$$x^2 + 0x - 25$$

KeyConcept Difference of Squares

Symbols

$a^2 - b^2 = (a + b)(a - b)$ or $(a - b)(a + b)$

Examples

$x^2 - 25 = (x + 5)(x - 5)$ or $(x - 5)(x + 5)$

$t^2 - 64 = (t + 8)(t - 8)$ or $(t - 8)(t + 8)$

-8×8, 0, -64

5×-5, 0, -25

	x	-5
x	x^2	$-5x$
5	$5x$	-25

EXAMPLE 1 **Factor Differences of Squares**

A. Factor $m^2 - 64$.

$m^2 - 64 = m^2 - 8^2$ Write in the form $a^2 - b^2$.

$(a + b)(a - b)$

$\qquad = (m + 8)(m - 8)$ Factor the difference of squares.

Answer: $(m + 8)(m - 8)$

EXAMPLE 1 Factor Differences of Squares

B. Factor $16y^2 - 81z^2$.

$16y^2 - 81z^2 = (4y)^2 - (9z)^2$	Write in the form $a^2 - b^2$.
$= (4y + 9z)(4y - 9z)$	Factor the difference of squares.

Answer: $(4y + 9z)(4y - 9z)$

EXAMPLE 1 **Factor Differences of Squares**

C. Factor $3b^3 - 27b$.

If the terms of a binomial have a common factor, the GCF should be factored out first before trying to apply any other factoring technique.

$3b^3 - 27b = 3b(b^2 - 9)$

The GCF of $3b^3$ and $27b$ is $3b$.

$= 3b[(b)^2 - (3)^2]$

Write in the form $a^2 - b^2$.

$= 3b(b + 3)(b - 3)$

Factor the difference of squares.

Examples 1–3 Factor each polynomial.

1. $x^2 - 9$ **$(x + 3)(x - 3)$** 2. $4a^2 - 25$ **$(2a + 5)(2a - 5)$**

3. $9m^2 - 144$ **$9(m + 4)(m - 4)$**

5. $u^4 - 81$

(7) $20r^4 - 45n^4$

9. $2c^3 + 3c^2 - 2c - 3$

11. $3t^3 + 2t^2 - 48t - 32$

③ $9(m^2 - 16)$

$(3m - 12)(3m + 12)$

$= 3(m - 4)(m + 4)$

EXAMPLE 2 **Apply a Technique More than Once**

A. Factor $y^4 - 625$.

EXAMPLE 2 **Apply a Technique More than Once**

B. Factor $256 - n^4$.

Examples 1–3 Factor each polynomial.

1. $x^2 - 9$ [ ]

3. $9m^2 - 144$ [ ]

5. $u^4 - 81$ [ ]

7. $20r^4 - 45n^4$ [ ]

9. $2c^3 + 3c^2 - 2c - 3$

11. $3t^3 + 2t^2 - 48t - 32$

9. $(c + 1)(c - 1)(2c + 3)$ 11. $(t + 4)(t - 4)(3t + 2)$

EXAMPLE 3 **Apply Different Techniques**

A. Factor $9x^5 - 36x$.

$9x^5 - 36x = 9x(x^4 - 4)$	Factor out the GCF.
$= 9x[(x^2)^2 - 2^2]$	Write $x^2 - 4$ in $a^2 - b^2$ form.
$= 9x(x^2 - 2)(x^2 + 2)$	Factor the difference of squares.

Answer: $9x(x^2 - 2)(x^2 + 2)$

EXAMPLE 3   **Apply Different Techniques**

B. Factor $6x^3 + 30x^2 - 24x - 120$.

$6x^3 + 30x^2 - 24x - 120$	Original polynomial
$= 6(x^3 + 5x^2 - 4x - 20)$	Factor out the GCF.
$= 6[(x^3 - 4x) + (5x^2 - 20)]$	Group terms with common factors.
$= 6[x(x^2 - 4) + 5(x^2 - 4)]$	Factor each grouping.
$= 6(x^2 - 4)(x + 5)$	$x^2 - 4$ is the common factor.
$= 6(x + 2)(x - 2)(x + 5)$	Factor the difference of squares.

Answer: $6(x + 2)(x - 2)(x + 5)$

Examples 1–3 Factor each polynomial.

