpha})(\beta - \frac{1}{\beta})(\alpha + \frac{1}{\beta})(\beta + \frac{1}{\alpha})$ is equal to : **[03 Sep 2020]**

(A) $\frac{9}{4}(9 + q^2)$ (B) $\frac{9}{4}(9 - q^2)$
(C) $\frac{9}{4}(9 + p^2)$ (D) $\frac{9}{4}(9 - p^2)$

39. Let α and β be two real roots of the equation $(k + 1)\tan^2 x - \sqrt{2} \cdot \lambda \tan x = (1 - k)$, where $k(\neq -1)$ and λ are real numbers. If $\tan^2(\alpha + \beta) = 50$, then a value of λ is **[07 Jan 2020]**

(A) $10\sqrt{2}$ (B) 10 (C) 5 (D) $5\sqrt{2}$

40. If m is chosen in the quadratic equation $(m^2 + 1)x^2 - 3x + (m^2 + 1)^2 = 0$ such that the sum of its roots is greatest, then the absolute difference of the cubes of its roots is: **[09 Apr 2019]**

(A) $4\sqrt{3}$ (B) $10\sqrt{5}$ (C) $8\sqrt{3}$ (D) $8\sqrt{5}$

41. If α and β are the roots of the quadratic equation $x^2 + x\sin\theta - 2\sin\theta = 0, \theta \in (0, \frac{\pi}{2})$, then $\frac{\alpha^{12}+\beta^{12}}{(\alpha^{-12}+\beta^{-12})\cdot(\alpha-\beta)^{24}}$ is equal to: **[10 Apr 2019]**

(A) $\frac{2^6}{(\sin\theta+8)^{12}}$ (B) $\frac{2^{12}}{(\sin\theta-4)^{12}}$
(C) $\frac{2^{12}}{(\sin\theta+8)^{12}}$ (D) $\frac{2^{12}}{(\sin\theta-8)^6}$

42. Let α and β be the roots of the quadratic equation $x^2\sin\theta - x(\sin\theta\cos\theta + 1) + \cos\theta = 0 (0 < \theta < 45°)$, and $\alpha < \beta$. Then $\sum_{n=0}^{\infty}(\alpha^n + \frac{(-1)^n}{\beta^n})$ is equal to: **[11 Jan 2019]**

(A) $\frac{1}{1-\cos\theta}-\frac{1}{1+\sin\theta}$ (B) $\frac{1}{1+\cos\theta}+\frac{1}{1-\sin\theta}$
(C) $\frac{1}{1-\cos\theta}+\frac{1}{1+\sin\theta}$ (D) $\frac{1}{1+\cos\theta}-\frac{1}{1-\sin\theta}$

43. If p, q and r be real numbers ($p, q, r \neq 0$), such that the roots of the equation $\frac{1}{x+p}+\frac{1}{x+q}=\frac{1}{r}$ are equal in magnitude but opposite in sign, then the sum of squares of these roots is equal to. **[April 16, 2018]**

(A) $p^2+q^2+r^2$ (B) p^2+q^2
(C) $2(p^2+q^2)$ (D) $\frac{p^2+q^2}{2}$

44. If α and β are roots of the equation, $x^2-4\sqrt{2}kx+2e^{4\ln k}-1=0$ for some k, and $\alpha^2+\beta^2=66$, then $\alpha^3+\beta^3$ is equal to: **[April 11, 2014]**

(A) $248\sqrt{2}$ (B) $280\sqrt{2}$ (C) $-32\sqrt{2}$ (D) $-280\sqrt{2}$

45. If α and β are roots of the equation $x^2+px+\frac{3p}{4}=0$, such that $|\alpha-\beta|=\sqrt{10}$, then p belongs to the set: **[April 22, 2013]**

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

46. Sachin and Rahul attempted to solve a quadratic equation. Sachin made a mistake in writing down the constant term and ended up in roots (4,3). Rahul made a mistake in writing down coefficient of x to get roots (3,2). The correct roots of equation are: **[2011]**

(A) 6,1 (B) 4,3 (C) -6,-1 (D) -4,-3

Properties of Roots

47. Let α, β be roots of equation $x^2-70x+\lambda=0$, where $\frac{\lambda}{2}, \frac{\lambda}{3} \notin \mathbb{N}$. If $\alpha, \beta \in \mathbb{N}$ and λ assumes the minimum possible value, then $\frac{(\sqrt{\alpha-1}+\sqrt{\beta-1})(\lambda+35)}{|\alpha-\beta|}$ is equal to : **[30 Jan 2024]**

48. The number of pairs (a, b) of real numbers, such that whenever α is a root of the equation $x^2+ax+b=0, \alpha^2-2$ is also a root of this equation, is: **[01 Sep 2021]**

