



## MATHS

### BOOKS - VK JAISWAL ENGLISH

### QUADRATIC EQUATIONS

#### Exercise Single Choice Problems

1. Sum of values of  $x$  and  $y$  satisfying  $3^x - 4^y = 77$ ,  $3^{\frac{x}{2}} - 2^y = 7$  is

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2. If  $f(x) = \prod_{i=1}^3 (x - a_i) + \sum_{i=1}^3 -3a_i - 3x$  where  $a_i < a_{i+1}$  for  $i = 1, 2$ ,

then  $f(x) = 0$  have

A. only one distinct real root

B. exactly two distinct real roots

C. exactly 3 distinct real roots

D. 3 equal real roots

**Answer: C**



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3. Complete set of real values of 'a' for which the equation

$x^4 - 2ax^2 + x + a^2 - a = 0$  has all its roots real

A.  $\left[\frac{3}{4}, \infty\right)$

B.  $[1, \infty)$

C.  $[2, \infty)$

D.  $[0, \infty)$

**Answer: A**



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4. The cubic polynomial with leading coefficient unity all whose roots are 3 units less than the roots of the equation  $x^3 - 3x^2 - 4x + 12 = 0$  is denoted as  $f(x)$  then  $f'(x)$  is equal to :

A.  $3x^2 - 12x + 5$

B.  $3x^2 - 4x + 12 = 0$

C.  $3x^2 + 12x - 5$

D.  $3x^2 - 12x - 5$

**Answer: B**



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5. The set of value of  $k(k \in R)$  for which the equation  $x^2 - 4|x| + 3 - |k - 1| = 0$  will have exactly four real roots, is:

A.  $(-2, 4)$

B.  $(-4, 4)$

C.  $(-4, 2)$

D.  $(-1, 0)$

**Answer: A**



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6. The number of integers satisfying the inequality  $\frac{x}{x+6} \leq \frac{1}{x}$  is:

A. 7

B. 8

C. 9

D. 3

**Answer: A**



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7. The product of uncommon real roots of the polynomials

$$p(x) = x^4 + 2x^3 - 8x^2 - 6x + 15 \text{ and } q(x) = x^3 + 4x^2 - x - 10 \text{ is :}$$

A. 4

B. 6

C. 8

D. 12

**Answer: B**



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8. If  $\lambda_1, \lambda_2 (\lambda_1 > \lambda_2)$  are two values of  $\lambda$  for which the expression

$$f(x, y) = x^2 + \lambda xy + y^2 - 5x - 7y + 6 \text{ can be resolved as a product of}$$

two linear factors, then the value of  $3\lambda_1 + 2\lambda_2$  is

A. 5

B. 10

C. 15

D. 20

**Answer: C**



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9. Let  $\alpha, \beta$  be the roots of the quadratic equation  $ax^2 + bx + c = 0$  then the roots of the equation  $a(x + 1)^2 + b(x + 1)(x - 2) + c(x - 2)^2 = 0$  are:-

A.  $\frac{2\alpha + 1}{\alpha - 1}, \frac{2\beta + 1}{\beta - 1}$

B.  $\frac{2\alpha - 1}{\alpha + 1}, \frac{2\beta}{\alpha + 1}, \frac{2\beta - 1}{\beta + 1}$

C.  $\frac{\alpha + 1}{\alpha - 2}, \frac{\beta + 1}{\beta - 2}$

D.  $\frac{2\alpha + 3}{\alpha - 1}, \frac{2\beta + 3}{\beta - 1}$

**Answer: A**



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10. If  $a, b \in \mathbb{R}$  distinct numbers satisfying  $|a-1| + |b-1| = |a| + |b| = |a+1| + |b+1|$ , Then the minimum value of  $|a-b|$  is :

A. 3

B. 0

C. 1

D. 2

**Answer: D**



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11. The smallest positive integer  $p$  for which expression  $x^2 - 2px + 3p + 4$  is negative for atleast one real  $x$  is:

A. 3

B. 4

C. 5

D. 6

**Answer: C**



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12. For  $x \in \mathbb{R}$  the expression  $\frac{x^2 + 2x + c}{x^2 + 4x + 3x}$  can take all real value if  $c \in$

:

A. (1, 2)

B. [0, 1]

C. (0, 1)

D. (-1, 0)

**Answer: C**



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13. If 2 lies between the roots of the equation  $t^2 - mt + 2 = 0$ , ( $m \in R$ )

then the value of  $\left[ \left( \frac{2|x|}{9+x^2} \right)^m \right]$  is:

(where  $[.]$  denotes greatest integer function)

A. 0

B. 1

C. 8

D. 27

**Answer: A**



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14. The number of integral roots of the equation

$$x^8 - 24x^7 - 18x^5 + 39x^2 + 1155 = 0 \text{ is:}$$

A. 0

B. 2

C. 4

D. 6

**Answer: A**



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15. If the value of  $m^4 + \frac{1}{m^4} = 119$ , then the value of  $\left| m^3 - \frac{1}{m^2} \right| =$

A. 11

B. 18

C. 24

D. 36

**Answer: D**



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16. If the equation  $ax^2 + 2bx + c = 0$  and  $ax^2 + 2cx + b = 0$ ,  $a \neq 0$ ,  $b \neq c$ , have a common root then their other roots are the roots of the quadratic equation

A.  $a^2x(x + 1) + 4bc = 0$

B.  $a^2x(x + 1) + 8bc = 0$

C.  $a^2x(x + 2) + 8bc = 0$

D.  $a^2x(1 + 2x) + 8bc = 0$

**Answer: D**



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17. If  $\cos \alpha, \cos \beta$  and  $\cos \gamma$  are the roots of the equation  $9x^3 - 9x^2 - x + 1 = 0$ ,  $\alpha, \beta, \gamma \in [0, \pi]$  then the radius of the circle whose centre is  $(\sum \alpha, \sum \cos \alpha)$  and passing through  $(2 \sin^{-1}(\tan \pi/4), 4)$  is :

A. 2

B. 3

C. 4

D. 5

**Answer: B**

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18. For real value of  $x$ , the value of expression  $\frac{11x^2 - 12x - 6}{xz^2 + 4x + 2}$  :

A. lies between -17 and -3

B. does not lie between -17 and -3

C. lies between 3 and 17

D. does not lie between 3 and 17

**Answer: B**

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19.  $\frac{x + 3}{x^2 - x - 2} \geq \frac{1}{x - 4}$  holds for all  $x$  satisfying :

A.  $-2 < x < 1$  or  $x > 4$

B.  $-1 < x < 2$  or  $x > 4$

C.  $x < -1$  or  $2 < x < 4$

D.  $x > -1$  or  $2 < x < 4$

**Answer: C**



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20. If  $x = 4 + 3i$  (where  $I = \sqrt{-1}$ ), then the value of  $x^3 - 4x^2 - 7x + 12$  equals:

A.  $-88$

B.  $48 + 36i$

C.  $-256 + 12i$

D.  $-84$

**Answer: A**



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21. Let  $f(x) = \frac{x^2 + x - 1}{x^2 - x + 1}$ , then the largest value of  $f(x) \forall x \in [-1, 3]$  is:

A.  $\frac{3}{5}$

B.  $\frac{5}{3}$

C. 1

D.  $\frac{4}{3}$

**Answer: B**



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22. Let  $f(x) = \frac{x^2 + x - 1}{x^2 - x + 1}$ , In above problem, the range of  $f(x) \forall x \in [-1, 1]$  is:

A.  $\left[-1, \frac{3}{5}\right]$

B.  $\left[-1, \frac{5}{3}\right]$

C.  $\left[-\frac{1}{3}, 1\right]$

D.  $[-1, 1]$

**Answer: D**



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23. If 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 product of the roots is :

A.  $-2(p^2 + q^2)$

B.  $(p^2 + q^2)$

C.  $-\left(\frac{p^2 + q^2}{2}\right)$

D.  $-pq$

**Answer: C**



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**24.** The roots of  $a_1x^2 + b_1x + c_1 = 0$  are reciprocal of the roots of the equation  $a_2x^2 + b_2x + c_2 = 0$  if

A.  $(a_1a_2 - c_1c_2)^2 = (a_1b_2 - b_2c_2)(a_2b_1 - b_2c_1)$

B.  $(a_1a_2 - b_1b_2)^2 = (a_2b_2 - b_1c_2)(a_2b_1 - b_2c_1)$

C.  $(b_1c_2 - b_2c_1)^2 = (a_1b_2 + b_1c_2)(a_2b_1 - b_2c_1)$

D.  $(b_1c_2 - b_2c_1)^2 = (a_1b_2 + b_1c_2)(a_1b_1 - b_2c_1)$

**Answer: A**



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25. If  $\alpha \neq \beta$  but  $\alpha^2 = 5\alpha - 3$  and  $\beta^2 = 5\beta - 3$  then the equation having  $\alpha/\beta$  and  $\beta/\alpha$  as its roots is :

A.  $3x^2 - 25x + 3 = 0$

B.  $x^2 + 5x - 3 = 0$

C.  $x^2 - 5x + 3 = 0$

D.  $3x^2 - 19x + 3 = 0$

**Answer: D**



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26. If the difference between the corresponding roots of the equations  $x^2 + ax + b = 0$  and  $x^2 + bx + a = 0$  ( $a \neq b$ ) is the same, find the value of  $a + b$ .

A.  $a + b + 4 = 0$

B.  $a + b - 4 = 0$

C.  $a - b - 4 = 0$

D.  $a - b + 4 = 0$

**Answer: A**



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27. If  $\tan \theta_1, \tan \theta_2, \tan \theta_3, \tan \theta_4$  are the roots of the equation  $x^4 - x^3 \sin 2\beta + x^2 \cos 2\beta - x \cos \beta - \sin \beta = 0$  then prove that

$$\tan(\theta_1 + \theta_2 + \theta_3 + \theta_4) = \cot \beta$$

A.  $\sin \beta$

B.  $\cos \beta$

C.  $\tan \beta$

D.  $\cot \beta$

**Answer: D**



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28. Let  $a, b, c, d$  are positive real numbers such that  $\frac{a}{b} \neq \frac{c}{d}$ , then the roots of the equation:  $(a^2 + b^2)x^2 + 2x(ac + bd) + (c^2 + d^2) = 0$  are :

- A. real and distinct
- B. real and equal
- C. imaginary
- D. nothing can be said

**Answer: C**



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29. If  $\alpha, \beta$  are roots of  $ax^2 + bx + c = 0$ , then the equation whose roots are  $2 + \alpha, 2 + \beta$ , is

- A.  $ax^2 + x(4a - b) + 4a - 2b + c = 0$
- B.  $ax^2 + x(4a - b) + 4a + 2b + c = 0$

C.  $ax^2 + x(b - 4a) + 4a + 2b + c = 0$

D.  $ax^2 + x(b - 4a) + 4a - 2b + c = 0$

**Answer: D**



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**30.** Minimum possible number of positive root of the quadratic equation

$$x^2 - (1 + \lambda)x + \lambda - 2 = 0, \lambda \in R:$$

A. 2

B. 0

C. 1

D. can not be determined

**Answer: C**



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31. Let  $\alpha, \beta$  be real roots of the quadratic equation  $x^2 + kx + (k^2 + 2k - 4) = 0$ , then the maximum value of  $(\alpha^2 + \beta^2)$  is equal to :

A. 12

B.  $\frac{4}{9}$

C.  $\frac{16}{9}$

D.  $\frac{8}{9}$

**Answer: D**



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32. Polynomial  $P(x) = x^2 - ax + 5$  and  $Q(x) = 2x^3 + 5x - (a - 3)$  when divided by  $x - 2$  have same remainders, then 'a' is equal to

A. 10

B. -10

C. 20

D. -20

**Answer: D**



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**33.** If  $a$  and  $b$  ( $a \neq b$ ) are the roots of the equation  $x^2 + ax + b = 0$ , then find the least value of  $x^2 + ax + b$  ( $x \in R$ ).

