

Please find the roots of all polynomials below :

$$1. \ x^3 - x^2 - 16x - 20$$

$$= (x+2)(x^2 - 3x - 10)$$

$$= (x+2)(x+2)(x-5)$$

$$2. \ x^4 - 2x^3 - 63x^2 + 128x - 64$$

$$= (x-1)(x^3 - x^2 - 64x + 64)$$

$$= (x-1)^2(x^2 - 64)$$

$$= (x-1)^2(x+8)(x-8)$$

$$3. \ x^3 + 15x^2 + 54x + 40$$

$$= (x+1)(x^2 + 14x + 40)$$

$$= (x+1)(x+4)(x+10)$$

$$4. \quad x^4 - 3x^3 - 56x^2 - 132x - 80$$

$$= (x+1)(x^3 - 4x^2 - 52x - 80)$$

$$= (x+1)(x+2)(x^2 - 6x - 40)$$

$$= (x+1)(x+2)(x+4)(x-10)$$

$$5. \quad x^4 - 4x^3 - 9x^2 + 16x + 20$$

$$= (x+1)(x^3 - 5x^2 - 4x + 20)$$

$$= (x+1)(x-2)(x^2 - 3x - 10)$$

$$= (x+1)(x-2)(x+2)(x-5)$$

$$6. \quad x^3 + 13x^2 + 39x + 27$$

$$= (x+1)(x^2 + 12x + 27)$$

$$= (x+1)(x+3)(x+9)$$

$$7. \quad x^3 + 8x^2 + 19x + 12$$

$$= (x+1)(x^2 + 7x + 12)$$

$$= (x+1)(x+3)(x+4)$$

$$8. \quad 2x^3 + 17x^2 + 22x + 7$$

$$= (x+1)(2x^2 + 15x + 7)$$

$$= (x+1)(2x+1)(x+7)$$

$$9. \quad x^3 + 17x^2 + 79x + 63$$

$$= (x+1)(x^2 + 16x + 63)$$

$$= (x+1)(x+7)(x+9)$$

$$10. \quad x^4 - x^3 - 60x^2 + 4x + 224$$

$$= (x-2)(x^3 + x^2 - 58x - 112)$$

$$= (x-2)(x+2)(x^2 - x - 56)$$

$$= (x-2)(x+2)(x+7)(x-8)$$

11. $x^4 + 24x^3 + 184x^2 + 480x + 400$

$$= (x+2)(x^3 + 22x^2 + 140x + 200)$$

$$= (x+2)(x+2)(x^2 + 20x + 100)$$

$$= (x+2)^2 (x+10)^2$$

12. $x^4 - 17x^3 + 71x^2 + 17x - 72$

$$= (x-1)(x^3 - 16x^2 + 55x + 72)$$

$$= (x-1)(x+1)(x^2 - 17x + 72)$$

$$= (x-1)(x+1)(x-8)(x-9)$$

13. $x^4 + 14x^3 + 33x^2 - 80x - 100$

$$= (x+1)(x^3 + 13x^2 + 20x - 100)$$

$$= (x+1)(x-2)(x^2 + 15x + 50)$$

$$= (x+1)(x-2)(x+10)(x+5)$$

14. $x^4 - 9x^3 + 18x^2 + 4x - 24$

$$= (x+1)(x^3 - 10x^2 + 28x - 24)$$

$$= (x+1)(x-2)(x^2 - 8x + 12)$$

$$= (x+1)(x-2)(x-2)(x-6)$$

$$\begin{aligned}15. \quad & x^4 - 12x^3 + 27x^2 + 4x - 36 \\&= (x+1)(x^3 - 13x^2 + 40x - 36) \\&= (x+1)(x-2)(x^2 - 11x + 18) \\&= (x+1)(x-2)(x-2)(x-9)\end{aligned}$$

$$\begin{aligned}16. \quad & 7x^3 - 29x^2 - 31x + 5 \\&= (x+1)(7x^2 - 36x + 5) \\&= (x+1)(7x-1)(x-5)\end{aligned}$$