(A) 6 (B) 8 (C) 4 (D) 2

49. If λ be the ratio of the roots of the quadratic equation in x, $3m^2x^2+m(m-4)x+2=0$, then the least value of m for which $\lambda+\frac{1}{\lambda}=1$, is: **[12 Jan 2019]**

(A) $2-\sqrt{3}$ (B) $-2+\sqrt{2}$ (C) $4-2\sqrt{3}$ (D) $4-3\sqrt{2}$

50. If one real root of the quadratic equation $81x^2+kx+256=0$ is cube of the other root, then a value of k is: **[11 Jan 2019]**

(A) -81 (B) 100 (C) 144 (D) -300

51. If the difference between the roots of the equation $x^2+ax+1=0$ is less than $\sqrt{5}$, then the set of possible values of a is **[2007]**

(A) $(3,\infty)$ (B) $(-\infty,-3)$ (C) $(-3,3)$ (D) $(-3,\infty)$

52. If the roots of the equation $x^2-bx+c=0$ be two consecutive integers, then b^2-4c equals **[2005]**

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

53. If $(1-p)$ is a root of quadratic equation $x^2+px+(1-p)=0$ then its roots are **[2004]**

(A) -1, 2 (B) -1, 1 (C) 0, -1 (D) 0, 1

54. The value of 'a' for which one root of the quadratic equation $(a^2-5a+3)x^2+(3a-1)x+2=0$ is twice as large as the other is **[2003]**

(A) $-\frac{1}{3}$ (B) $\frac{2}{3}$ (C) $-\frac{2}{3}$ (D) $\frac{1}{3}$

55. If p and q are the roots of the equation $x^2+px+q=0$, then **[2002]**

(A) $p=1, q=-2$ (B) $p=0, q=1$
(C) $p=-2, q=0$ (D) $p=-2, q=1$

56. Difference between the corresponding roots of $x^2 + ax + b = 0$ and $x^2 + bx + a = 0$ is same and $a \neq b$, then **[2002]**

(A) $a + b + 4 = 0$ (B) $a + b - 4 = 0$
(C) $a - b - 4 = 0$ (D) $a - b + 4 = 0$

+Trigonometry

57. If an angle A of a $\triangle ABC$ satisfies $5\cos A + 3 = 0$ then the roots of the quadratic equation, $9x^2 + 27x + 20 = 0$ are. **[April 16, 2018]**

(A) $\sin A, \sec A$ (B) $\sec A, \tan A$
(C) $\tan A, \cos A$ (D) $\sec A, \cot A$

58. If $\tan A$ and $\tan B$ are the roots of the quadratic equation, $3x^2 - 10x - 25 = 0$ then the value of $3\sin^2(A + B) - 10\sin(A + B)\cos(A + B) - 25\cos^2(A + B)$ is **[April 15, 2018]**

(A) 25 (B) -25 (C) -10 (D) 10

59. If the roots of the quadratic equation $x^2 + px + q = 0$ are $\tan 30°$ and $\tan 15°$, respectively, then the value of $2 + q - p$ is **[2006]**

(A) 2 (B) 3 (C) 0 (D) 1

60. In a triangle PQR, $\angle R = \frac{\pi}{2}$. If $\tan(\frac{P}{2})$ and $\tan(\frac{Q}{2})$ are the roots of $ax^2 + bx + c = 0, a \neq 0$ then **[2005]**

(A) $a = b + c$ (B) $c = a + b$
(C) $b = c$ (D) $b = a + c$

Type 3: Nature of Roots

61. If the set of all $a \in R$ for which the equation $2x^2 + (a - 5)x + 15 = 3a$ has no real root, is the interval (α, β), and $X = \{x \in Z : \alpha < x < \beta\}$, then $\sum_{x \in X} x^2$ is equal to: **[29 Jan 2025]**

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

62. 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 **[23 Jan 2025]**

63. Let the equation $x(x + 2)(12 - k) = 2$ have equal roots. Then the distance of the point $(k, \frac{k}{2})$ from the line $3x + 4y + 5 = 0$ is: **[03 Apr 2025]**

(A) 15 (B) 12 (C) $5\sqrt{3}$ (D) $15\sqrt{5}$

64. 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 **[4 April 2025]**

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

65. The set of all values of $k > -1$ for which the equation $(3x^2 + 4x + 3)^2 - (k + 1)(3x^2 + 4x + 3)(3x^2 + 4x + 2) + k(3x^2 + 4x + 2)^2 = 0$ has real roots, is: **[27 Aug 2021]**

