Factoring Rules

1. $x^2 - (r+s)x + rs = (x - r)(x - s)$

2. $x^2 + 2ax + a^2 = (x+a)^2$ and $x^2 - 2ax + a^2 = (x - a)^2$

3. Difference of squares: $a^2 - b^2 = (a - b)(a + b)$

4. Difference of cubes: $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$

5. $a^4 - b^4 = (a - b)(a^3 + a^2b + ab^2 + b^3) = (a - b)\,[\,a^2(a+b) + b^2(a+b)\,] = (a - b)(a + b)(a^2 + b^2)$

   or, more simply, $a^4 - b^4 = (a^2 - b^2)(a^2 + b^2) = (a - b)(a + b)(a^2 + b^2)$

6. $a^5 - b^5 = (a - b)(a^4 + a^3b + a^2b^2 + ab^3 + b^4)$

7. $a^n - b^n = (a - b)(a^{n-1} + a^{n-2}b + a^{n-3}b^2 + \cdots + ab^{n-2} + b^{n-1})$

8. Sum of cubes: $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$

9. $a^5 + b^5 = (a + b)(a^4 - a^3b + a^2b^2 - ab^3 + b^4)$

10. $a^7 + b^7 = (a + b)(a^6 - a^5b + a^4b^2 - a^3b^3 + a^2b^4 - ab^5 + b^6)$

11. If n is odd, then $a^n + b^n = (a + b)(a^{n-1} - a^{n-2}b + a^{n-3}b^2 - \cdots + a^2b^{n-3} - ab^{n-2} + b^{n-1})$

12. Sum of squares: $a^2 + b^2 = (a - bi)(a + bi)$ Note: $a^2 + b^2$ does not factor using real numbers.

13. $a^4 + b^4 = \left(a^2 - \sqrt{2}ab + b^2\right)\left(a^2 + \sqrt{2}ab + b^2\right)$