$$\begin{aligned}17. \quad & 3x^3 - 14x^2 - 23x - 6 \\&= (x+1)(3x^2 - 17x - 6) \\&= (x+1)(3x+1)(x-6)\end{aligned}$$

$$18. \ x^3 - 17x^2 + 54x + 72$$

$$= (x+1)(x^2 - 18x + 72)$$

$$= (x+1)(x-12)(x-6)$$

$$19. \ x^3 + 5x^2 - 73x - 77$$

$$= (x+1)(x^2 + 4x - 77)$$

$$= (x+1)(x+11)(x-7)$$

$$20. \ x^3 - 2x^2 - 31x - 28$$

$$= (x+1)(x^2 - 3x - 28)$$

$$= (x+1)(x+4)(x-7)$$

$$21. \ x^3 + 2x^2 - 89x - 90$$

$$= (x+1)(x^2 + x - 90)$$

$$= (x+1)(x+10)(x-9)$$

$$22. \ x^4 + 15x^3 + 73x^2 + 129x + 70$$

$$= (x+1)(x^3 + 14x^2 + 59x + 70)$$

$$= (x+1)(x+2)(x^2 + 12x + 35)$$

$$= (x+1)(x+2)(x+5)(x+7)$$

$$23. \ x^4 + 18x^3 + 101x^2 + 192x + 108$$

$$= (x+1)(x^3 + 17x^2 + 84x + 108)$$

$$= (x+1)(x+2)(x^2 + 15x + 54)$$

$$= (x+1)(x+2)(x+6)(x+9)$$

$$24. \ x^4 + 19x^3 + 113x^2 + 221x + 126$$

$$= (x+1)(x^3 + 18x^2 + 95x + 126)$$

$$= (x+1)(x+2)(x^2 + 16x + 63)$$

$$= (x+1)(x+2)(x+7)(x+9)$$

$$\begin{array}{r} 6x^3 \\ \hline 25. \quad x^4 + \cancel{6x^3} - 68x^2 - 312x - 320 \end{array}$$

$$= (x+2)(x^3 + 4x^2 - 76x - 160)$$

$$= (x+2)(x+2)(x^2 + 2x - 80)$$

$$= (x+2)^2 (x+10)(x-8)$$

$$26. \quad x^4 - 33x^2 - 100x - 84$$

$$= (x+2)(x^3 - 2x^2 - 29x - 42)$$

$$= (x+2)(x+2)(x^2 - 4x - 21)$$

$$= (x+2)^2 (x+3)(x-7)$$

$$27. \quad x^4 - 10x^3 - 4x^2 + 136x + 192$$

$$= (x+2)(x^3 - 12x^2 + 20x + 96)$$

$$= (x+2)(x+2)(x^2 - 14x + 48)$$

$$= (x+2)^2 (x-6)(x-8)$$

$$28. \quad 2x^3 + 11x^2 + 17x + 6$$

$$= (x+2)(2x^2 + 7x + 3)$$

$$= (x+2)(2x+1)(x+3)$$

$$29. \ x^3 - 6x^2 - 49x - 66$$

$$= (x+2)(x^2 - 8x - 33)$$

$$= (x+2)(x+3)(x-11)$$

$$30. \ 3x^3 + 26x^2 + 33x - 14$$

$$= (x+2)(3x^2 + 20x - 7)$$

$$= (x+2)(3x-1)(x+7)$$

$$31. \ x^3 + 14x^2 + 51x + 54$$

$$= (x+2)(x^2 + 12x + 27)$$

$$= (x+2)(x+3)(x+9)$$

$$\begin{aligned}32. \quad & x^4 + 9x^3 - 14x^2 - 36x + 40 \\&= (x-1)(x^3 + 10x^2 - 4x - 40) \\&= (x-1)(x+10)(x^2-4) \\&= (x-1)(x+10)(x+2)(x-2)\end{aligned}$$