(A) $[-\frac{1}{2}, 1)$ (B) $(\frac{1}{2}, \frac{3}{2}] - \{1\}$ (C) $(1, \frac{5}{2}]$ (D) (2,3)

66. 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 **[26 Aug 2021]**

67. If $\alpha, \beta \in R$ are such that $1 - 2i$ (here $i^2 = -1$) is a root of $z^2 + \alpha z + \beta = 0$, then $(\alpha - \beta)$ is equal to: **[25 Feb 2021]**

(A) -7 (B) 7 (C) -3 (D) 3

68. The number of all possible positive integral value of α for which the roots of the quadratic equation $6x^2 - 11x + \alpha = 0$ are rational numbers is: **[25 Jul 2021]**

(A) 5 (B) 3 (C) 4 (D) 2

69. Consider the two sets: $A = \{m \in R$: both the roots of $x^2 - (m+1)x + m + 4 = 0$ are real$\}$ and $B = [-3, 5)$. Which of the following is not true? **[03 Sep 2020]**

(A) $A - B = (-\infty, -3) \cup (5, \infty)$ (B) $A \cap B = \{-3\}$
(C) $B - A = (-3, 5)$ (D) $A \cup B = R$

70. The least positive value of 'a' for which the equation, $2x^2 + (a-10)x + \frac{33}{2} = 2a$ has real roots is **[08 Jan 2020]**

71. The number of integral values of m for which the equation, $(1+m^2)x^2 - 2(1+3m)x + (1+8m) = 0$ has no real root, is **[08 Apr 2019]**

(A) 2 (B) 3 (C) Infinitely many (D) 1

72. If p, $q \in Q$. If $2 - \sqrt{3}$ is a root of the quadratic equation $x^2 + px + q = 0$ then **[09 Apr 2019]**

(A) $p^2 - 4q + 12 = 0$ (B) $q^2 + 4p + 14 = 0$
(C) $p^2 - 4q - 12 = 0$ (D) $q^2 - 4p - 16 = 0$

Type 4: Range/Max/Min Value

73. The minimum value of the sum of the squares of the roots of $x^2 + (3-a)x = 2a - 1$ is **[31 Jan 2024]**

(A) 6 (B) 4 (C) 5 (D) 8

74. If $x^2 + 9y^2 - 4x + 3 = 0, x, y \in R$, then x and y respectively lie in the intervals **[27 Aug 2021]**

(A) $[-\frac{1}{3}, \frac{1}{3}]$ and $[-\frac{1}{3}, \frac{1}{3}]$ (B) [1, 3] and $[-\frac{1}{3}, \frac{1}{3}]$
(C) $[-\frac{1}{3}, \frac{1}{3}]$ and [1, 3] (D) [1, 3] and [1, 3]

75. The value of λ such that sum of the squares of the roots of the quadratic equation, $x^2 + (3-\lambda)x + 2 = \lambda$ has the least value is: **[10 Jan 2019]**

(A) 2 (B) $\frac{4}{9}$ (C) $\frac{15}{8}$ (D) 1

76. The value of a for which the sum of the squares of the roots of the equation $x^2 - (a-2)x - a - 1 = 0$ assumes the least value is **[2005]**

(A) 1 (B) 0 (C) 3 (D) 2

77. If $\lambda \in R$ is such that the sum of the cubes of the roots of the equation, $x^2 + (2-\lambda)x + (10-\lambda) = 0$ is minimum, then the magnitude of the difference of the roots of this equation is **[April 15, 2018]**

(A) 20 (B) $2\sqrt{5}$ (C) $2\sqrt{7}$ (D) $4\sqrt{2}$

78. If non-zero real numbers b and c are such that $\min f(x) > \max g(x)$ where $f(x) = x^2 + 2bx + 2c^2$ and $g(x) = -x^2 - 2cx + b^2 (x \in R)$; then $|\frac{c}{b}|$ lies in the interval: **[April 19, 2014]**

(A) $(0, \frac{1}{2})$ (B) $[\frac{1}{2}, \frac{1}{\sqrt{2}})$
(C) $[\frac{1}{\sqrt{2}}, \sqrt{2}]$ (D) $(\sqrt{2}, \infty)$

79. If x is real, the maximum value of $\frac{3x^2+9x+17}{3x^2+9x+7}$ is **[2006]**

(A) $\frac{1}{4}$ (B) 41 (C) 1 (D) $\frac{17}{7}$

Sign of Quadratic Expression

80. The probability of selecting integers $a \in [-5, 30]$ such that $x^2 + 2(a+4)x - 5a + 64 > 0$ for all $x \in R$, is: **[20 Jul 2021(M)]**

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

81. The integer k, for which the inequality $x^2 - 2(3k-1)x + 8k^2 - 7 > 0$ is valid for every x in R is: **[25 Feb 2021]**

