

Definition:

- **Prime:** We say that a polynomial is prime if it cannot be factored.

Important Properties:

- Difference of Squares:

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

- Difference of Cubes:

$$x^3 - y^3 = (x - y)(x^2 + xy + y^2)$$

- Sum of Cubes:

$$x^3 + y^3 = (x + y)(x^2 - xy + y^2)$$

- Remember that it does not matter in what order you list the factors. For example,

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

Common Mistakes to Avoid:

- The sum of two cubes does factor but the sum of two squares does NOT.
- $x^3 + y^3 \neq (x + y)^3$ AND $x^3 - y^3 \neq (x - 3)^2$.

PROBLEMS

Factor completely.

1. $9x^2 - 4$

$$\begin{aligned} 9x^2 - 4 \\ (3x)^2 - 2^2 \\ \boxed{(3x - 2)(3x + 2)} \end{aligned}$$

2. $16x^2 - 25$

$$\begin{aligned} 16x^2 - 25 \\ (4x)^2 - 5^2 \\ \boxed{(4x - 5)(4x + 5)} \end{aligned}$$

Difference of Squares and Difference and Sum of Cubes, page 2

3. $16x^2 + 9$

$$\begin{array}{c} 16x^2 + 9 \\ \boxed{\text{PRIME}} \end{array}$$

8. $x^3 + 8$

$$\begin{array}{c} x^3 + 8 \\ x^3 + 2^3 \\ \boxed{(x+2)(x^2 - 2x + 4)} \end{array}$$

4. $81x^2 - 49$

$$\begin{array}{c} 81x^2 - 49 \\ (9x)^2 - 7^2 \\ \hline \end{array}$$

9. $x^3 - 1$

$$\begin{array}{c} x^3 - 1 \\ \boxed{(x-1)(x^2 + x + 1)} \end{array}$$

5. $16x^2 - y^2$

$$\begin{array}{c} 16x^2 - y^2 \\ (4x)^2 - y^2 \\ \hline \boxed{(4x-y)(4x+y)} \end{array}$$

10. $8x^3 - 1$

$$\begin{array}{c} 8x^3 - 1 \\ (2x)^3 - 1^3 \\ (2x-1)((2x)^2 + 2x + 1) \\ \hline \boxed{(2x-1)(4x^2 + 2x + 1)} \end{array}$$

6. $x^3 - 8$

$$\begin{array}{c} x^3 - 8 \\ x^3 - 2^3 \\ \hline \boxed{(x-2)(x^2 + 2x + 4)} \end{array}$$

11. $27x^3 + 1$

7. $x^3 - 27$

$$\begin{array}{c} x^3 - 27 \\ x^3 - 3^3 \\ \hline \boxed{(x-3)(x^2 + 3x + 9)} \end{array}$$

$$\begin{array}{c} 27x^3 + 1 \\ (3x)^3 + 1^3 \\ (3x+1)((3x)^2 - 3x + 1) \\ \hline \boxed{(3x+1)(9x^2 - 3x + 1)} \end{array}$$

12. $64x^3 - y^3$

$$\begin{array}{c} 64x^3 - y^3 \\ (4x)^3 - y^3 \\ (4x - y)((4x)^2 + 4xy + y^2) \\ \boxed{(4x - y)(16x^2 + 4xy + y^2)} \end{array}$$

13. $16x^4 - 81$

$$\begin{array}{c} 16x^4 - 81 \\ (4x^2 - 9)(4x^2 + 9) \\ \boxed{(2x - 3)(2x + 3)(4x^2 + 9)} \end{array}$$

14. $81x^4 - 1$

$$\begin{array}{c} 81x^4 - 1 \\ (9x^2)^2 - 1 \\ (9x^2 - 1)(9x^2 + 1) \\ \boxed{(3x - 1)(3x + 1)(9x^2 + 1)} \end{array}$$