$$\begin{aligned}33. \quad & x^4 - 9x^2 - 4x + 12 \\&= (x-1)(x^3 + x^2 - 8x - 12) \\&= (x-1)(x+2)(x^2 - x - 6) \\&= (x-1)(x+2)(x+2)(x-3)\end{aligned}$$

$$\begin{aligned}34. \quad & x^4 - 2x^3 - 15x^2 - 4x + 20 \\&= (x-1)(x^3 - x^2 - 16x - 20) \\&= (x-1)(x+2)(x^2 - 3x - 10) \\&= (x-1)(x+2)(x+2)(x-5)\end{aligned}$$

$$\begin{aligned}35. \quad & x^4 + 17x^3 + 77x^2 + 31x - 126 \\&= (x-1)(x^3 + 18x^2 + 95x + 126) \\&= (x-1)(x+2)(x^2 + 16x + 63) \\&= (x-1)(x+2)(x+7)(x+9)\end{aligned}$$

$$36. \ x^4 - 3x^3 - 27x^2 - 13x + 42$$

$$= (x-1)(x^3 - 2x^2 - 29x - 42)$$

$$= (x-1)(x+2)(x^2 - 4x - 21)$$

$$= (x-1)(x+2)(x+3)(x-7)$$

$$37. \ x^4 + 2x^3 - 91x^2 - 92x + 180$$

$$= (x-1)(x^3 + 3x^2 - 88x - 180)$$

$$= (x-1)(x+2)(x^2 + x - 90)$$

$$= (x-1)(x+2)(x+10)(x-9)$$

$$38. \ x^4 - 17x^3 + 61x^2 + 117x - 162$$

$$= (x-1)(x^3 - 16x^2 + 45x + 162)$$

$$= (x-1)(x+2)(x^2 - 18x + 81)$$

$$= (x-1)(x+2)(x-9)^2$$

39. $x^3 - 17x^2 + 52x + 180$

$$= (x+2)(x^2 - 19x + 90)$$

$$= (x+2)(x-9)(x-10)$$

40. $x^4 + 15x^3 + 50x^2 - 60x - 216$

$$= (x+2)(x^3 + 13x^2 + 24x - 108)$$

$$= (x+2)(x-2)(x^2 + 15x + 54)$$

$$= (x+2)(x-2)(x+6)(x+9)$$

41. $x^4 - 12x^3 + 32x^2 + 48x - 144$

$$= (x-2)(x^3 - 10x^2 + 12x + 72)$$

$$= (x-2)(x+2)(x^2 - 12x + 36)$$

$$= (x-2)(x+2)(x-6)^2$$

42. $x^4 - 5x^3 - 40x^2 + 20x + 144$

$$= (x-2)(x^3 - 3x^2 - 46x - 72)$$

$$= (x-2)(x+2)(x^2 - 5x - 36)$$

$$= (x-2)(x+2)(x+4)(x-9)$$

$$43. \ 3x^3 - 2x^2 - 19x - 6$$

$$= (x+2)(3x^2 - 8x - 3)$$

$$= (x+2)(3x+1)(x-3)$$

$$44. \ 3x^3 - 4x^2 - 17x + 6$$

$$= (x+2)(3x^2 - 10x + 3)$$

$$= (x+2)(3x-1)(x-3)$$

$$45. \ x^3 - 10x^2 + 3x + 54$$

$$= (x+2)(x^2 - 12x + 27)$$

$$= (x+2)(x-3)(x-9)$$

$$46. \ 7x^3 - 13x^2 - 58x - 8$$

$$= (x+2)(7x^2 - 27x - 4)$$

$$= (x+2)(7x+1)(x-4)$$

$$47. \ x^3 - 14x^2 + 16x + 96$$

$$= (x+2)(x^2 - 16x + 48)$$

$$= (x+2)(x-4)(x-12)$$

$$48. \ x^3 - 8x^2 + 5x + 50$$

$$= (x+2)(x^2 - 10x + 25)$$