A.  $\frac{2}{3}$

B.  $\frac{9}{4}$

C.  $-\frac{9}{4}$

D. 1

**Answer: C**



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34. Let  $\alpha, \beta$  be the roots of the equation  $ax^2 + bx + c = 0$ . A root of the equation  $a^3x^2 + abcx + c^3 = 0$  is (i)  $\alpha + \beta$  (ii)  $\alpha^2 + \beta$  (iii)  $\alpha^2 - \beta$  (iv)  $\alpha^2\beta$

- A.  $\alpha + \beta$
- B.  $\alpha^2 + \beta$
- C.  $\alpha^2 - \beta$
- D.  $\alpha^2\beta$

**Answer: D**



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35. Let  $a, b, c$  be the length of the sides of a triangle (on two of them are equal) and  $k \in \mathbb{R}$ . If the roots of the equation  $x^2 + 2(a + b + c)x + 6k(ab + bc + ca) = 0$  are real, then:

- A.  $k < \frac{2}{3}$

B.  $k > \frac{2}{3}$

C.  $k > 1$

D.  $k < \frac{1}{4}$

**Answer: A**



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**36.** Root(s) of the equation  $9x^2 - 18|x| + 5 = 0$  belonging to the domain of definition of the function  $f(x) = \log(x^2 - x - 2)$ , is (are)

A.  $\frac{-5}{3}, \frac{-1}{3}$

B.  $\frac{5}{3}, \frac{1}{3}$

C.  $\frac{-5}{3}$

D.  $\frac{-1}{3}$

**Answer: C**



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37. If  $\beta + \cos^2 \alpha, \beta + \sin^2 \alpha$  are the roots of  $x^2 + 2bx + c = 0$  and  $\gamma + \cos^4 \alpha, \gamma + \sin^4 \alpha$  are the roots of  $x^2 + 2Bx + C = 0$ , then :

A.  $b - B = c - C$

B.  $b^2 - B^2 = c - C$

C.  $b^2 - B^2 = 4(c - C)$

D.  $(b^2 - B^2) = C - C$

**Answer: B**



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38. Minimum value of  $|x - p| + |x - 15| + |x - p - 15|$ . If  $p \leq x \leq 15$  and  $0 < p < 15$ :

A. 30

B. 15

C. 10

D. 0

**Answer: B**



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**39.** If the quadratic equation

$$4x^2 - 2x - m = 0 \text{ and } 4p(q - r)x^2 - 2p(r - p)x + r(p - q) \equiv 0$$

have a common root such that second equation has equal roots then the value of  $m$  will be :

A. 0

B. 1

C. 2

D. 3

**Answer: C**



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**40.** The range of  $k$  for which the inequality

$$k \cos^2 x - k \cos x + 1 \geq 0 \forall x \in (-\infty, \infty), \text{ is}$$

A.  $k > \frac{1}{2}$

B.  $k > 4$

C.  $\frac{1}{2} \leq k \leq 4$

D.  $\frac{1}{2} \leq k \leq 5$

**Answer: C**



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**41.** If  $\frac{1+\alpha}{1-\alpha}, \frac{1+\beta}{1-\beta}, \frac{1+\gamma}{1-\gamma}$  are the roots of the cubic equation  $f(x) = 0$  where  $\alpha, \beta, \gamma$

are the roots of the cubic equation  $3x^3 - 2x + 5 = 0$ , then the number

of negative real roots of the equation  $f(x) = 0$  is :

A. 0

B. 1

C. 2

D. 3

**Answer: B**



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**42.** The sum of all intergral values of  $\lambda$  for which

$$(\lambda^2 + \lambda - 2)x^2 + (\lambda + 2)x < 1 \forall x \in R, \text{ is:}$$

A.  $-1$

B.  $-3$

C. 0

D.  $-2$

**Answer: B**



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43. If  $\alpha, \beta, \gamma, \delta \in R$  satisfy

$$\frac{(\alpha + 1)^2 + (\beta + 1)^2 + (\gamma + 1)^2 + (\delta + 1)^2}{\alpha + \beta + \gamma + \delta} = 4$$

If biquadratic equation

$$a_0x^4 + a_1x^3 + a_2x^2 + a_3x + a_4 = 0$$

has the roots

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

Then the value of  $a_1/a_0$  is:

A. 4

B. -4

C. 6

D. none of these

**Answer: C**



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44. If the complete set of value of  $x$  satisfying  $|x - 1| + |x - 2| + |x - 3| \geq 6$  is  $(-\infty, a] \cup [b, \infty)$ , then  $a + b =$

- A. 2
- B. 3
- C. 6
- D. 4

**Answer: D**



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45. If exactly one root of the quadratic equation  $x^2 - (a + 1)x + 2a = 0$  lies in the interval  $(0, 3)$  then the set of value 'a' is given by :

- A.  $(-\infty, 0) \cup (6, 0)$
- B.  $(-\infty, 0) \cup (6, \infty)$
- C.  $(-\infty, 0] \cup [6, \infty)$

D. (0, 6)

**Answer: B**



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46. The condition that the root of  $x^3 + 3px^2 + 3qx + r = 0$  are in H.P. is :

A.  $2p^3 - 3pqr + r^2 = 0$

B.  $3p^2(3) - 2pqr + p^2 = 0$

C.  $2q^3 - 3pqr + r^2 = 0$

D.  $r^3 + 3pqr + 2q^3 = 0$

**Answer: C**



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47. If  $x$  is rational and  $4y^2 + 4xy + x + 6 = 0$ , then the complete set of values of  $x$  for which  $y$  is real, is :

A.  $x \leq -2$  or  $x \geq 3$

B.  $x \leq 2$  or  $x \geq 3$

C.  $x \leq -3$  or  $x \geq 2$

D.  $-3 \leq x \leq 2$

**Answer: A**



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48. The solution of the equation  $\log_{\cos x^2}(3 - 2x) < \log_{\cos x^2}(2x - 1)$  is:

A.  $(1/2, 1)$

B.  $(-\infty, 1)$

C.  $(1/2, 3)$

D.  $(1, \infty - \sqrt{2\pi\pi}, n \in N)$



**Answer: A**



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**49.** The roots  $\alpha$  and  $\beta$  of the quadratic equation  $px^2 + qx + r = 0$  are real and of opposite signs. The roots of  $\alpha(x - \beta)^2 + \beta(x - \alpha)^2 = 0$  are:

- A. positive
- B. negative
- C. real and of opposite sign
- D. imaginary

**Answer: C**



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**50.** Let  $a, b$  and  $c$  be three distinct real roots of the cubic  $x^3 + 2x^2 - 4x - 4 = 0$ . If the equation  $x^3 + qx^2 + rx + \leq = 0$  has

roots  $\frac{1}{a}$ ,  $\frac{1}{b}$  and  $\frac{1}{c}$ , then the value of  $(q + r + s)$  is equal to :

A.  $\frac{3}{4}$

B.  $\frac{1}{2}$

C.  $\frac{1}{4}$

D.  $\frac{1}{6}$

**Answer: C**



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51. Solution set of the inequality,  $2 - \log_2(x^2 + 3x) \geq 0$  is:

A.  $[-2, 1]$

B.  $[-4, -3 \cup (0, 1)$

C.  $(-\infty, -3) \cup (1, \infty)$

D.  $(-\infty, -4) \cup [1, \infty)$

**Answer: B**



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52. For what least integral 'k' is the quadratic trinomial  $(k - 2)x^2 + 8x + (k + 4)$  is positive for all real values of x ?

A.  $k = 4$

B.  $k = 5$

C.  $k = 3$

D.  $k = 6$

**Answer: B**



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53. If roots of the equation  $(m - 2)x^2 - (8 - 2m)x - (8 - 3m) = 0$  are opposite in sign, then number of integral values (s) of m is/are :

A. 0

B. 1

C. 2

D. more than 2

**Answer: A**



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54. If  $\log_{0.6} \left( \log_6 \left( \frac{x^2 + x}{x + 4} \right) \right) < 0$ , then complete set of value of 'x' is:

A.  $(-4, -3) \cup (8, \infty)$

B.  $(-\infty, -3) \cup (8, \infty)$

C.  $(8, \infty)$

D. none of these

**Answer: A**



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55. Two different real numbers  $\alpha$  and  $\beta$  are the roots of the quadratic equation  $ax^2 + c = 0$ ,  $a, c \neq 0$ , then  $\alpha^3 + \beta^3$  is:

- A.  $a$
- B.  $-c$
- C.  $0$
- D.  $-1$

**Answer: C**



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56. The least integral value of 'k' if  $(k - 1)x^2 - (k + 1)x + (k + 1)$  is positive for all real value of x is:

- A. 1
- B. 2
- C. 3

D. 4

**Answer: B**



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57. If  $(-2, 7)$  is the highest point on the graph of  $y = -2x^2 - 4ax + \lambda$  then  $\lambda$  equals

A. 31

B. 11

C.  $-1$

D.  $-1/3$

**Answer: C**



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58. If  $a + b + c = 0$ ,  $a, b, c \in \mathbb{Q}$  then roots of the equation  $(b + c - a)x^2 + (c + a - b)x + (a + b - c) = 0$  are:

- A. rational
- B. irrational
- C. imaginary
- D. none of these

**Answer: A**



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59. If two roots of  $x^3 - ax^2 + bx - c = 0$  are equal in magnitude but opposite in signs, then prove that  $ab = c$

- A.  $a + bc = 0$
- B.  $a^2 = bc$
- C.  $ab = c$

D.  $a - b + c = 0$

**Answer: C**



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60. If  $\alpha, \beta$  are the roots of  $ax^2 + bx + c = 0$  and  $\alpha + h, \beta + h$  are the roots of  $px^2 + qx + r = 0$ , then  $h =$

- A. one positive and one negative root
- B. two positive roots
- C. two negative roots
- D. can't say anything

**Answer: A**



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61. If  $(x^2 + px + 1)$  is a factor of  $(ax^3 + bx + c)$ , then

$a^2 + c^2 = -ab$  b.  $a^2 - c^2 = -ab$  c.  $a^2 - c^2 = ab$  d. none of these

A.  $a^2 + c^2 = -ab$

B.  $a^2 + c^2 = ab$

C.  $a^2 - c^2 = ab$

D.  $a^2 - c^2 = -ab$

**Answer: C**



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62. In a  $\triangle ABC$   $\tan \frac{A}{2}, \tan \frac{B}{2}, \tan \frac{C}{2}$  are in H.P., then the value of  $\cot \frac{A}{2} \cot \frac{C}{2}$  is :

A. 3

B. 2

C. 1

D.  $\sqrt{3}$

**Answer: A**



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63. Q. Let  $f(x) = 10 - |x - 10| \quad \forall x \in [-9, 9]$  If  $M$  and  $m$  be the maximum and minimum value of  $f(x)$  respectively then

A.  $M + m = 0$

B.  $2M + m = -9$

C.  $2M + m = 7$

D.  $M = m = 7$

**Answer: A**



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64. Solution of the quadratic equation  $(3|x| - 3)^2 = |x| + 7$ , which belongs to the domain of the function  $y = \sqrt{(x - 4)x}$  is :

A.  $\pm \frac{1}{9}, \pm 2$

B.  $\frac{1}{9}, 8$

C.  $-2, -\frac{1}{9}$

D.  $-\frac{1}{9}, 8$

**Answer: C**



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65. Number of real solutions of the equation  $x^2 + 3|x| + 2 = 0$  is:

A. 0

B. 2

C. 2

D. -4

**Answer: A**



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66. If the roots of the equation  $x^2 - bx + c = 0$  are two consecutive integers, then find the value of  $b^2 = 4c$

A. 3

B. -2

C. 1

D. 2

**Answer: C**



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67. If  $x$  is real, then minimum value of  $\frac{3x^2 + 9x + 17}{3x^2 + 9x + 7}$  is:

A. 41

B. 1

C.  $\frac{17}{7}$

D.  $\frac{1}{4}$

**Answer: A**

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68. If  $\frac{x^2 + 2x + 7}{2x + 3} < 6, x \in R$  then :

A.  $x \in \left( -\infty, -\frac{3}{2} \right) \cup (11, \infty)$

B.  $x \in (-\infty, -1) \cup (11, \infty)$

C.  $x \in \left( -\frac{3}{2}, -1 \right)$

D.  $x \in \left( -\infty, -\frac{3}{2} \right) \cup (-1, 11)$

**Answer: D**

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69. If  $x$  is real, then range of  $\frac{3x - 2}{7x + 5}$  is :

A.  $R - \left\{ \frac{2}{5} \right\}$

B.  $R - \left\{ \frac{3}{7} \right\}$

C.  $(-\infty, \infty)$

D.  $R - \left\{ \frac{-2}{5} \right\}$

**Answer: B**



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70. Let A denotes the set of values of  $x$  for which  $\frac{x + 2}{x - 4} \leq 0$  and B denotes the set of values of  $x$  for which  $x^2 - ax - 4 \leq 0$ . If B is the subset of A then  $a$  cannot take integral value (a) 0, (b) 1 (c) 2 (d) 3

A. 0

B. 1

C. 2

D. 3

**Answer: D**



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71. If the quadratic polynomial  $P(x) = (p - 3)x^2 - 2px + 3p - 6$  ranges from  $[0, \infty)$  for every  $x \in R$ , then the value of  $p$  can be:

A. 3

B. 4

C. 6

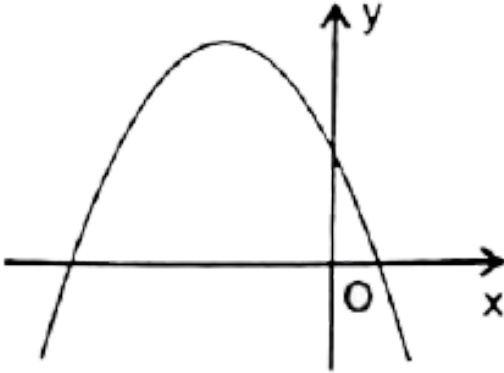
D. 7

**Answer: C**



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72. If graph of the quadratic  $y = ax^2 + bx + c$  is given below :



then:

A.  $a < 0, b > 0, c > 0$

B.  $a < 0, b > 0, c < 0$

C.  $a < 0, b < 0, c > 0$

D.  $a < 0, b < 0, c < 0$

**Answer: C**



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73. If quadratic equation  $ax^2 + bx + c = 0$  does not have real roots, then which of the following may be false (a)  $a(a - b + c) > 0$  (b)  $c(a - b + c) > 0$  (c)  $b(a - b + c) > 0$  (d)  $(a + b + c)(a - b + c) > 0$

A.  $a(a - b + c) > 0$

B.  $c(a - b + c) > 0$

C.  $b(a - b + c) > 0$

D.  $(a + b + c)(a - b + c) > 0$

**Answer: C**



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74. Minimum value of  $y = x^2 - 3x + 5$ ,  $x \in [-4, 1]$  is:

A. 3

B.  $\frac{11}{4}$

C. 0

D. 9

**Answer: A**



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75. If  $3x^2 - 17x + 10 = 0$  and  $x^2 - 5x + m = 0$  has a common root, then sum of all possible real values of 'm' is:

A. 0

B.  $-\frac{26}{9}$

C.  $\frac{29}{9}$

D.  $\frac{26}{3}$

**Answer: b**



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76. For real numbers  $x$  and  $y$ , if  $x^2 + xy - y^2 + 2x - y + 1 = 0$ , then :

A.  $x$  can not be between  $0$  and  $\frac{8}{5}$

B.  $y$  can not be between  $-\frac{8}{5}$  and  $\frac{8}{5}$

C.  $x$  can not be between  $-\frac{8}{5}$  and  $0$

D.  $y$  can not be between  $-\frac{16}{5}$  and  $0$

**Answer: C**



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77. If  $3x^4 - 6x^3 + kx^2 - 8x - 12$  is divisible by  $x - 3$ , then it is also divisible by :

A.  $3x^2 - 4$

B.  $3x^2 + 4$

C.  $3x^2 + x$

D.  $3x^2 - x$

**Answer: B**



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78. The complete set of values of  $a$  so that equation  $\sin^4 x + a \sin^2 x + 4 = 0$  has at least one real root is:

A.  $(-\infty, -5]$

B.  $(-\infty, 4] \cup [4, \infty)$

C.  $(-\infty, -4]$

D.  $[4, \infty)$

**Answer: A**



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79. Let  $r, s, t$  be the roots of the equation  $x^3 + ax^2 + bx + c = 0$ , such that  $(rs)^2 + (st)^2 + (rt)^2 = b^2 - kac$ , then  $k =$

A. 1

B. 2

C. 3

D. 4

**Answer: B**



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**80.** If the roots of the cubic equation,  $x^3 + ax^2 + bx + c = 0$  are three consecutive positive integers, then the value of  $(a^2/b + 1)$  is equal to?

A. 1

B. 2

C. 3

D. 4

**Answer: C**

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81. Let 'k' be a real number. The minimum number of distinct real roots possible of the equation  $(3x^2 + kx + 3)(x^2kx - 1) = 0$  is:

A. 0

B. 2

C. 3

D. 4

**Answer: B**

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82. If r and s are variables satisfying the equation  $\frac{1}{r+s} = \frac{1}{r} + \frac{1}{s}$ . The value of  $\left(\frac{r}{s}\right)^3$  is equal to :

A. 1

B.  $-1$

C.  $3$

D. not possible to determine

**Answer: A**



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**83.** Let  $f(x) = x^2 + ax + b$ . If the maximum and the minimum values of  $f(x)$  are  $3$  and  $2$  respectively for  $0 \leq x \leq 2$ , then the possible ordered pair of  $(a, b)$  is :

A.  $(-2, 3)$

B.  $(-3/2, 2)$

C.  $(-5/2, 3)$

D.  $(-5/2, 2)$

**Answer: B**



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84. The equation  $|x^2 - x - 6| = x + 2$  has :

A.  $-2, 2, 4$

B.  $0, 1, 4$

C.  $-2, 1, 4$

D.  $0, 2, 4$

Answer: A



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85. If  $a, b, c$ , be the sides of  $\triangle ABC$  and equations  $ax^2 + bx + c = 0$  and  $5x^2 + 12x + 13 = 0$  have a common root, then find  $\angle C$ .



A.  $60^\circ$

B.  $90^\circ$

C.  $120^\circ$

D.  $45^\circ$

**Answer: B**



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**86.** If  $\alpha, \beta$  and  $\gamma$  are three real roots of the equation  $x^3 - 6x^2 + 5x - 1 = 0$ , then the value of  $\alpha^4 + \beta^4 + \gamma^4$  is:

A. 250

B. 650

C. 150

D. 950

**Answer: B**

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87. If one of the values of  $x$  of the equation  $2x^2 - 6x + k = 0$  be  $\frac{1}{2}(a + 5i)$ , find the values of  $a$  and  $k$ .

A.  $\alpha = 3, k = 8$

B.  $\alpha = \frac{3}{2}, k = 17$

C.  $\alpha = -3, k = -17$

D.  $\alpha = 3, k = 17$

**Answer: D**

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88. Let  $x_1$  and  $x_2$  be the real roots of the equation  $x^2 - (k - 2)x + (k^2 + 3k + 5) = 9$ , then the maximum value of  $x_1^2 + x_2^2$  is:

A. 19

B. 18

C.  $\frac{50}{9}$

D. non-existent

**Answer: B**



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**89.** The set of value of  $a$  for which  $(a - 1)x^2(a + 1)x + a - 1 \geq 0$  is true for all  $x \geq 2$  is (a)  $(-\infty, 1)$  b.  $(1, \frac{7}{3})$  c.  $(\frac{7}{3}, \infty)$  d. none of these

A.  $(\frac{3}{7}, 1]$

B.  $(-\infty, 1)$

C.  $(-\infty, \frac{7}{3}]$

D.  $[\frac{7}{3}, \infty)$

**Answer: D**



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90. If  $\alpha, \beta$  be the roots of the equation  $4x^2 - 16x + c = 0, c \in \mathbb{R}$  such that  $1 < \alpha < 2$  and  $2 < \beta < 3$ , then the number of integral values of  $c$  are

A. 1

B. 2

C. 3

D. 4

**Answer: B**



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91. Assume that  $p$  is a real number. In order of  ${}^3\sqrt{x + 3p + 1} - {}^3\sqrt{x} = 1$  to have real solutions, it is necessary that:

A.  $p \geq 1/4$

B.  $p \geq -1/4$

C.  $p \geq 1/3$

D.  $p \geq -1/3$

**Answer: B**



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92. If  $\alpha, \beta$  are the roots of the quadratic equation  $x^2 - \left(3 + 2\sqrt{\log_2 3} - 3\sqrt{\log_3 2}\right)x - 2\left(3^{\log_3 2} - 2^{\log_2 3}\right) = 0$ , then the value of  $\alpha^2 + \alpha\beta$  is equal to :

A. 3

B. 5

C. 7

D. 11

**Answer: C**



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**93.** If  $m$  is the minimum value of  $f(x, y) = x^2 - 4x + y^2 + 6y$  when  $x$  and  $y$  are subjected to the restrictions  $0 \leq x \leq 1$  and  $0 \leq y \leq 1$ , then the value of  $|m|$  is \_\_\_\_\_

A.  $-1$

B.  $-2$

C.  $-3$

D.  $-5$

**Answer: C**



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94. The expression  $ax^2 + 2hx + c$ , where 'a' is non-zero real number, has same sign as that of 'a' for every real value of x, then roots of quadratic equation  $ax^2 + (b - c)x - 2b - c - a = 0$ , are

- A. real and equal
- B. real and unequal
- C. non-real having positive real part
- D. non-real having negative real part

**Answer: B**



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95. Let a, b and c be the roots of  $x^3 - x + 1 = 0$ , then the value of

$\left( \frac{1}{a+1} + \frac{1}{b+1} + \frac{1}{c+1} \right)$  equals to :

- A. 1
- B. -1

C. 2

D. -2

**Answer: D**



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**96.** The number of integral values of  $k$  for which the inequality

$x^2 - 2(4k - 1)x + 15k^2 - 2k - 7 \geq 0$  hold for  $x \in R$  are \_\_\_\_\_

A. 2

B. 3

C. 4

D. infinite

**Answer: B**



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97. The number of integral values which can be taken by the expression,

$$f(x) = \frac{x^3 - 1}{(x - 1)(x^2 - x + 1)} \text{ for } x \in R, \text{ is:}$$

- A. 1
- B. 2
- C. 3
- D. infinite

**Answer: B**



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98. The complete set of values of  $m$  for which the inequality

$$\frac{x^2 - mx - 2}{x^2 + mx + 4} > -1 \text{ is satisfied } \forall x \in R, \text{ is :}$$

- A.  $m = 0$
- B.  $-1 < m < 1$
- C.  $-2 < m < 2$

D.  $-4 < m < 4$

**Answer: D**



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**99.** The complete set of values of  $a$  for which the roots of the equation  $x^2 - 2|a + 1|x + 1 = 0$  are real is given by :

A.  $(-\infty, -2] \cup [0, \infty)$

B.  $(-\infty, -1] \cup [0, \infty)$

C.  $(-\infty, -1] \cup [1, \infty)$

D.  $(-\infty, -2] \cup [1, \infty)$

**Answer: A**



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100. If the quadratic polynomials defined on real coefficient

$P(x) = a_1x^2 + 2b_1x + c_1$  and  $Q(x) = a_2x^2 + 2b_2x + c_2$  take positive

values  $\forall x \in R$ , what can we say for the trinomial

$g(x) = a_1a_2x^2 + b_1b_2x + c_1c_2$ ?

