MATHS

BOOKS - VIKRAM PUBLICATION (ANDHRA PUBLICATION)

THEORY OF EQUATIONS

Solved Problems

1. Form the polynomial equation of degree 3 whose roots are 2,3 and 6.

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2. Find the relation between the roots and the coefficients of the cubic equation .

$3x^3 - 10x^2 + 7x + 10 = 0$

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3. Write down the relations between the roots and the coefficients of the bi-quadratic equation

$x^4 - 2x^3 + 4x^2 + 6x - 21 = 0$

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4. If 1,2,3 and 4 are the roots of $x^4 + ax^3 + bx^2 + cx + d = 0$, then find the values of a,b,c and d.

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5. If a,b,c are roots of $x^3 - px^2 + qx - r = 0$ and r $\neq$ 0, then find $\frac{1}{a^2} + \frac{1}{b^2} + \frac{1}{c^2}$ in terms of p,q,r.

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6. Find the sum of the squares and the sum of the cubes of the roots of the equations $x^3 - px^2 + qx - r = 0$ in terms of p,q,r

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7. Obtain the cubic equation, whose roots are the squares of the roots of the equation ,

$x^3 + p_1x^2 + p_2x + p_3 = 0$

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8. Let ,α, β, γ be the roots of

$x^3 + px^2 + qx + r = 0$. Then find the

$\alpha\beta + \beta\gamma + \gamma\alpha$ and $\alpha\beta\gamma$

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9. Let ,α, β, γ be the roots of $x^3 + px^2 + qx + r = 0$. Then find the

(i) $\sum \alpha^2$

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10. Let ,α, β, γ be the roots of $x^3 + px^2 + qx + r = 0$. Then find the

(ii) $\sum \frac{1}{\alpha}$

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11. Let ,α, β, γ be the roots of $x^3 + px^2 + qx + r = 0$. Then find the

(ii) $\sum \alpha^3$

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12. Let ,α, β, γ be the roots of $x^3 + px^2 + qx + r = 0$. Then find the

(iv) $\sum \beta^2\gamma^2$

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13. Let ,α, β, γ be the roots of

$x^3 + px^2 + qx + r = 0$. Then find the

(v) $(\alpha + \beta)(\beta + \gamma)(\gamma + \alpha)$

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14. Letα, β, γ be the roots of

$x^3 + ax^2 + bx + c = 0$ then find $\sum \alpha^2\beta + \sum \alpha\beta^2$.

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

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16. solve $x^3 - 3x^2 - 16x + 48 = 0$

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17. Find the roots of $x^4 - 16x^3 + 86x^2 - 176x + 105 = 0$

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18. solve $x^3 - 7x^2 + 36 = 0$ given one root being twice the other .

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19. Given that 2 is a root of $x^3 - 6x^2 + 3x + 10 = 0$, find the other roots

.

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20. Given that two roots of $4x^3 + 20x^2 - 23x + 6 = 0$ are equal,find all the roots of the given equation .

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21. Given that the sum of two roots of $x^4 - 2x^3 + 4x^2 + 6x - 21 = 0$ is zero , find the roots of the equation .

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22. Solve $4x^3 - 24x^2 + 23x + 18 = 0$,givne that the roots of this equation are in arithmetic progression

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23. solve $x^3 - 7x^2 + 14x - 8 = 0$ given that the roots are in geometric progression.

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24. Solve $x^4 - 5x^3 + 5x^2 + 5x - 6 = 0$ given that the product of two of its roots is 3

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25. Solve $x^4 + x^3 - 2x^2 - 12x + 9 = 0$, Given that it has two pairs of equal roots .

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26. Prove that the sum of any two of roots of the equation $x^4 + px^3 + qx^2 + rx + s = 0$ is equal to the sum of the remaining two roots of the equation iff $p^3 - 4pq + 8r = 0$

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27. Form the polynomial equation of degree 4 whose roots are

$4+\sqrt{3}, 4-\sqrt{3}, 2+I$ and $2-i$

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28. Solve $6x^4-13x^3-35x^2-x+3=0$ given that one of its roots is

$2+\sqrt{3}$

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29. Find the polynomial equation of degree 4 whose roots are the negatives of the roots of $x^4-6x^3+7x^2-2x+1=0$

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30. Find the algebraic equation of the degree 4 whose roots are 3 times the roots of the equation . $6x^4-7x^3+8x^2-7x+2=0$

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31. Form the equation whose roots are m times the roots of the equation $x^3 + \frac{x^2}{4} - \frac{x}{16} + \frac{1}{72} = 0$ and deduce the case when m =12 .