$$= (x+2)(x-5)^2$$

$$49. \ x^3 + 8x^2 - 60x - 144$$

$$= (x+2)(x^2 + 6x - 72)$$

$$= (x+2)(x+12)(x-6)$$

$$50. \quad x^4 + 6x^3 - 41x^2 - 6x + 40$$

$$= (x-1)(x^3 + 7x^2 - 34x - 40)$$

$$= (x-1)(x+1)(x^2 + 6x - 40)$$

$$= (x-1)(x+1)(x+10)(x-4)$$

$$51. \quad x^4 + 3x^3 - 19x^2 - 3x + 18$$

$$= (x-1)(x^3 + 4x^2 - 15x - 18)$$

$$= (x-1)(x+1)(x^2 + 3x - 18)$$

$$= (x-1)(x+1)(x+6)(x-3)$$

$$52. \quad x^4 - 17x^3 + 71x^2 + 17x - 72$$

$$= (x-1)(x^3 - 16x^2 + 55x + 72)$$

$$= (x-1)(x+1)(x^2 - 17x + 72)$$

$$= (x-1)(x+1)(x-9)(x-8)$$

$$53. \ x^4 + 8x^3 - 25x^2 - 44x + 60$$

$$= (x-1)(x^3 + 9x^2 - 16x - 60)$$

$$= (x-1)(x+2)(x^2 + 7x - 30)$$

$$= (x-1)(x+2)(x+10)(x-3)$$

$$54. \ x^3 - 6x^2 - 9x + 14$$

$$= (x-1)(x^2 - 5x - 14)$$

$$= (x-1)(x+2)(x-7)$$

$$55. \ x^4 + 13x^3 + 29x^2 - 13x - 30$$

$$= (x-1)(x^3 + 14x^2 + 43x + 30)$$

$$= (x-1)(x+1)(x^2 + 13x + 30)$$

$$= (x-1)(x+1)(x+3)(x+10)$$

$$56. \ 7x^3 + 15x^2 - 19x - 3$$

$$= (x-1)(7x^2 + 22x + 3)$$

$$= (x-1)(7x+1)(x+3)$$

$$57. \ 2x^3 + 9x^2 - 6x - 5$$

$$= (x-1)(2x^2 + 11x + 5)$$

$$= (x-1)(2x+1)(x+5)$$

$$58. \ 3x^3 + 13x^2 - 11x - 5$$

$$= (x-1)(3x^2 + 16x + 5)$$

$$= (x-1)(3x+1)(x+5)$$

$$59. \ 7x^3 + 27x^2 - 39x + 5$$

$$= (x-1)(7x^2 + 34x - 5)$$

$$= (x-1)(7x-1)(x+5)$$

$$60. \quad x^3 + 16x^2 + 43x - 60$$

$$= (x-1)(x^2 + 17x + 60)$$

$$= (x-1)(x+5)(x+12)$$

$$61. \quad x^4 - x^3 - 13x^2 + 25x - 12$$

$$= (x-1)(x^3 - 13x + 12)$$

$$= (x-1)^2(x^2 + x - 12)$$

$$= (x-1)^2(x+4)(x-3)$$

$$62. \quad x^4 - x^3 - 31x^2 + 61x - 30$$

$$= (x-1)(x^3 - 31x + 30)$$

$$= (x-1)^2(x^2 + x - 30)$$

$$= (x-1)^2(x+6)(x-5)$$

$$63. \quad x^4 - 6x^3 - 3x^2 + 20x - 12$$

$$= (x-1)(x^3 - 5x^2 - 8x + 12)$$

$$= (x-1)^2(x^2 - 4x - 12)$$

$$= (x-1)^2(x+2)(x-6)$$

64. $x^4 - 4x^3 - 19x^2 + 46x - 24$

$$= (x-1)(x^3 - 3x^2 - 22x + 24)$$

$$= (x-1)^2(x^2 - 2x - 24)$$

$$= (x-1)^2(x+4)(x-6)$$

65. $x^4 - 10x^3 - \cancel{7}x^2 + 76x - 60$