A.  $f(x) < 0 \forall x \in R$

B.  $f(x) > 0 \forall x \in R$

C.  $f(x)$  takes both positive and negative values

D. Nothing can be said about  $f(x)$

**Answer: B**



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101.  $0 \leq a \leq 3, 0 \leq b \leq 3$  and the equation,

$x^2 + 4 + 3 \cos(ax + b) = 2x$  has atleast one solution, then find the

value of  $(a+b)$ .

A.  $\frac{\pi}{4}$

B.  $\frac{\pi}{3}$

C.  $\frac{\pi}{2}$

D.  $\pi$

**Answer: D**



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**102.** Let  $\alpha, \beta$  be the roots of  $x^2 - 4x + A = 0$  and  $\gamma, \delta$  be the roots of  $x^2 - 36x + b = 0$ . If  $\alpha, \beta, \gamma, \delta$  form an increasing G.P. and  $A^t = B$  then the value of 't' equals

A. 4

B. 5

C. 6

D. 8

**Answer: B**



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**103.** How many roots does the following equation possess

$$3^{|x|} (|2 - |x||) = 1?$$

A. 2

B. 3

C. 4

D. 6

**Answer: C**



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**104.** If  $\cot \alpha$  equals the integral solution of inequality

$$4x^2 - 16x + 15 \leq 0 \text{ and } \sin \beta \text{ equals to the slope of the bisector of the}$$

first quadrant, then  $\sin(\alpha + \beta)\sin(\alpha - \beta)$  is equal to:

A.  $-\frac{3}{5}$

B.  $-\frac{4}{5}$

C.  $\frac{2}{\sqrt{2}}$

D. 3

**Answer: B**



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**105.** Graph of  $f(x) = x$  &  $g(x) = 2 + \ln x$ ,  $x > 0$  where  $e$  is base of natural log. Graph intersect at=?

A. once in  $(0, 1)$  and never in  $(1, \infty)$

B. once in  $(0, 1)$  and once in  $(e^2, \infty)$

C. once in  $(0, 1)$  and one in  $(e, e^2)$

D. more than twice in  $(0, \infty)$

**Answer: C**



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**106.** The sum of all the roots of equation

$$x^4 - 3x^3 - 2x^2 - 3x + 1 = 0 \text{ is :}$$

- A. 1
- B. 2
- C. 3
- D. 4

**Answer: D**



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**107.** If  $\alpha, \beta (\alpha < \beta)$  are the real roots of the equation  $x^2 - (k + 4)x + k^2 - 12 = 0$  such that  $4 \in (\alpha, \beta)$ , then the number of

integral values of  $k$  equal to :

A. 4

B. 5

C. 6

D. 7

**Answer: D**



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**108.** Let  $\alpha, \beta$  be real roots of the quadratic equation  $x^2 + kx + (k^2 + 2k - 4) = 0$ , then the maximum value of  $(\alpha^2 + \beta^2)$  is equal to :

A. 9

B. 10

C. 11



D. 12

**Answer: D**



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**109.** Let  $f(x) = a^x - x$  in  $a, a > 1$ . Then the complete set of real values of  $x$  for which  $f(x) > 0$  is :

A.  $(1, \infty)$

B.  $(-1, \infty)$

C.  $(0, \infty)$

D.  $(0, 1)$

**Answer: C**



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110. If  $a, b$  and  $c$  are the roots of the equation  $x^3 + 2x^2 + 1 = 0$ , find

$$\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} :$$

A. 8

B.  $-8$

C. 0

D. 2

**Answer: A**



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111. Let  $\alpha, \beta$  are the two real roots of equation

$x^2 + px + q = 0, p, q \in R, q \neq 0$ . If the quadratic equation  $g(x) = 0$

has two roots  $\alpha + \frac{1}{\alpha}, \beta + \frac{1}{\beta}$  such that sum of roots is equal to product

of roots, then the complete range of  $q$  is:

A.  $\left[ \frac{1}{3}, 3 \right]$

B.  $\left(\frac{1}{3}, 3\right]$

C.  $\left[\left(1-\frac{1}{3}, 3\right)\right]$

D.  $\left(-\infty, \frac{1}{3}\right) \cup [3, \infty)$

**Answer: A**



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112. If the equation  $\ln(x^2 + 5x) - \ln(x + a + 3) = 0$  has exactly one solution for  $x$ , then possible integral value of  $a$  is:

A. 4

B. 5

C. 6

D. 7

**Answer: B**



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113. Let  $f(x) = x^2 + \frac{1}{x^2} - 6x - \frac{6}{x} + 2$ , then minimum value of  $f(x)$

is:

- A.  $-2$
- B.  $-8$
- C.  $-9$
- D.  $-12$

**Answer: C**



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114. If  $x^2 + bx + b$  is a factor of  $x^3 + 2x^2 + 2x + c (c \neq 0)$ , then  $b + c$  is

:

- A.  $2$
- B.  $-1$

C. 0

D.  $-2$

**Answer: a**



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115. If roots of  $x^3 + 2x^2 + 1 = 0$  are  $\alpha, \beta$  and  $\gamma$ , then the value of  $(\alpha\beta)^3 + (\beta\gamma)^3 + (\alpha\gamma)^3$ , is:

A.  $-11$

B. 3

C. 4

D. 6

**Answer: B**



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116. How many roots does the following equation possess

$$3^{|x|}(|2 - |x||) = 2?$$

A. 2

B. 3

C. 4

D. 6

**Answer: C**



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117. The sum of all the roots of equation

$$x^4 - 3x^3 - 2x^2 - 3x + 1 = 0 \text{ is :}$$

A. 1

B. 2

C. 3

D. 4

**Answer: D**



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**118.** If  $\alpha$  and  $\beta$  are the roots of the quadratic equation  $4x^2 + 2x - 1 = 0$

then the value of  $\sum_{r=1}^{\infty} (\alpha^r + \beta^r)$  is :

A. 2

B. 3

C. 6

D. 0

**Answer: D**



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119. The number of value (s) of  $x$  satisfying the equation  $(2011)^x + (2012)^x + (2013)^x - (2014)^x = 0$  is/are:

- A. exactly 2
- B. exactly 1
- C. more than one
- D. 0

**Answer: B**



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120. If  $\alpha, \beta (\alpha < \beta)$  are the real roots of the equation  $x^2 - (k + 4)x + k^2 - 12 = 0$  such that  $4 \in (\alpha, \beta)$ , then the number of integral values of  $k$  equal to :

- A. 4
- B. 5



C. 6

D. 7

**Answer: D**



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121. Let  $\alpha, \beta$  be real roots of the quadratic equation  $x^2 + kx + (k^2 + 2k - 4) = 0$ , then the maximum value of  $(\alpha^2 + \beta^2)$  is equal to :

A. 9

B. 10

C. 11

D. 12

**Answer: D**



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122. The set of value of  $a$  for which  $(a - 1)x^2(a + 1)x + a - 1 \geq 0$  is true for all  $x \geq 2$  is (a)  $(-\infty, 1)$  b.  $\left(1, \frac{7}{3}\right)$  c.  $\left(\frac{7}{3}, \infty\right)$  d. none of these

A.  $(-\infty, 1)$

B.  $\left[\frac{7}{3}, \infty\right)$

C.  $\left[\frac{3}{7}, \infty\right)$

D. none of these

**Answer: B**



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123. If the equation

$$x^2 + ax + 12 = 9, x^2 + bx + 15 = 0 \text{ and } x^2 + (a + b)x + 36 = 0$$

have a common positive root, then  $b + 2a$  equal to.

A.  $-6$

B. 22

C. 6

D. - 22

**Answer: D**



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**124.** The equation  $e^{\sin x} - e^{-\sin x} - 4 = 0$  has (A) infinite number of real roots (B) no real roots (C) exactly one real root (D) exactly four real roots

A. infinite number of real roots

B. no real root

C. exactly one real root

D. exactly four real roots

**Answer: B**



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125. The difference between the maximum and minimum value of the function  $f(x) = 3\sin^4 x - \cos^6 x$  is :

A.  $\frac{3}{2}$

B.  $\frac{5}{2}$

C. 3

D. 4

**Answer: D**



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126. If  $\alpha, \beta$  are the roots of  $x^2 - 3x + a = 0$ ,  $a \in \mathbb{R}$  and  $0 < \alpha < 1 < \beta$ ,

then find the values of  $a$

A.  $\lambda \in \left(2, \frac{9}{4}\right]$

B.  $\lambda \in \left(-\infty, \frac{9}{4}\right]$

C.  $\lambda \in (2, \infty)$

D.  $\lambda \in (-\infty, 2)$

**Answer: D**



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127. If  $2x^2 + 5x + 5x + 7 = 0$  and  $ax^2 + bx + c = 0$  have at least one root common such that  $a, b, c \in \{1, 2, \dots, 100\}$ , then the difference between the maximum and minimum values of  $a + b + c$  is:

A. 196

B. 284

C. 182

D. 126

**Answer: C**



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128. Two particles, A and B, are in motion in the  $xy$ -plane. Their coordinates at each instant of time  $t (t \geq 0)$  are given by  $x_A = t, y_A = 2t, x_B = 1 - t$  and  $y_B = y$ . The minimum distance between particles A and B is :

A.  $\frac{1}{5}$

B.  $\frac{1}{\sqrt{5}}$

C. 1

D.  $\sqrt{\frac{2}{3}}$

**Answer: B**



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129. If  $a \neq 0$  and the equation  $ax^2 + bx + c = 0$  has two roots  $\alpha$  and  $\beta$  such that  $\alpha < -3$  and  $\beta > 2$ . Which of the following is always true ?

