THEORY OF EQUATIONS

- An expression of the form
$f(x) = a_0x^n + a_1x^{n-1} + a_2x^{n-2} + ... + a_n$, where $n \in N$
and $a_0, a_1, a_2, ..., a_n$ are complex numbers $(a_0 \neq 0)$
is a polynomial in x of degree n. deg $f(x) = n$
- If $f(x) = a_0, a_0 \neq 0$ then f(x) a constant polynomial, or zero degree polynomial.
- Polynomials of degree 1, 2, 3, 4 are respectively called as a linear, quadratic, cubic, biquadratic polynomials.
- **DIVISION ALGORITHM:** If f(x), g(x) are two polynomials $[g(x) \neq 0]$ then there exists polynomials q(x), r(x) uniquely such that f(x)=q(x).g(x)+r(x), here r(x)=0 or deg r(x)< deg g(x). q(x) iscalled quotient and r(x) is called remainder of f(x).
- **REMAINDER THEOREM:** If a polynomial f(x) is divided by $x - a$ then the remainder is f(a).
- **FACTOR THEOREM:** If f(x) is a polynomial and f(a)=0 then (x-a) is a factor of f(x).
- If f(x) is a polynomial of degree n then f(x)=0 is called a polynomial equation of degree n. It is also called as algebric equation.
If $f(\alpha) = 0$ then α is a root of the equation f(x)=0.
- An equation
$f(x) = a_0x^n + a_1x^{n-1} + a_2x^{n-2} + ... + a_n = 0$
is said to be an equation with
  - Real coefficients, if $a_0, a_1, a_2, ..., a_n$ are real numbers.
  - Rational coefficients, if $a_0, a_1, a_2, ..., a_n$ are rational numbers.
  - Integer coefficients, if $a_0, a_1, a_2, ..., a_n$ are integers.
- **FUNDAMENTAL THEOREM OF ALGEBRA:** Every polynomial equation of degree $n \geq 1$ has atleast one root.
- Every polynomial equation of degree 'n' has only 'n' roots and no more.
- In an equation with real coefficients, imaginary roots occur in conjugate pairs.
- In an equation with rational coefficients, irrational roots occur in pairs of conjugate surds.
- The functions of the roots of an equation which remains unaltered in value when any two of the roots are interchanged is called symmetric functions of the roots.
- **RELATION BETWEEN THE ROOTS AND THE COEFFICIENTS**:
If $\alpha_1, \alpha_2, ..., \alpha_n$ are the roots of the equation $f(x) = a_0x^n + a_1x^{n-1} + a_2x^{n-2} + ... + a_n = 0$ then
  - sum of the roots $= \Sigma\alpha_1 = S_1 = -\frac{a_1}{a_0}$
  - sum of the products of the roots taken two at a time $= \Sigma\alpha_1\alpha_2 = S_2 = \frac{a_2}{a_0}$
  - sum of the products of the roots taken three at a time $= \Sigma\alpha_1\alpha_2\alpha_3 = S_3 = -\frac{a_3}{a_0}$

  - product of 'n' the roots
$= \alpha_1.\alpha_2.\alpha_3.......\alpha_n = S_n = (-1)^n \frac{a_n}{a_0}$
- In an equation, if all the coefficients are positive, then the equation has no positive root.
- In an equation, if all the coefficients of the even powers of x are of the same signs and the coefficients of odd powers of x are of opposite signs, then the equation has no negative root.
- In an equation, if all the powers of x are odd and all the coefficients are of the same sign, then the equation has no real root except '0'.
- In an equation, if all the powers of x are even and all the coefficients are of the same signs, then the equation has no real root.
- The equation of lowest degree with rational coefficients, having a root $\sqrt{a} + \sqrt{b}$ is $x^4 - 2(a+b)x^2 + (a-b)^2 = 0$
- The equation of lowest degree with rational coefficients, having a root $\sqrt{a} + i\sqrt{b}$ is $x^4 - 2(a-b)x^2 + (a+b)^2 = 0$
- The condition that the roots of $ax^3 + bx^2 + cx + d = 0$ may be in
  - A.P. is $2b^3 + 27a^2d = 9abc$
  - G.P. is $ac^3 = b^3d$
  - H.P. is $2c^3 + 27ad^2 = 9bcd$

- Condition that the product of two roots of $x^4 + px^3 + qx^2 + rx + s = 0$ is equal to the product of the other two roots is $p^2s = r^2$
- The condition that one root of $ax^3 + bx^2 + cx + d = 0$ may be the sum of the other two roots is $8a^2d + b^3 = 4abc$
- The condition that the product of two of the roots of $ax^3 + bx^2 + cx + d = 0$ may be -1 is $a(a+c) + d(b+d) = 0$
- If α, β, γ are the roots of $ax^3 + bx^2 + cx + d = 0$ then
  - $\alpha^2 + \beta^2 + \gamma^2 = \dfrac{b^2 - 2ac}{a^2}$
  - $\alpha^3 + \beta^3 + \gamma^3 = \dfrac{3abc - b^3 - 3a^2d}{a^3}$
- $\alpha, \beta, \gamma, \delta$ are the roots of $ax^4 + bx^3 + cx^2 + dx + e = 0$ then
  - $\alpha^2 + \beta^2 + \gamma^2 + \delta^2 = \dfrac{b^2 - 2ac}{a^2}$
  - $\alpha^3 + \beta^3 + \gamma^3 + \delta^3 = \dfrac{3abc - b^3 - 3a^2d}{a^3}$
- A root α of of f(x) = 0 is said to be a multiple root of order 'm' or multiplicity 'm' if it occurs m times.
- A multiple root α of order 'm' of f(x) =0 is a multiple root of order m - 1 of $f^1(x) = 0$
- If $\alpha_1, \alpha_2, \ldots, \alpha_n$ are the roots of the equation f(x)=0 then the equation whose roots are $-\alpha_1, -\alpha_2, \ldots, -\alpha_n$ is $f(-x) = 0$.
- If $\alpha_1, \alpha_2, \ldots, \alpha_n$ are the roots of the equation $f(x) = 0$ and $k \neq 0$ then the equation whose roots are $k\alpha_1, k\alpha_2, \ldots, k\alpha_n$ is $f\left(\dfrac{x}{k}\right) = 0$.
- The equation whose roots are reciprocals of the roots of the equation $f(x) = 0$ is $f\left(\dfrac{1}{x}\right) = 0$.
- The equation whose roots are exceed by k than those of f(x)=0 is f(x-k)=0.
- The equation whose roots are diminished by k than those of f(x)=0 is f(x+k)=0.
- If $\alpha_1, \alpha_2, \ldots, \alpha_n$ are the roots of f(x)=0 then the equation whose roots are $\alpha_1^2, \alpha_2^2, \ldots, \alpha_n^2$ is $f\left(\sqrt{x}\right) = 0$.
- If α, β, γ are the roots of $f(x) = x^3 + ax^2 + bx + c = 0$ then the equation whose roots are
  - $\alpha+\beta, \beta+\gamma, \gamma+\alpha$ is $f(-a-y) = 0$
  - $\alpha\beta, \beta\gamma, \gamma\alpha$ is $f\left(\dfrac{-c}{y}\right) = 0$
  - $\alpha^2\beta^2, \beta^2\gamma^2, \gamma^2\alpha^2$ is $f\left(\dfrac{c}{\sqrt{y}}\right) = 0$
  - $\alpha(\beta+\gamma), \beta(\gamma+\alpha), \gamma(\alpha+\beta)$ is $f\left(\dfrac{c}{y-b}\right) = 0$
  - $\alpha\beta + \dfrac{1}{\gamma}, \beta\gamma + \dfrac{1}{\alpha}, \gamma\alpha + \dfrac{1}{\beta}$ is $f\left(\dfrac{1-c}{y}\right) = 0$
  - $\alpha - \dfrac{1}{\beta\gamma}, \beta - \dfrac{1}{\gamma\alpha}, \gamma - \dfrac{1}{\alpha\beta}$ is $f\left(\dfrac{cy}{c+1}\right) = 0$
- If the second term in the transformed equation of f(x)=0 is to be removed then the roots of the equation f(x)=0 are to be diminished by 'h', where $h = -\dfrac{a_1}{a_0 n}$.
- If an equation is unaltered by changing 'x' into $\dfrac{1}{x}$, then it is a reciprocal equation. It is denoted by R.E.
- A reciprocal equation $f(x) = x^n + a_1x^{n-1} + a_2x^{n-2} + \ldots + a_n = 0$ is called a reciprocal equation of the first type if $a_{n-1} = a_1, a_{n-2} = a_2, \ldots,$
- A reciprocal equation $f(x) = x^n + a_1x^{n-1} + a_2x^{n-2} + \ldots + a_n = 0$ is a reciprocal equation of the second type if $a_{n-1} = -a_1,\ a_{n-2} = -a_2, \ldots$
- A reciprocal equation of the first type and even degree is a standard reciprocal equation.
- If f(x) = 0 is a R.E. of the first type and odd degree, then x+1 is a factor of f(x).
- If f(x) = 0 is a R.E. of the second type and odd degree, then x-1 is a factor of f(x).
- If f(x) = 0 is a R.E. of the second type and even degree then $x^2 - 1$ is a factor of f(x).

LEVEL - I

PROBLEMS ON RELATION BETWEEN ROOTS & COEFFICIENTS AND FINDING THE ROOTS OF THE EQUATION:

1. If $1,1,\alpha$ are the roots of $x^3-6x^2+9x-4=0$ then $\alpha=$
   1. -4 2. 4 3. -6 4. 6
2. If $-1,2,\alpha$ are the roots of $2x^3+x^2-7x-6=0$ then $\alpha=$
   1. $\frac{-3}{2}$ 2. $\frac{3}{2}$ 3. 3 4. -3
3. If sum of the roots of the equation $5x^4-kx^3+8x+1=0$ is 6 then K =
   1. 6 2. -6 3. -30 4. 30
4. If sum of the roots of the equation $2x^9-11x^7+6x^4+8=0$ is 'a' then 'a' =
   1. $\frac{11}{2}$ 2. $\frac{-11}{2}$ 3. 0 4. $\frac{2}{11}$
5. If $\alpha,\beta,\gamma,\delta$ are the roots of the equation $3x^4-8x^3+2x^2-9=0$ then $\Sigma\alpha\beta=$
   1. $\frac{2}{3}$ 2. $\frac{-2}{3}$ 3. $\frac{8}{3}$ 4. $\frac{-8}{3}$
6. If $\alpha,\beta,\gamma,\delta$ are the roots of the equation $9x^4+Kx^2-7x+4=0$ and $\Sigma\gamma\delta=2$ then K =
   1. 18 2. -18 3. 9 4. 2
7. If $\alpha_1,\alpha_2,\alpha_3,\alpha_4$ are the roots of the equation $7x^4+2x^3-4x+11=0$ then $\Sigma\alpha_1\alpha_2\alpha_3=$
   1. $\frac{-4}{7}$ 2. $\frac{4}{7}$ 3. $\frac{2}{7}$ 4. $\frac{-2}{7}$
8. If $\alpha_1,\alpha_2,\alpha_3,\alpha_4$ are the roots of the equation $3x^4-(l+m)x^3+2x+5l=0$ and $\Sigma\alpha_1=3$, $\alpha_1\alpha_2\alpha_3\alpha_4=10$ then $(l,m)=$
   1. $(9,1)$ 2. $(-9,-1)$ 3. $(-6,-3)$ 4. $(6,3)$
9. If α,β and 1 are the roots of $x^3-2x^2-5x+6=0$ then $(\alpha,\beta)=$
   1. $(3,2)$ 2. $(3,-2)$ 3. $(-3,-2)$ 4. $(-3,2)$
10. The roots of $x^3+x^2-4x-4=0$ are
    1. $-1,-2,-2$ 2. $-1,-2,2$ 3. $1,-2,2$ 4. $-2,2,4$
11. The roots of $x^3-12x^2+39x-28=0$ are
    1. $1,-4,7$ 2. $1,4,-7$ 3. $1,4,7$ 4. $1,-4,-7$
12. The roots of $x^3+x^2-16x+20=0$ are
    1. $2,2,-5$ 2. $2,2,-4$ 3. $2,-2,-5$ 4. $-2,-2,5$
13. The roots of the equation $x^3-9x^2+14x+24=0$ are
    1. $-1,-4,6$ 2. $-1,4,-6$ 3. $-1,-4,-6$ 4. $-1,4,6$
14. The roots of the equation $x^3-5x^2-2x+24=0$ are
    1. $-2,-3,4$ 2. $-2,3,4$ 3. $-2,3,-4$ 4. $2,-3,-4$
15. If α,β,γ are the roots of the equation $2x^3-5x^2+3x-1=0$ then $\frac{1}{\alpha\beta}+\frac{1}{\beta\gamma}+\frac{1}{\gamma\alpha}=$
    1. -4 2. -5 3. 5 4. -4
16. If α,β,γ are the roots of the equation $2x^3-x^2+x-1=0$ then $\alpha^2+\beta^2+\gamma^2=$
    1. $\frac{5}{4}$ 2. $\frac{3}{4}$ 3. $\frac{-5}{4}$ 4. $\frac{-3}{4}$
17. If α,β,γ are the roots of the equation $x^3+px^2+qx+r=0$ then $\alpha^2+\beta^2+\gamma^2=$
    1. p^2+2q 2. $-p^2+2q$ 3. $-p^2-2q$ 4. p^2-2q
18. If α,β,γ are the roots of $x^3+x^2+x+1=0$ then $(\alpha-\beta)^2+(\beta-\gamma)^2+(\gamma-\alpha)^2=$
    1. 3 2. -3 3. 4 4. -4
19. If $3x^4-27x^3+36x^2-5=0$ then $s_1+s_2=$
    1. 3 2. 21 3. -21 4. -3
20. If $x^5-x^2+4x-9=0$ then $s_3+s_4-s_5=$
    1. 14 2. -4 3. -9 4. 4
21. If $x^4+2x^3-4x^2-4x+4=0$ then $2s_1-s_2+s_3-s_4=$
    1. 3 2. 2 3. 1 4. 0
22. If $7x^4+kx-9=0$ and $s_3=-8$ then k =
    1. 28 2. -28 3. 56 4. -56
23. If $2x^9-5x^4+k=0$ and $s_9=16$ then k =
    1. 16 2. -16 3. 32 4. -32
24. If α,β,γ are the roots of $x^3+ax^2+bx+c=0$, then $\Sigma\left(\frac{\alpha}{\beta}+\frac{\beta}{\alpha}\right)=$
    1. $\frac{ab}{c}$ 2. $\frac{ab}{c}-1$ 3. $\frac{ab}{c}-2$ 4. $\frac{ab}{c}-3$
25. If α,β,γ are the roots of $x^3+ax^2+bx+c=0$, then $\pi(\alpha+\beta-2\gamma)=$
    1. $2a^3-9ab+27c$ 2. $2a^3+9ab+27c$
    3. $2a^3-9ab-27c$ 4. $2a^3+9ab-27c$
26. If α,β,γ are the roots of $x^3+ax+b=0$ then $(\alpha+\beta)^{-1}+(\beta+\gamma)^{-1}+(\gamma+\alpha)^{-1}=$
    1. $\frac{a}{b}$ 2. $-\frac{a}{b}$ 3. $\frac{a^2}{b^2}$ 4. $-\frac{a^2}{b^2}$
27. If one root of $x^3-kx^2+kx-4=0$ is the reciprocal of another then K =
    1. 2 2. 3 3. 4 4. 5