$$= (x-1)(x^3 - 9x^2 - 16x + 60)$$

$$= (x-1)(x-2)(x^2 - 7x - 30)$$

$$= (x-1)(x-2)(x+3)(x-10)$$

66. $x^4 + \cancel{x}^3 - 22x^2 + 44x - 24$

$$= (x-1)(x^3 + 2x^2 - 20x + 24)$$

$$= (x-1)(x-2)(x^2 + 4x - 12)$$

$$= (x-1)(x-2)(x+6)(x-2)$$

67. $x^4 + 7x^3 - \cancel{7x^2} - 43x + 42$

$$= (x-1)(x^3 + 8x^2 + x - 42)$$

$$= (x-1)(x-2)(x^2 + 10x + 21)$$

$$= (x-1)(x-2)(x+3)(x+7)$$

68. $x^4 - 3x^3 - 98x^2 + 300x - 200$

$$= (x-1)(x^3 - 2x^2 - 100x + 200)$$

$$= (x-1)(x-2)(x^2 - 100)$$

$$= (x-1)(x-2)(x+10)(x-10)$$

69. $x^4 - 7x^3 - 31x^2 + 127x - 90$

$$= (x-1)(x^3 - 6x^2 - 37x + 90)$$

$$= (x-1)(x-2)(x^2 - 4x - 45)$$

$$= (x-1)(x-2)(x+5)(x-9)$$

70. $x^4 + 11x^3 + 8x^2 - 116x + 96$

$$= (x-1)(x^3 + 12x^2 + 20x - 96)$$

$$= (x-1)(x-2)(x^2 + 14x + 48)$$

$$= (x-1)(x-2)(x+6)(x+8)$$

$$71. \ 5x^3 - 19x^2 + 11x + 3$$

$$= (x-1)(5x^2 - 14x - 3)$$

$$= (x-1)(5x+1)(x-3)$$

$$72. \ 5x^3 - 31x^2 + 31x - 5$$

$$= (x-1)(5x^2 - 26x + 5)$$

$$= (x-1)(5x-1)(x-5)$$

$$73. \ 3x^3 - 25x^2 + 29x - 7$$

$$= (x-1)(3x^2 - 22x + 7)$$

$$= (x-1)(3x-1)(x-7)$$

$$74. \ x^3 - 19x^2 + 95x - 77$$

$$= (x-1)(x^2 - 18x + 77)$$

$$= (x-1)(x-7)(x-11)$$

$$75. \ x^4 - 17x^3 + 92x^2 - 172x + 96$$

$$= (x-1)(x^3 - 16x^2 + 76x - 96)$$

$$= (x-1)(x-2)(x^2 - 14x + 48)$$

$$= (x-1)(x-2)(x-6)(x-8)$$

$$76. \ x^4 + 16x^3 + 35x^2 - 232x + 180$$

$$= (x-1)(x^3 + 17x^2 + 52x - 180)$$

$$= (x-1)(x-2)(x^2 + 19x + 90)$$

$$= (x-1)(x-2)(x+10)(x+9)$$

$$77. \ x^3 - 17x^2 + 80x - 100$$

$$= (x-2)(x^2 - 15x + 50)$$

$$= (x-2)(x-5)(x-10)$$

$$78. \ x^3 - 19x^2 + 100x - 132$$

$$= (x-2)(x^2 - 17x + 66)$$

$$= (x-2)(x-6)(x-11)$$

$$79. \ x^4 - 17x^3 + 98x^2 - 220x + 168$$

$$= (x-2)(x^3 - 15x^2 + 68x - 84)$$

$$= (x-2)^2(x^2 - 13x + 42)$$

$$= (x-2)^2(x-6)(x-7)$$

$$80. \ x^3 + 2x^2 - 29x + 42$$

$$= (x-2)(x^2 + 4x - 21)$$

$$= (x-2)(x+7)(x-3)$$

$$81. \ 5x^3 - 29x^2 + 34x + 8$$

$$= (x-2)(5x^2 - 19x - 4)$$