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

82. The number of integral values of m for which the quadratic expression $(1+2m)x^2 - 2(1+3m)x + 4(1+m), x \in R$ is always positive, is **[12 Jan 2019]**

(A) 7 (B) 3 (C) 6 (D) 8

83. 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: **[09 Jan 2019]**

(A) ∞ (B) 0 (C) 1 (D) 3

84. The least integral value α of x such that $\frac{x-5}{x^2+5x-14} > 0$ satisfies: **[April 23, 2013]**

(A) $\alpha^2 + 3\alpha - 4 = 0$ (B) $\alpha^2 - 5\alpha + 4 = 0$
(C) $\alpha^2 - 7\alpha + 6 = 0$ (D) $\alpha^2 + 5\alpha - 6 = 0$

Type 5: Newton's Sums

85. Let $P_n = \alpha^n + \beta^n, n \in N$. 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: **[2 April 2025]**

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

86. Let α and β be the roots of $x^2 + \sqrt{3}x - 16 = 0$, and γ and δ be the roots of $x^2 + 3x - 1 = 0$. If $P_n = \alpha^n + \beta^n$ and $Q_n = \gamma^n + \delta^n$, then $\frac{P_{25} + \sqrt{3}P_{24}}{2P_{23}} + \frac{Q_{25} - Q_{23}}{Q_{24}}$ is equal to **[7 April 2025]**

(A) 3 (B) 4 (C) 5 (D) 7

87. Let α, β be the distinct roots of the equation $x^2 - (t^2 - 5t + 6)x + 1 = 0, t \in \mathbb{R}$ and $a_n = \alpha^n + \beta^n$. Then the minimum value of $\frac{a_{2023} + a_{2025}}{a_{2024}}$ is: **[06 Apr 2024]**

(A) $-1/4$ (B) $-1/2$ (C) $-1/4$ (D) $1/4$

88. Let $\alpha, \beta; \alpha > \beta$, be the roots of the equation $x^2 - \sqrt{2}x - \sqrt{3} = 0$. Let $P_n = \alpha^n - \beta^n, n \in N$. Then $(11\sqrt{3} - 10\sqrt{2})P_{10} + (11\sqrt{2} + 10)P_{11} - 11P_{12}$ is equal to **[09 Apr 2024]**

(A) $10\sqrt{3}P_9$ (B) $11\sqrt{3}P_9$
(C) $10\sqrt{2}P_9$ (D) $11\sqrt{2}P_9$

89. Let α, β be roots of $x^2 + \sqrt{2}x - 8 = 0$. If $U_n = \alpha^n + \beta^n$, then $\frac{U_{10} + \sqrt{2}U_9}{2U_8}$ is equal to **[06 Apr 2024]**

90. If α, β are the roots of the equation, $x^2 - x - 1 = 0$ and $S_n = 2023\alpha^n + 2024\beta^n$, then **[06 Apr 2023]**

(A) $2S_{12} = S_{11} + S_{10}$ (B) $S_{12} = S_{11} + S_{10}$
(C) $2S_{11} = S_{12} + S_{10}$ (D) $S_{11} = S_{10} + S_{12}$

91. 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 **[29 Jul 2022]**

92. For a natural number n, let $\alpha_n = 19^n - 12^n$. Then, the value of $\frac{31\alpha_9 - \alpha_{10}}{57\alpha_8}$ is **[25 Jun 2022]**

93. If α, β 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 $(\frac{P_{17}P_{20} + 5\sqrt{2}P_{17}P_{19}}{P_{18}P_{19} + 5\sqrt{2}P_{18}^2})$ is equal to **[25 Jul 2021]**

94. Let α and β be two real numbers such that $\alpha + \beta = 1$ and $\alpha\beta = -1$. Let $p_n = (\alpha)^n + (\beta)^n$, $p_{n-1} = 11$ and $p_{n+1} = 29$ for some integer $n \geq 1$. Then, the value of p_n^2 is **[26 Feb 2021]**

95. Let α and β be the roots of $x^2 - 6x - 2 = 0$. If $a_n = \alpha^n - \beta^n$ for $n \geq 1$, then the value of $\frac{a_{10} - 2a_8}{3a_9}$ is: **[25 Feb 2021]**

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

96. Let α and β be the roots of the equation, $5x^2 + 6x - 2 = 0$. If $S_n = \alpha^n + \beta^n, n = 1, 2, 3, \ldots$, then **[02 Sep 2020]**