28. If one root of $x^3+2x^2+3x+k=0$ is the sum of the other two roots then K =

1. 0 2. 1 3. 2 4. 3

29. If the product of two of the roots $x^3-kx^2+5x+3=0$ is -1 then k =

1. 2 2. 3 3. 4 4. 5

30. If $1,3,-4$ are the roots of $x^3+kx+12=0$ then k =

1. 11 2. – 11 3. 13 4. – 13

31. If α,β,γ are the roots of $x^3+2x^2+3x+8=0$ then $(\alpha+\beta)(\beta+\gamma)(\gamma+\alpha)=$

1. – 2 2. 2 3. 4 4. – 4

32. If the sum of two roots of the equation $x^4-x^3+2x^2+kx+17=0$ equals to the sum of the other two then k =

1. $\frac{7}{8}$ 2. $-\frac{7}{8}$ 3. $\frac{9}{8}$ 4. $-\frac{9}{8}$

33. If the equation $2x^3-9x^2+12x+k=0$ has two equal roots then k =

1. -5 2. 5 3. 4 4. 6

34. If $\frac{a}{k},a$, ak are the roots of $x^3-px^2+qx-r=0$, then a =

1. p^2 2. r^2 3. $\frac{p}{q}$ 4. $\frac{q}{p}$

35. If $k\sqrt{-1}$ is a root of the equation $x^4+6x^3-16x^2+24x-80=0$ then k =

1. ± 1 2. ± 2 3. ± 3 4. ± 4

36. The roots of the equation $x^4-10x^3+50x^2-130x+169=0$ are of the form $a\pm ib$ and $b\pm ia$, then (a,b) =

1. (3,2) 2. (2,1) 3. (-3, 2) 4. (-3, -2)

PROBLEMS ON FINDING ROOTS WHEN EQUATION IS GIVEN:

37. If one root of $x^3-5x^2+2x+8=0$ is double the other then the roots are

1. – 1,3,6 2. – 1,2,4 3. 1,2,4 4. 1,3,6

38. If one root of $x^3+4x^2-4x-16=0$ is double the other then the roots are

1. – 4, – 2, 2 2. – 6, – 3, 2
3. 2, 2, 4 4. – 1, – 2, 4

39 If one root of $ax^4+bx^3+cx^2+dx+e=0$, where a, b, c, d, e are rational numbers, is $\sqrt{2}+\sqrt{3}$ then the other roots are

1. $\sqrt{2}-\sqrt{3}, 2, 5$ 2. $\sqrt{2}-\sqrt{3}, -2, 5$
3. $\sqrt{2}-\sqrt{3}, -\sqrt{2}+\sqrt{3}, 5$
4. $\sqrt{2}-\sqrt{3}, -\sqrt{2}+\sqrt{3}, -\sqrt{2}-\sqrt{3}$

40. If $\sqrt{5}-i\sqrt{7}$ is a root of $ax^4+bx^3+cx^2+dx+e=0$, where a, b, c, d, e are rational numbers, then the other roots are

1. $\sqrt{5}+i\sqrt{7},\frac{2}{3},\frac{1}{3}$
2. $\sqrt{5}+i\sqrt{7},-\sqrt{5}+i\sqrt{7},\frac{2}{3}$
3. $\sqrt{5}+i\sqrt{7}, -\sqrt{5}+i\sqrt{7}, -\sqrt{5}-i\sqrt{7}$
4. $\sqrt{5}-i\sqrt{7},\frac{2}{3},\frac{1}{3}$

41. If two roots of $4x^3-12x^2+9x-2=0$ are equal then the roots are

1. $\frac{1}{2},\frac{1}{2},2$ 2. $-\frac{1}{2},-\frac{1}{2},2$ 3. $\frac{1}{4},\frac{1}{4},1$ 4. $\frac{1}{4},\frac{1}{4},2$

42. If the two roots of $9x^3+24x^2+13x+2=0$ are equal then the roots are

1. $-2,\frac{1}{3},\frac{1}{3}$ 2. $2,-\frac{1}{3},-\frac{1}{3}$
3. $1,-\frac{1}{3},-\frac{1}{3}$ 4. $-2,-\frac{1}{3},-\frac{1}{3}$

43. If two roots of $x^3-7x^2+4x+12=0$ are in the ratio 1:3 then the roots are

1. $-1,1,3$ 2. $-1,2,6$ 3. $2,3,6$ 4. $2,-3,6$

44. If two roots of $9x^3-30x^2+31x-10=0$ are in the ratio 2:5 then the roots are

1. $1,-\frac{2}{3},-\frac{5}{3}$ 2. $-1,\frac{2}{3},\frac{5}{3}$ 3. $1,\frac{2}{3},\frac{5}{3}$ 4. $1,2,5$

45. If the sum of two of the roots of $x^3-5x^2-4x+20=0$ is zero then the roots are

1. $2,-2,4$ 2. $2,-2,3$ 3. $2,-2,5$ 4. $2,-2,6$

46. If the sum of two of the roots of $x^4-5x^3-3x^2+15x=0$ is zero then the roots are

1. $0, 5, \pm\sqrt{3}$ 2. $0, 5, \pm\sqrt{2}$ 3. $0, 5, \pm\sqrt{5}$ 4. $0, 5, \pm\sqrt{6}$

47. If one root of the equation $4x^3-x^2-16x+4=0$ is 8 times the other, then the roots are

1. 1, 2, 8 2. $\frac{1}{2},4,-1$ 3. $\frac{1}{4},-2,2$ 4. 2,4,16

48. If the sum of two roots of the equation $x^3-3x^2-16x+k=0$ is zero then k =

1. 24 2. 36 3. – 36 4. 48

49. If the sum of two roots of the equation $x^3-3x^2+kx+48=0$ is zero then k =

1. 16 2. – 16 3. 24 4. – 24

50. If the product of two roots of $x^3+kx^2+31x-30=0$ is 15 then k =

1. 2 2. – 2 3. – 10 4. 10

51. If the product of two roots of $x^3+3x^2-10x+k=0$ is 8 then k =
1. – 10 2. 24 3. – 24 4. 10

52. If one root of $3x^3+kx^2+53x-15=0$ is the reciprocal of another then the value of k =
1. – 25 2. 25 3. 5 4. – 5

53. If two roots of $x^3+ax^2+bx+c=0$ are connected by the relation $\alpha\beta+1=0$ then the condition is
1. $c^2+ac+b+1=0$ 2. $c^2-ac+b+1=0$
3. $c^2+ac+b=0$ 4. $c^2-ac+b=0$

54. If one of the roots of $27x^3-108x^2+117x-28=0$ is equal to half the sum of the other two, then one of its roots is
1. $\frac{3}{4}$ 2. $-\frac{3}{4}$ 3. $-\frac{4}{3}$ 4. $\frac{4}{3}$

55. If 1, 2, 3 are the roots of $x^3+ax^2+bx+c=0$ then (a, b, c) =
1. $(-6,11,-6)$ 2. $(6,11,6)$
3. $(-6,11,6)$ 4. $(6,11,-6)$

56. The roots of the equation $x^4+3x^3-3x-1=0$ are
1. $-1,1,\frac{-3\pm\sqrt{5}}{2}$ 2. $1,1,\frac{-3\pm\sqrt{5}}{2}$
3. $-1,-1,\frac{-3\pm\sqrt{5}}{2}$ 4. $-1,1,\frac{3\pm\sqrt{5}}{2}$

57. The roots of the equation $2x^4+x^3-6x^2+x+2=0$ are
1. $\frac{1}{2},1,1,2$ 2. $1,1,-2,-\frac{1}{2}$
3. $1,1,2,-\frac{1}{2}$ 4. $1,1,-2,\frac{1}{2}$

PROBLEMS ON FINDING EQUATION WHEN ROOTS ARE GIVEN:

58. The equation whose roots are $1,1,-2$ is
1. $x^3+3x-2=0$ 2. $x^3+x-2=0$
3. $x^3+2x-3=0$ 4. $x^3-3x+2=0$

59. The equation whose roots are $-2,1,3$ is
1. $x^3+2x^2+3x-6=0$ 2. $x^3-2x^2-5x+6=0$
3. $x^3+x^2-x-1=0$ 4. $x^3-x^2+x+1=0$

60. The equation whose roots are $-1,\ 2\pm\sqrt{3}$ is
1. $x^3+2x^2+3x+2=0$ 2. $x^3+3x^2+3x+1=0$
3. $x^3-3x^2-3x+1=0$ 4. $x^3-2x^2-3x+2=0$

61. The equation whose roots are $2,\ 1\pm 3i$ is
1. $x^3-4x^2+14x-20=0$
2. $x^3-x^2+5x-14=0$
3. $x^3+2x^2-3x-10=0$
4. $x^3-3x^2-14x+10=0$

62. The equation whose roots are 0, 1, 2, -3 is
1. $x^4-5x^2+4x=0$ 2. $x^4-6x^2+5x=0$
3. $x^4-7x^2+6x=0$ 4. $x^4-8x^2+7x=0$

63. The equation whose roots are 0, 0, 3, -4 is
1. $x^4+x^3+12x^2=0$ 2. $x^4+x^3-12x^2=0$
3. $x^4-x^3+12x^2=0$ 4. $x^4-x^3-12x^2=0$

64. The equation whose roots are $2+\sqrt{3},\ 2-\sqrt{3},\ 1+2i,\ 1-2i$ is
1. $x^4-7x^3-25x^2-43x+40=0$
2. $x^4-7x^3+25x^2+43x-40=0$
3. $x^4+6x^3+14x^2-22x+5=0$
4. $x^4-6x^3+14x^2-22x+5=0$