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32. Find the algebraic equation of degree 5 whose roots are the translates of the roots of $x^5 + 4x^3 - x^2 + 11 = 0$ by -3.

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33. Find the algebraic equation of degree 4 whose roots are the translates of the roots

$4x^4 + 32x^3 + 83x^2 + 76x + 21 = 0$ by 2.

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34. Find the polynomial equation whose roots are the reciprocals of the roots of the equation

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

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35. Find the polynomial equation whose roots are the squares of the roots of $x^3 - x^2 + 8x - 6 = 0$

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36. Show that $2x^3 + 5x^2 + 5x + 2 = 0$ is a reciprocal equation of class one .

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37. slove the equation $4x^3 - 13x^2 - 13x + 4 = 0$

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38. Solve the equation $6x^4 - 35x^3 + 62x^2 - 35x + 6 = 0$.

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39. solve $x^5 - 5x^4 + 9x^3 - 9x^2 + 5x - 1 = 0$

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40. Solve the equation $6x^6 - 25x^5 + 31x^4 - 31x^2 + 25x - 6 = 0$

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Exercise 4 A

1. Form polynomial equations of the lowest degree , with roots as given below .

Hint : Equation having roots α, β, γ is $(x-\alpha)(x-\beta)(x-\gamma)=0$

1,-1,3

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2. Form polynomial equations of the lowest degree , with roots as given below

`1pm 2i, 4,2

Hint : In an equation Imaginary roots occur in conjugate pairs.

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3. Form polynomial equations of the lowest degree , with roots as given below

$2 \pm \sqrt{3}, 1 \pm 2i$

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4. Form polynomial equations of the lowest degree , with roots as given below 0,0,2,,2,-2,-2

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5. Form polynomial equations of the lowest degree , with roots as given below

$1 \pm \sqrt{3}, 2, 5$

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6. Form polynomial equations of the lowest degree , with roots as given below

0,1,-$\frac{3}{2}, -\frac{5}{2}$

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7. If α, β, γ are the roots of

$4x^3 - 6x^2 + 7x + 3 = 0$ then find the value of $\alpha\beta + \beta\gamma + \gamma\alpha$.

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8. if 1,1,α are the roots of

$x^3 - \times^2 + 9x - 4 = 0$,then find α .

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9. If -1,2 and α are the roots of

$2x^3 + x^2 - 7x - 6 = 0$, then find α

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10. If 1,-2 and 3 are roots of

$x^3 - 2x^2 + ax + 6 = 0$, then find a .

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11. If the product of the roots of

$4x^3 + 16x^2 - 9xa = 0$ is 9 , then find a .

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12. Find the values of s_1, s_2, s_3 and s_4 for each of the following equations .

$x^4 - 16x^3 + 86x^2 - 176x + 105 = 0$

Hint : $s_1 = \sum_{i=1}^{4} \alpha_i$, $s_2 = \sum_{l \le i \le j \le 4} \alpha_i \alpha i$, $s_3 = \sum_{l \le i \le j \le k \le 4} \alpha_i \alpha_j \alpha_k$, $s_4 = \alpha_1 \alpha_2$

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13. Find the values of s_1, s_2, s_3 and s_4 for each of the following equations .