(A) $6S_6 + 5S_5 = 2S_4$ (B) $5S_6 + 6S_5 + 2S_4 = 0$
(C) $5S_6 + 6S_5 = 2S_4$ (D) $6S_6 + 5S_5 + 2S_4 = 0$

97. Let α and β be the roots of the equation $x^2 - x - 1 = 0$. If $p_k = (\alpha)^k + (\beta)^k, k \geq 1$, then which one of the following statements is not true? **[07 Jan 2020]**

(A) $p_3 = p_5 - p_4$ (B) $p_5 = 11$
(C) $(p_1 + p_2 + p_3 + p_4 + p_5) = 26$ (D) $p_5 = p_2 \cdot p_3$

Shifting Middle Term

98. If a and b are the roots of the equation $x^2 - 7x - 1 = 0$, then the value of $\frac{a^{21} + b^{21} + a^{17} + b^{17}}{a^{19} + b^{19}}$ is equal to **[11 Apr 2023]**

99. If α and β are the distinct roots of the equation $x^2 + (3)^{\frac{1}{4}}x + 3^{\frac{1}{2}} = 0$ then the value of $\alpha^{96}(\alpha^{12} - 1) + \beta^{96}(\beta^{12} - 1)$ is equal to: **[20 Jul 2021]**

(A) 56×3^{25} (B) 56×3^{24} (C) 52×3^{24} (D) 28×3^{25}

100. Let α, β be two roots of the equation $x^2 + (20)^{1/4}x + (5)^{1/2} = 0$. Then $\alpha^8 + \beta^8$ is equal to **[27 Jul 2021]**

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

Complex Roots (Solve after Learning Complex Equation Chapter)

101. Let α, β be the roots of the equation $x^2 - \sqrt{2}x + 2 = 0$. Then $\alpha^{14} + \beta^{14}$ is equal to **[13 Apr 2023]**

(A) -64 (B) $-64\sqrt{2}$ (C) -128 (D) $-128\sqrt{2}$

102. Let α, β 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 **[12 Apr 2023]**

(A) 81 (B) 9 (C) 72 (D) 729

Type 6: Common Roots

103. If the value of real number $\alpha > 0$ for which $x^2 - 5\alpha x + 1 = 0$ and $x^2 - \alpha x - 5 = 0$ have a common real roots is $\frac{3}{\sqrt{2\beta}}$ then β is equal to **[30 Jan 2023]**

104. If for some p, q, $r \in R$, all having positive sign, one of the roots of the equation $(p^2 + q^2)x^2 - 2q(p + r)x + q^2 + r^2 = 0$ is also a root of the equation $x^2 + 2x - 8 = 0$, then $\frac{q^2 + r^2}{p^2}$ is equal to **[26 Jul 2022]**

105. Let $a, b \in R$ be such that the equation $ax^2 - 2bx + 15 = 0$ has a repeated root α and if α and β are the roots of the equation $x^2 - 2bx + 21 = 0$, then $\alpha^2 + \beta^2$ is equal to: **[25 Jun 2022]**

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

106. Let $a, b \in R, a \neq 0$ be such that the equation, $ax^2 - 2bx + 5 = 0$ has a repeated root α, which is also a root of the equation, $x^2 - 2bx - 10 = 0$. If β is the other root of this equation, then $\alpha^2 + \beta^2$ is equal to: **[09 Jan 2020]**

(A) 25 (B) 26 (C) 28 (D) 24

107. If α, β and γ are three consecutive terms of a non-constant G.P. such that the equations $\alpha x^2 + 2\beta x + \gamma = 0$ and $x^2 + x - 1 = 0$ have a common root, then $\alpha(\beta + \gamma)$ is equal to: **[12 Apr 2019]**

(A) $\beta\gamma$ (B) $\alpha\beta$ (C) $\alpha\gamma$ (D) 0

108. If three distinct numbers a, b, c are in G.P. and the equations $ax^2+2bx+c=0$ and $dx^2+2ex+f=0$ have a common root, then which one of the following statements is correct? **[08 Apr 2019]**

(A) $\frac{d}{a}, \frac{e}{b}, \frac{f}{c}$ are in A.P. (B) d, e, f are in A.P.
(C) d, e, f are in G.P. (D) $\frac{d}{a}, \frac{e}{b}, \frac{f}{c}$ are in G.P.