A.  $a(a + |b| + c) > 0$

B.  $a(a + |b| + c) < 0$

C.  $9a - 3b + c > 0$

D.  $(9a - 3b + c)(4a + 2b + c) < 0$

**Answer: B**



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**130.** The number of negative real roots of the equation

$$(x^2 + 5x)^2 - 24 = 2(x^2 + 5x) \text{ is :}$$

A. 4

B. 3

C. 2

D. 1

**Answer: B**



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131. The number of real values of  $x$  satisfying the equation

$$3|x - 2| + |1 - 5x| + 4|3x + 1| = 13 \text{ is:}$$

- A. 1
- B. 4
- C. 2
- D. 3

**Answer: C**



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132. If  $\log_{\cos x} \sin \geq 2$  and  $0 \leq x \leq 3\pi$  then  $\sin x$  lies in the interval

- A.  $\left[ \frac{\sqrt{5} - 1}{2}, 1 \right]$
- B.  $\left[ 0, \frac{\sqrt{5} - 1}{2} \right]$
- C.  $\left[ \frac{1}{2}, 1 \right]$



D. none of these

**Answer: B**



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**133.** Let  $f(x) = x^2 + bx + c$ , minimum value of  $f(x)$  is  $-5$ , then absolute value of the difference of the roots of  $f(x)$  is :

A. 5

B.  $\sqrt{20}$

C.  $\sqrt{15}$

D. Can't be determined

**Answer: B**



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134. Sum of all the solutions of the equation  $|x - 3| + |x + 5| = 7x$ , is :

A.  $\frac{6}{7}$

B.  $\frac{8}{7}$

C.  $\frac{58}{63}$

D.  $\frac{8}{45}$

**Answer: B**



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135.  $f(x) = x^2 + \frac{1}{x^2} - 6x - \frac{6}{x} + 2$  then min value of  $f(x)$

A.  $-2$

B.  $-8$

C.  $-9$

D.  $-12$

**Answer: C**



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**136.** If  $a + b + c = 1$ ,  $a^2 + b^2 + c^2 = 9$  and  $a^3 + b^3 + c^3 = 1$ , then

$\frac{1}{a} + \frac{1}{b} + \frac{1}{c}$  is (i)0 (ii)-1 (iii)1 (iv)3

A.  $\frac{2}{3}$

B. 5

C. 6

D. 1

**Answer: D**



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**137.** If roots of  $x^3 + 2x^2 + 1 = 0$  are  $\alpha, \beta$  and  $\gamma$ , then the value of

$(\alpha\beta)^3 + (\beta\gamma)^3 + (\alpha\gamma)^3$ , is :

A.  $-11$

B.  $3$

C.  $0$

D.  $-2$

**Answer: B**



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**138.** If  $x^2 + bx + b$  is a factor of  $x^3 + 2x^2 + 2x + c$  ( $c \neq 0$ ), then  $b - c$  is

:

A.  $2$

B.  $-1$

C.  $0$

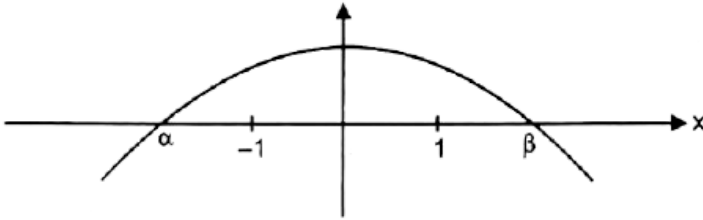
D.  $-2$

**Answer: C**



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139. The graph of quadratic polynomial  $f(x) = ax^2 + bx + c$  is shown below



A.  $\frac{c}{a}|\beta - \alpha| < -2$

B.  $f(x) > 0 \forall x > \beta$

C.  $ac > 0$

D.  $\frac{c}{a} > -1$

Answer: A



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140. If  $f(x) = \frac{x^2 - 3x + 4}{x^2 + 3x + 4}$ , then complete solution of  $0 < f(x) < 1$ ,

is :

- A.  $(-\infty, \infty)$
- B.  $(0, \infty)$
- C.  $(-\infty, 0)$
- D.  $(0, 1) \cup (2, \infty)$

**Answer: B**



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141. If  $\alpha, \beta, \gamma$  are the roots of the equation  $x^3 + 2x^2 - x + 1 = 0$ , then

value of  $\frac{(2 - \alpha)(2 - \beta)(2 - \gamma)}{(2 + \alpha)(2 + \beta)(2 + \gamma)}$  is :

- A. 5
- B. -5
- C. 10

D.  $\frac{5}{3}$

**Answer: B**



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**142.** If  $\alpha$  and  $\beta$  are roots of the quadratic equation  $x^2 + 4x + 3 = 0$ , then the equation whose roots are  $2\alpha + \beta$  and  $\alpha + 2\beta$  is :

A.  $x^2 - 12x + 35 = 0$

B.  $x^2 + 12x - 33 = 0$

C.  $x^2 - 12x - 33 = 0$

D.  $x^2 + 12x + 35 = 0$

**Answer: D**



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143. If  $a, b, c$  are real distinct numbers such that  $a^3 + b^3 + c^3 = 3abc$ , then the quadratic equation  $ax^2 + bx + c = 0$  has (a) Real roots (b) At least one negative root (c) Both roots are negative (d) Non real roots

- A. Real roots
- B. At least one negative root
- C. Both roots are negative
- D. Non real roots

**Answer: A**



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144. If the equation

$$x^2 + ax + 12 = 0, x^2 + bx + 15 = 0 \text{ and } x^2 + (a + b)x + 36 = 0$$

have a common positive root, then  $b - 2a$  is equal to

- A.  $-6$



B. 22

C. 6

D. -22

**Answer: C**



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**145.** Consider the equation  $x^3 - ax^2 + bx - c = 0$ , where  $a, b, c$  are rational number,  $a \neq 1$ . It is given that  $x_1, x_2$  and  $x_1x_2$  are the real roots of the equation. Then  $x_1x_2 \left( \frac{a+1}{b+c} \right) =$

A. 1

B. 2

C. 3

D. 4

**Answer: A**



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146. The set of value of  $a$  for which  $(a - 1)x^2(a + 1)x + a - 1 \geq 0$  is true for all  $x \geq 2$  is (a)  $(-\infty, 1)$  b.  $\left(1, \frac{7}{3}\right)$  c.  $\left(\frac{7}{3}, \infty\right)$  d. none of these

A.  $(-\infty, . 1)$

B.  $\left[\frac{7}{3}, \infty\right)$

C.  $\left[\frac{3}{7}, \infty\right)$

D. none of these

Answer: B



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147. The number of real solutions of the equation  $|x^2| - 3|x| + 2 = 0$  is

(a) 3 (b) 4 (c) 1 (d) 3.

A. 2

B. 4

C. 1

D. 3

**Answer: B**



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**148.** Show that the equation  $e^{\sin x} - e^{-\sin x} - 4 = 0$  has no real solution.

A. infinite number of real roots

B. no real root

C. exactly one real root

D. exactly four real roots

**Answer: B**



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149. If  $\alpha, \beta$  are the roots of the quadratic equation  $x^2 - 2(1 - \sin 2\theta)x - 2\cos^2(2\theta) = 0$ , then the minimum value of  $(\alpha^2 + \beta^2)$  is equal to

A.  $-4$

B.  $8$

C.  $0$

D.  $2$

**Answer: C**



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150. If the equation  $|\sin x|^2 + |\sin x| + b = 0$  has two distinct roots in  $[0, \pi[$  then the number of integers in the range of  $b$  is equal to:

A.  $0$

B.  $1$

C. 2

D. 3

**Answer: C**



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**151.** If  $a \neq 0$  and the equation  $ax^2 + bx + c = 0$  has two roots  $\alpha$  and  $\beta$  such that  $\alpha < -3$  and  $\beta > 2$ . Which of the following is always true ?

A.  $a(a + |b| + c) > 0$

B.  $a(a + |b| + c) < 0$

C.  $9a - 3b + c > 0$

D.  $(9a - 3b + c)(4a + 2b + c) < 0$

**Answer: B**



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152. If  $\alpha, \beta$  are the roots of the quadratic equation  $x^2 + px + q = 0$  and  $\gamma, \delta$  are the roots of  $x^2 + px - r = 0$  then  $(\alpha - \gamma)(\alpha - \delta)$  is equal to :

- A.  $q + r$
- B.  $q - r$
- C.  $-(q + r)$
- D.  $-(p + q + r)$

**Answer: C**



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153. The solution set of inequation  $\log_{1/3}(2^{x+2} - 4^x) \geq -2$ , is

- A.  $(-\infty, 2)$
- B.  $(-\infty, 2 + \sqrt{13})$
- C.  $(2, \infty)$

D. none of these

**Answer: A**



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**Exercise One Or More Than One Answer Is Are Correct**

1. If  $S$  is the set of all real  $x$  such that  $\frac{2x - 1}{2x^3 + 3x^2 + x}$  is  $\left(-\infty, -\frac{3}{2}\right)$

b.  $\left(-\frac{3}{2}, \frac{1}{4}\right)$  c.  $\left(-\frac{1}{4}, \frac{1}{2}\right)$  d.  $\left(\frac{1}{2}, 3\right)$  e. None of these

A.  $\left(-\infty, -\frac{3}{2}\right)$

B.  $\left(-\frac{3}{2}, -\frac{1}{2}\right)$

C.  $\left(\frac{-1}{2}, 0\right)$

D.  $\left(\frac{1}{2}, 2\right)$

**Answer: A::B::D**



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2. If  $kx^2 - 4x + 3k + 1 > 0$  for atleast one  $x > 0$ , then if  $k \in S$  contains :

A.  $(1, \infty)$

B.  $(0, \infty)$

C.  $(-1, \infty)$

D.  $\left(-\frac{1}{4}, \infty\right)$

**Answer: A**



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3. The roots of the equation  $|x^2 - x - 6| = x + 2$  are

A. two positive roots

B. two real roots

C. three real roots



D. four real roots

**Answer: C**



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4. If the roots of the equation  $x^2 - ax - b = 0$  ( $a, b, \in R$ ) are both lying between  $-2$  and  $2$ , then :

A.  $|a| < 2 - \frac{b}{2}$

B.  $|a| > 2 - \frac{b}{2}$

C.  $|a| < 4$

D.  $|a| \leq \frac{b}{2} - 2$

**Answer: A::C::D**



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5. Consider the equation is real number  $x$  and a real parameter  $\lambda$ ,  $|x - 1| - |x - 2| + |x - 4| = \lambda$  Then for  $\lambda \geq 1$ , the number of solutions, the equation can have is/are :

A. 1

B. 2

C. 3

D. 4

**Answer: A::B::C::D**



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6. If  $a$  and  $b$  are two distinct non-zero real numbers such that

$$a - b = \frac{a}{b} = \frac{1}{b} - \frac{1}{a}, \text{ then : (a) } a > 0 \text{ (b) } a < 0 \text{ (c) } b < 0 \text{ (d) } b > 0$$

A.  $a > 0$

B.  $a < 0$

C.  $b < 0$

D.  $b > 0$

**Answer: A::C**



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7.

Let

$$f(x) = ax^2 + bx + c, a > 0 \text{ and } f(2-x) = f(2+x) \forall x \in R \text{ and } f(x)$$

has 2 distinct real roots, then which of the following is true ?

A. Atleast one roots must be positive

B.  $f(2) < f(0) > f(1)$

C. Vertex of graph of  $y = f(x)$  is negative

D. Vertex of graph of  $y = f(x)$  lies in 3rd quadrat

**Answer: A::B::C**



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8. If exactly two integers lie between the roots of equation  $x^2 + ax + a + 1 = 0$ . Then integral value (s) of 'a' is/are :

A. -1

B. -2

C. 1

D. 2

**Answer: A::C**



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9. If the minimum value of the quadratic expression  $y = ax^2 + bx + c$  is negative attained at negative value of x, then :

A.  $a > 0$

B.  $b > 0$

C.  $c > 0$

D.  $D > 0$

**Answer: A::B::D**



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10. The quadratic expression  $ax^2 + bx + c > 0 \forall x \in R$ , then :

A.  $13a - 5b + 2c > 0$

B.  $13a - b + 2c > 0$

C.  $c > 0, D < 0$

D.  $a + c > b, D < 0$

**Answer: A::B::C::D**



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11. The sum of all possible integral value of 'k' for which  $5x^2 - 2kx + 1 < 0$  has exactly one integral solution :

A. 2

B. 3

C. 5

D. 9

**Answer: A::C**



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12. The coefficient of x in the equation  $x^2 + px + q = 0$  was wrongly written as 17 in place of 13 and the roots thus found were -2 and -15. The roots of the correct equation are (A) 15, -2 (B) -3, -10 (C) -13, 30 (D) 4, 13

A. -1

B.  $-3$

C.  $-5$

D.  $-10$

**Answer: B::D**



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13. If  $x$  is real and  $x^2 - 3x + 2 > 0$ ,  $x^2 - 3x - 4 \leq 0$ , then which one of the following is correct?