$8x^4 - 2x^3 - 27x^2 + 6x + 9 = 0$

Hint : $s_1 = \sum_{r=1}^{4} \alpha_i,\ s_2 = \sum_{l \le i \le j \le 4} \alpha_i \alpha i,\ s_3 = auml \le i \le j \le k \le 4 \Big) \alpha_i \alpha_j$

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14. If α, β and 1 are the roots of $x^3 - 2x^2 - 5x + 6 = 0$, then find α and β

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15. If α, β and γ are the roots of

$x^3 - 2x^2 + 3x - 4 = 0$, then find

(i) $\sum \alpha^2 \beta^2 (ii) \sum \alpha\beta(\alpha + \beta)$

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16. If α, β and γ are the roots of $x^3 + px^2 + qx + r = 0$ then find the following :

(i) $\alpha+\beta+\gamma$

(ii) $\alpha\times\beta+\beta\times\gamma+\gamma\times\alpha$

(iii) $\alpha\times\beta\times\gamma$

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17. If α, β and γ are the roots of $x^3+px^2+qx+r=0$ then find the following : $\sum\frac{1}{\alpha^2\beta^2}$

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18. If α, β and γ are the roots of $x^3+px^2+qx+r=0$ then find the following : $\frac{\beta^2+\gamma^2}{\beta\gamma}+\frac{\gamma^2+\alpha^2}{\gamma\alpha}+\frac{\alpha^2+\beta^2}{\alpha\beta}$ or $\sum\frac{\beta^2+\gamma^2}{\beta\gamma}$

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

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20. If α, β and γ are the roots of $x^3 + px^2 + qx + r = 0$ then find the following : $\sum \alpha^3 \beta^3$

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21. If α, β, γ are the roots of

$x^3 - 6x^2 + 11x - 6 = 0$ then find the equation whose roots are $\alpha^2 + \beta^2, \beta^2 + \gamma^2, \gamma^2 + \alpha^2$

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22. If α, β, γ are the roots of

$x^3 - 7x + 6 = 0$ then find the equation whose roots are $(\alpha - \beta)^2, (\beta - \gamma)^2, (\gamma - \alpha)^2$

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23. If α, β, γ are the roots of $x^3 - 3ax + b = 0$

prove that $\sum(\alpha - \beta)(\alpha - \gamma) = 9a.$

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Exercise 4 B

1. Solve $x^3 - 3x^2 - 16x + 48 = 0$, given that tha sum of two roots is zero .

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2. Find the condition that $x^3 - px^2 + qx - r = 0$ may have sum of its two roots is zero .

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3. Given that roots of $x^3 + 3px^2 + 3qx + r = 0$ are in

(i)A.P., show that $2p^3 - 3qp + r = 0$

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4. Given that roots of $x^3 + 3px^2 + 3qx + r = 0$ are in

G.P. show that $p^3 r = q^3$

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5. Given that roots of $x^3 + 3px^2 + 3qx + r = 0$

(iii) H.P ,. Show that $2q^3 = r(3pq - r)$

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6. Find the condition that $x^3 - px^2 + qx - r = 0$ may have the roots in

G.P .

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7. Solve $9x^3 - 15x^2 + 7x - 1 = 0$, given that two of its roots are equal .

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8. Given that one root of $2x^3 + 3x^2 - 8x + 3 = 0$ is double of another root , find the roots of the equation.

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9. Solve $x^3 - 9x^2 + 14x + 24 - 0$, given that two of the roots are in the ratio $3 : 2$.

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10. Solve the following equation ,given that the root of each are in A.P .

(i) $8x^3 - 36c^2 - 18x + 81 = 0$

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11. Solve the following equation ,given that the root of each are in A.P .

(ii) $x^3 - 3x^2 - 6x + 8 = 0$

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12. solve the following equations , given that the roots of each are in G.P

(i) $3x^3 - 26x^2 + 52x - 24 = 0$

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13. solve the following equations , given that the roots of each are in G.P

(ii) $54x^3 - 39x^2 - 26x + 16 = 0$

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14. Solve the following equations , given that the roots of each are in H.P .

(i) $6x^3 - 11x^2 + 6x - 1 = 0$

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15. Solve the following equations , given that the roots of each are in H.P .

(ii) $15x^3 - 23x^2 + 9x - 1 = 0$

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16. solve the following equation , given that they have multiple roots .

$x^4 - 6x^3 + 13x^2 - 24x + 36 = 0$

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17. solve the following equation , given that they have multiple roots .

$3x^4 + 16x^3 + 24x^2 - 16 = 0$

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18. Solve $x^4 + x^3 - 16x^2 - 4x + 48 = 0$ that the product of the two roots is 6 .