109. If the equations $x^2+bx-1=0$ and $x^2+x+b=0$ have a common root different from -1, then $|b|$ is equal to: **[April 9, 2016]**

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

110. If equations $ax^2+bx+c=0$ $(a,b,c \in R, a \neq 0)$ and $2x^2+3x+4=0$ have a common root, then a:b:c equals: **[April 9, 2014]**

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

111. If the equations $x^2+2x+3=0$ and $ax^2+bx+c=0$, $a,b,c \in R$ have a common root, then $a:b:c$ is **[2013]**

(A) 1:2:3 (B) 3:2:1 (C) 1:3:2 (D) 3:1:2

112. The quadratic equations $x^2-6x+a=0$ and $x^2-cx+6=0$ have one root in common. The other roots of the first and second equations are integers in the ratio 4:3. Then the common root is **[2009]**

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

Common Roots: Better to Solve using Relation Between Roots and Coefficients

113. Let $\lambda \neq 0$ be a real number. Let α, β be the roots of the equation $14x^2-31x+3\lambda=0$ and α, γ 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: **[29 Jan 2023]**

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

114. Let α, β be the roots of the equation $x^2-4\lambda x+5=0$ and α, γ be the roots of the equation $x^2-(3\sqrt{2}+2\sqrt{3})x+7+3\lambda\sqrt{3}=0$. If $\beta+\gamma=3\sqrt{2}$, then $(\alpha+2\beta+\gamma)^2$ is equal to **[27 Jun 2022]**

115. Let $\lambda \neq 0$ be in R. If α and β are the roots of the equation $x^2-x+2\lambda=0$ and α and γ are the roots of the equation $3x^2-10x+27\lambda=0$, then $\frac{\beta\gamma}{\lambda}$ is equal to **[26 Aug 2021]**

116. Let $\lambda \neq 0$ be in R. If α and β are the roots of the equation, $x^2-x+2\lambda=0$ and α and γ are the roots of the equation, $3x^2-10x+27\lambda=0$ then $\frac{\beta\gamma}{\lambda}$ is equal to: **[04 Sep 2020]**

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

Type 7: Location of Roots

117. 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: **[07 Apr 2025]**

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

118. If the set of all $a \in R-\{1\}$, for which the roots of the equation $(1-a)x^2+2(a-3)x+9=0$ are positive is $(-\infty,-\alpha] \cup [\beta,\gamma)$, then $2\alpha+\beta+\gamma$ is equal to **[2 April 2025]**

119. The number of integral values of k, for which one root of the equation $2x^2-8x+k=0$ lies in the interval (1, 2) and its other root lies in the interval (2, 3), is: **[01 Feb 2023]**

(A) 2 (B) 0 (C) 1 (D) 3

120. The set of all real values of λ for which the quadratic equation $(\lambda^2+1)x^2-4\lambda x+2=0$ always have exactly one root in the interval (0, 1) is: **[03 Sep 2020]**

(A) (-3,-1) (B) (0, 2) (C) (1, 3] (D) (2, 4]

121. Consider the quadratic equation $(c-5)x^2-2cx+(c-4)=0, c\neq 5$. Let S be the set of all integral values of c for which one root of the equation lies in the interval (0, 2) and its other root lies in the interval (2, 3). Then the number of elements in S is **[10 Jan 2019]**

(A) 11 (B) 12 (C) 18 (D) 10

122. If both the roots of the quadratic equation $x^2-mx+4=0$ are real and distinct and they lie in the interval (1, 5), then m lies in the interval: **[09 Jan 2019]**

(A) (-5,-4) (B) (3, 4) (C) (5, 6) (D) (4, 5)

123. The values of 'a' for which one root of the equation $x^2-(a+1)x+a^2+a-8=0$ exceeds 2 and the other is lesser than 2, are given by: **[April 9, 2013]**

(A) $3<a<10$ (B) $a\geq 10$
(C) $-2<a<3$ (D) $a\leq -2$

124. The value of k for which the equation $(k-2)x^2+8x+k+4=0$ has both roots real, distinct and negative is **[May 7, 2012]**

(A) 6 (B) 3 (C) 4 (D) 1

125. All the values of m for which both roots of the equation $x^2-2mx+m^2-1=0$ are greater than -2 but less than 4, lie in the interval **[2006]**

(A) $-2<m<0$ (B) $m>3$
(C) $-1<m<3$ (D) $1<m<4$

126. If both the roots of the quadratic equation $x^2-2kx+k^2+k-5=0$ are less than 5, then k lies in the interval **[2005]**

(A) (5,6] (B) (6,∞) (C) $(-\infty,4)$ (D) [4,5]

Type 8: Theory of Equations

127. 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 **[06 Apr 2024]**

128. Let α,β,γ 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 **[08 Apr 2023]**

(A) $\frac{155}{8}$ (B) 21 (C) $\frac{169}{8}$ (D) 19

129. Let $\alpha_1,\alpha_2,...,\alpha_7$ be the roots of the equation $x^7+3x^5-13x^3-15x=0$ and $|\alpha_1|\geq|\alpha_2|\geq...\geq|\alpha_7|$. Then, $\alpha_1\alpha_2-\alpha_3\alpha_4+\alpha_5\alpha_6$ is equal to **[29 Jan 2023]**

