**1.** Let $\alpha$ and $\beta$ be the roots of the equation $\mathrm{x}^2+\mathrm{ax}+1=0,\ \mathrm{a} \neq 0$ . Then the equation whose roots are $-\left(\alpha+\frac{1}{\beta}\right)$ and $-\left(\frac{1}{\alpha}+\beta\right)$ is

(1) $\mathrm{x}^2=0$
(2) $\mathrm{x}^2+2\mathrm{ax}+4=0$
(3) $\mathrm{x}^2-2\mathrm{ax}+4=0$
(4) $\mathrm{x}^2-\mathrm{ax}+1=0$

**2.** If the roots of the quadratic equation $ax^2+bx+c=0$ are $\frac{k+1}{k}$ and $\frac{k+2}{k+1}$, then the value of $(a+b+c)^2$ is equal to

(1) $2b^2-ac$
(2) $\Sigma a^2$
(3) $b^2-4ac$
(4) $b^2-2ac$

**3.** The possible values of $n$ for which the equation $nx^2+(2n-1)x+(n-1)=0$ has roots of opposite sign is/are given by

(1) no values of $n$
(2) all values of $n$
(3) $-1<n<0$
(4) $0<n<1$

**4.** Consider the equation $\mathrm{x}^2+2\mathrm{x}-\mathrm{n}=0$, where $\mathrm{n} \in \mathrm{N}$ and $\mathrm{n} \in [5,\ 100]$. The number of different values of n so that the given equation has integral roots, is

**5.** If $-\pi<\theta<\pi$, the equation $(\cos 3\theta+1)x^2+(2\cos 2\theta-1)x+(1-2\cos\theta)=0$ has more than two roots for

(1) no value of $\theta$
(2) one value of $\theta$
(3) two value of $\theta$
(4) all values of $\theta$

**6.** Let $\alpha$ and $\beta$ are the roots of equation $ax^2+bx+c=0\ (a \neq 0)$. If $1,\ \alpha+\beta,\ \alpha\beta$ are in arithmetic progression and $\alpha,\ 2,\ \beta$ are in harmonic progression, then the value of $\frac{\alpha^2+\beta^2-2\alpha^2\beta^2}{2\left(\alpha^2+\beta^2\right)}$ is equal to

(1) 0
(2) 0.5
(3) 1
(4) 1.5

**7.** The number of quadratic equations that are unchanged by squaring their roots is

(1) 2
(2) 4
(3) 6
(4) 8

**8.** 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

**9.** Let $\alpha, \beta$ are the roots of the quadratic equation $2x^2-5x+1=0$. If $S_n=(\alpha)^{2n}+(\beta)^{2n}$ then find the value of $\frac{4S_{2021}+S_{2019}}{S_{2020}}$.

**10.** If $f(x)=\prod_{k=1}^{999}\left(x^2-47x+k\right)$, then product of all real roots of $f(x)=0$ is

(1) 550!
(2) 551!
(3) 552!
(4) 999!

**11.** If $-3<\frac{x^2-\lambda x-2}{x^2+x+1}<2$ for all $x \in R$, then the value of $\lambda$ belongs to

(1) $(-1,7)$
(2) $(-6,2)$
(3) $(-1,2)$
(4) $(-6,7)$

**12.** For the equation $\left|x^2-2x-3\right|=b$, which of the following statements is true?

(1) For $b<0$, there are no solutions
(2) For $b=0$, there are three solutions
(3) For $0<b<4$, there are two solutions
(4) For $b=4$, there are four solutions

**13.** If $a, b, c$ are real numbers satisfying the condition $a+b+c=0$, then the roots of the quadratic equation $3ax^2+5bx+7c=0$ are

(1) Positive
(2) negative
(3) real and equal
(4) distinct but not imaginary

**14.** If $a + b + c > \frac{9c}{4}$ and the equation $ax^2 + 2bx - 5c = 0$ has non-real complex roots, then

(1) $a > 0, c > 0$
(2) $a > 0, c < 0$
(3) $a < 0, c < 0$
(4) $a < 0, c > 0$

**15.** If the graph of the function $y = (a-b)^2 x^2 + 2(a+b-2c)x + 1$ ($\forall a \neq b$) is strictly above the $x$-axis, then

