Important Properties:

- When a polynomial has four terms, common factors can sometimes be used to factor by grouping.
- Recall the formula for the difference of two squares:
  \[ x^2 - y^2 = (x - y)(x + y) \]
- It does not matter the order that you list the factors. For example,
  \[(3x - 2)(x + 1) = (x + 1)(3x - 2).\]
- You can always check your answer by multiplication.

Common Mistakes to Avoid:

- Recall that the sum of two squares does not factor.
- Sometimes the current order does not lead to a common factor. If this happens try rearranging the terms. Do not assume that this means that the expression cannot be factored.
- Be on the lookout for the difference of squares, the difference of cubes and the sum of cubes. Remember that these can be factored further.

PROBLEMS

Factor completely.

1. \(2x^3 + 3x^2 - 8x - 12\)

\[
\begin{align*}
2x^3 + 3x^2 - 8x - 12 &= x^2(2x + 3) - 4(2x + 3) \\
&= (2x + 3)(x^2 - 4) \\
&= (2x + 3)(x - 2)(x + 2)
\end{align*}
\]

2. \(3x^3 - 2x^2 - 3x + 2\)

\[
\begin{align*}
3x^3 - 2x^2 - 3x + 2 &= x^2(3x - 2) - (3x - 2) \\
&= (3x - 2)(x^2 - 1) \\
&= (3x - 2)(x - 1)(x + 1)
\end{align*}
\]
3. $12x^3 - 16x^2 + 3x - 4$

\[
\begin{align*}
12x^3 - 16x^2 + 3x - 4 & = 4x^2(3x - 4) + (3x - 4) \\
& = (3x - 4)(4x^2 + 1)
\end{align*}
\]

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

\[
\begin{align*}
5x^3 - x^2 + 20x - 4 & = x^2(5x - 1) + 4(5x - 1) \\
& = (5x - 1)(x^2 + 4)
\end{align*}
\]

5. $24x^3 - 4x^2 - 6x + 1$

\[
\begin{align*}
24x^3 - 4x^2 - 6x + 1 & = 4x^2(6x - 1) - (6x - 1) \\
& = (6x - 1)(2x - 1)(2x + 1)
\end{align*}
\]

6. $18x^3 - 27x^2 + 8x - 12$

\[
\begin{align*}
18x^3 - 27x^2 + 8x - 12 & = 9x^2(2x - 3) + 4(2x - 3) \\
& = (2x - 3)(9x^2 + 4)
\end{align*}
\]

7. $2x^3 + x^2 + 50x + 25$

\[
\begin{align*}
2x^3 + x^2 + 50x + 25 & = x^2(2x + 1) + 25(2x + 1) \\
& = (2x + 1)(x^2 + 25)
\end{align*}
\]

8. $10x^2 - 12y + 15x - 8xy$

NOTE: The current order does not lead to a common factor. Therefore, we must first rearrange the terms.

\[
\begin{align*}
10x^2 - 12y + 15x - 8xy & = 2x(5x - 4y) + 3(-4y + 5x) \\
& = 2x(5x - 4y) + 3(5x - 4y) \\
& = (5x - 4y)(2x + 3)
\end{align*}
\]

9. $10x^3 - 2x^2y^2 - 5xy + y^3$

NOTE: The current order does not lead to a common factor. Therefore, we must first rearrange the terms.

\[
\begin{align*}
10x^3 - 2x^2y^2 - 5xy + y^3 & = 5x(2x^2 - y) - y^2(2x^2 - y) \\
& = (2x^2 - y)(5x - y^2)
\end{align*}
\]