65. The cubic equation which has two roots $1,3-i\sqrt{2}$ is
1. $x^3+7x^2+17x-11=0$
2. $x^3-7x^2+17x-11=0$
3. $x^3-7x^2+17x+11=0$ 4. $x^3+7x^2-8=0$

66. The equation whose roots are $-1\pm i,-1\pm\sqrt{2}$ is
1. $x^4+4x^3+5x^2+2x-2=0$
2. $x^4+4x^3-5x^2+2x+2=0$
3. $x^4-4x^3+5x^2+2x-2=0$
4. $x^4-4x^3+5x^2+2x+2=0$

67. The equation whose roots are 0, 0, 2, 2, -2, -2 is
1. $x^6+8x^4-16x^2=0$ 2. $x^6-4x^4-16x^2=0$
3. $x^6-8x^4+16x^2=0$ 4. $x^6+4x^4+16x^2=0$

68. The equation whose roots are 0, 0, 1, 1, -1 is
1. $x^5+x^4-x^3-x^2=0$ 2. $x^5-x^4+x^3-x^2=0$
3. $x^5-x^4-x^3+x^2=0$ 4. $x^5+x^4-x^3+x^2=0$

69. If $\Sigma\alpha=\frac{2}{3},\Sigma\alpha\beta=\frac{4}{3}$ and $\alpha\beta\gamma=\frac{8}{3}$ then the equation whose roots are α,β,γ is
1. $x^3-2x^2+4x-8=0$ 2. $3x^3+2x^2-4x+8=0$
3. $3x^3-2x^2+4x-8=0$ 4. $x^3+2x^2-4x+8=0$

70. If two of the roots of $2x^3+7x^2+2x-3=0$ are differ by 2 then the roots are
1. $-3,-1,\frac{1}{2}$ 2. $-3,-1,\frac{1}{3}$ 3. $3,1,\frac{1}{2}$ 4. $-3,1,\frac{1}{2}$

71. If the product of two of the roots $x^4-8x^3+21x^2-20x+5=0$ is 5 then the roots are
1. $\frac{2\pm\sqrt{5}}{2},\frac{5\pm\sqrt{5}}{2}$ 2. $\frac{3\pm\sqrt{5}}{2},\frac{5\pm\sqrt{5}}{2}$
3. $1,5,1\pm\sqrt{2}$ 4. $\frac{4\pm\sqrt{5}}{2},\frac{5\pm\sqrt{5}}{2}$

72. If $\sqrt{2}$ and 3i are two roots of a biquadratic equation with rational coefficients, then its equation is
1. $x^4-7x^2-18=0$ 2. $x^4-7x^2+18=0$
3. $x^4+7x^2-18=0$ 4. $x^4+7x^2+18=0$

73. $f(x) = 2x^4 - 7x^3 + ax + b$ is divisible by x -1 and x -2 then (a, b) =
1. (19, -14) 2. (19, 14)
3. (-19, 14) 4. (-19, -14)

PROBLEMS ON LOWEST DEGREE WITH RATIONAL COEFFICIENTS:

74. The equation of fourth degree with rational coefficients one of whose roots is $\sqrt{3}+\sqrt{2}$ is
1. $x^4-10x^2-1=0$ 2. $x^4+10x^2-1=0$
3. $x^4+10x^2+1=0$ 4. $x^4-10x^2+1=0$

75. The equation of lowest degree with rational coefficients having a root $\sqrt{5}+\sqrt{7}$ is
1. $x^4-24x^2+4=0$ 2. $x^4+24x^2-4=0$
3. $x^4-24x^2-4=0$ 4. $x^4+24x^2+4=0$

76. The equation of lowest degree with rational coefficients having a root $\sqrt{3}-\sqrt{5}$ is
1. $x^4+16x^2-4=0$ 2. $x^4-12x^2+4=0$
3. $x^4-16x^2+4=0$ 4. $x^4-12x^2-4=0$

77. The equation of the lowest degree with rational coefficients having a root $\sqrt{3}+i\sqrt{2}$ is
1. $x^4+2x^2-25=0$ 2. $x^4-10x^2+1=0$
3. $x^4+10x^2-1=0$ 4. $x^4-2x^2+25=0$

78. The equation of the lowest degree with rational coefficients having a root $\sqrt{7}-i$ is
1. $x^4-16x^2+36=0$ 2. $x^4-12x^2+64=0$
3. $x^4-16x^2+64=0$ 4. $x^4-12x^2+36=0$

79. The equation of the lowest degree with rational coefficients having a root 1 + i is
1. $x^4+4=0$ 2. $x^4-4=0$
3. $x^4-4x^2+1=0$ 4. $x^4+4x^2+1=0$

PROBLEMS ON A.P.:

80. The condition that the roots of $ax^3+bx^2+cx+d=0$ may be in A.P. if
1. $2b^3+27a^2d=9abc$ 2. $2b^3+27a^2d=-9abc$
3. $2b^3-27a^2d=9abc$ 4. $2b^3-27a^2d=-9abc$

81. If the roots of the equation $x^3+3px^2+3qx+r=0$ are in A.P. the condition is
1. $2p^3=3pq+r$ 2. $2p^3=3pq$
3. $2p^3+r=3pq$ 4. $2p^3-r=3pq$

82. If The roots of the equation $x^3-24x^2+188x-480=0$ are in A.P. then one of its roots is
1. -8 2. 8 3. 7 4. -7

83. If the roots of $x^3-9x^2+23x-15=0$ are in A.P. then the common difference of A.P. is
1. ±5 2. ±4 3. ±3 4. ±2

84. If the roots of $x^3-12x^2+39x+k=0$ are in A.P. then k =
1. 28 2. -28 3. 18 4. -18

85. If the roots of $x^3-3x^2+kx+3=0$ are in A.P. then k=
1. -1 2. 1 3. -3 4. 3

86. If the roots of $x^3-18x^2+107x-210=0$ are in A.P. then the roots are
1. 3, 6, 9 2. 4, 6, 8 3. 2, 6, 10 4. 5, 6, 7

87. The roots of $x^4-8x^3+14x^2+8x-15=0$ are in A.P. then the roots are
1. $-1,2,5,8$ 2. $-1,1,3,5$ 3. $1,2,3,4$ 4. $1,3,5,7$

88. If the roots of $px^3+qx^2+rx+s=0$ are in A.P. then the roots of $8px^3+4qx^2+2rx+s=0$ are in
1. A.P. 2. G.P. 3. H.P. 4. A.G.P.

89. If the roots of $ax^3+bx^2+cx+d=0$ are in A.P. then the roots of $a(x+k)^3+b(x+k)^2+c(x+k)+d=0$ are in
1. A.P. 2. G.P. 3. H.P. 4. A.G.P.

PROBLEMS ON G.P.:

90. The condition that the roots of $ax^3+bx^2+cx+d=0$ may be in G.P. if
1. $ab^3=c^2d$ 2. $a^3c=bd^3$
3. $ac^3=b^3d$ 4. $a^3b=cd^2$

91. If the roots of $x^3+3px^2+3qx+r=0$ are in G.P., the condition is
1. $pr=q^3$ 2. $p^2r=q^3$ 3. $p^3r=q^3$ 4. $pr^3=q^3$

92. If the roots of $x^3-7x^2+14x+k=0$ are in G.P. then k =
1. -8 2. 8 3. 7 4. -7

93. If the roots of $kx^3-26x^2+52x-24=0$ are in G.P. then k =
1. 3 2. -3 3. 4 4. -4

94. Condition for the roots of the equation $x^3-px^2+qx-r=0$ are in G.P. is
1. $q=pr$ 2. $q^2=p^2r$ 3. $q^3=pr^3$ 4. $q^3=p^3r$

95. If the roots of $ax^3+bx^2+cx+d=0$ are in G.P. then the roots of $ax^3+3bx^2+9cx+27d=0$ are in
1. A.P. 2. G.P. 3. H.P. 4. A.G.P.

PROBLEMS ON H.P.:

96. If the roots of $x^3+3ax^2+3bx+c=0$ are in H.P. then
1. $2b^2=c(3ab-c)$ 2. $2b^3=c(3ab-c)$
3. $2b^3=c^2(3ab-c)$ 4. $2b^2=c^2(3ab-c)$

97. If the roots of $x^3+px^2+qx+r=0$ are in H.P. then
1. $2q^3-27r^2=9pqr$ 2. $2q^3+27r^2=9pqr$
3. $2q^3+27r^2=-9pqr$ 4. $2q^3-27r^2=-9pqr$

98. If the roots of the equation $x^3-lx^2+mx-n=0$ are in H.P., then the mean root is
1. $\frac{3n}{m}$ 2. $\frac{2n}{m}$ 3. $\frac{n}{m}$ 4. $-\frac{n}{m}$

99. If the roots of the equation $x^3-3px^2+3qx-r=0$ are in H.P., then the mean root is
1. $\frac{3r}{q}$ 2. $\frac{2r}{q}$ 3. $\frac{r}{q}$ 4. $-\frac{r}{q}$

100. The condition that the roots of $ax^3+bx^2+cx+d=0$ may be in H.P. is
1. $2c^3+27ad^2=9bcd$ 2. $2b^3+27a^2d=9abc$
3. $2b^3+27ad^2=9abc$ 4. $2c^3+27a^2d=9bcd$

101. If the roots of $2x^3+kx^2-x+1=0$ are in H.P. then k=
1. $\frac{-50}{9}$ 2. $\frac{52}{9}$ 3. $\frac{-52}{9}$ 4. $\frac{50}{9}$

102. If the roots of $ax^3+bx^2+cx+d=0$ are in H.P. then the roots of $dx^3-cx^2+bx-a=0$ are in
1. A.P. 2. G.P. 3. H.P. 4. A.G.P.

PROBLEMS ON, EQUATION WHEN ROOTS ARE EXCEED BY K ETC.,:

103. If α,β,γ are the roots of $2x^3-5x^2-7x+8=0$ then the equation whose roots are $-\alpha,-\beta,-\gamma$ is
1. $2x^3+5x^2+7x+8=0$
2. $2x^3+5x^2-7x-8=0$
3. $-2x^3-5x^2-7x+8=0$
4. $2x^3-5x^2+7x-8=0$

104. If α,β,γ are the roots of $7x^3+x-11=0$ then the equation whose roots are $-\alpha,-\beta,-\gamma$ is
1. $7x^3-x+11=0$ 2. $7x^3-x-11=0$
3. $7x^3+x+11=0$ 4. $7x^3+x-11=0$

105. If $\alpha,\beta,\gamma,\delta$ are the roots of $3x^4-8x^3+x^2-10x+5=0$ then the equation whose roots are $-\alpha,-\beta,-\gamma,-\delta$ is
1. $3x^4+8x^3+x^2+10x+5=0$
2. $3x^4+8x^3+x^2-10x+5=0$
3. $3x^4-8x^3+x^2-10x+5=0$
4. $3x^4-8x^3+x^2+10x+5=0$

106. The equation whose roots are those of equation $x^4+x^3-x-25=0$ with contrary signs
1. $x^4+x^3-x-25=0$ 2. $x^4+x^3+x-25=0$
3. $x^4+x^3+x+25=0$ 4. $x^4-x^3+x-25=0$

107. The equation whose roots are those of $x^n+x^{n-2}+x^{n-5}+m=0$ with contrany signs (n is even as $n\geq 6$)
1. $x^n-x^{n-2}+x^{n-5}+m=0$
2. $x^n+x^{n-2}-x^{n-5}+m=0$
3. $x^n+x^{n-2}+x^{n-5}+m=0$
4. $x^n-x^{n-2}-x^{n-5}+m=0$

108. If 5, −7, 2 are the roots of $lx^3+mx^2+nx+p=0$ then the roots of $lx^3-mx^2+nx-p=0$ are
1. $-5,-7,-2$ 2. $5,7,2$
3. $7,-5,-2$ 4. $-7,-5,2$

109. The equation whose roots are 2 times the roots of $x^3+3x^2-5x+1=0$ is
1. $x^3+6x^2-20x+8=0$
2. $x^3+6x^2+20x+8=0$
3. $x^3-6x^2-20x+8=0$ 4. $x^3-6x^2+20x+8=0$

110. The equation whose roots are multiplied by -3 of those of $9x^3-6x^2+5x-4=0$ is
1. $x^3+2x^2-5x+12=0$ 2. $x^3-2x^2+5x+12=0$
3. $x^3+2x^2+5x+12=0$ 4. $x^3-2x^2-5x+12=0$

