Definition:
- **Trinomial**: is a polynomial with three terms.

Important Properties:
- Factoring is completed by trial and error. The more you do, the easier factoring will become and the quicker you will be able to see the integers to use.
- You should always check your solution by multiplication.
- Remember to look for the greatest common factor (GCF) first. If the original problem has no common factors then none of its factors will either.

**Factoring** \( x^2 + bx + c \): Find two integers whose product is \( c \) and whose sum is \( b \).
- If \( c \) and \( b \) are both positive, then the integers must be positive.
- If \( c \) is positive and \( b \) is negative, then the integers must be negative.
- If \( c \) is negative, then one integer will be positive and one integer will be negative.

**Factoring** \( ax^2 + bx + c \): We need to find integers \( p, q, r, \) and \( s \) such that
\[
pq = a, \quad rs = c \quad \text{and} \quad ps + qr = b.
\]

In other words,
\[
ax^2 + bx + c = \left( \frac{p}{\text{factors of } a} x + \frac{r}{\text{factors of } c} \right) \left( \frac{q}{\text{factors of } a} x + \frac{s}{\text{factors of } c} \right)
\]

Common Mistakes to Avoid:
- If the problem has a GCF, do not forget to write it with the answer in the final step.
- You can avoid sign mistakes by checking your answer with multiplication.
**PROBLEMS**

Factor completely.

1. \( x^2 - 14x + 48 \)

\[
\frac{x^2 - 14x + 48}{(x - 8)(x - 6)}
\]

2. \( x^2 - 4x - 21 \)

\[
\frac{x^2 - 4x - 21}{(x - 7)(x + 3)}
\]

3. \( x^2 + 18x + 81 \)

\[
\frac{x^2 + 18x + 81}{(x + 9)(x + 9)}
\]

OR \( (x + 9)^2 \)

4. \( x^2 - 5xy + 6y^2 \)

\[
\frac{x^2 - 5xy + 6y^2}{(x - 3y)(x - 2y)}
\]

5. \( x^2y^2 + 3xy - 4 \)

\[
\frac{x^2y^2 + 3xy - 4}{(xy + 4)(xy - 1)}
\]

6. \( 4x^2 - 4x - 48 \)

First, factor out the GCF of 4.

\[
\frac{4x^2 - 4x - 48}{4(x^2 - x - 12)}
\]

\[
4(x - 4)(x + 3)
\]

7. \( 2x^5 - 14x^4 + 24x^3 \)

First, factor out the GCF of \( 2x^3 \).

\[
\frac{2x^5 - 14x^4 + 24x^3}{2x^3(x^2 - 7x + 12)}
\]

\[
2x^3(x - 4)(x - 3)
\]

8. \( 3x^2 + 20x - 63 \)

\[
\frac{3x^2 + 20x - 63}{(3x - 7)(x + 9)}
\]

9. \( 2x^2 - x - 6 \)

\[
\frac{2x^2 - x - 6}{(2x + 3)(x - 2)}
\]

10. \( 8x^2 - 17x + 9 \)

\[
\frac{8x^2 - 17x + 9}{(8x - 9)(x - 1)}
\]

11. \( 4x^2 - 8x - 21 \)
12. $12x^3 - 27x^2 - 27x$

First, factor out the GCF of 3.

$$12x^3 - 27x^2 - 27x$$
$$3x(4x^2 - 9x - 9)$$
$$3x(4x + 3)(x - 3)$$

13. $12x^3 - 62x^2 + 10x$

First, factor out the GCF of 2x.

$$12x^3 - 62x^2 + 10x$$
$$2x(6x^2 - 31x + 5)$$
$$2x(6x - 1)(x - 5)$$

14. $10x^6 - 15x^5 - 10x^4$

First, factor out the GCF of $5x^4$.

$$10x^6 - 15x^5 - 10x^4$$
$$5x^4(2x^2 - 3x - 2)$$
$$5x^4(2x + 1)(x - 2)$$

15. $12 + 16x - 3x^2$

$$12 + 16x - 3x^2$$
$$3(x + 4)(4 - x)$$
$$3(6 - x)(2 + 3x)$$

16. $7 - 12x - 4x^2$

$$7 - 12x - 4x^2$$
$$2(3 - 2x)(1 + 2x)$$
$$2(7 + 2x)(1 - 2x)$$

17. $16 + 22x - 3x^2$

$$16 + 22x - 3x^2$$
$$3(8 - x)(2 + 3x)$$