WILLIAM D. LAW, JR. LEARNING COMMONS

Factoring Summary

(1) factor out the Greatest Common Factor (GCF) *Form for GCF:* $ax^2 + ax + ab = a(x^2 + x + b)$
(2) factor by grouping *(see example below)*
(3) form: $\mathbf{x^2 + bx + c}$. Find factors of c that add to get b and multiply to get c.
(4) form: $\mathbf{ax^2 + bx + c}$. Use trial and error to find the factored form.
(5) form: $\mathbf{P^2 \pm 2PQ + Q^2}$ Then this factors into: $\mathbf{(P \pm Q)^2}$ *(called "perfect square")*
(6) form: $x^2 - y^2 = (x+y)(x-y)$
(7) form: $\mathbf{x^2 + y^2}$ *(cannot be factored with integers!)*
(8) form: $x^3 + y^3 = (x+y)(x^2 - xy + y^2)$
(9) form: $x^3 - y^3 = (x-y)(x^2 + xy + y^2)$

Examples: **Directions - factor all of the following completely.**

(1) $\mathbf{3x^2 + 9x + 15}$ has a GCF of 3. (NOTE: ALWAYS FACTOR OUT GCF FIRST!!)
Thus, factoring out 3 yields: $\mathbf{3(x^2 + 3x + 5)}$
(Since the expression inside the parintheses cannot be factored, this is the final answer.)

(2) $\mathbf{3x^3 + 2x^2 - 6x - 4}$ is a candidate for factoring by grouping. Grouping terms:
$\mathbf{(3x^3 + 2x^2) + (-6x - 4)} = \mathbf{x^2(3x+2) - 2(3x+2)} = \mathbf{(3x+2)(x^2 - 2)}$

(3) $\mathbf{x^2 + 4x - 12}$ Since a=1 in the trinomial, need to find factors of -12 that add to get 4.
All the possible pairs of factors for -12 are: 1,-12 ; -1,12 ; 2,-6 ; **-2,6** ; 3,-4 ; -3,4
Since the only pair that adds to 4 is {-2,6} the answer is: **(x - 2)(x + 6)**

(4) $\mathbf{3x^2 + 2x - 8}$ Since $a \neq 1$ in the trinomial, use trial and error to find the answer.
The factor pairs of 3 are: {3,1}. The factor pairs for -8 are: {1,-8}, {-1,8}, {2,-4}, {-2,4}
By trial and error it is found that the answer is **(3x - 4)(x + 2)**

Sign Hints:

If trinomial has the form:	$\mathbf{ax^2 + bx + c}$	then factored form is	**(px + m)(qx + n)**
If trinomial has the form:	$\mathbf{ax^2 - bx + c}$	then factored form is	**(px - m)(qx - n)**
If trinomial has the form:	$\mathbf{ax^2 \pm bx - c}$	then factored form is	**(px + m)(qx - n)** OR **(px - m)(qx + n)**

(5) $\mathbf{4x^2 - 12x + 9}$ is in the form $\mathbf{P^2 \pm 2PQ + Q^2}$. Thus, $\mathbf{4x^2 - 12x + 9 = (2x - 3)^2}$ ***(perfect square)***

(6) $\mathbf{9x^2 - 36y^2}$ is in the form of $x^2 - y^2 = (x+y)(x-y)$. Thus, $\mathbf{9x^2 - 36y^2}$ = **(3x + 6y)(3x - 6y)**

(7) $\mathbf{9x^2 + 36y^2}$ is in the form of $\mathbf{x^2 + y^2}$. Thus, $\mathbf{9x^2 + 36y^2}$ is **non-factorable** using integers.

(8) $\mathbf{8x^3 + 27y^3}$ is in the form of $x^3 + y^3 = (x+y)(x^2 - xy + y^2)$.
Thus, $\mathbf{8x^3 + 27y^3 = (2x + 3y)(4x^2 - 6xy + 9y^2)}$

(9) $\mathbf{8x^3 - 27y^3}$ is in the form of $x^3 - y^3 = (x-y)(x^2 + xy + y^2)$
Thus, $\mathbf{8x^3 - 27y^3 = (2x - 3y)(4x^2 + 6xy + 9y^2)}$