130. The sum of the cubes of all the roots of the equation $x^4-3x^3-2x^2+3x+1=0$ is **[26 Jun 2022]**

131. If the two roots of the equation, $(a-1)(x^4+x^2+1)+(a+1)(x^2+x+1)^2=0$ are real and distinct, then the set of all values of 'a' is: **[April 11, 2015]**

(A) $(0,\frac{1}{2})$ (B) $(-\frac{1}{2},0)\cup(0,\frac{1}{2})$
(C) $(-\frac{1}{2},0)$ (D) $(-\infty,-2)\cup(2,\infty)$

132. If $2+3i$ is one of the roots of the equation $2x^3-9x^2+kx-13=0, k\in R$ then the real root of this equation: **[April 10, 2015]**

(A) exists and is equal to $-\frac{1}{2}$ (B) exists and is equal to $\frac{1}{2}$
(C) exists and is equal to 1 (D) does not exist

Type 9: Number of Real Roots

133. 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 **[11 Apr 2023]**

134. The equation $e^{4x} + 8e^{3x} + 13e^{2x} - 8e^{x} + 1 = 0, x \in R$ has: **[31 Jan 2023]**

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

135. The number of real solutions of the equation $3(x^2 + \frac{1}{x^2}) - 2(x + \frac{1}{x}) + 5 = 0$, is **[24 Jan 2023]**

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

136. The number of real solutions of the equation $e^{4x} + 4e^{3x} - 58e^{2x} + 4e^{x} + 1 = 0$ is **[28 Jun 2022]**

137. The number of real roots of the equation $e^{4x} - e^{3x} - 4e^{2x} - e^{x} + 1 = 0$ is equal to **[27 Jul 2021]**

138. The number of real roots of the equation, $e^{4x} + e^{3x} - 4e^{2x} + e^{x} + 1 = 0$ is: **[09 Jan 2020]**

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

Type 10: Transformation of Roots

139. 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: **[04 Apr 2024]**

(A) $2x^2 + 11x + 12 = 0$
(B) $x^2 + 8x + 12 = 0$
(C) $4x^2 + 14x + 12 = 0$
(D) $x^2 + 10x + 16 = 0$

140. If $\frac{1}{\sqrt{\alpha}}$ and $\frac{1}{\sqrt{\beta}}$ are the roots of the equation, $ax^2+bx+1 = 0\,(a \neq 0, a, b \in R)$, then the equation, $x(x+b^3)+(a^3-3abx) = 0$ has roots: **[April 9, 2014]**

(A) $\alpha^{3/2}$ and $\beta^{3/2}$
(B) $\alpha\beta^{1/2}$ and $\alpha^{1/2}\beta$
(C) $\sqrt{\alpha\beta}$ and $\alpha\beta$
(D) $\alpha^{-3/2}$ and $\beta^{-3/2}$

141. If p and q are non-zero real numbers and $\alpha^3 + \beta^3 = -p, \alpha\beta = q$, then a quadratic equation whose roots are $\frac{\alpha^2}{\beta}, \frac{\beta^2}{\alpha}$ is: **[April 25, 2013]**

(A) $px^2 - qx + p^2 = 0$
(B) $qx^2 + px + q^2 = 0$
(C) $px^2 + qx + p^2 = 0$
(D) $qx^2 - px + q^2 = 0$

142. If $\alpha \neq \beta$ but $\alpha^2 = 5\alpha - 3$ and $\beta^2 = 5\beta - 3$ then the equation having α/β and β/α as its roots is **[2002]**

(A) $3x^2 - 19x + 3 = 0$
(B) $3x^2 + 19x - 3 = 0$
(C) $3x^2 - 19x - 3 = 0$
(D) $x^2 - 5x + 3 = 0$

Properties of Polynomials

143. 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 **[28 Jun 2022]**

(A) $\frac{11}{3}$ (B) $\frac{7}{3}$ (C) $\frac{13}{3}$ (D) $\frac{14}{3}$

144. 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 **[02 Sep 2020]**

(A) (-1,0) (B) (1,3) (C) (-3,-1) (D) (0,1)

145. If $f(x)$ is a quadratic expression such that $f(1) + f(2) = 0$, and -1 is a root of $f(x) = 0$ then the other root of $f(x) = 0$ is **[April 15, 2018]**

(A) $-\frac{5}{8}$ (B) $-\frac{8}{5}$ (C) $\frac{5}{8}$ (D) $\frac{8}{5}$

146. Let $p(x)$ be a quadratic polynomial such that $p(0) = 1$. If $p(x)$ leaves remainder 4 when divided by $x - 1$ and it leaves remainder 6 when divided by $x + 1$ then: **[April 8, 2017]**