111. The equation whose roots are 5 times the roots of $x^4+1=0$ is
1. $x^4+5=0$ 2. $x^4+25=0$
3. $x^4+125=0$ 4. $x^4+625=0$

112. If α,β,γ are the roots of $4x^3-7x^2+2x-6=0$ then the equation whose roots are $\frac{\alpha}{2},\frac{\beta}{2},\frac{\gamma}{2}$ is
1. $32x^3-28x^2+4x+6=0$
2. $32x^3-28x^2+4x-6=0$
3. $32x^3-28x^2-4x-6=0$
4. $32x^3-28x^2-4x+6=0$

113. If $-3,6,9$ are the roots of $px^3+qx^2+rx+s=0$ then the roots of $27px^3+9qx^2+3rx+s=0$ are
1. $-1,2,3$ 2. $-3,6,9$ 3. $-2,4,6$ 4. $-\frac{1}{3},\frac{2}{3},1$

114. If 1, 5, 7 are the roots of $ax^3+bx^2+cx+d=0$ then the roots of $ax^3+2bx^2+4cx+8d=0$ are
1. 2, 10, 14 2. 2, 20, 28
3. 1, 5, 7 4. $\frac{1}{2},\frac{5}{2},\frac{7}{2}$

115. The equation whose roots are diminished by 1 than those of $4x^3-x^2+2x-3=0$ is

1. $4x^3-11x^2+12x+2=0$ 2. $4x^3-11x^2+12x-3=0$
3. $4x^3+11x^2+12x+2=0$ 4. $4x^3+11x^2+12x-3=0$

116. The equation whose roots are diminished by 3 than those of $x^3-x^2-x+1=0$ is

1. $x^3+8x^2+20x+16=0$
2. $x^3-8x^2-20x+16=0$
3. $x^3-8x^2+20x+16=0$
4. $x^3+8x^2-20x+16=0$

117. The equation whose roots are exceed by $\frac{1}{2}$ than those of $8x^3-4x^2+6x-1=0$ is

1. $8x^3-16x^2+8x-3=0$
2. $8x^3-16x^2-8x-3=0$
3. $8x^3-8x^2+8x-3=0$
4. $4x^3-8x^2+8x-3=0$

118. The equation whose roots are diminished by 2 than those of $x^4-5x^3+7x^2-17x+11=0$ is

1. $x^4+3x^3-x^2-17x-19=0$
2. $x^4+3x^3+x^2-17x-19=0$
3. $x^4+3x^3+x^2+17x-19=0$
4. $x^4+3x^3-x^2+17x-19=0$

119. The equation whose roots are exceed by 2 than those of $2x^3+3x^2-4x+5=0$ is

1. $2x^3+9x^2-8x+9=0$ 2. $2x^3+9x^2+8x+9=0$
3. $2x^3-9x^2+8x+9=0$ 4. $2x^3-9x^2-8x+9=0$

120. The equation whose roots are the roots of $x^4+1=0$ each increases by 1 is

1. $x^4+1=0$
2. $x^4-4x^3+6x^2-4x+2=0$
3. $x^4+4x^3-6x^2-4x+2=0$
4. $x^4-1=0$

121. If $-3,1,8$ are the roots of $px^3+qx^2+rx+s=0$ then the roots of $p(x-3)^3+q(x-3)^2+r(x-3)+s=0$ are

1. 0, 4, 11 2. $-6,-2,5$ 3. $-2,2,9$ 4. $-1,3,10$

122. If $\frac{1}{2},\frac{1}{3},\frac{1}{4}$ are the roots of $ax^3+bx^2+cx+d=0$ then the roots of $a(x+1)^3+b(x+1)^2+c(x+1)+d=0$ are

1. $-\frac{1}{2},-\frac{1}{3},-\frac{1}{4}$ 2. $\frac{3}{2},\frac{4}{3},\frac{5}{4}$
3. $-\frac{1}{2},-\frac{2}{3},-\frac{3}{4}$ 4. $\frac{1}{2},\frac{2}{3},\frac{3}{4}$

123. If $f(x)=x^3-2x^2+7x+5$ then $f(x-2)=$

1. $x^3+8x^2+27x-25$ 2. $x^3-8x^2+27x-25$
3. $x^3+8x^2+27x+25$ 4. $x^3-8x^2-27x+25$

124. If $f(x)=3x^4-9x+1$ then f(x+1) =

1. $3x^4+12x^3+18x^2+3x-5$
2. $3x^4-12x^3-18x^2+3x-5$
3. $3x^4-18x^2+3x$ 4. $3x^4+18x^2-3x$

125. The equation whose roots are the squares of the roots of $x^3+ax+b=0$ is

1. $x^3+2ax^2-a^2x-b^2=0$
2. $x^3+2ax^2+a^2x-b^2=0$
3. $x^6+ax^2+6=0$ 4. $x^6-ax^2+6=0$

126. The equation whose roots are the squares of the roots of $x^4+3x+8=0$ is

1. $x^4-16x^2-9x-64=0$
2. $x^4+16x^2-9x-64=0$
3. $x^4+16x^2-9x+64=0$
4. $x^4-16x^2+9x-64=0$

127. If α,β,γ are the roots of the equation $x^3+qx+r=0$ the equation whose roots are $-\alpha^{-1},-\beta^{-1},-\gamma^{-1}$ is

1. $rx^3+qx^2-1=0$ 2. $rx^3-qx^2-1=0$
3. $rx^3+qx^2+1=0$ 4. $rx^3-qx^2+1=0$

128. The equation whose roots are cubes of the roots of $x^3+3x^2+2=0$ is

1. $x^3-33x^2+12x+8=0$
2. $x^3+33x^2+12x+8=0$
3. $x^3-33x^2+8=0$ 4. $x^3+33x^2+8=0$

129. If α,β,γ are the roots of $x^3-3x^2+4x-7=0$, then $(\alpha+2)(\beta+2)(\gamma+2)=$

1. 25 2. -25 3. 35 4. -35

130. If $\alpha,\beta,\gamma,\delta$ are the roots of the equation $x^4-2x^3+2x^2+1=0$ then the equation whose roots are $2+\frac{1}{\alpha},2+\frac{1}{\beta},2+\frac{1}{\gamma},2+\frac{1}{\delta}$ is

1. $x^4-2x^3+29=0$ 2. $x^4+6x^2+29=0$
3. $x^4-14x+29=0$
4. $x^4-8x^3+26x^2-42x+29=0$

131. On diminishing the roots of $x^5+4x^3-x^2+11=0$ by 3, the transformed equation is $y^5+p_1y^4+p_2y^3+p_3y^2+p_4y+p_5=0$ then $p_3=$

1. 353 2. 507 3. 305 4. 94

132. The equation whose roots are cubes of the roots of $x^3+3x^2+2=0$ is

1. $x^3-33x^2+12x+8=0$
2. $x^3+33x^2+12x+8=0$
3. $x^3+33x^2-12x-8=0$
4. $x^3-33x^2-12x-8=0$

PROBLEMS ON ELIMINATING 2ND TERM IN THE GIVEN EQUATION:

133. The transformed equation of $x^3-6x^2+10x-3=0$ by eliminating second term is

1. $x^3+2x+1=0$ 2. $x^3-2x+1=0$
3. $x^3-2x-1=0$ 4. $x^3+1=0$

134. The transformed equation of $x^3+6x^2+12x-19=0$ by eliminating second term is

1. $x^3+3x-27=0$ 2. $x^3-3x+27=0$
3. $x^3+27=0$ 4. $x^3-27=0$

135. The transformed equation of $x^4+8x^3+x-5=0$ by eliminating second term is

1. $x^4-24x^2+65x-55=0$
2. $x^4+24x^2-65x+55=0$
3. $x^4-24x^2-65x-55=0$
4. $x^4+24x^2+65x+55=0$

136. The transformed equation of $x^4+4x^3+2x^2-4x-2=0$ by eliminating second term is

1. $x^4+4x^2+1=0$ 2. $x^4+4x^2-1=0$
3. $x^4-4x^2+1=0$ 4. $x^4-2x^2+1=0$

137. The third term of $x^3+2x^2+x+1=0$ is eliminated by putting $x=y+h$. The values of 'h' are

1. 1, 1/3 2. 1, -1/3 3. -1, 1/3 4. -1, -1/3

PROBLEMS ON QUOTIENT AND REMAINDERS:

138. If $x^4-6x^3+3x^2+26x-24$ is divided by x-4 then the quotient is

1. 0 2. x^3+2x^2-5x+6
3. x^3-2x^2+5x+6 4. x^3-2x^2-5x+6

139. The quotient and the remainder when $3x^4-x^3+2x^2-2x-4$ is divided by (x+2) are

1. $3x^3-7x^2+16x-34,\ 64$
2. $3x^3+7x^2-16x-34,\ 64$
3. $3x^3-7x^2-16x-34,\ 64$
4. $3x^3+7x^2+16x-34,\ 64$

140. The quotient and the remainder when $2x^5-3x^4+5x^3-3x^2+7x-9$ is divided by x^2-x-3 are

1. $2x^3-x^2, 41$ 2. $2x^3-x^2,\ 41x+3$
3. $2x^3-x^2+10x+4,\ 41x+3$
4. $2x^3-x^2+10x-4,\ 41$

141. The quotient and the remainder when $x^4-11x^3+44x^2-76x+48$ is divided by $x^2-7x+12$ are

1. $x^2-4x-2,\ 0$ 2. $x^2-4x+4,\ 0$
3. $x^2-4x,\ 0$ 4. $x^2+4x,\ 0$

142. The value of b so that $x^4-3x^3+5x^2-33x+b$ is divisible by x^2-5x+6 is

1. 45 2. 48 3. 51 4. 54

PROBLEMS ON REMOVING FRACTIONAL COEFFICIENTS:

143. The transformed equation of $x^3-\frac{5}{2}x^2-\frac{7}{18}x+\frac{1}{108}=0$ by removing fractional coefficients is

1. $x^3-15x^2+14x-2=0$ 2. $x^3-15x^2-14x-2=0$
3. $x^3-15x^2+14x-2=0$ 4. $x^3-15x^2-14x+2=0$

144. The transformed equation of $x^3-\frac{1}{4}x^2+\frac{1}{3}x-\frac{1}{144}=0$ by removing fractional coefficients is

1. $y^3-3y^2+48y-12=0$
2. $y^3+3y^2+48y+12=0$
3. $y^3-3y^2+48y+12=0$
4. $y^3+3y^2+48y-12=0$

145. The transformed equation of $\frac{2}{3}x^4+\frac{1}{4}x^3-\frac{x}{768}+\frac{1}{256}=0$ with integral coefficients and unity for the coefficient of the first term is

1. $x^4+3x^3-x+1=0$ 2. $x^4-3x^3+x+1=0$
3. $x^4+3x^3-x+24=0$ 4. $x^4+3x^3-x-1=0$

146. If $\alpha,\beta,\gamma,\delta$ are the roots of $x^4-x^3-7x^2+x+6=0$ then $\alpha^4+\beta^4+\gamma^4+\delta^4=$

1. 79 2. 89 3. 99 4. 109

147. If α,β,γ are the roots of $4x^3-7x^2+1=0$ then $\alpha^{-4}+\beta^{-4}+\gamma^{-4}=$

1. -98 2. 98 3. 96 4. -96

148. The number of real roots of $x^{10} - x^7 + x^5 + 2x^4 + 6 = 0$ is
1. atmost five 2. atmost four
3. atmost three 4. atmost two

149. The number of negative roots of $x^4 - x^3 + x^2 + 9 = 0$ is
1. 3 2. 2 3. 1 4. 0

150. The number of imaginary roots of $x^6 - 2x^5 - 7x + 4 = 0$ is
1. atleast three 2. atleast four
3. atmost three 4. atmost four

PROBLEMS ON RECIPROCAL EQUATIONS: RECIPROCAL EQUATION IS DENOTED BY R.E.:

151. If α is a root of R.E. f(x) = 0 then .... is also a root of f(x) = 0
1. $-\alpha$ 2. α^2 3. $\frac{1}{\alpha}$ 4. 2α

152. If $ax^3 + bx^2 + cx + d = 0$ is a R.E. of the first type then
1. $a = d, b = c$ 2. $a = c, b = d$
3. $a = -d, b = -c$ 4. $a = -c, b = -d$

153. If $px^3 + qx^2 + rx + s = 0$ is a R.E. of second type then
1. $p = s, q = r$ 2. $p = -s, q = -r$
3. $p = s, q = -r$ 4. $p = -s, q = r$

154. $2x^4 - 15x^3 + 19x^2 - 15x + 2 = 0$ is a
1. R.E. of first type 2. R.E. of second type
3. Standard R.E. 4. None

