Factor each and find all zeros. One factor has been given.

1) \( f(x) = x^3 + 9x^2 + 23x + 15; \ x + 5 \)
2) \( f(x) = x^3 - x^2 - 14x + 24; \ x - 3 \)

3) \( f(x) = x^4 + 3x^3 - 13x^2 - 15x; \ x - 3 \)
4) \( f(x) = x^3 - 12x^2 + 47x - 60; \ x - 3 \)

5) \( f(x) = x^3 - 7x^2 + 2x + 40; \ x - 5 \)
6) \( f(x) = x^3 - 3x^2 - 9x + 27; \ x - 3 \)

7) \( f(x) = 10x^3 + 37x^2 + 37x + 6; \ 5x + 1 \)
8) \( f(x) = 25x^3 + 150x^2 + 131x + 30; \ 5x + 3 \)

9) \( f(x) = 5x^3 + 21x^2 - 21x - 5; \ x + 5 \)
10) \( f(x) = 3x^3 - 4x^2 - 9x + 10; \ x - 2 \)
11) \( f(x) = 5x^3 + 9x^2 - 26x - 24; \ x + 3 \)  
12) \( f(x) = 6x^3 + 7x^2 - 1; \ 2x + 1 \)

**Factor each and find all zeros. One zero has been given.**

13) \( f(x) = 5x^3 + 4x^2 - 20x - 16; \ 2 \)

14) \( f(x) = 25x^4 - 40x^3 - 19x^2 - 2x; \ \ -\frac{1}{5} \)

15) \( f(x) = 3x^4 + 5x^3 + 81x + 135; \ \ -\frac{5}{3} \)

16) \( f(x) = 2x^4 - x^3 - 18x^2 + 9x; \ -3 \)

17) \( f(x) = 10x^3 - 41x^2 + 32x + 20; \ \ \frac{5}{2} \)

18) \( f(x) = 3x^3 + 4x^2 - 35x - 12; \ 3 \)
More on Factors, Zeros, and Dividing

Factor each and find all zeros. One factor has been given.

1) \( f(x) = x^3 + 9x^2 + 23x + 15; \ x + 5 \)
   
   Factors to: \( f(x) = (x + 1)(x + 3)(x + 5) \)
   
   Zeros: \( \{-1, -3, -5\} \)

2) \( f(x) = x^3 - x^2 - 14x + 24; \ x - 3 \)
   
   Factors to: \( f(x) = (x - 2)(x + 4)(x - 3) \)
   
   Zeros: \( \{2, -4, 3\} \)

3) \( f(x) = x^4 + 3x^3 - 13x^2 - 15x; \ x - 3 \)
   
   Factors to: \( f(x) = x(x + 1)(x + 5)(x - 3) \)
   
   Zeros: \( \{0, -1, -5, 3\} \)

4) \( f(x) = x^3 - 12x^2 + 47x - 60; \ x - 3 \)
   
   Factors to: \( f(x) = (x - 4)(x - 5)(x - 3) \)
   
   Zeros: \( \{4, 5, 3\} \)

5) \( f(x) = x^3 - 7x^2 + 2x + 40; \ x - 5 \)
   
   Factors to: \( f(x) = (x + 2)(x - 4)(x - 5) \)
   
   Zeros: \( \{-2, 4, 5\} \)

6) \( f(x) = x^3 - 3x^2 - 9x + 27; \ x - 3 \)
   
   Factors to: \( f(x) = (x + 3)(x - 3)^2 \)
   
   Zeros: \( \{-3, 3 \text{ mult. } 2\} \)

7) \( f(x) = 10x^3 + 37x^2 + 37x + 6; \ 5x + 1 \)
   
   Factors to: \( f(x) = (2x + 3)(x + 2)(5x + 1) \)
   
   Zeros: \( \{-\frac{3}{2}, -2, -\frac{1}{5}\} \)
   
   \[ 2.4 \approx 8 \]
   
   \[ 4.2 \approx 8 \]
   
   \[ 4.2 \frac{4}{4} = 8 \]

8) \( f(x) = 25x^3 + 150x^2 + 131x + 30; \ 5x + 3 \)
   
   Factors to: \( f(x) = (5x + 2)(x + 5)(5x + 3) \)
   
   Zeros: \( \{-\frac{2}{5}, -5, -\frac{3}{5}\} \)

9) \( f(x) = 5x^3 + 21x^2 - 21x - 5; \ x + 5 \)
   
   Factors to: \( f(x) = (5x + 1)(x - 1)(x + 5) \)
   
   Zeros: \( \{-\frac{1}{5}, 1, -5\} \)

10) \( f(x) = 3x^3 - 4x^2 - 9x + 10; \ x - 2 \)

   Factors to: \( f(x) = (3x + 5)(x - 1)(x - 2) \)
   
   Zeros: \( \{-\frac{5}{3}, 1, 2\} \)
11) \( f(x) = 5x^3 + 9x^2 - 26x - 24; \ x + 3 \)
Factors to: \( f(x) = (5x + 4)(x - 2)(x + 3) \)
Zeros: \( \left\{ \frac{4}{5}, 2, -3 \right\} \)

12) \( f(x) = 6x^3 + 7x^2 - 1; \ 2x + 1 \)
Factors to: \( f(x) = (3x - 1)(x + 1)(2x + 1) \)
Zeros: \( \left\{ \frac{1}{3}, -1, -\frac{1}{2} \right\} \)

Factor each and find all zeros. One zero has been given.

13) \( f(x) = 5x^3 + 4x^2 - 20x - 16; \ 2 \)
Factors to: \( f(x) = (5x + 4)(x + 2)(x - 2) \)
Zeros: \( \left\{ \frac{4}{5}, -2, 2 \right\} \)

14) \( f(x) = 25x^4 - 40x^3 - 19x^2 - 2x; \ -\frac{1}{5} \)
Factors to: \( f(x) = x(5x + 1)^2(x - 2) \)
Zeros: \( \left\{ 0, -\frac{1}{5} \text{ mult. 2}, 2 \right\} \)

Quad Formula

15) \( f(x) = 3x^4 + 5x^3 + 81x + 135; \ -\frac{5}{3} \)
Factors to: \( f(x) = (x + 3)(x^2 - 3x + 9)(3x + 5) \)
Zeros: \( \left\{ -3, \frac{3 + 3i\sqrt{3}}{2}, \frac{3 - 3i\sqrt{3}}{2}, -\frac{5}{3} \right\} \)

16) \( f(x) = 2x^4 - x^3 - 18x^2 + 9x; \ -3 \)
Factors to: \( f(x) = x(2x - 1)(x - 3)(x + 3) \)
Zeros: \( \left\{ 0, \frac{1}{2}, -3, -3 \right\} \)

17) \( f(x) = 10x^3 - 41x^2 + 32x + 20; \ \frac{5}{2} \)
Factors to: \( f(x) = (5x + 2)(x - 2)(2x - 5) \)
Zeros: \( \left\{ -\frac{2}{5}, 2, \frac{5}{2} \right\} \)

18) \( f(x) = 3x^3 + 4x^2 - 35x - 12; \ 3 \)
Factors to: \( f(x) = (3x + 1)(x + 4)(x - 3) \)
Zeros: \( \left\{ -\frac{1}{3}, -4, 3 \right\} \)

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