(1) $a < b < c$
(2) $a < c < b$
(3) $b < a < c$
(4) $c < b < a$

**16.** 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 equation and the second equation are integers in the ratio 4 : 3. Then the common root is

(1) 4
(2) 3
(3) 2
(4) 1

**17.** The value of $k$ for which both the roots of the equation $4x^2 - 20kx + (25k^2 + 15k - 66) = 0$ are less than 2, lies in

(1) $\left(\frac{4}{5}, 2\right)$
(2) $(0, 2)$
(3) $\left(-1, -\frac{4}{5}\right)$
(4) $(-\infty, -1)$

**18.** The range of a for which the equation $x^2 + ax - 4 = 0$ has its smaller root in the interval $(-1, 2)$ is

(1) $(-\infty, -3)$
(2) $(0, 3)$
(3) $(0, \infty)$
(4) $(-\infty, -3) \cup (0, \infty)$

**19.** If $f(x)$ is a polynomial of degree four with the leading coefficient one satisfying $f(1) = 1$, $f(2) = 2$ and $f(3) = 3$, then $\left[\frac{f(-1)+f(5)}{f(0)+f(4)}\right]$ (where $[\cdot]$ represents the greatest integer function) is equal to

(1) 4
(2) 5
(3) 6
(4) 7

**20.** Sum of the squares of all integral values of $a$ for which the inequality $x^2 + ax + a^2 + 6a < 0$ is satisfied for all $x \in (1, 2)$ must be equal to

(1) 90
(2) 89
(3) 88
(4) 91

**21.** The equations $kx^2 + x + k = 0$ and $kx^2 + kx + 1 = 0$ have exactly one root in common for

(1) $k = -\frac{1}{2}, 1$
(2) $k = 1$
(3) $k = -\frac{1}{2}$
(4) $k = \frac{1}{2}$

**22.** If the quadratic equations $k(6x^2 + 3) + rx + 2x^2 - 1 = 0$ and $6k(2x^2 + 1) + px + 4x^2 - 2 = 0$ have both the roots common, then $2r - p$ is equal to

(1) 0
(2) 1
(3) 2
(4) None of these

**23.** If $\alpha, \beta$ and $\gamma$ are the roots of the equation $x^3 - 13x^2 + 15x + 189 = 0$ and one root exceeds the other by 2, then the value of $|\alpha| + |\beta| + |\gamma|$ is equal to

(1) 23
(2) 17
(3) 13
(4) 19

**24.** If equations $x^2 + ax + b = 0$ $(a, b \in R)$ & $x^3 + 3x^2 + 5x + 3 = 0$ have two common roots, then value of $\frac{b}{a}$ is equal to

**25.** If $x$ is rational and $4\left(x^2 + \frac{1}{x^2}\right) + 16\left(x + \frac{1}{x}\right) - 57 = 0$, then the product of all possible values of $x$ is

(1) 4
(2) 3
(3) 2
(4) 1

**26.** The sum of all real values of $x$ satisfying the equation $\left(x^2-5x+5\right)^{x^2+4x-60}=1$ is

(1) 6
(2) 5
(3) 3
(4) $-4$

**27.** If $\alpha$ and $\beta$ are the real roots of $(\log_x 10)^3-(\log_x 10)^2-6\left(\log_x 10\right)=0$, then the value of $\left|\frac{1}{\log_{10}\alpha\beta}\right|$ is

**28.** The sum of the roots of the equation $2^{(33x-2)}+2^{(11x+2)}=2^{(22x+1)}+1$ is

(1) $\frac{1}{11}$
(2) $\frac{2}{11}$
(3) $\frac{3}{11}$
(4) $\frac{4}{11}$

**29.** The number of real roots of the equation $e^{4x}-e^{3x}-4e^{2x}-e^{x}+1=0$ is equal to

**30.** If the equation in x given by $\left(2^{\left(\frac{1}{\cos^{-1}x}\right)}\right)^{2\pi}-\left(a+\frac{1}{2}\right)\left(2^{\left(\frac{1}{\cos^{-1}x}\right)}\right)^{\pi}-a^2=0$ has only one real solution then exhaustive set of values of ‘a’ is

(1) $(-3\ ,1)$
(2) $(-\infty,-3]\cup[1,\infty)$
(3) $(-\infty,-3)\cup(1,\infty)$
(4) $[-3,\infty)$