155. If f(x) = 0 is a R.E. of first type and odd degree then a factor of f(x) is
1. x-2 2. x-1 3. x 4. x+1

156. If f(x) = 0 is a R.E. of first type and odd degree then a root of f(x) = 0 is
1. 2 2. 1 3. 0 4. -1

157. If f(x) = 0 is a R.E. of second type and seventh degree then a factor of f(x) is
1. $x-2$ 2. $x-1$ 3. x 4. x+1

158. If f(x) = 0 is a R.E. of second type and fifth degree then a root of f(x) = 0 is
1. 0 2. 1 3. -1 4. 2

159. If f(x) = 0 is a R.E. of second type and even degree then a factor of f(x) is
1. $x+1$ 2. $x-1$ 3. x^2-1 4. x^2

PROBLEMS ON MULTIPLE ROOTS:

160. The multiple roots of $x^4 - 2x^3 - 11x^2 + 12x + 36 = 0$ are
1. 2, 3 2. 2, -3 3. -2, -3 4. -2, 3

161. The multiple roots of $x^5 - 3x^4 - 5x^3 + 27x^2 - 32x + 12 = 0$ are
1. 1, 2 2. 2, 3 3. 3, 4 4. 4, 1

162. The order of the multiple roots of 2 of the equation $x^4 - 5x^3 + 6x^2 + 4x - 8 = 0$ is
1. 1 2. 2 3. 3 4. 4

163. The order of the multiple root of -1 of the equation $x^4 + 4x^3 + 6x^2 + 4x + 1 = 0$ is
1. 1 2. 2 3. 3 4. 4

164. If f(x) = 0 has a repeated root a, then another equation having a as root is
1. f(2x) = 0 2. f(3x) = 0
3. f '(x) = 0 4. f "(x) = 0

PROBLEMS ON ONE ROOT OF EQUATION LIE BETWEEN 'a' & 'b':

165. One root of $x^3 - 3x^2 + 4x - 1 = 0$ lies between
1. 0 and 1 2. 1 and 2 3. 2 and 3 4. 4 and 5

166. One root of $x^3 + x^2 - 2x - 1 = 0$ lies between
1. –2 and –3 2. 0 and 1
3. 1 and 2 4. 2 and 3

167. One root of $x^3 - 7x + 7 = 0$ lies between
1. -1 and 0 2. -2 and -1
3. -3 and -2 4. -4 and -3

PROBLEMS ON DEGREE OF AN EQUATION:

168. The degree of the equation $\left(x^{\frac{3}{2}} + 2\right)^2 = (3x+1)^2$ is
1. 3 2. 4 3. 5 4. 6

169. The degree of the equation $\frac{4}{x} + \frac{x}{7} = \frac{x-1}{3}$ is
1. 1 2. 2 3. 3 4. 4

PROBLEMS ON SYMMETRIC TERM OF ROOTS:

170. If α, β, γ are the roots of $x^3 + px^2 + qx + r = 0$ then $\Sigma\alpha^2\beta^2 =$
1. $q^2 - 2pr$ 2. $q^2 + 2pr$ 3. $q + 2pr$ 4. $q - 2pr$

171. If α, β, γ are the roots of $4x^3 - x^2 + 10x + d = 0$ then $\Sigma\alpha(\beta+\gamma) =$
1. 10 2. -10 3. 5 4. -5

172 If α, β, γ are the roots of $x^3 + px^2 + qx + r = 0$ then $\Sigma\alpha(\beta+\gamma) =$
1. 2q 2. $-2q$ 3. 2p 4. $-2p$

173. If α, β, γ are the roots of $x^3 + px^2 + qx + r = 0$ then $\Sigma\alpha^2\beta =$
1. $3r + pq$ 2. $3r - pq$ 3. $pq - 3r$ 4. $pq + 3r$

174. If α,β,γ are the roots of $x^3+2x^2+3x+4=0$ then $\Sigma\alpha^2\beta^2=$

1. 7 2. –14 3. 14 4. –7

175. If α,β,γ are the roots of $x^3+3x^2+2x+3=0$, then $\Sigma\frac{1}{\alpha^2\beta^2}=$

1. $\frac{4}{9}$ 2. $\frac{5}{9}$ 3. $-\frac{5}{9}$ 4. $-\frac{4}{9}$

176. If α,β,γ are the roots of $x^3+ax^2+bx+c=0$, then $\Sigma\alpha^2(\beta+\gamma)=$

1. ab+3c 2. ab – 3c 3. 3c – ab 4. 3c+ab

177. If α,β,γ are the roots of $x^3+2x^2+3x+4=0$ then $\Sigma\alpha^2\beta=$

1. –6 2. –12 3. 12 4. 6

178. If α,β,γ are the roots of $x^3+px^2+qx+r=0$ then $\Sigma\frac{1}{\alpha^2\beta^2}=$

1. $\frac{p^2-2q}{r^2}$ 2. $\frac{p^2+2q}{r^2}$ 3. $\frac{p^2+2q}{r}$ 4. $\frac{p^2-2q}{r}$

179. If α,β,γ are the roots of $x^3+px^2+qx+r=0$ then $\Sigma\frac{\beta^2+\gamma^2}{\beta\gamma}=$

1. $\frac{pq}{r}-1$ 2. $\frac{pq}{r}-2$ 3. $\frac{pq}{r}-3$ 4. $\frac{pq}{r}-4$

180. If α,β,γ are the roots of $x^3+px^2+qx+r=0$ then $(\beta+\gamma-3\alpha)(\gamma+\alpha-3\beta)(\alpha+\beta-3\gamma)=$

1. $3p^3+16pq+64r$ 2. $3p^3-16pq+64r$
3. $3p^3-16pq$ 4. $3p^3+16pq$

181. If α,β,γ are the roots of the equation $x^3+px^2+qx+r=0$ such that $\alpha+\beta=0$ then

1. pr = q 2. pr + q = 0
3. pq + r = 0 4. pq = r

182. If α,β,γ are the roots of $x^3-x-1=0$ then the transformed equation having the roots $\frac{1+\alpha}{1-\alpha},\frac{1+\beta}{1-\beta},\frac{1+\gamma}{1-\gamma}$ is obtained by taking x =

1. $\frac{2y-1}{y+1}$ 2. $\frac{y-1}{y+1}$ 3. $\frac{y-1}{2y+1}$ 4. $\frac{y-1}{3y+1}$

KEY

1. 2	2. 1	3. 4	4. 3
5. 1	6. 1	7. 2	8. 4
9. 2	10. 2	11. 3	12. 1
13. 4	14. 2	15. 3	16. 4
17. 4	18. 4	19. 2	20. 2
21. 4	22. 3	23. 4	24. 4
25. 1	26. 1	27. 4	28. 3
29. 4	30. 4	31. 2	32. 2
33. 1	34. 4	35. 2	36. 1
37. 2	38. 1	39. 4	40. 3
41. 1	42. 4	43. 2	44. 3
45. 3	46. 1	47. 3	48. 4
49. 2	50. 3	51. 3	52. 1
53. 1	54. 4	55. 1	56. 1
57. 2	58. 4	59. 2	60. 3
61. 1	62. 3	63. 2	64. 4
65. 2	66. 1	67. 3	68. 3
69. 3	70. 1	71. 2	72. 3
73. 1	74. 4	75. 1	76. 3
77. 4	78. 2	79. 1	80. 1
81. 3	82. 2	83. 4	84. 2
85. 1	86. 4	87. 2	88. 1
89. 1	90. 3	91. 3	92. 1
93. 1	94. 4	95. 2	96. 2
97. 2	98. 1	99. 3	100. 1
101. 3	102. 1	103. 2	104. 3
105. 1	106. 4	107. 2	108. 3
109. 1	110. 3	111. 4	112. 2
113. 1	114. 1	115. 3	116. 1
117. 4	118. 2	119. 3	120. 2
121. 1	122. 3	123. 2	124. 1
125. 2	126. 3	127. 2	128. 2
129. 3	130. 4	131. 3	132. 2
133. 2	134. 4	135. 1	136. 3
137. 4	138. 4	139. 1	140. 3
141. 2	142. 4	143. 4	144. 1
145. 3	146. 3	147. 2	148. 2
149. 4	150. 2	151. 3	152. 1
153. 2	154. 3	155. 4	156. 4
157. 2	158. 2	159. 3	160. 4
161. 1	162. 3	163. 4	164. 3
165. 1	166. 3	167. 4	168. 4
169. 2	170. 1	171. 3	172. 1
173. 2	174. 4	175. 2	176. 3
177. 4	178. 1	179. 3	180. 2
181. 4	182. 2		

HINTS

11. $s_1 = 12$ verify options .

16. a = 2; b = -1; c = 1; d = -1

use formula $s_2=\frac{b^2-2ac}{a^2}$

25. Put a = 1; b = 1, c = 1

Þ x = -1, x = i, x = -i

Þ a = - 1, b = i, g = - i

Verify the options

26. $(-g)^{-1}+(-a)^{-1}+(-b)^{-1} = \left[\frac{bg+ag+ab}{abg}\right]$

31. $y = \alpha + \beta = s_1 - \gamma$

$y = -2 - \gamma = -2 - x$

Put y = -2 - x and verify s_3.

32. Use $P^3 + 8r = 4pq$

34. Use the condition of G.P.

$q^3 = p^3 r \Rightarrow r = \left(\frac{q}{p}\right)^3 \Rightarrow \alpha = r^{1/3} = \frac{q}{p}$

35. Substitute x = ik and verify value of k from options.

36. $s_1 = 2(\alpha + \beta) = 10$

$\therefore \alpha + \beta = 5$ then verify from the options.

44. Find $s_1 = \frac{30}{9} = \frac{10}{3}$

Verify sum of roots in options.

49. Take roots $\alpha, -\alpha, \beta$

51. $\alpha\beta\gamma = -k \Rightarrow 8\gamma = -k$

$\alpha + \beta + \gamma = -3 \Rightarrow (\alpha + \beta) = -3 - r$

$\alpha\beta + \gamma(\alpha + \beta) = -10 \Rightarrow \gamma(-3 - \gamma) = -18$

Find value of γ

58. $s_3 = 1(1)(-2)$ verify s_3 in options.

60. $s_1 = -1 + 2 + \sqrt{3} + 2 - \sqrt{3} = 3$

Verify in options.

62. Find $s_3 = \sum \alpha\beta\gamma = 1(2)(-3) = -6$

verify in options.

63. Find $s_2 = \sum \alpha\beta = 3(-4)(-4) = -12$

Verify in options.

65. Roots are 1, $3 - i\sqrt{2}$, $3 + i\sqrt{2}$

Find $s_1 = 1 + 3 - i\sqrt{2} + 3 + i\sqrt{2} = 7$

$s_3 = 1(3 - i\sqrt{2})(3 + i\sqrt{2}) = 11$

Now verify s_1 and s_3 in options.

68. Verify S_2

70. Verify $s_1 = -\frac{7}{2}$ in options.

73. f(1) = 0 and f(2) = 0.

74. Substitute a = 3, b = 2 in the formula

$x^4 - 2(a + b)x^2 + (a - b)^2 = 0$

75. Apply the formula $x^4 - 2(a + b)x^2 + (a - b)^2 = 0$.

76. Apply the formula $x^4 - 2(a + b)x^2 + (a - b)^2 = 0$.

77. Use the formula $x^4 - 2(a - b)x^2 + (a + b)^2 = 0$

78. Use the formula $x^4 - 2(a - b)x^2 + (a + b)^2 = 0$

86. $s_3 = 210$

Verify product of roots in options.

104. Put x = -x

110. Put $X = \frac{x}{-3}$

117. Put $X = x - \frac{1}{2}$

126. Put $X = \sqrt{x}$

131. Roots of $dx^3 + cx^2 + bx + a = 0$ are in A.P.

137. $3h^2 + 4h + 1 = 0$. Since all coefficients are positive, so both values of 'h' are negative.