$$= (x-2)(5x+1)(x-4)$$

$$82. \ 2x^3 - 15x^2 + 27x - 10$$

$$= (x-2)(2x^2 - 11x + 5)$$

$$= (x-2)(2x-1)(x-5)$$

$$83. \ 5x^3 - 36x^2 + 57x - 10$$

$$= (x-2)(5x^2 - 26x + 5)$$

$$= (x-2)(5x-1)(x-5)$$

$$84. \ x^3 - 14x^2 + 59x - 70$$

$$= (x-2)(x^2 - 12x + 35)$$

$$= (x-2)(x-5)(x-7)$$

$$85. \ 3x^3 - 25x^2 + 44x - 12$$

$$= (x-2)(3x^2 - 19x + 6)$$

$$= (x-2)(3x-1)(x-6)$$

$$86. \ x^3 - x^2 - 74x + 144$$

$$= (x-2)(x^2 + x - 72)$$

$$= (x-2)(x+9)(x-8)$$

$$87. \ x^4 - x^3 - 102x^2 + 100x + 200$$

$$= (x-2)(x^3 + x^2 - 100x - 100)$$

$$= (x-2)(x+1)(x+10)(x-10)$$

$$88. \ x^4 - x^3 - 6x^2 + 4x + 8$$

$$= (x-2)(x^3 + x^2 - 4x - 4)$$

$$= (x-2)(x+1)(x+2)(x-2)$$

$$89. \ x^4 + 10x^3 + 11x^2 - 46x - 48$$

$$= (x-2)(x^3 + 12x^2 + 35x + 24)$$

$$= (x-2)(x+1)(x^2 + 11x + 24)$$

$$= (x-2)(x+1)(x+3)(x+8)$$

$$90. \ x^4 + 13x^3 + 33x^2 - 77x - 98$$

$$= (x-2)(x^3 + 15x^2 + 63x + 49)$$

$$= (x-2)(x+1)(x^2 + 14x + 49)$$

$$= (x-2)(x+1)(x+7)^2$$

$$91. \ x^3 + 10x^2 - 4x - 40$$

$$= (x+10)(x+2)(x-2)$$

$$92. \quad x^4 + 4x^3 - 64x^2 - 16x + 240$$

$$= (x-2)(x^3 + 6x^2 - 52x - 120)$$

$$= (x-2)(x+2)(x^2 + 4x - 60)$$

$$= (x-2)(x+2)(x+10)(x-6)$$

$$93. \quad x^3 + 11x^2 - 4x - 44$$

$$= (x+11)(x+2)(x-2)$$

$$94. \quad x^4 + 2x^3 - 12x^2 - 8x + 32$$

$$= (x-2)(x^3 + 4x^2 - 4x - 16)$$

$$= (x-2)(x+4)(x+2)(x-2)$$

$$95. \ x^4 + x^3 - 34x^2 - 4x + 120$$

$$= (x-2)(x^3 + 3x^2 - 28x - 60)$$

$$= (x-2)(x+2)(x^2 + x - 30)$$

$$= (x-2)(x+2)(x+6)(x-5)$$

$$96. \ x^3 - 8x^2 - 28x + 80$$

$$= (x-2)(x^2 - 6x - 40)$$

$$= (x-2)(x+4)(x-10)$$

$$97. \ x^3 + 9x^2 + 8x - 60$$

$$= (x-2)(x^2 + 11x + 30)$$

$$= (x-2)(x+5)(x+6)$$

$$98. \ 3x^3 + 14x^2 - 47x + 14$$

$$= (x-2)(3x^2 + 20x - 7)$$

$$= (x-2)(3x-1)(x+7)$$

$$99. \quad x^3 + 3x^2 - 34x + 48$$

$$= (x-2)(x^2 + 5x - 24)$$

$$= (x-2)(x+8)(x-3)$$

$$100. \quad x^3 + 10x^2 + 3x - 54$$

$$= (x-2)(x^2 + 12x + 27)$$

$$= (x-2)(x+3)(x+9)$$