A.  $|x| \leq 2$

B.  $2 \leq x \leq 4$

C.  $-1 \leq x \leq 1$

D.  $2 < x \leq 4$

**Answer: C::D**



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14. If  $5^x + (2\sqrt{3})^{2x} - 169 \leq 0$  is true for  $x$  lying in the interval :

A.  $(-\infty, 2)$

B.  $(0, 2)$

C.  $(2, \infty)$

D.  $(0, 4)$

**Answer: A:B**



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15. Let  $f(x) = x^2 + ax + b$  and  $g(x) = x^2 + cx + d$  be two quadratic polynomials with real coefficients and satisfy  $ac = 2(b + d)$ . Then which of the following is (are) correct ?

A. Exactly one of either  $f(x) = 0$  or  $g(x) = 0$  must have real roots.

B. Atleast one of either  $f(x) = 0$  or  $g(x) = 0$  must have real roots.



C. Both  $f(x) = 0$  and  $g(x) = 0$  must have real roots.

D. Both  $f(x) = 0$  and  $g(x) = 0$  must have imaginary roots.

**Answer: B**

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16. The expression  $\frac{1}{\sqrt{x+2\sqrt{x-1}}} + \frac{1}{\sqrt{x-2\sqrt{x-1}}}$  simplifies to:

A.  $\frac{2}{3-x}$  if  $1 < x < 2$

B.  $\frac{2}{2-x}$  if  $1 < x < 2$

C.  $\frac{2\sqrt{x-1}}{(x-2)}$  if  $x > 2$

D.  $\frac{2\sqrt{x-1}}{(x+2)}$  if  $x > 2$

**Answer: B::C**

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17. if all values of  $x$  which satisfies the inequality  $\log_{(1/3)}(x^2 + 2px + p^2 + 1) \geq 0$  also satisfy the inequality  $kx^2 + kx - k^2 \leq 0$  for all real values of  $k$ , then all possible values of  $p$  lies in the interval :

A.  $[-1, 1]$

B.  $[0, 1]$

C.  $[0, 2]$

D.  $[-2, 0]$

**Answer: A::B::C**



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18. If  $(a, 0)$  is a point on a diameter of the circle  $x^2 + y^2 = 4$ , then the equation  $x^2 - 4x - a^2 = 0$  has

A. Exactly one real root in  $[-1, 0]$

B. Exactly one real root in  $[2, 5]$

C. Distinct roots greater than  $-1$

D. Distinct roots less than 5

**Answer: A::B::C::D**



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19. Let  $x^2 - px + q = 0$  where  $p \in \mathbb{R}, q \in \mathbb{R}, pq \neq 0$  have the roots  $\alpha, \beta$  such that  $\alpha + 2\beta = 0$ , then :

A.  $2p^2 + q = 0$

B.  $2q^3 + p = 0$

C.  $q < 0$

D.  $q > 0$

**Answer: A::C**



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20. If  $a, b, c$  are positive numbers such that  $a > b > c$  and the equation  $(a + b - 2c)x^2 + (b + c - 2a)x + (c + a - 2b) = 0$  has a root in the interval  $(-1, 0)$ , then

A.  $a + c < 2b$

B. both roots are rational

C.  $ax^2 + 2bx + c = 0$  have both roots negative

D.  $cx^2 + 2bx + a = 0$  have both roots negative

Answer: A::B::C::D



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21. For the quadratic polynomial  $f(x) = 4x^2 - 8ax + a$ . the statements (s) which hold good is/are:

A. There is only one integral 'a' for which  $f(x)$  is non-negative  $\forall x \in R$

B. For  $a < 0$ , the number zero lies between the zeroes of the polynomial

C.  $f(x) = 0$  has two distinct solutions in  $(0, 1)$  for  $a \in \left(\frac{1}{7}, \frac{4}{7}\right)$

D. The minimum value of  $f(x)$  for minimum value of  $a$  for which  $f(x)$  is non-negative  $\forall x \in R$  is 0

**Answer: A::B::D**



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22. Given  $a, b, c$  are three distinct real numbers satisfying the inequality

$a - 2b + 4c > 0$  and the equation  $ax^2 + bx + c = 0$  has no real roots.

Then the possible value (s) of  $\frac{4a + 2b + c}{a + 3b + 9c}$  is/are:

A. 2

B. -1

C. 3

D.  $\sqrt{2}$

**Answer: A::C::D**



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**23.** Let  $f(x) = x^2 - 4x + c \forall x \in \mathbb{R}$ , where  $c$  is a real constant, then which of the following is/are true ?

A.  $f(0) > f(1) > f(2)$

B.  $f(2) > f(3) > f(4)$

C.  $f(1) < f(4) < f(-1)$

D.  $f(0) = f(4) > f(3)$

**Answer: A::C::D**



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24. If  $0 < a < b < c$  and the roots  $\alpha, \beta$  of the equation  $ax^2 + bx + c = 0$  are non-real complex numbers, then

A.  $|\alpha| = |\beta|$

B.  $|\alpha| > 1$

C.  $|\alpha| < 1$

D.  $|\alpha| = 1$

**Answer: A::B**



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25. If satisfies  $|x - 1| + |x - 2| + |x - 3| > 6$ , then :

A.  $x \in (-\infty, 1)$

B.  $x \in (-\infty, 0)$

C.  $x \in (4, \infty)$

D.  $(2, \infty)$

**Answer: B::C**



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**26.** If both roots of the quadratic equation  $ax^2 + x + b - a = 0$  are non real and  $b > -1$ , then which of the following is/are correct ? (a)  $a > 0$   
(b)  $a < b$  (c)  $3a > 2 + 4b$  (d)  $3a < 2 + 4b$

A.  $a > 0$

B.  $a < b$

C.  $3a > 2 + 4b$

D.  $3a < 2 + 4b$

**Answer: A::B**



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27. If  $a, b$  are two numbers such that  $a^2 + b^2 = 7$  and  $a^3 + b^3 = 10$ , then :

- A. The greatest value of  $|a + b| = 5$
- B. The greatest value of  $(a + b)$  is 4
- C. The least value of  $(a + b)$  is 1
- D. The least value of  $|a + b|$  is 1

**Answer: A::B::C**



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28. The number of non-negative integral ordered pair(s)  $(x, y)$  for which  $(xy - 7)^2 = x^2 + y^2$  holds is greater than or equal to :

- A. 1
- B. 2
- C. 3

D. 4

Answer: A::B::C::D



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29. If  $\alpha, \beta, \gamma$  and  $\delta$  are the roots of the equation  $x^4 - bx - 3 = 0$ , then an equation whose roots are  $\frac{\alpha + \beta + \gamma}{\delta^2}, \frac{\alpha + \beta + \gamma}{\gamma^2}, \frac{\alpha + \beta + \gamma}{\beta^2}$ , and  $\frac{\alpha + \beta + \gamma}{\alpha^2}$ , is:

A.  $3x^4 + bx + 1 = 0$

B.  $3x^4 - bx + 1 = 0$

C.  $3x^4 + bx^3 - 1 = 0$

D.  $3x^4 - bx^3 - 1 = 0$

Answer: D



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30. The value of 'k' for which roots of the equation  $4x^2 - 2x + k = 0$  are completely in  $(-1,1)$  may be equal to

A.  $-1$

B.  $0$

C.  $2$

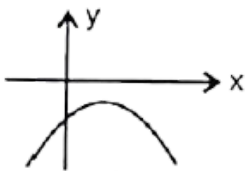
D.  $-3$

Answer: A:B

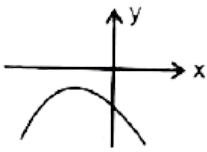


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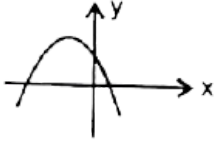
31. For which of the following graphs the quadratic expression  $y = ax^2 + bx + c$  the product  $abc$  is negative ?



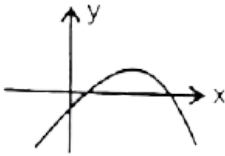
A.



B.



C.



D.

Answer: A::C::D



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32. If  $ax^2 + bx + c = 0$ ,  $a, b, c \in \mathbb{R}$  has no real zeros, and if  $c > 0$  and  $a > 0$

A.  $(a + b + c)(a - b + c) > 0$

B.  $(a + b + c)(a - 2b + 4c) > 0$

C.  $(a - b + c)(4a - 2b + c) > 0$

$$D. a(b^2 - 4ac) > 0$$

Answer: A::B::D



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33. If  $\alpha$  and  $\beta$  are the roots of the equation  $ax^2 + bx + c = 0$ ,  $a, b, c \in R$ ,  $\alpha \neq 0$  then which is (are) correct:

$$A. \alpha^2 + \beta^2 = \frac{b^2 - 2ac}{a^2}$$

$$B. \frac{1}{\alpha^2} + \frac{1}{\beta^2} = \frac{b^2 - 2ac}{c^2}$$

$$C. \frac{1}{\alpha^3} + \frac{1}{\beta^3} = \frac{abc - b^3}{c^3}$$

$$D. \alpha\beta(\alpha + \beta) = \frac{-bc}{\alpha^2}$$

Answer: A::B::D



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34. The equation  $\cos^2 x - \sin x + \lambda = 0$ ,  $x \in (0, \pi/2)$  has roots then value(s) of  $\lambda$  can be equal to :

A. 0

B.  $1/2$

C.  $-1$

D.  $1/2$

**Answer: A::C**



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35. If the equation  $\ln(x^2 + 5x) - \ln(x + a + 3) = 0$  has exactly one solution for  $x$ , then possible integral value of  $a$  is:

A.  $-3$

B.  $-1$

C. 0

D. 2

**Answer: B::C::D**



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**36.** The number of non-negative integral ordered pair (s)  $(x, y)$  for which  $(xy - 7)^2 = x^2 + y^2$  holds is greater then or equal to :

A. 1

B. 2

C. 3

D. 4

**Answer: A::B::C::D**



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37. For  $a < 0$ , determine all real roots of the equation  $x^2 - 2a|x - a| - 3a^2 = 0$ .

A.  $a(1 - \sqrt{2})$

B.  $a(1 + \sqrt{2})$

C.  $a(-1 - \sqrt{6})$

D.  $a(-1 + \sqrt{6})$

**Answer: A:D**



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38. If  $0 < a < b < c$  and the roots  $\alpha, \beta$  of the equation  $ax^2 + bx + c = 0$  are non-real complex numbers, then

A.  $|\alpha| = |\beta|$

B.  $|\alpha| > 1$

C.  $|\beta| < 1$



D.  $|\alpha| = 1$

**Answer: A::B**



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39. Solve :  $|x - 1| + |x - 2| + |x - 3| > 6$

A.  $x \in (-\infty, 1)$

B.  $x \in (-\infty, 0)$

C.  $x \in (4, \infty)$

D.  $(2, \infty)$

**Answer: B::C**



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40. The value of 'k' for which roots of the equation  $4x^2 - 2x + k = 0$  are completely in  $(-1,1)$  may be equal to

A.  $-1$

B.  $0$

C.  $2$

D.  $-3$

Answer: A::B



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41. Let  $\alpha, \beta, \gamma, \delta$  are roots of  $x^4 - 12x^3 + \lambda x^2 - 54x + 14 = 0$  If  $\alpha + \beta = \gamma + \delta$ , then

A.  $\lambda = 45$

B.  $\lambda = -45$

C. If  $\alpha^2 + \beta^2 < \gamma^2 + \delta^2$  then  $\frac{\alpha\beta}{\gamma\delta} = \frac{7}{2}$

D. If  $\alpha^2 + \beta^2 < \gamma^2 + \delta^2 = \frac{\alpha\beta}{\gamma\delta} = \frac{2}{7}$

Answer: A::C



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42. If the points  $\left(\frac{a^3}{(a-1)}, \left(\frac{a^2-3}{(a-1)}\right), \left(\frac{b^3}{(b-1)}, \left(\frac{b^2-3}{(b-1)}\right), \left(\frac{c^3}{(c-1)}, \left(\frac{c^2-3}{(c-1)}\right)\right)$ , where  $a, b, c$  are different from 1, lie on the

$$lx + my + n = 0 \quad , \quad \text{then} \quad a + b + c = -\frac{m}{l} \quad ab + bc + ca = \frac{n}{l}$$

$$abc = \frac{(m+n)}{l} abc - (bc + ca + ab) + 3(a + b + c) = 0$$

A.  $a + b + c = -\frac{m}{l}$

B.  $abc = \frac{m + \pi}{l}$

C.  $ab + bc + ca = \frac{\pi}{l}$

D.  $abc - (ab + bc + ca) + 3(a + b + c) = 0$

Answer: A::C::D



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## Exercise Comprehension Type Problems

1. Let  $f(x) = ax^2 + bx + c$ ,  $a \neq 0$ , such that the  $f(-1-x) = f(-1+x) \forall x \in R$ . Also given that  $f(x) = 0$  has no real roots and  $4a + b > 0$ .