(A) $p(2) = 11$
(B) $p(2) = 19$
(C) $p(-2) = 19$
(D) $p(-2) = 11$

147. Let for $a \neq a_1 \neq 0$, $f(x) = ax^2 + bx + c$, $g(x) = a_1x^2 + b_1x + c_1$ and $p(x) = f(x) - g(x)$. If $p(x) = 0$ only for $x = -1$ and $p(-2) = 2$, then the value of $p(2)$ is: **[2011]**

(A) 3 (B) 9 (C) 6 (D) 18

Logarithmic Properties

148. If α, β are the roots of the equation $x^2 - (5+3\sqrt{\log_3 5} - 5\sqrt{\log_5 3})x + 3(3^{(\log_3 5)^{1/3}} - 5^{(\log_5 3)^{2/3}} - 1) = 0$ then the equation, whose roots are $\alpha + \frac{1}{\beta}$ and $\beta + \frac{1}{\alpha}$, is: **[27 Jul 2022]**

(A) $3x^2 - 20x - 12 = 0$ (B) $3x^2 - 10x - 4 = 0$
(C) $3x^2 - 10x + 2 = 0$ (D) $3x^2 - 20x + 16 = 0$

Diophantine Equation

149. Let the set $C = \{(x, y) | x^2 - 2^y = 2023, x, y \in \mathbb{N}\}$. Then $\sum_{(x,y)\in C}(x + y)$ is equal to **[29 Jan 2024]**

Miscellaneous

150. 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 **[28 Jul 2022]**

151. Let $\alpha = max_{x\in R}\{8^{2\sin 3x} \cdot 4^{4\cos 3x}\}$ and $\beta = min_{x\in R}\{8^{2\sin 3x} \cdot 4^{4\cos 3x}\}$. If $8x^2 + bx + c = 0$ is a quadratic equation whose roots are $\alpha^{1/5}$ and $\beta^{1/5}$, then the value of $c - b$ is equal to: **[27 Jul 2021]**

(A) 42 (B) 47 (C) 43 (D) 50

Answer Key

1 (D)	**2** (A)	**3** (B)	**4** 4	**5** 13	**6** (A)	**7** (A)	**8** (D)	**9** (A)	**10** (A)
11 (A)	**12** (C)	**13** (D)	**14** (B)	**15** 25	**16** 45	**17** (B)	**18** (C)	**19** (C)	**20** (B)
21 (C)	**22** (C)	**23** (A)	**24** 2	**25** 3	**26** (B)	**27** 1	**28** (B)	**29** (C)	**30** (A)
31 45	**32** (B)	**33** 38	**34** (C)	**35** (A)	**36** (B)	**37** (D)	**38** (D)	**39** (B)	**40** (D)
41 (C)	**42** (C)	**43** (B)	**44** (D)	**45** (C)	**46** (A)	**47** 60	**48** (A)	**49** (D)	**50** (D)
51 (C)	**52** (D)	**53** (C)	**54** (B)	**55** (A)	**56** (A)	**57** (B)	**58** (B)	**59** (B)	**60** (B)
61 (D)	**62** 117	**63** (A)	**64** (C)	**65** (B)	**66** 66	**67** (A)	**68** (B)	**69** (A)	**70** 8
71 (C)	**72** (C)	**73** (A)	**74** (B)	**75** (A)	**76** (A)	**77** (B)	**78** (D)	**79** (B)	**80** (B)
81 (C)	**82** (A)	**83** (B)	**84** (A)	**85** (B)	**86** (C)	**87** (B)	**88** (A)	**89** 4	**90** (B)
91 16	**92** 4	**93** 1	**94** 324	**95** (C)	**96** (C)	**97** (D)	**98** 51	**99** (C)	**100** (C)
101 (C)	**102** (A)	**103** 13	**104** 272	**105** (B)	**106** (A)	**107** (A)	**108** (A)	**109** (C)	**110** (B)
111 (A)	**112** (D)	**113** (C)	**114** 98	**115** 18	**116** (B)	**117** (A)	**118** 7	**119** (C)	**120** (C)
121 (A)	**122** (D)	**123** (C)	**124** (B)	**125** (C)	**126** (C)	**127** 221	**128** (D)	**129** 9	**130** 36
131 (B)	**132** (B)	**133** 2	**134** (B)	**135** (B)	**136** 2	**137** 2	**138** (A)	**139** (B)	**140** (A)
141 (D)	**142** (A)	**143** (A)	**144** (A)	**145** (D)	**146** (C)	**147** (D)	**148** (B)	**149** 46	**150** 6
151 (A)									