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19. solve $8x^4 - 2x^3 - 27x^2 + 6x + 9 = 0$ given that two roots have the same absolute value , but are oppsite in signs .

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20. Solve $18x^3 + 81x^2 + 121x + 60 = 0$ given that one roots is equal to half the sum of the remainging roots .

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21. Find the condition in order that the equation $ax^4 + 4bx^3 + 6cx^2 + 4dx + e = 0$ may have a pair of equal roots .

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22. Show that $x^5 - 5x^3 + 5x^2 - 1 = 0$ has three equal roots and find this roots .

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23. Find the repeated roots of $x^5 - 3x^4 - 5x^3 + 27x^2 - 32x + 12 = 0$

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24. Solve the equation $8x^3 - 20x^2 + 6x + 9 = 0$ given that the equation has multiple roots .

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Exercise 4 C

1. From the polynomial equation whose roots are

$2 + 3i, 2 - 3i, 1 + i, 1 - i$

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2. From the polynomial equation whose roots are 3,2,1+I,,1-I

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3. From the polynomial equation whose roots are 1+I,1-I,-1+I,-1-I

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4. From the polynomial equation whose roots are 1+I,1-I,1+I,1-I

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5. Form the polynomial equation with rational coefficients whose roots are$4\sqrt{3}, 5 + 2i$

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6. Form the polynomial equation with rational coefficients whose roots are 1+5i,5-I

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7. Form the polynomial equation with rational coefficients whose roots are $i - \sqrt{5}$

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8. Form the polynomial equation with rational coefficients whose roots are $-\sqrt{3} + i\sqrt{2}$

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9. Solve the equation $x^4 + 2x^3 - 5x^2 + 6x + 2 = 0$ given that 1+I is one of its roots .

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10. solve the equation $3x^3 - 4x^2 + x + 88 = 0$ which has $2 - \sqrt{-7}$ as a root.

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11. Solve $x^4 - 4x^2 + 8x + 35 = 0$,given that $2 + i\sqrt{3}$ is a root.

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12. Solve the equation $x^4 - 6x^3 + 11x^2 - 10x + 2 = 0$,given that $2 + \sqrt{3}$ is a root of the equation.

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13. Given that $-2 + \sqrt{-7}$ is a root of the equation $x^4 + 2x^2 - 16x + 77 = 0$ solve it completely .

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14. Solve the equations

$x^4 + 2x^3 - 16x^2 - 22x + 7 = 0$ given that $2 - \sqrt{3}$ is a root of it .

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15. Solve the equation , $3x^5 - 4x^4 - 42x^3 + 56x^2 + 27x - 36 = 0$ given that $\sqrt{2} + \sqrt{5}$ is one of its roots .

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16. Solve the equation $x^4 - 9x^3 + 27x^2 - 29x + 6 = 0$ given that one root of it is $2 - \sqrt{3}$

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17. Show that equation

$$\frac{a^2}{x - a'} + \frac{b^2}{x - b'} + \frac{c^3}{x - c'} + \ldots\ldots + \frac{k^2}{x - k'} = x - m$$

Where a ,b,c.....k, m,a',b',c'.....k' are all real numbers , cannot have a non real root .

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Exercise 4 D

1. Find the algebraic equation whose roots are 2 times the roots of $x^5 - 2x^4 + 3x^3 - 2x^2 + 4x + 3 = 0$

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2. Find the transformed equation whose roots are the negative of the roots of $x^4 + 5x^3 + 11x + 3 = 0$

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3. Find the transformed equation whose roots aren the negatives of the roots of $x^7 + 3x^5 + x^3 - x^2 + 7x + 2 = 0$

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4. Find the polynomial equation whose roots are the reciprocals of the roots of $x^4 - 3x^3 + 7x^2 + 5x - 2 = 0$

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5. Find the polynomial equation whose roots are the reciprocals of the roots of $x^5 + 11x^4 + x^3 + 4x^2 + 13x + 6 = 0$

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6. Find the polynomial equation whose roots are the squares of the roots of $x^4 + x^3 + 2x^2 + x + 1 = 0$

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7. Form the polynomial equation whose roots are the squares of the roots of $x^3 + 3x^2 - 7x + 6 = 0$

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8. Form the polynomial equation whose roots are cubes of the roots of $x^3 + 3x^2 + 2 = 0$

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9. Find the polynomial equation whose roots are the translates of those of the equation $x^4 - 5x^3 + 7x^2 - 17x + 11 = 0$ by -2.