Let  $\alpha = 4a - 2b + c$ ,  $\beta = 9a + 3b + c$ ,  $\gamma = 9a - 3b + c$ , then which of the following is correct ?

A.  $\beta < \alpha < \gamma$

B.  $\gamma < \alpha < \beta$

C.  $\alpha < \gamma < \beta$

D.  $\alpha < \beta < \gamma$

**Answer: C**



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2. Let  $f(x) = ax^2 + bx + c, a \neq 0$ , such the  $f(-1-x) = f(-1+x) \forall x \in R$ . Also given that  $f(x) = 0$  has no real roots and  $4a + b > 0$ .

Let  $p = b - 4a, q = 2a + b$ , then  $pq$  is:

- A. negative
- B. positive
- C. 0
- D. nothing can be said

**Answer: A**



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3. If  $\alpha, \beta$  the roots of equation  $(k + 1)x^2 - (20k + 14)x + 91k + 40 = 0, (\alpha < \beta)k < 0$ , then answer the following questions.

The smaller root ( $\alpha$ ) lie in the interval :

A. (4, 7)

B. (7, 10)

C. (10, 13)

D. None of these

**Answer: A**

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4. If  $\alpha, \beta$  the roots of equation  $(k + 1)x^2 - (20k + 14)x + 91k + 40 = 0$ ,  $(\alpha < \beta)k < 0$ , then answer the following questions.

The larger root ( $\beta$ ) lie in the interval :

A. (4, 7)

B. (7, 10)

C. (10, 13)

D. None of these

**Answer: C**



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5. Let  $f(x) = x^2 + bx + c \forall x \in R, (b, c, \in R)$  attains its least value at  $x = -1$  and the graph of  $f(x)$  cuts y-axis at  $y = 2$ .

The value of  $f(-2) + f(0) + f(1) =$

A.  $-1$

B.  $0$

C.  $1$

D.  $3/2$

**Answer: C**



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6. Let  $f(x) = x^2 + bx + c \forall x \in R, (b, c, \in R)$  attains its least value at  $x = -2$  and the graph of  $f(x)$  cuts y-axis at  $y = 2$ .

The value of  $f(-2) + f(0) + f(1) =$

A. 3

B. 5

C. 7

D. 9

**Answer: D**



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7. Let  $f(x) = x^2 + bx + c \forall x \in R, (b, c, \in R)$  attains its least value at  $x = -2$  and the graph of  $f(x)$  cuts y-axis at  $y = 2$ .

If  $f(x) = a$  has two distinct real roots, then complete set of values of  $a$  is :

A.  $(1, \infty)$



B.  $(-2, -1)$

C.  $(0, 1)$

D.  $(1, 2)$

**Answer: A**



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8. Consider the equation  $\log_2^2 x - 4\log_2 x - m^2 - 2m - 13 = 0, m \in R$ . Let the real roots of the equation be  $x_1, x_2$ , such that  $x_1 < x_2$ . The set of all values of  $m$  for which the equation has real roots is (i)  $(-\infty, 0)$  (ii)  $(0, \infty)$  (iii)  $[1, \infty)$  (iv)  $(-\infty, \infty)$

A.  $(-\infty, 0)$

B.  $(0, \infty)$

C.  $[1, \infty)$

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

**Answer: D**



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9. Consider the equation  $\log_2^2 x - 4\log_2 x - m^2 - 2m - 13 = 0, m \in R$ . Let the real roots of the equation be  $x_1, x_2$  such that  $x_1 < x_2$ .

The sum of maximum value of  $x_1$  and minimum value of  $x_2$  is :

A.  $\frac{513}{8}$

B.  $\frac{513}{4}$

C.  $\frac{1025}{8}$

D.  $\frac{257}{4}$

**Answer: D**



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10. The equation  $x^4 - 2x^3 + 4x - 1 = 0$  has four distinct real roots  $x_1, x_2, x_3, x_4$  such that  $x_1 < x_2 < x_3 < x_4$  and product of two roots is unity, then :

$$x_1, x_2 = x_1x_3 + x_2x_4 + x_3x_4 =$$

A. 0

B. 1

C.  $\sqrt{5}$

D. -1

**Answer: B**



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11. The equation  $x^4 - 2x^3 + 4x - 1 = 0$  has four distinct real roots  $x_1, x_2, x_3, x_4$  such that  $x_1 < x_2 < x_3 < x_4$  and product of two roots is unity, then :

$$x_2^3 + x_4^3 =$$

A.  $\frac{2 + 5\sqrt{5}}{8}$

B.  $-4$

C.  $\frac{27\sqrt{5} + 5}{4}$

D.  $18$

**Answer: D**



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**12.** Let  $f(x)$  be a polynomial of degree 5 with leading coefficient unity such that  $f(1) = 5, f(2) = 4, f(3) = 3, f(4) = 2, f(5) = 1$ . Then  $f(6)$  is equal to :

A.  $120$

B.  $-120$

C.  $0$

D.  $6$

**Answer: A**



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13. Let  $f(x)$  be a polynomial of degree 5 with leading coefficient unity, such that  $f(1) = 5$ ,  $f(2) = 4$ ,  $f(3) = 3$ ,  $f(4) = 2$  and  $f(5) = 1$ , then :

Sum of the roots of  $f(x)$  is equal to :

A. 15

B.  $-15$

C. 21

D. can't be determine

**Answer: A**



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14. Let  $f(x)$  be a polynomial of degree 5 with leading coefficient unity, such that  $f(1) = 5$ ,  $f(2) = 4$ ,  $f(3) = 3$ ,  $f(4) = 2$  and  $f(5) = 1$ , then :

Sum of the roots of  $f(x)$  is equal to :

A. 120

B.  $-120$

C. 114

D.  $-114$

**Answer: A**



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15. Consider the cubic equation in

$$x, x^3 - x^2 + (x - x^2)\sin\theta + (x - x^2)\cos\theta + (x - 1)\sin\theta\cos\theta = 0$$

whose roots are  $\alpha, \beta, \gamma$ .

The value of  $\left(\frac{\alpha}{2}\right)^2 + \left(\frac{\beta}{2}\right)^2 + \left(\frac{\gamma}{2}\right)^2 =$

A. 1

B.  $\frac{1}{2}$

C.  $2 \cos \theta$

D.  $\frac{1}{2}(\sin \theta + \cos \theta + \sin \theta \cos \theta)$

**Answer: B**



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**16.** Consider the cubic equation in

$$x, x^3 - x^2 + (x - x^2)\sin \theta + (x - x^2)\cos \theta + (x - 1)\sin \theta \cos \theta = 0$$

whose roots are  $\alpha, \beta, \gamma$ .

The value of  $\left(\frac{\alpha}{2}\right)^2 + \left(\frac{\beta}{2}\right)^2 + \left(\frac{\gamma}{2}\right)^2 =$

A. 2

B. 3

C. 4

D. 5

**Answer: D**



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17. Let  $P(x)$  be quadratic polynomial with real coefficient such that for all real  $x$  the relation  $2(1 + P(x)) = P(x - 1) + P(x + 1)$  holds. If  $P(0) = 8$  and  $P(2) = 32$  then

Sum of all coefficients of  $P(x)$  can not be

A. 20

B. 19

C. 17

D. 15

**Answer: B**



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18. Let  $P(x)$  be quadratic polynomial with real coefficient such that for all real  $x$  the relation  $2(1 + P(x)) = P(x - 1) + P(x + 1)$  holds. If  $P(0) = 8$  and  $P(2) = 32$  then

If the range of  $P(x)$  is  $[m, \infty)$  then 'm' is less than

A. -12

B. 15

C. -17

D. -5

**Answer: C**



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19. Let  $t$  be a real number satisfying  $2t^3 - 9t^2 + 30 - \lambda = 0$  where  $t = x + \frac{1}{x}$  and  $\lambda \in R$ .

If the above cubic has three real and distinct solutions for  $x$  then exhaustive set of value of  $\lambda$  be :

A.  $3 < \lambda < 10$

B.  $3 < \lambda < 30$

C.  $\lambda = 10$

D. None of these

**Answer: C**

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20. If  $t$  is a real number satisfying the equation  $2t^3 - 9t^2 + 30 - a = 0$ , then find the values of the parameter  $a$  for which the equation  $x + \frac{1}{x} = t$  gives six real and distinct values of  $x$ .

A.  $\lambda \in (-\infty, 3) \cup (30, \infty)$

B.  $\lambda \in (-\infty, -22) \cup (10, \infty) \cup \{3\}$

C.  $\lambda \in \{3, 30\}$

D. None of these

**Answer: B**



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21. Let  $t$  be a real number satisfying  $2t^2 - 9t^2 + 30 - \lambda = 0$  where  $t = x + \frac{1}{x}$  and  $\lambda \in R$ .

If the above cubic has three real and distinct solutions for  $x$  then exhaustive set of value of  $\lambda$  be :

A.  $\lambda \in (3, 10)$

B.  $\lambda \in \{3, 10\}$

C.  $\lambda \in (-\infty, -22) \cup (10, \infty)$

D. None of these

**Answer: A**



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22. Consider a quadratic expression  $f(x) = tx^2 - (2t - 1)x + (5x - 1)$

If  $f(x)$  can take both positive and negative values then  $t$  must lie in the interval

A.  $\left(-\frac{1}{4}, \frac{1}{4}\right)$

B.  $\left(-\infty, \frac{-1}{4}\right) \cup \left(\frac{1}{4}\right)$

C.  $\left(\frac{1}{4}\right) = \{0\}$

D.  $(-4, 4)$

**Answer: C**



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23. Consider a quadratic expression  $f(x) = tx^2 - (2t - 1)x + (5x - 1)$

If  $f(x)$  is non-negative  $\forall x \geq 0$  then  $t$  lies in the interval

A.  $\left[\frac{1}{5}, \frac{1}{4}\right]$

B.  $\left[\frac{1}{4}, \infty\right)$

C.  $\left[ \frac{1}{4}, \frac{1}{4} \right]$

D.  $\left[ \frac{1}{5}, \infty \right)$

Answer: D

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## Exercise Matching Type Problems

1. Match the following columns properly

(A)	The least positive integer $x$ , for which $\frac{2x-1}{2x^3+3x^2+x}$ is positive, is equal to	(P)	$\frac{4}{3}$
(B)	If the quadratic equation $3x^2 + 2(a^2 + 1)x + (a^2 - 3a + 2) = 0$ possess roots of opposite sign then $a$ can be equal to	(Q)	1
(C)	The roots of the equation $\sqrt{x+3} - 4\sqrt{x-1} + \sqrt{x+8} - 6\sqrt{x-1} = 1$ can be equal to	(R)	6
(D)	If the roots of the equation $x^4 - 8x^3 + bx^2 - cx + 16 = 0$ are all real and positive then $2(c-b)$ is equal to	(S)	16
		(T)	10

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(A)	The real root(s) of the equation $x^4 - 8x^2 - 9 = 0$ are	(P)	No real roots
(B)	The real root(s) of the equation $x^{2/3} + x^{1/3} - 2 = 0$ are	(Q)	-3, 3
(C)	The real root(s) of the equation $\sqrt{3x+1} + 1 = \sqrt{x}$ are	(R)	-8, 1

2.

