

Show all work as you perform the indicated operation.

1. $(2x^4 + 9x - 9) - (x^4 - 2x^2 + 4x - 8)$

$$x^4 + 2x^2 + 5x - 1$$

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

$$2x^4 - x^3$$

3. $(2x + 7)(4x - 3)$

$$8x^2 + 22x - 21$$

4. $(2x - 5)^2$

$$4x^2 - 20x + 25$$

5. $(w + 4)(w^2 + 6w - 11)$

$$w^3 + 10w^2 + 13w - 44$$

Factor the following expressions completely.

6. $2m^3 + 6m^2 - 8m$

$$2m(m+4)(m-1)$$

7. $3m^2 + 18m + 15$

$$3(m+5)(m+1)$$

8. $x^2 - 9$

$$(x+3)(x-3)$$

9. $x^3 + 5x^2 + 4x + 20$

$$(x^2 + 4)(x + 5)$$

10. $5x^3 - 20x^2 - 25x$

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

11. $2x^5 + 6x^4 + 2x^3 + 6x^2$

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

12. $x^4 - 7x^2 - 18$

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

13. $18y^3 - 50y$

$$2y(3y+5)(3y-5)$$

14. $x^4 - 16$

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

Solve the equations, real and imaginary. Leave solutions in exact form.

15. $2x(4x + 3)(x - 5) = 0$

$$x = 0, -3/4, 5$$

16. $(x^2 + 9)(x^2 + 5) = 0$

$$x = \pm 3i, \pm 2\sqrt{5}$$

17. $8x^2 - 2x = 0$

$$x = 0, 1/4$$

Answer the following about the graphs of $f(x)$. Then sketch the graph using the zeros, multiplicity, and end behavior.

18. $f(x) = 2x^4 - 7x^3 + x^2 + 16x - 12$

$$\begin{array}{r} 1 \mid 2 \quad -7 \quad 1 \quad 16 \quad -12 \\ \quad 2 \quad -5 \quad -4 \quad 12 \\ \hline 2 \mid 2 \quad -5 \quad -4 \quad 12 \quad \checkmark \\ \quad 2 \quad \quad 4 \quad -2 \quad -12 \\ \hline \quad 2 \quad -1 \quad -6 \quad \checkmark \end{array}$$

$$2x^2 - x - 6$$

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

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

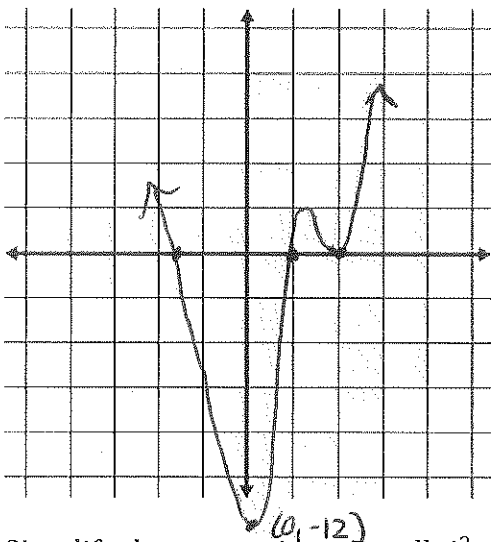
x-intercepts and multiplicity: $x = 1, 2, -3/2$
 multiplicity $\downarrow \downarrow \downarrow$
 $1, 2, 1$

y-intercept: $(0, -12)$

end behavior:

$$x \rightarrow -\infty, f(x) \rightarrow \infty$$

$$x \rightarrow \infty, f(x) \rightarrow \infty$$



Simplify the expressions. Recall: $i^2 = -1$

20. $(2 + 3i)(5 - 2i)$

$$\boxed{16 + 11i}$$

21. $(3i + 5) - (5 - 2i)$

$$\boxed{5i}$$

22. $(8i + 1) + (10i - 3)$

$$\boxed{-2 + 18i}$$

23. $(x - \sqrt{3})(x + \sqrt{3})$

$$\boxed{x^2 - 3}$$

24. $\sqrt{6} \cdot \sqrt{15}$

$$\boxed{3\sqrt{10}}$$

25. $(x - 1 + \sqrt{3})(x - 1 - \sqrt{3})$

$$\boxed{x^2 - 2x - 2}$$

19. $f(x) = 3x^2(x - 5)^3(x + 4)^4$

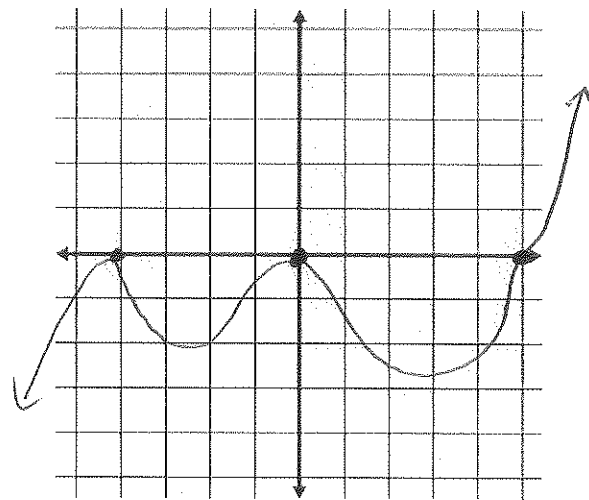
x-intercepts and multiplicity: $0, 5, -4$
 multiplicity $\rightarrow 2, 3, 4$

y-intercept: $(0, 0)$
 $x = 0$

end behavior:

$$x \rightarrow -\infty, f(x) \rightarrow -\infty$$

$$x \rightarrow \infty, f(x) \rightarrow \infty$$



Solve by the quadratic formula.

26. $x^2 - 2x - 4 = 0$

$$X = \frac{2 \pm \sqrt{(-2)^2 - 4(1)(-4)}}{2}$$

$$X = \frac{2 \pm \sqrt{4 + 16}}{2}$$

$$X = \frac{2 \pm \sqrt{20}}{2} = \frac{2 \pm 2\sqrt{5}}{2} \quad \boxed{X = 1 \pm \sqrt{5}}$$

27. $x^2 - 4x + 13 = 0$

$$X = \frac{4 \pm \sqrt{(-4)^2 - 4(1)(13)}}{2}$$

$$X = \frac{4 \pm \sqrt{16 - 52}}{2}$$

$$X = \frac{4 \pm \sqrt{-36}}{2}$$

$$X = \frac{4 \pm 6i}{2} = 2 \pm 3i \quad \boxed{X = 2 \pm 3i}$$

Write an equation of a polynomial in standard form with the given \bar{x} -intercepts. Assume the leading coefficient is one.

28. $x = 3, 2i$

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

$$\boxed{f(x) = x^3 - 3x^2 + 4x - 12}$$

29. $x = -1, \sqrt{5}$

$$(x+1)(x-\sqrt{5})(x+\sqrt{5})$$
$$(x+1)(x^2-5)$$

$$\boxed{f(x) = x^3 + x^2 - 5x - 5}$$

30. $x = 4, (1-i)$

$$(x-4)(x-1+i)(x-1-i)$$
$$(x-4)(x^2-2x+2)$$

$$\boxed{f(x) = x^3 - 6x^2 + 10x - 8}$$