LEVEL-2

1. If the roots of the equation $x^4 - 6x^3 + 18x^2 - 30x + 25 = 0$ are of the form $\alpha \pm i\beta$ and $\beta \pm i\alpha$, then $(\alpha, \beta) =$

1. $(-1, -2)$ 2. (1, 2) 3. $(1, -2)$ 4. (5, 1)

2 If two roots α, β of the equation $x^4 - 5x^3 + 11x^2 - 13x + 6 = 0$ are connected by the relation $2\alpha + 3\beta = 7$ then the roots of the equation are

1. $-1, 3, 1 \pm i\sqrt{2}$ 2. $-1, 3, 1 \pm i\sqrt{3}$
3. $2, 1, 1 \pm i\sqrt{2}$ 4. $2, 1, 1 \pm i\sqrt{3}$

3. If two of the roots of $x^3 + ax + b = 0$ are equal, the condition is

1. $27b^2 - 4a^3 = 0$ 2. $27b^2 + 4a^3 = 0$
3. $27b - 4a^2 = 0$ 4. $27b + 4a^2 = 0$

4. If α is an imaginary root of $x^5 - 1 = 0$, then the equation whose roots are $\alpha + \alpha^4$ and $\alpha^2 + \alpha^3$ is

1. $x^2 - x - 1 = 0$ 2. $x^2 + x - 1 = 0$
3. $x^2 - x + 1 = 0$ 4. $x^2 + x + 1 = 0$

5. The real root of the equation $x^3 + 12x - 12 = 0$ is

1. $2\sqrt[3]{2} - \sqrt[3]{5}$ 2. $2\sqrt[3]{2} + \sqrt[3]{5}$
3. $2\sqrt[3]{2} + \sqrt[3]{4}$ 4. $2\sqrt[3]{2} - \sqrt[3]{4}$

6. If α, β, γ are the roots of the equation $x^3 - x + 2 = 0$ then the equation whose roots are $\alpha\beta + \frac{1}{\gamma}, \beta\gamma + \frac{1}{\alpha}, \gamma\alpha + \frac{1}{\beta}$ is

1. $2y^3 + y^2 + 1 = 0$ 2. $2y^3 - y^2 + 1 = 0$
3. $y^3 + y^2 + 1 = 0$ 4. $2y^3 + y^2 - 1 = 0$

7. If α, β, γ are the roots of $x^3 + px^2 + qx + r = 0$ then $(\alpha + \beta)(\beta + \gamma)(\gamma + \alpha) =$

1. $pq - r$ 2. $r - pq$ 3. p+pqr 4. pq+r

8. If α,β,γ are the roots of $x^3+px^2+qx+r=0$ then $\Sigma\alpha^3\beta^3=$

1. $q^3+3pqr+3r^3$ 2. $q^3-3pqr+3r^3$

3. $q^3+3pqr+3r^2$ 4. $q^3-3pqr+3r^2$

9. If the product of the two roots of $x^4+px^3+qx^2+rx+s=0$ is equal to the product of the other two, then

1. $ps^2=r$ 2. $p^2s=r^2$ 3. $ps=r^3$ 4. $p^2s=r^3$

10. If one root of $x^3+ax^2+bx+c=0$ is the sum of the other two roots then

1. $a^3=4(ab-c)$ 2. $a^3=4(ab-2c)$

3. $a^3=ab-c$ 4. $a^3=ab-2c$

11. If the sum of two roots of the equation $x^4+px^3+qx^2+rx+8=0$ equals to the sum of the other two, then $p^3+8r=$

1. pq 2. 2pq 3. 3pq 4. 4pq

12. If one root of the equation $x^3+qx+r=0$ is double the other then $343r^2+36q^3+1=$

1. 1 2. 0 3. -1 4. -2

13. If α,β,γ are the roots of the equation $x^3+2x+1=0$ then the equation whose roots are $\beta^2\gamma^2,\gamma^2\alpha^2,\alpha^2\beta^2$ is

1. $y^3-4y^2-4y-1=0$ 2. $y^3+4y^2-4y-1=0$

3. $y^3+4y^2+4y-1=0$ 4. $y^3-4y^2+4y-1=0$

14. If α,β,γ are the roots of the equation $x^3+3x-2=0$ then the equation whose roots are $\alpha(\beta+\gamma),\beta(\gamma+\alpha),\gamma(\alpha+\beta)$ is

1. $y^3+6y^2+9y+4=0$ 2. $y^3+6y^2-9y+4=0$

3. $y^3+6y^2+9y-4=0$ 4. $y^3-6y^2+9y+4=0$

15. If α,β,γ are the roots of the equation $x^3+qx+r=0$ then the equation whose roots are $\beta\gamma-\alpha^2,\gamma\alpha-\beta^2,\alpha\beta-\gamma^2$ is

1. $(y-q)^3=0$ 2. $(y-r)^3=0$

3. $(y-q+r)^3=0$ 4. $(y+q-r)^3=0$

16. If α,β,γ are the roots of $x^3-x^2+x+2=0$ then the equation whose roots are $\beta^2\gamma^2,\gamma^2\alpha^2,\alpha^2\beta^2$ is

1. $y^3-5y^2+4y+16=0$ 2. $y^3-5y^2-4y-16=0$

3. $y^3+5y^2-4y+16=0$ 4. $y^3+5y^2+4y-16=0$

17. If α,β,γ are the roots of $x^3+2x-3=0$ then the transformed equation having the roots $\frac{\alpha}{\beta}+\frac{\beta}{\alpha},\frac{\beta}{\gamma}+\frac{\gamma}{\beta},\frac{\gamma}{\alpha}+\frac{\alpha}{\gamma}$ is obtained by taking x =

1. $\frac{3}{2}(1-y)$ 2. $-\frac{3}{2}(1+y)$ 3. $3(1-y)$ 4. $3(1+y)$

18. If α,β,γ are the roots of $x^3+ax+b=0$ then the transformed equation having the roots $(\beta-\gamma)^2,(\gamma-\alpha)^2,(\alpha-\beta)^2$ is obtained by taking x=

1. $\frac{b}{y+a}$ 2. $\frac{2b}{y+a}$ 3. $\frac{3b}{y+a}$ 4. $\frac{4b}{y+a}$

19. If α,β,γ are the roots of a cubic equation satisfying the relations $\alpha+\beta+\gamma=2,\ \alpha^2+\beta^2+\gamma^2=6$ and $\alpha^3+\beta^3+\gamma^3=8$ then the equation is

1. $x^3+2x^2-x+2=0$ 2. $x^3-2x^2-x+2=0$

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

20. If $\sqrt{5}+\sqrt{2}$ is a root of $3x^5-4x^4-42x^3+56x^2+27x-36=0$, then the rational root is

1. 4/3 2. 3/4 3. 12 4. -4/3

21. If the sum of two roots of $x^5+ax+b=0$ is zero, then the value of b is

1. a 2. 1 3. -1 4. 0

22. The condition that the product of two roots of $ax^3+bx^2+cx+d=0$ may be equal to -1 is

1. c(a+d) + b(a+d) = 0
2. d(b+d) + a(a+c) = 0
3. a(b+c) + b(c+d) = 0
4. a(a+b) + d(a+c) = 0

23. If 1,2,3 are the roots of $ax^3+bx^2+cx+d=0$, then the roots of $ax\sqrt{x}+bx+c\sqrt{x}+d=0$ are

1. 2,3,4 2. 1,4,9

3. 2,4,6 4. $1,\sqrt{2},\sqrt{3}$

24. The equation whose roots are a+b, a-b, -a+b, -a-b is

1. $x^4-2(a^2+b^2)x^2+(a^2-b^2)^2=0$

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

3. $x^4+2(a^2+b^2)x^2+(a^2-b^2)^2=0$

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

25. For the equation $6x^4-13x^3-35x^2-x+3=0$, $2+\sqrt{3}$, is a root, then the quadratic equation to which rational roots of f(x) = 0 are roots is

1. $6x^2+11x+3=0$ 2. $6x^2-11x+3=0$

3. $6x^2+11x-3=0$ 4. $6x^2-11x-3=0$

26. If a, b, g, d are the roots of $x^4+2x^3+x^2+2x+1=0$, then the value of å a^2b is

1. 2 2. 3 3. 4 4. 6

27. If α and β are two roots of $x^4 - x^3 + 1 = 0$ then the value of $\frac{\alpha^3(1-\alpha)}{\beta^3(1-\beta)} =$

1. 1 2. 2 3. Not defined 4. 0

28. If a,b,c,d are real then

$\frac{1}{x-a} + \frac{1}{x-b} + \frac{1}{x-c} + \frac{1}{x-d} = 0$ has

1. all real roots 2. all imaginary roots
3. two real roots 4. three real roots

29. If $(x^2 - x + 1)$ is a factor of f(x) = ax³ + bx² + cx + d where $a \neq 0$ and a,b,c,d are real, then the real root of f(x) = 0 is

1. a/d 2. d/a 3. -a/d 4. -d/a

30. The number of real roots of the equation $\left(x+\frac{1}{x}\right)^3 + \left(x+\frac{1}{x}\right) = 0$ is

1. 2 2. 3 3. 6 4. 0

31. If 2,3 are roots of $2x^3 + mx^2 - 13x + n = 0$ then the other root is

1. 4 2. 5/2 3. -5/2 4. 3

32. If f(x) = x³ + ax² + bx + c = 0 has roots α, β, γ and a,b,c are real and if the roots of $x^3 + a_1x^2 + b_1x + c_1 = 0$ are $(\alpha-\beta)^2, (\beta-\gamma)^2$ and $(\gamma-\alpha)^2$ then $c_1 = 0 \Rightarrow$ roots of f(x) = 0 are

1. real and distinct
2. such that at least two of them are equal
3. such that two of them are non real
4. real and equal

KEY

1. 2	2. 3	3. 2	4. 2	5. 4
6. 4	7. 2	8. 4	9. 2	10. 2
11. 4	12. 1	13. 1	14. 4	15. 1
16. 2	17. 2	18. 3	19. 2	20. 1
21. 4	22. 2	23. 2	24. 1	25. 1
26. 3	27. 1	28. 1	29. 1	30. 4
31. 3	32. 2			

HINTS

1. Use the formula $x^4 - 2(a-b)x^2 + (a+b)^2 = 0$

6. $y = \alpha + \beta = s_1 - \gamma$; and $y = -r - \gamma = -r - x$
Put y = $-r$ - x and verify s_3.

19. $s_1 = \beta^2\gamma^2 + \gamma^2\alpha^2 + \alpha^2\beta^2 = s_2^2 - 2s_3.s_1$

$s_1 = 5$

Also

$s_3 = \beta^2\gamma^2.\gamma^2\alpha^2.\alpha^2\beta^2 = (\alpha\beta\gamma)^4 = s_3^4 = (-2)^4 = 16$

20. Roots are $\pm\sqrt{5}\pm\sqrt{2}, \alpha$. So $s_1 = 0 + \alpha = 4/3$

$\Rightarrow \alpha = \frac{4}{3}$

21. Take two roots as $\alpha, -\alpha$

$\alpha^5 + a\alpha + b = 0$ and $-\alpha^5 - a\alpha + b = 0$. The value of b is obtained by adding these two equations.

22. $\alpha\beta = -1$

$\alpha\beta\gamma = \frac{-d}{a} \Rightarrow \gamma = \frac{d}{a}$.

substitute $x = \frac{d}{a}$ in given equation.

23. The second equation is obtained by replacing x by $\sqrt{x}$. Hence the roots are $\alpha^2, \beta^2, \gamma^2$

27. α, β satisfies equation

$\alpha^4 - \alpha^3 + 1 = 0 \Rightarrow \alpha^3(1-\alpha) = 1$

$\beta^4 - \beta^3 + 1 = 0 \Rightarrow \beta^3(1-\beta) = 1$

29. $x = \frac{1\pm\sqrt{3}i}{2} \Rightarrow \frac{1+\sqrt{3}i}{2}, \frac{1-\sqrt{3}i}{2}$.