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10. Find the polynomial equation whose roots are the translates of those of $x^5 - 4x^4 + 3x^2 = 4x + 6 = 0$ by -3.

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11. Find the polynomial equation whose roots are the translates of the roots of the equation . $x^4 - x^3 - 10x^2 + 4x + 24 = 0$ by 2 .

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12. Find the polynomial equation whose roots are the translates of the equation $3x^5 - 5x^3 + 7 = 0$ by 4.

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13. Transform eanc of the following equations into ones in which of the coefficients of the second highest power of x is zero and also find their

transformed equations . $x^3 - 6x^2 + 10x - 3 = 0$

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14. Transform eanc of the following equations into ones in which of the coefficients of the second highest power of x is zero and also find their transformed equations $x^4 + 4x^3 + 2x^2 - 4x - 2 = 0$

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15. Transform eanc of the following equations into ones in which of the coefficients of the second highest power of x is zero and also find their transformed equations $x^3 - 6x^2 + 4x - 7 = 0$

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16. Transform eanc of the following equations into ones in which of the coefficients of the second highest power of x is zero and also find their

transformed equations $x^3 + 6x^2 + 4x + 4 = 0$

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17. Transform each of the following equations into ones in which the coefficients of the third highest power of x is zero . $x^4 + 2x^3 - 12x^2 + 2x - 1 = 0$

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18. Transform each of the following equations into ones in which the coefficients of the third highest power of x is zero . $x^3 + 2x^2 + x + 1 = 0$

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19. Solve the following equations . $x^4 - 10x^3 + 26x^2 - 10x + 1 = 0$

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20. Solve the following equations $2x^5 + x^4 - 12x^3 - 12x^2 + x2 = 0$

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Dam Sure Vsaq 2 Marks

1. Form polynomial equation of the lowest degree with roots 1,-1,3

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2. If $1, 1, \alpha$ are the roots of $x^3 - 6x^3 + 9x - 4 = 0$ then $\alpha =$

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3. If $-1, 2, \alpha$ are the roots of the equation $2x^3 + x^2 - 7x - 6 = 0,$ then α is

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4. If 1,-2 and 3 are roots of

$x^3 - 2x^2 + ax + 6 = 0$, then find a .

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5. If the product of the roots of

$4x^3 + 16x^2 - 9x - a = 0$ is 9 , then find a .

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6. Find the transformed equation whose roots are the negative of the roots of $x^4 + 5x^3 + 11x + 3 = 0$

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7. Form the polynamial equation of 3 whose roots are 2,3 and 6.

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8. Let α, β, γ be the roots of $x^3 + px^2 + qx + r = 0$ then find $\sum \alpha^3$

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Dam Sure Saq 4 Marks

1. If α, β and 1 are the roots of $x^3 - 2x^2 - 5x + 6 = 0$, then find α and β

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2. If α, β and γ are the roots of

$x^3 - 2x^2 + 3x - 4 = 0$, then find

(i) $\sum \alpha^2\beta^2(ii)\sum \alpha\beta(\alpha+\beta)$

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3. Solve the $x^3-3x^2-6x+8=0$ equation , given that the roots of each are in A.P .

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4. Solve $x^4-4x^2+8x+35=0$,given that $2+i\sqrt{3}$ is a root.

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5. Find the polynomial equation whose roots are the reciprocals of the roots of $x^4-3x^3+7x^2+5x-2=0$

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Dam Sure Laq 7 Marks

1. Solve the $8x^3 - 36x^2 - 18x + 81 = 0$ equation, given that the roots of each are in A.P.

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2. Solve the $3x^3 - 26x^2 + 52x - 24 = 0$ equations , given that the roots of each are in G.P.

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3. Solve $18x^3 + 81x^2 + 121x + 60 = 0$ given that one roots is equal to half the sum of the remainging roots .

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4. Solve the equation $2x^5 + x^4 - 12x^3 - 12x^2 + x + 2 = 0$

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