Vocabulary:
Standard form
Degree of the polynomial
Leading coefficient
Classification by the number of terms
Factor completely
Roots

Find the sum. Give all answers in standard form.

1. $3r^4 - 7r^2 + r - 9$ and $r^4 + 5r^3 - 2r^2 + 1$
2. $5x^3 + 4x^2 - 6x - 3$ and $-8x^3 - 7x^2 - 7$

Find the difference.

3. $x^3 - 5x^2 + 7$ from $x^5 - 2x^3 + 3x^2 - 3$
4. $8y^3 + 7y^2 - 4y + 3$ from $-5y^3 + 3y + 8$

Simplify.

5. $6y^2(3y^2 - 1)$
6. $(4p - 3)^2$
7. $(5t - 3)(2t + 2)$
8. $(3x - 2)(4x^2 + 3x + 2)$
9. $(3x + 4y)^2$
10. $(4d + 5e)(3d - e)$
11. $(3a - 8)(7a^2 - 8a + 4)$
12. $(2x - 3)9x + 4)(3x - 8)$

Factor each polynomial completely.

13. $7a^3 + 28a^2 - 35a$
14. $9x^2 - 36x + 36$
15. $25a^2 - 9b^4$
16. $12x^2 - 50x + 48$
17. $x^2 + 7x - 30$
18. $12x^2 - 28x + 15$
19. $18x^2 - 3x - 10$
20. $6x^2 + 11x - 10$
21. $4x^2 + 15x + 9$

Solve by factoring.

22. $a^2 - 2a = 15$
23. $x^2 - 30 = x$
24. $2x^2 - 13x = -20$
25. $6x^2 + 16x + 8 = 0$
26. $u^2 - 9 = 0$
27. $3x^2 - x = 0$
28. $4x^2 - 5x - 6 = 0$
29. $24x^2 + 4x - 8 = 0$
30. $2x^3 - 16x^2 = 0$
31. \[2x^2 - 7 = -13x\]  
32. \[4x^2 + 12x + 9 = 0\]  
33. \[18x^2 - 3x - 10 = 0\]

34. Give the perimeter of the rectangle shown in terms of \(x\).

35. Give the area of the whole rectangle in terms of \(x\).

36. Give the area of the shaded region in terms of \(x\).

37. Write an expression, in terms of \(y\), which represents the perimeter of rectangle with a length of \(y + 5\) units and a width of \(y - 2\) units.

38. The area of a square is represented by \[4p^2 - 12p + 9\].
   a. Give the length of each side in terms of \(p\).
   b. Give the perimeter of the square in terms of \(p\).

39. A foul ball leaves the end of a baseball bat and travels according to the formula \[h(t) = 64t - 16t^2\] where \(h\) is the height of the ball in feet and \(t\) is the time in seconds. Find the roots of the equation when \(y = 0\). Explain what the roots mean in this situation.

40. If a toy rocket is launched vertically upward from ground level with an initial velocity of 128 feet per second, then its height \(h\) after \(t\) seconds is given by the equation \[h(t) = -16t^2 + 128t\] (if air resistance is neglected). Find the roots of the equation when \(y = 0\). What do the roots mean in this situation?
**Answer Key**

1. \[4r^4 + 5r^3 - 9r^2 + r - 8\]  
   2. \[-3x^3 - 3x^2 - 6x - 10\]  
   3. \[x^5 - 3x^3 + 8x^2 - 10\]  

4. \[-13y^3 - 7y^2 + 7y + 5\]  
   5. \[18y^4 - 6y^2\]  
   6. \[16p^2 - 24p + 9\]  

7. \[10t^2 + 4t - 6\]  
   8. \[12x^3 + x^2 - 4\]  
   9. \[9x^2 + 24xy + 16y^2\]  

10. \[12d^2 + 11de - 5e^2\]  
    11. \[21a^3 - 80a^2 + 76a - 32\]  
    12. \[54x^3 - 201x^2 + 116x + 96\]  

13. \[7a(a + 5)(a - 1)\]  
    14. \[9(x - 2)^2\]  
    15. \[(5a - 3b^2)(5a + 3b^2)\]  

16. \[2(2x - 3)(3x - 8)\]  
    17. \[(x + 10)(x - 3)\]  
    18. \[(6x - 5)(2x - 3)\]  

19. \[(6x - 5)(3x + 2)\]  
   20. \[(2x + 5)(3x - 2)\]  
   21. \[(4x + 3)(x + 3)\]  

22. \[a = 5, a = -3\]  
   23. \[x = 6, x = -5\]  
   24. \[x = \frac{5}{2}, x = 4\]  

25. \[x = -2, x = -\frac{2}{3}\]  
   26. \[u = 3, u = -3\]  
   27. \[x = 0, x = \frac{1}{3}\]  

28. \[x = 2, x = -\frac{3}{4}\]  
   29. \[x = \frac{1}{2}, x = -\frac{2}{3}\]  
   30. \[x = 0, x = 8\]  

31. \[x = -7, x = \frac{1}{2}\]  
   32. \[x = -\frac{3}{2}\]  
   33. \[x = \frac{5}{6}, x = -\frac{2}{3}\]  

34. \[2(2x + 3) + 2(3x + 7)\]  
   35. \[(3x + 7)(2x + 3)\]  
   36. \[6x^2 + 23x + 21 - 4x^2\]  
   37. \[2(y + 5) + 2(y - 2)\]  
   38. \[6x^2 + 23x + 21 - (2x \cdot 2x)\]  
   39. \[2y + 10 + 2y - 4\]  
   40. \[4y + 6\]  

38. a. \((2p - 3)(2p - 3)\), so the side length is \(2p - 3\)  
   b. \[\frac{4(2p - 3)}{8p - 12}\]  

39. The roots are 0 and 4. That means that the ball leaves the ground at 0 seconds and returns to the ground at 4 seconds. The ball is in the air for 4 seconds.  

40. The roots are 0 and 8. The rocket leaves the ground after 0 seconds and hits the ground after 8 seconds.