LEVEL - III

1. If $1, \alpha_1, \alpha_2, ..., \alpha_{n-1}$ are the roots of $x^n - 1 = 0$ then $(1-\alpha_1)(1-\alpha_2)......(1-\alpha_{n-1}) =$

1. 0 2. 1 3. $-n$ 4. n

2. If $\frac{A_1^2}{x-a_1} + \frac{A_2^2}{x-a_2} + ... + \frac{A_k^2}{x-a_k} = m$ and A_i, a_i, m are different rational numbers then the equation has

1. no imaginary roots 2. no positive roots
3. no negative roots 4. no real roots

3. If $x^4 + px^3 + rx + s^2$ is a perfect square then

1. $ps = \pm r, p^3 \pm sr = 0$
2. $ps = \pm q, p^3 + sr = p^2$
3. $ps = 1, p^3 + sr = 0$
4. $ps = 0, p^3 + sr = 4$

4. The equation whose roots are reciprocals of the roots of $x^4 + 3x^3 - 6x^2 + 2x - 4 = 0$ is $px^4 + qx^3 + rx^2 + sx + 1 = 0$ then q + r =

1. 4 2. -4 3. -3 4. 5

5. Number of transformed equations of $x^4 + 2x^3 - 12x^2 + 2x - 1 = 0$ by eliminating third term is

1. 0 2. 1 3. 2 4. 3

6. For Δ ABC, Δ, R, r, r_1, r_2, r_3, s have the usual meanings, then if the cubic equation with roots r_1, r_2, r_3 is $x^3+lx^2+mx+n=0$, then $l=$

1. -(4R+r) 2. 1+ r/R
3. 2(R+r) 4. (4R+r)

7. If $x^3+ax+1=0$ and $x^4+ax^2+1=0$ have a common root then a =

1. 2 2. -2 3. 0 4. 3

8. If there is a multiple root of order 3 for the equation $x^4-2x^3+2x-1=0$, then the other root is

1. -1 2. 0 3. 1 4. 2

9. If α,β,γ are the roots of $x^3-7x+6=0$, then the equation whose roots are $(\alpha-\beta)^2,(\beta-\gamma)^2,(\gamma-\alpha)^2$ is

1. $(x-7)^3-21(x-7)^2+972=0$
2. $(x+1)^3-21(x+1)^2+972=0$
3. $(x+7)^3-21(x+7)^2+972=0$
4. $(x+7)^3-21(x+7)^2-400=0$

10. If α,β,γ are the roots of $x^3+2x+1=0$, then the equation whose roots are $\frac{\alpha^2}{\beta+\gamma}$, $\frac{\beta^2}{\gamma+\alpha},\frac{\gamma^2}{\alpha+\beta}$ is

1. $x^3-2x-1=0$ 2. $x^3+2x^2+1=0$
3. $x^3+2x-1=0$ 4. $x^3-2x^2-1=0$

11. If $\alpha+\beta+\gamma=1$, $\alpha^2+\beta^2+\gamma^2=2$, $\alpha^3+\beta^3+\gamma^3=3$ then $\alpha^4+\beta^4+\gamma^4=$

1. $\frac{25}{6}$ 2. 6 3. 7 4. $\frac{9}{2}$

12. If $\alpha_1,\alpha_2,\alpha_3,....,\alpha_n$ are the roots of the equation $(x-\beta_1)(x-\beta_2)......(x-\beta_n)=A$ and if the equation having $\beta_1,\beta_2,\beta_3,....\beta_n$ as the roots is $(x-\alpha_1)(x-\alpha_2)....(x-\alpha_n)=k$ then k =

1. A 2. $-A$
3. $\frac{A}{\alpha_1\alpha_2.....\alpha_n}$ 4. $\frac{-A}{\alpha_1\alpha_2.....\alpha_n}$

13. If $\alpha_1,\alpha_2,\alpha_3.....\alpha_n$ are the roots of $x^n+ax+b=0$, then $(\alpha_1-\alpha_2)(\alpha_1-\alpha_3)(\alpha_1-\alpha_4)....(\alpha_1-\alpha_n)=$

1. $n\alpha_1^{n-1}$ 2. a
3. $n\alpha_1^{n-1}+a$ 4. $n\alpha_1^{n-1}-a$

14. If $2+\sqrt{3}$ is a root of $6x^4-13x^3-35x^2-x+3=0$ then

1. only two roots are rational
2. only two roots are real but not equal
3. only three roots are equal 4. None

15. If α,β,γ are the roots of $x^3+px^2+qx+r=0$ then the value of $(1+\alpha^2)(1+\beta^2)(1+\gamma^2)$ is

1. $(r+p)^2+(q+1)^2$ 2. $(r-p)^2+(q-1)^2$
3. $(1+p)^2+(1+q)^2$ 4. $(r-p)^2+(r-q)^2$

KEY

01. 4	02. 1	03. 1	04.2	05. 3
06. 1	07.4	08. 1	09. 1	10. 3
11. 1	12.2	13. 3	14. 1	15.2

HINTS

3. Let $x^4+px^3+rx+s^2=(x^2+2ax+b)^2$.
$\therefore p=2a$, r = 2ab, $s^2=b^2$

4. R.E. = $-4x^4+2x^3-6x^2+3x+1=0$.
$\therefore q+r=-4$

5. For eliminating third term, take h value from $\frac{n(n-1)}{2!}.p_0h^2+(n-1).p_1.h+p_2=0$. Since it is quadratic equation 'h' has two values. So, we get two equations.

9. Put $y=(\alpha+\beta)^2-4\alpha\beta=r^2+\frac{24}{r}$ = $=\frac{r^3+24}{r}=\frac{7r+18}{r}\Rightarrow r=\frac{18}{y-7}$ is a root.

10. Put $a + b + g = 0$ Þ $\frac{a^2}{b+g} = -a$

11. Take equation as $x^3 + px^2 + qx + r = 0$. Using s_1, s_2, s_3 find p,q,r and hence s_4.

12. $(x - b_1)(x - b_2)....(x - b_n) - A$

$= (x - a_1)(x - a_2)...(x - a_n)$.

$(x - b_1)(x - b_2).....(x - b_n)$

$= (x - a_1)(x - a_2).....(x - a_n) + A$.

13. $(a_1 - a_2)(a_1 - a_3).....(a_1 - a_n) =$

$\underset{x® a_1}{Lt} \frac{x^n + ax + b}{x - a_1}$

14. $(x^2 - 4x + 1)(6x^2 + 11x + 3) = 0$ remaining roots are $x = -\frac{1}{2}, -\frac{3}{2}$

15. Put x = i,

Þ $-i - p + qi + r = (i + a)(i + b)(i + g)$

take modulus on either side and squaring on both sides.

LEVEL-IV

01. If the quotient of $2x^5 - 3x^4 + 5x^3 - 3x^2 + 7x - 9$ when it is divided by $x^2 - x - 3$ is $Ax^3 + Bx^2 + Cx + D$ then the ascending order of A, B, C, D is

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

02. If 1, -1, 2 are the roots of $x^3 + Ax^2 + Bx + C = 0$ then the ascending order of A, B, C is

1) A, B, C 2) B, A, C 3) C, B, A 4) C, A, B

03. If $x^4 - 16x^3 + 86x^2 - 176x + 105 = 0$ then the descending order of S_1, S_2, S_3, S_4 is

1) S_4, S_1, S_3, S_2 2) S_4, S_3, S_2, S_1
3) S_1, S_2, S_3, S_4 4) S_3, S_4, S_2, S_1

04. The transformed equation of $x^4 + 8x^3 + x - 5 = 0$ so that the second term is absent is $Ax^4 + Bx^2 + Cx + D = 0$ then the descending order of A, B, C, D is

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

05. The transformed equation of $x^4 - \frac{1}{2}x^3 + \frac{3}{4}x^2 - \frac{5}{4}x + \frac{1}{16} = 0$ with integer coefficients and unity for the coefficient of first term is $x^4 + Ax^3 + Bx^2 + Cx + D = 0$ then the increasing order of A, B, C, D is

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

06. The transformed equation of $x^4 - 5x^3 + 7x^2 - 17x + 11 = 0$ by diminishing the roots by 2 is $x^4 + Ax^3 + Bx^2 + Cx + D = 0$ then ascending order of A, B, C, D is

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

WHICH OF THE FOLLOWING IS TRUE

07. I. The quotient and remainder of $x^4 + x^3 - 13x^2 + 5x - 1$ when divide by x - 3 are $x^3 + 4x^2 - x + 2$, and 5

II. The quotient and remainder of $2x^5 - 3x^4 + 5x^3 - 7x^2 + 3x - 4$ when divided by x - 2 are $2x^3 + x^2 + 7x + 17$, 20

1) only I is true 2) only II is true
3) both I and II are true 4) Neither I nor II true

08. I. The equation whose roots are 1, -1, 3 is $x^3 - 3x^2 - x + 3 = 0$

II. The equation whose roots are -2, $3 \pm \sqrt{5}$ is $x^3 - 4x^2 - 8x + 8 = 0$

1) only I is true 2) only II true
3) both I and II is true 4) neither I nor II true

09. I. The roots of $5x^3 - 8x^2 + 7x - 4 = 0$ are $1, -3, \frac{18}{5}$

II. The roots of $15x^3 - 23x^2 + 9x - 1 = 0$ are , $1, \frac{1}{3}, \frac{1}{5}$

1) only I is true 2) only II true
3) both I and II is true 4) neither I nor II true

10. I. If α, β, γ are the roots of $x^3 + ax^2 + bx + c = 0$ then $\alpha^2 + \beta^2 + \gamma^2 = a^2 - 2b$

II. If $\alpha, \beta, \gamma, \delta$ are the roots of $x^4 + ax^3 + bx^2 + cx + d = 0$ then $\alpha^2 + \beta^2 + \gamma^2 + \delta^2 = a^2 - 2b$

1) only I is true 2) only II true
3) both I and II is true 4) neither I nor II true

11. I. The equation of lowest degree with rational co-efficients, one of whose roots is $\sqrt{7}+\sqrt{3}$ is

$x^4-20x^2+16=0$

II. The equation of lowest degree with rational coefficients, one of whose roots is $\sqrt{2}+\sqrt{3}\,i$ is

$x^4+2x^2+25=0$

1) only I is true 2) only II true
3) both I and II is true 4) neither I nor II true

12. I. The roots of the equation

$x^3-9x^2+26x-24=0$ are in A.P.

II. The roots of the equation

$6x^3-11x^2+6x-1=0$ are in G.P.

1) only I is true 2) only II true
3) both I and II is true 4) neither I nor II true

13. I. The equation whose roots are the squares of the roots of $x^3-x^2+8x-6=0$ is

$x^3+15x^2+52x+36=0$

II. The equation whose roots ar the cubes of the roots of $x^3+3x^2+2=0$ is

$x^3+33x^2+12x+8=0$

1) only I is true 2) only II true
3) both I and II is true 4) neither I nor II true

MATCH THE FOLLOWING

14. If α,β,γ are the roots of $x^3-px^2+qx-r=0$ then match the following

I) $\frac{1}{\alpha}+\frac{1}{\beta}+\frac{1}{\gamma}=$ a) $\frac{p^2-2q}{r^2}$

II) $\frac{1}{\alpha\beta}+\frac{1}{\beta\gamma}+\frac{1}{\gamma\alpha}=$ b) $\frac{q^2-2pr}{r^2}$

III) $\frac{1}{\alpha^2}+\frac{1}{\beta^2}+\frac{1}{\gamma^2}=$ c) $\frac{p}{r}$

IV) $\frac{1}{\alpha^2\beta^2}+\frac{1}{\beta^2\gamma^2}+\frac{1}{\gamma^2\alpha^2}=$ d) $\frac{q}{r}$

1) c, d, a, b 2) d, c, b, a
3) c, a, b, d 4) c, b, a, d

15. If α,β,γ are the roots of $f(x)=x^3+ax^2+bx+c=0$ then the equation whose roots are

I) $\alpha+\beta,\beta+\gamma,\gamma+\alpha$ a) $f\left(\frac{1-c}{y}\right)=0$

II) $\alpha\beta,\ \beta\gamma,\gamma\alpha$ b) $f\left(\frac{cy}{c+1}\right)=0$

III) $\beta\gamma+\frac{1}{\alpha},\gamma\alpha+\frac{1}{\beta},\alpha\beta+\frac{1}{\gamma}$ c) $f(-a-y)=0$

IV) $\alpha-\frac{1}{\beta\gamma},\beta-\frac{1}{\gamma\alpha},\gamma-\frac{1}{\alpha\beta}$ d) $f\left(\frac{-c}{y}\right)=0$

1) c, a, b, d 2) c, b, a, d
3) a, b, c, d 4) c, d, a, b

16. Match the following :

Equation	Roots
1) $x^3-3x^2-16x+48=0$	a) 6, 4, -1
2) $x^3-7x^2+14x-8=0$	b) 1,1/3,1/5
3) $15x^3-23x^2+9x-1=0$	c) 1, 2, 4
4) $x^3-9x^2+14x+24=0$	d) 4, 3, -4

1) d, c, b, a 2) d, a, b, c
3) a, d, b, c 4) d, c, a, b

17. If α,β,γ are the roots of the equations $f(x)=x^3+ax^2+bx+c=0$ then equation whose roots are
Match the following

I) $-\alpha,-\beta,-\gamma$ a) $f\left(\frac{c}{y-b}\right)=0$

II) $\frac{1}{\alpha},\frac{1}{\beta},\frac{1}{\gamma}$ b) $f\left(\frac{c}{\sqrt{y}}\right)=0$

