Difference of Squares	$a^2 - b^2$	$(a-b)(a+b)$
Sum of Cubes	$a^3 + b^3$	$(a+b)(a^2 - ab + b^2)$
Difference of Cubes	$a^3 - b^3$	$(a-b)(a^2 + ab + b^2)$

"plus minus, plus"

"minus, plus, plus"

Factor each:

1. $27 - r^3 = (3)^3 - (r)^3$

$a = 3 \quad b = r$

$(3-r)(3^2 + 3r + r^2)$

$= (3-r)(9 + 3r + r^2)$

2. $8m^3 - 27n^3 = (2m)^3 - (3n)^3$

$a = 2m \quad b = 3n$

$= (2m - 3n)((2m)^2 + (2m)(3n) + (3n)^2)$

$= (2m - 3n)(4m^2 + 6mn + 9n^2)$

3. $x^3 + 64 = (x)^3 + (4)^3$

$a = x \quad b = 4$

$= (x+4)(x^2 - 4x + 4^2)$

$= (x+4)(x^2 - 4x + 16)$

4. $16x^4 + 54xy^3$ * GCF

$= 2x(8x^3 + 27y^3)$

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

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

$= 2x(2x + 3y)(4x^2 - 6xy + 9y^2)$

Factor by grouping:

$4x^3 + 2x^2 - 2x - 1$

$= (4x^3 + 2x^2) + (-2x - 1)$

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

* $2x+1$ GCF

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

$10ab - 6b + 35a - 21$

$= (10ab - 6b) + (35a - 21)$

$= 2b(5a - 3) + 7(5a - 3)$

$= (5a - 3)(2b + 7)$

$8r^3 - 64r^2 + r - 8$ $= (8r^3 - 64r^2) + (r - 8)$ $= 8r^2(r - 8) + (r - 8)$ $= (r - 8)(8r^2 + 1)$	$(4x^6 + 36) + (-x^6y - 9y)$ $= 4(x^6 + 9) + (-y)(x^6 + 9)$ $= (x^6 + 9)(4 - y)$

Factor each expression completely:

1. $3y^5 - 75y^3$ $= 3y^3(y^2 - 25)$ $= 3y^3(y - 5)(y + 5)$	2. $(x^3 - 3x^2) + (-16x + 48)$ $= x^2(x - 3) + (-16)(x - 3)$ $= (x - 3)(x^2 - 16)$ $= (x - 3)(x - 4)(x + 4)$
3. $2x^4 + 128x$ $= 2x(x^3 + 64)$ $= 2x(x + 4)(x^2 - 4x + 16)$ prime, so done factoring	4. $2p^8 + 10p^5 + 12p^2$ $= 2p^2(p^6 + 5p^3 + 6)$ $= 2p^2(p^3 + 3)(p^3 + 2)$

$0 = (x-a)(x-b)$

$0 = x-a$ or $0 = x-b$

Use the zero product property to solve:

*Notice # of solutions and degree!

5. $3x^5 + 15x = 18x^3$ $3x^5 - 18x^3 + 15x = 0$ $3x(x^4 - 6x^2 + 5) = 0$ $3x(x^2-5)(x^2-1) = 0$ $3x(x^2-5)(x-1)(x+1) = 0$ $3x = 0$ $x^2-5=0$ $x+1=0$ $x-1=0$ $x=0$ $x = \pm\sqrt{5}$ $x=-1$ $x=1$ $x = 0, \pm\sqrt{5}, \pm 1$	6. $5b^3 + 15b^2 + 12b = -36$ $(5b^3 + 15b^2) + (12b + 36) = 0$ $5b^2(b+3) + 12(b+3) = 0$ $(5b^2+12)(b+3) = 0$ $5b^2 + 12 = 0$ $b+3=0$ $b = \pm\sqrt{-12/5}$ $b=-3$ $b = \pm i \frac{\sqrt{12}}{\sqrt{5}}$ $b = \pm i \frac{\sqrt{60}}{5}$ $b = -3, \pm i \sqrt{60}/5$
7. $(x^6 - 4x^4) + (-9x^2 + 36) = 0$ $x^4(x^2-4) - 9(x^2-4) = 0$ $(x^4-9)(x^2-4) = 0$ $(x^2-3)(x^2+3)(x-2)(x+2) = 0$ $x^2-3=0$ $x^2+3=0$ $x-2=0$ $x+2=0$ $x=\pm\sqrt{3}$ $x=\pm i\sqrt{3}$ $x=2$ $x=-2$ $x = \pm\sqrt{3}, \pm i\sqrt{3}, \pm 2$	8. $x^3 + 1000 = 0$ $(x+10)(x^2 - 10x + 100) = 0$ *prime $x+10=0$ $x=-10$ $x = \frac{10 \pm \sqrt{(-10)^2 - 4(1)(100)}}{2(1)}$ $= \frac{10 \pm \sqrt{100-400}}{2}$ $= \frac{10 \pm \sqrt{-300}}{2}$ $= \frac{10 \pm 10i\sqrt{3}}{2}$ $= 5 \pm 5i\sqrt{3}$ $x = -10, 5 \pm 5i\sqrt{3}$

Factor the following:

9. $(8ax + 4bx + 4cx) + (6ay + 3by + 3cy)$

$= 4x(2a + b + c) + 3y(2a + b + c)$

$= (4x + 3y)(2a + b + c)$

10. $20fy - 16fz + 15gy + 8hz - 10hy - 12gz$

$= (20fy + 15gy - 10hy) + (-16fz + 8hz - 12gz)$

$= 5y(4f + 3g - 2h) + (-4)(4f - 2h + 3g)$

$= 5y(4f + 3g - 2h) - 4(4f + 3g - 2h)$

$= (5y - 4)(4f + 3g - 2h)$

11. $x^6 - y^6$

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

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

$= (x^2 - y^2)(x^4 + x^2y^2 + y^4)$

$= (x - y)(x + y)(x^4 + x^2y^2 + y^4)$

prime 5

12. $(a^3x^2 - 6a^3x + 9a^3) + (-b^3x^2 + 6b^3x - 9b^3)$

$= a^3(x^2 - 6x + 9) + (-b^3)(x^2 - 6x + 9)$

$= (a^3 - b^3)(x^2 - 6x + 9)$

$= (a - b)(a^2 + ab + b^2)(x - 3)(x - 3)$

prime 5

13. $150n^8 + 40n^4 - 15$ $5(30n^8 + 8n^4 - 3)$ cannot be factored further	**14.** $y^8 + 12y^3 + 8$ cannot be factored