(D)	The real root(s) of the equation $9^x - 10(3^x) + 9 = 0$ are	(S)	0, 2
-----	--	-----	------



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(A)	If $a, b$ are the roots of equation $x^2 + ax + b = 0$ ( $a, b \in R$ ), then the number of ordered pairs $(a, b)$ is equal to	(P)	1
(B)	If $P = \operatorname{cosec} \frac{\pi}{8} + \operatorname{cosec} \frac{2\pi}{8} + \operatorname{cosec} \frac{3\pi}{8} + \operatorname{cosec} \frac{13\pi}{8} + \operatorname{cosec} \frac{14\pi}{8} + \operatorname{cosec} \frac{15\pi}{8}$ and $Q = 8 \sin \frac{\pi}{18} \sin \frac{5\pi}{18} \sin \frac{7\pi}{18}$ , then $P + Q$ is equal to	(Q)	2
(C)	Let $a_1, a_2, a_3, \dots$ be positive terms of a G.P. and $\alpha_4, 1, 2, \alpha_{10}$ are the consecutive terms of another G.P. If $\prod_{i=2}^{12} a_i = 4^m$ where $m$ and $n$ are coprime, then $(m + n)$ equals	(R)	3
(D)	For $x, y \in R$ , if $x^2 - 2xy + 2y^2 - 6y + 9 = 0$ , then the value of $5x - 4y$ is equal to	(S)	15

3.



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## Exercise Subjective Type Problems

1. Let  $f(x) = ax^2 + bx + c$  where  $a, b, c$  are integers. If  $\sin \frac{\pi}{7} \cdot \sin \frac{3\pi}{7} + \sin \frac{3\pi}{7} \cdot \sin \frac{5\pi}{7} + \sin \frac{5\pi}{7} \cdot \sin \frac{\pi}{7} = f\left(\cos \frac{\pi}{7}\right)$ , then find the value of  $f(2)$ :

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2. Let  $a, b, c, d$  be distinct integers such that the equation  $(x - a)(x - b)(x - c)(x - d) - 9 = 0$  has an integer root 'r', then the value of  $a + b + c + d - 4t$  is equal to :

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3. Consider the equation  $(x^2 + x + 1)^2 - (m - 3)(x^2 + x + 1) + m = 0$  — (1), where  $m$  is a real parameter. By putting  $x^2 + x + 1 = t$  — (2) then  $t \geq \frac{3}{4}$  for real  $x$  the equation can be transferred to

$f(t) = t^2 - (m - 3)t + m = 0$  . At what values of  $m$  for which the equation (1) will have real roots?

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4. The number of positive integral values of  $m$ ,  $m \leq 16$  for which the equation  $(x^2 + x + 1)^2 - (m - 3)(x^2 + x + 1) + m = 0$ , has 4 distinct real root is:

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5. If the equation  $(m^2 - 12)x^4 - 8x^2 - 4 = 0$  has no real roots, then the largest value of  $m$  is  $p\sqrt{q}$  where  $p, q$  are coprime natural numbers, then  $p + q =$

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6. The least positive integral value of 'x' satisfying  $(e^x - 2)\left(\sin\left(x + \frac{\pi}{4}\right)\right)(x - \log_e 2)(\sin x - \cos x) < 0$  is:

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7. The integral values of x for which  $x^2 + 17x + 71$  is perfect square of a rational number are a and b, then  $|a - b| =$

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8. Let  $P(x) = x^6 - x^5 - x^3 - x^2 - x$  and  $\alpha, \beta, \gamma, \delta$  are the roots of the equation  $x^4 - x^3 - x^2 - 1 = 0$ , then  $P(\alpha) + P(\beta) + P(\gamma) + P(\delta) =$

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9. The number of real values of 'a' for which the largest value of the function  $f(x) = x^2 + ax + 2$  in the interval  $[-2, 4]$  is 6 will be :

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10. The number of all values of n, (where  $\pi$  is a whole number) for which the equation  $\frac{x - 6}{n - 10} = \frac{n}{x}$  has no solution.

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11. The number of negative integral values of m for which the expression  $x^2 + 2(m - 1)x + m + 5$  is positive  $\forall x > 1$  is:

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12. If the expression  $ax^4 + bx^3 - x^2 + 2x + 3$  has the remainder  $4x + 3$  when divided by  $x^2 + x - 2$ , then  $a + 4b = \dots$



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13. The smallest value of  $k$  for which both roots of the equation  $x^2 - 8kx + 16(k^2 - k + 1) = 0$  are real distinct and have value at least 4, is



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14. If  $x^2 - 3x + 2$  is a factor of  $x^4 - px^2 + q = 0$ , then  $p + q =$



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15. The sum of all real values of  $k$  for which the expression  $x^2 + 2xy + ky^2 + 2x + k = 0$  can be resolved into linear factors is :



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16. The curve  $y = (\lambda - 1)x^2 + 2$  intersects the curve  $y = \lambda x + 3$  in exactly one point, if  $\lambda$  equals { - 2, 2} b. {1} c. { - 2} d. {2}

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17. Find the number of integral values of 'a' for which the range of function

$$f(x) = \frac{x^2 - ax + 1}{x^2 - 3x + 3} \quad (-\infty, \infty),$$

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18. When  $x^{100}$  is divided by  $x^2 - 3x + 2$ , the remainder is  $(2^{k+1} - 1)x - 2(2^k - 1)$ , then  $k =$

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19. Let  $p(x) = 0$  be a polynomial equation of the least possible degree, with rational coefficients having  $\sqrt[3]{7} + \sqrt[3]{49}$  as one of its roots. Then

product of all the roots of  $p(x) = 0$  is

a. 56 b. 63 c. 7 d. 49

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20. The range of value's of  $k$  for which the equation  $2 \cos^4 x - \sin^4 x + k = 0$  has atleast one solution is  $[\lambda, \mu]$ . Find the value of  $(9\mu + \lambda)$ .

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21. Let  $p(x)$  be a polynomial with real coefficient and  $p(x) - p'(x) = x^2 + 2x + 1$ . Find  $P(-1)$ .

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22. Find the smallest positive integral value of  $a$  for which the greater root of the equation  $x^2 - (a^2 + a + 1)x + a(a^2 + 1) = 0$  lies between

the roots of the equation  $x^2 - a^2x - 2(a^2 - 2) = 0$

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23. If the equation  $x^4 + kx^2 + k = 0$  has exactly two distinct real roots, then the smallest integral value of  $|k|$  is:

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24. Let  $a, b, c, d$  be the roots of  $x^4 - x^3 - x^2 - 1 = 0$ . Also consider  $P(x) = x^6 - x^5 - x^3 - x^2 - x$ , then the value of  $p(a) + p(b) + p(c) + p(d)$  is equal to :

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25. The number of integral value of  $a, a, \in [-5, 5]$  for which the equation:  $x^2 + 2(a - 1)x + a + 5 = 0$  has one root smaller than 1 and the other root is greater than 3 :



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26. The number of non-negative integral values of  $n, n \leq 10$  so that a root of the equation  $n^2 \sin^2 x - 2 \sin x - (2n + 1) = 0$  lies in interval  $\left[0, \frac{\pi}{2}\right]$  is:



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27. If  $x$  and  $y$  are real numbers connected by the equation  $9x^2 + 2xy + y^2 - 92x - 20y + 244 = 0$ , then the sum of maximum value of  $x$  and the minimum value of  $y$  is :



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28. Consider two numbers  $a, b$ , sum of which is 3 and the sum of their cubes is 7. Then sum of all possible distinct values of  $a$  is :



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29. If  $y^2(y^2 - 6) + x^2 - 8x + 24 = 0$  and the minimum value of  $x^2 + y^4$  is  $m$  and maximum value is  $M$ , then find the value of  $M - 2m$ .

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30. Consider the equation  $x^3 - ax^2 + bx - c = 0$ , where  $a, b, c$  are rational number,  $a \neq 1$ . It is given that  $x_1, x_2$  and  $x_1x_2$  are the real roots of the equation. Then  $x_1x_2 \left( \frac{a+1}{b+c} \right) =$

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31. Let  $\alpha$  satisfy the equation  $x^3 + 3x^2 + 4x + 5 = 0$  and  $\beta$  satisfy the equation  $x^3 - 3x^2 + 4x - 5 = 0$ ,  $\alpha, \beta \in \mathbb{R}$ , then  $\alpha + \beta =$

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32. The number of ordered pairs  $(a, b)$  where  $a, b$  are integers satisfying the inequality  $\min(x^2 + (a - b)x + (1 - a - b)) > \max(-x^2 + (a + b)x - (1 + a + b))$  is :

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33. The real value of  $x$  satisfying  ${}^3\sqrt{20x + 3} \sqrt{20x + 13} = 13$  can be expressed as  $\frac{a}{b}$  where  $a$  and  $b$  are relatively prime positive integers. Find the value of  $b$  ?

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34. If the range of the values of  $a$  for which the roots of the equation  $x^2 - 2x - a^2 + 1 = 0$  lie between the roots of the equation  $x^2 - 2(a + 1)x + a(a - 1) = 0$  is  $(p, q)$ , then find the value of  $\left(q - \frac{1}{p}\right)$ .

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35. Find the number of positive integers satisfying the inequality  $x^2 - 10x + 16 < 0$ .

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36. If  $\sin \theta$  and  $\cos \theta$  are the roots of the quadratic equation  $ax^2 + bx + c = 0 (a \neq 0)$ . Then find the value of  $\frac{b^2 - a^2}{ac}$ .

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37. Let the inequality  $\sin^2 x + a \cos x + a^2 \geq 1 + \cos x$  is satisfied  $\forall x \in R$ , for  $a \in (-\infty, k_1] \cup [k_2, \infty)$ , then  $|k_1| + |k_2| =$

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38. If  $\alpha, \beta$  are the roots of the equation  $2x^2 - 35x + 2 = 0$ , then find the value of  $(2\alpha - 35)^3(2\beta - 35)^3$ .

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39. The sum of all integral values of 'a' for which the equation  $2x^2 - (1 + 2a)x + 1 + a = 0$  has an integral root.

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40. Let  $f(x)$  be a polynomial of degree 8 such that  $f(r) = \frac{1}{r}, r = 1, 2, 3, \dots, 8, 9$ , then  $\frac{1}{f(10)} =$

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41. Let  $\alpha, \beta$  are two real roots of equation  $x^2 + px + q = 0, p, q, \in R, q \neq 0$ . If the quadratic equation  $g(x) = 0$

has two roots  $\alpha + \frac{1}{\alpha}, \beta + \frac{1}{\beta}$  such that sum of its roots is equal to product of roots, then number of integral values  $g$  can attain is :

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**42.** If  $\cos A, \cos B$  and  $\cos C$  are the roots of the cubic  $x^3 + ax^2 + bx + c = 0$ , where  $A, B, C$  are the angles of a triangle, then the value of  $a^2 - 2b - 2c$  is

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**43.** Find the value of  $a$  for which  $ax^2 + (a - 3)x + 1 < 0$  for at least one positive real  $x$ .

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