III) $\alpha^2\beta^2,\beta^2\gamma^2,\gamma^2\alpha^2$ c) $f(-x)=0$

IV) $\alpha(\beta+\gamma),\beta(\gamma+\alpha),\gamma(\alpha+\beta)$ d) $f\left(\frac{1}{x}\right)=0$

1) c, d, a, b 2) c, a, b, d
3) c, d, b, a 4) a, b, c, d

18. If $\alpha,\beta,\gamma,\delta$ are the roots of the equation $x^4-16x^3+86x^2-176x+105=0$ then match the following

I) $\sum\alpha$ a) 86
II) $\sum\alpha\beta=$ b) 105
III) $\sum\alpha\beta\gamma=$ c) 16
IV) $\alpha\beta\gamma\delta=$ d) 176

1) c, a, b, d 2) c, b, a, d
3) c, b, d, a 4) c, a, d, b

19. Match the following :

Roots of the equation	Equation
I. 2, 3, 6	a) $2x^3+x^2-7x-6=0$
II. 1, -1, 3	b) $x^3-11x^2+36x-36=0$
III. -1, 2, -3/2	c) $x^2-3x-x-3=0$
IV. 1, -2, 3	d) $x^3-2x^2-5x+6=0$

1) b, c, a, d 2) b, c, d, a
3) b, a, d, c 4) c, b, d, a

20. Let α,β,γ be the roots of $ax^3+bx^2+cx+d=0$
Match the following:

I) the condition that α,β,γ to be in A.P. — a) $2c^3+27ad^2=9bcd$

II) the condition that α,β,γ to be in G.P. — b) $2b^3+27a^2d=9abc$

III) The conditon that α,β,γ to be in H.P. — c) $ac^3=db^3$

1) a, b, c 2) b, a, c 3) b, c, a 4) a, c, b

21. Match the following

I) The equation whose roots are multiplied by 3 of those of $x^3+2x^2-4x+1=0$ is — a) $x^3-8x^2+19x-15=0$

II) the equation whose roots are exceed by 1 then those of $x^3-5x^2+6x-3=0$ is — b) $x^3+5x^2+10x+10=0$

III) The equation whose roots are diminish by 1 than those of $x^3+2x^2+3x+4=0$ is — c) $4x^4-2x^3+6x^2-3x-1=0$

IV) The equation whose roots are the reciprocals of the roots of $x^4+3x^3-6x^2+2x-4=0$ is — d) $x^3+6x^2-36x+27=0$

1) d, c, a, b 2) d, a, b, c
3) c, a, b, d 4) c, d, a, b

22. Assertion(A): One root of $x^3-2x^2-1=0$ lies between 2 and 3.
Reason (R): If f(x) is continuous function and f(a), f(b). have opposite signs then one root of f(x)=0 lies between a and b.
1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A
3. A is true but R is false
4. A is false but R is true

23. Assertion(A): $3x^4-10x^3+4x^2-x-6=0$ then $S_2=\frac{4}{3}$.
Reason (R): $\alpha,\beta,\gamma,\delta$ are the roots of $ax^4+bx^3+cx^2+dx+c=0$ then $\sum\alpha\beta=\frac{c}{a}$
1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A
3. A is true but R is false
4. A is false but R is true

24. Assertion(A): The equation whose roots, exceed by 2 than those of $2x^3+3x^2-4x+5=0$ is $2x^3-7x^2+8x+99=0$.
Reason (R): The equation whose roots, exceed by h than those of f(x)=0 is f(x-h)=0.
1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A
3. A is true but R is false
4. A is false but R is true

25. Assertion(A): The equation whose roots are squares of the roots of $x^3-2x^2-2x+3=0$ is $x^3-8x^2+16x-9=0$.
Reason (R): The equation whose roots are the squares of the roots of f(x)=0is $f\left(\sqrt{x}\right)=0$
1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A
3. A is true but R is false
4. A is false but R is true

26. Assertion(A): The equation whose roots are 3 times the roots of $6x^4-7x^3+8x^2-7x+2=0$ is $2x^4-7x^3+24x^2-63x+54=0$.
Reason (R): The equation whose roots are multiplied by k of those of $f(x)=0$ is $f\left(\frac{x}{k}\right)=0$
1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A
3. A is true but R is false
4. A is false but R is true

27. Assertion(A): If the roots of $ax^4+bx^3+cx^2+dx+e=0$ are in H.P. Then the roots of $ex^4+dx^3+cx^2+bx+a=0$ are in A.P.
Reason (R): If $\alpha_1,\alpha_2,---,\alpha_n$ are the roots of $f(x)=0$ then the equation whose roots are

$\frac{1}{\alpha_1},\frac{1}{\alpha_2},-----,\frac{1}{\alpha_n}$ is $f\left(\frac{1}{x}\right)=0$.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A
3. A is true but R is false
4. A is false but R is true

KEY

1. 2	2. 1	3. 4	4. 3	5. 1
6. 3	7. 1	8. 3	9. 2	10. 3
11. 3	12. 1	13. 2	14. 2	15. 4
16. 1	17. 3	18. 4	19. 1	20. 3
21. 2	22. 1	23. 1	24. 4	25. 1
26. 1	27. 1			

LEVEL-V

If α is a repeated root of $f(x)=0$ where α is repeated for 'm' times ($m \le n$ where n is order of of equation) then $'\alpha'$ is called repeated root or multiple root. $'\alpha'$ satisfies

$f(x)=0, f'(x)=0, f''(x)=0, ..., f^{m-1}(x)=0$.

'm' is called order of multiple root of $f(x)=0$

1. Multiple root of the equation $x^4-6x^2+8x-3=0$ is
   1) 1 2) 2 3) -1 4) -3
2. '2' is multiple of $x^5-10x^4+40x^3-80x^2+80x-32=0$ then order of multiple root is
   1) 5 2) 4 3) 3 4) 2
3. $'\alpha'$ is a multiple root of $f(x)=0$ then $'\alpha'$ must satisfy
   1) $f''(x)=0$ 2) $f'''(x)=0$
   3) $f^{m-1}(x)=0$ 4) $f'(x)=0$

KEY

1) 1 2) 1 3) 4

II. If $\alpha,\beta,\gamma,\delta...$ are the roots of $f(x)=0$ then the equation whose roots of $a+k,\ \beta+k,\ \gamma+k....$ is $f(x-k)=0$

The equation whose roots are $k\alpha,k\beta,k\gamma,...$ is $f(x/k)=0$. The eqution whose roots are $\frac{1}{\alpha},\frac{1}{\beta}\cdots$ is $f(1/x)=0$

1. If $\alpha,\beta,\gamma,\delta$ are the roots of $x^4-2x^3+x^2-3x+5=0$ then $(\alpha+2)(\beta+2)(\gamma+2)(\delta+2)=$
   1) 7 2) 10 3) 47 4) 25
2. If α,β,γ are the roots $2x^3-5x^2+4x+1=0$ then the values of $\sum\left(\frac{1}{\alpha}+1\right)\left(\frac{1}{\beta}+1\right)$ is
   1) -2 2) -5 3) -100 4) -10

KEY

1) 3 2) 4

PREVIOUS EAMCET QUESTIONS

EAMCET-2001

1. Each of the roots of the equation $x^3-6x^2+6x-5=0$ are increased by k so that the new transformed equation does not contain x^2 term. Then k =
   1. $-\frac{1}{3}$ 2. $-\frac{1}{2}$ 3. -1 4. -2
2. The roots of the equation $x^3-14x^2+56x-64=0$ are in .... progression.
   1. Arithmetico-geometric
   2. Harmonic
   3. Arithmetic 4. Geometric
3. If there is a multiple root of order 3 for the equation $x^4-2x^3+2x-1=0$, then the other root is
   1. -1 2. 0 3. 1 4. 2
4. The equation whose roots are the negatives of the roots of the equation $x^7+3x^5+x^3-x^2+7x+2=0$
   1. $x^7+3x^5+x^3+x^2-7x+2=0$
   2. $x^7+3x^5+x^3+x^2+7x-2=0$
   3. $x^7+3x^5+x^3-x^2-7x-2=0$
   4. $x^7+3x^5+x^3-x^2+7x-2=0$

5. The biquadratic equation, two of whose roots are $1 + i$, $1 - \sqrt{2}$ is

1. $x^4 - 4x^3 + 5x^2 - 2x - 2 = 0$
2. $x^4 - 4x^3 - 5x^2 + 2x + 2 = 0$
3. $x^4 + 4x^3 - 5x^2 + 2x - 2 = 0$
4. $x^4 + 4x^3 + 5x^2 - 2x + 2 = 0$

EAMCET-2002

6. To remove the 2nd term of the equation $x^4 - 8x^3 + x^2 - x + 3 = 0$ diminished the root of the equation by

1. 1 2. 2 3. 3 4. 4

7. The maximum possible number of real roots of the equation $x^5 - 6x^2 - 4x + 5 = 0$ is

1. 3 2. 4 3. 5 4. 0

8. If a ,b, g are the roots of the equation $x^3 + ax^2 + bx + c = 0$ then $a^{-1} + b^{-1} + g^{-1} =$

1. $\frac{a}{c}$ 2. $-\frac{b}{c}$ 3. $\frac{c}{a}$ 4. $\frac{b}{a}$

9. If $\frac{1+\sqrt{3}i}{2}$ is a root of the equation $x^4 - x^3 + x - 1 = 0$ then its real roots are

1. 1,1 2. -1, -1 3. 1, 2 4. 1, -1

10. If a ,b, g are the roots of $2x^3 - 2x - 1 = 0$ then $(\text{å}\ \text{a b})^2 =$

1. -1 2. 1 3. 2 4. 3

EAMCET - 2003

11. If α,β,γ are the roots of the equation $x^3 + 4x + 1 = 0$ then $(\alpha+\beta)^{-1} + (\beta+\gamma)^{-1} + (\gamma+\alpha)^{-1} =$

1) 2 2) 3 3) 4 4) 5

12. Let $\alpha \neq 0$ and $P(x)$ be a polynomial of degree greater than 2. If P(x) leaves remainders α and $-\alpha$ when divided respectively by $x+\alpha$ and $x-\alpha$ then the remainder when P(x) is divided by $x^2 - \alpha^2$ is

1) 2x 2) -2x 3) x 4) -x

13. If the sum of two of the roots of $x^3 + px^2 + qx + r = 0$ is zero then pq =

1) -r 2) r 3) 2r 4) -2r

EAMCET-2004

14. If the roots of the equation $4x^3 - 12x^2 + 11x + k = 0$ are in A.P. Then K =

1) -3 2) 1 3) 2 4) 3

15. α,β,γ are the roots of the equation $x^3 - 10x^2 + 7x + 8 = 0$

Match the following

1) $\alpha+\beta+\gamma$	a) $-\frac{43}{4}$
2) $\alpha^2+\beta^2+\gamma^2$	b) $\frac{-7}{8}$
3) $\frac{1}{\alpha}+\frac{1}{\beta}+\frac{1}{\gamma}$	c) 86
4) $\frac{\alpha}{\beta\gamma}+\frac{\beta}{\gamma\alpha}+\frac{\gamma}{\alpha\beta}$	d) 0
	e) 10

1) e, c, a, b 2) d, c, a, b
3) e, c, b, a 4) e, b, c, a

16. If f(x) is a polynomial of degree n with rational coeffcients and $1+2i$, $2-\sqrt{3}$ and 5 are three roots of f(x)=0, then the least value of n is

1) 5 2) 4 3) 3 4) 6

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17. The roots of the equation $x^3 - 3x - 2 = 0$ are

1) -1, -1, 2 2) -1, 1, -2
3) -1, 2, -3 4) -1, -1, -2

18. If α,β,γ are the roots of $x^3 + 2x^2 - 3x - 1 = 0$ then $\alpha^{-2} + \beta^{-2} + \gamma^{-2} =$

1) 12 2) 13 3) 14 4) 15

19. If 1, 2, 3 and 4 are the roots of the equtaiton $x^4 + ax^3 + bx^2 + cx + d = 0$, then $a + 2b + c =$ **(E-2007)**

1) -25 2) 0
3) 10 4) 24

20. If α,β,γ are the roots of $x^3.2x^2 + 3x - 4 = 0$. then the value of $\alpha^2\beta^2 - \beta^2\gamma^2 + \gamma^2\alpha^2$ is **(E-2007)**

1) 7 2) -5
3) -3 4) 0

KEY

1. 4	2. 4	3. 1	4. 2	5. 1
6. 2	7. 1	8. 2	9. 4	10.2
11. 3	12. 4	13. 2	14. 1	15.3
16. 1	17. 1	18. 2	19. 3	20.1