1. $x^2 - 9$ [ ]
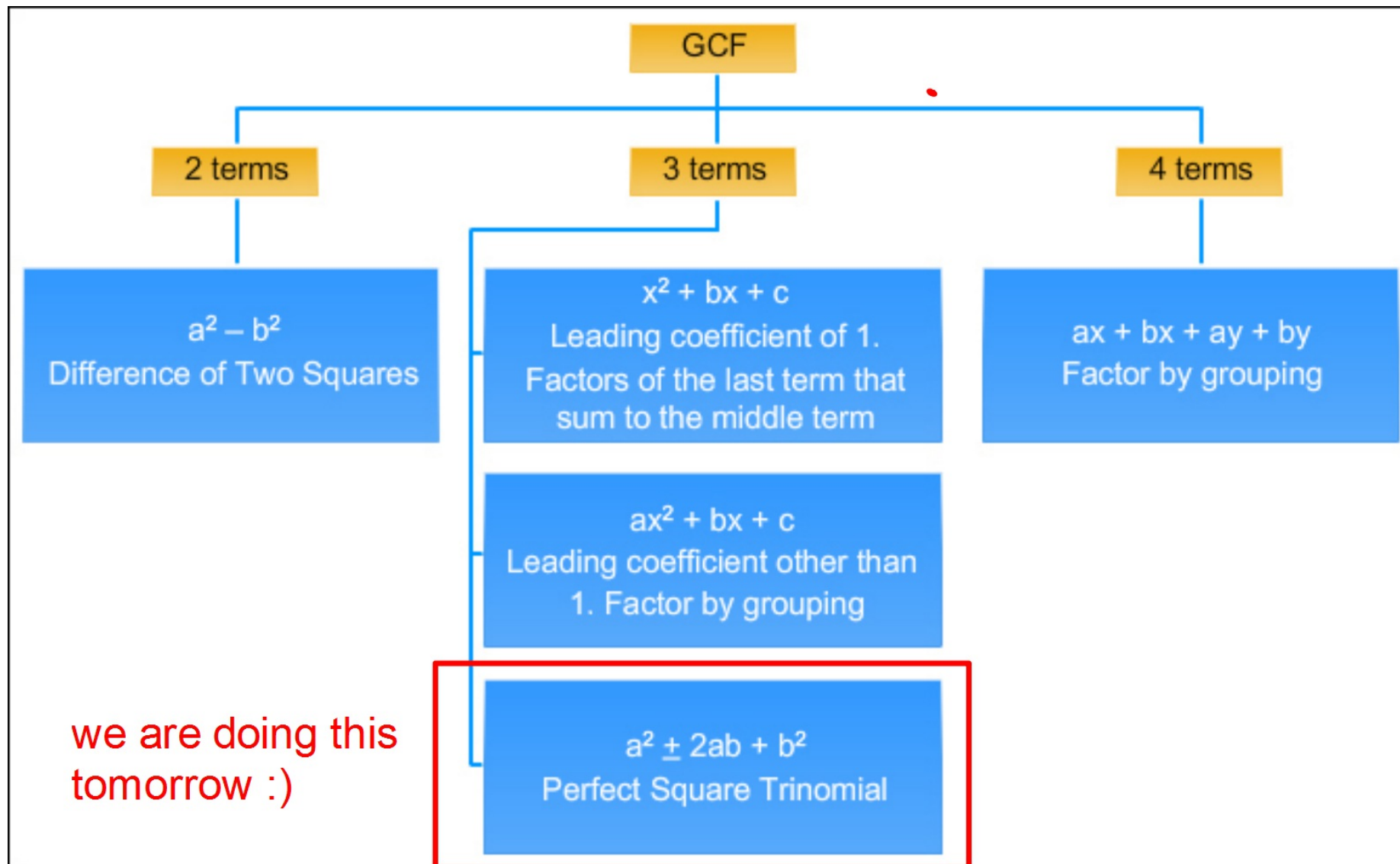
3. $9m^2 - 144$ [ ]

5. $u^4 - 81$ [ ]

⑦ $20r^4 - 45n^4$ **$5(2r^2 - 3n^2)(2r^2 + 3n^2)$**

9. $2c^3 + 3c^2 - 2c - 3$

11. $3t^3 + 2t^2 - 48t - 32$

[ ] [ ]

⑦ GCF: 5

$5(4r^4 - 9n^4)$

$5(2r^2 - 3n^2)(2r^2 + 3n^2)$

GCF

2 terms | 3 terms | 4 terms

$a^2 - b^2$
Difference of Two Squares

$x^2 + bx + c$
Leading coefficient of 1.
Factors of the last term that sum to the middle term

$ax^2 + bx + c$
Leading coefficient other than 1. Factor by grouping

$a^2 \pm 2ab + b^2$
Perfect Square Trinomial

$ax + bx + ay + by$
Factor by grouping

we are doing this tomorrow :)

If you can keep factoring, start back at GCF!

2. $4a^2 - 25$ $(2a+5)(2a-5)$

4. $2p^3 - 162p$ $2p(p+9)(p-9)$

6. $2d^4 - 32f^4$ $2(d^2+4f^2)(d+2f)(d-2f)$
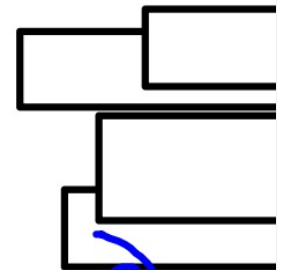
8. $256n^4 - c^4$ $(16n^2+c^2)(4n+c)(4n-c)$

10. $f^3 - 4f^2 - 9f + 36$ $(f+3)(f-3)(f-4)$

12. $w^3 - 3w^2 - 9w + 27$ $(w-3)(w+3)(w-3)$

⑥ $2(d^4 - 16f^4)$

⑧ $(16n^2 + c^2)$
$(16n^2 - c^2)$

④ GCF: $2p$
$= 2p(p^2 - 81)$
$= 2p(p-9)(p+9)$

⑥ $2(d^2 + 4f^2)(d^2 - 4f^2)$
$2(d^2 + 4f^2)(d+2f)(d-2f)$

10. $f^3 - 4f^2 - 9f + 36$ $(f+3)(f-3)(f-4)$

12. $w^3 - 3w^2 - 9w + 27$ $(w-3)(w+3)(w-3)$

⑩ $f^3 - 4f^2 - 9f + 36$

$= (f^3 - 4f^2) - (9f - 36)$

$= f^2(f-4) - 9(f-4)$

$= (f^2 - 9)(f-4)$

$= (f+3)(f-3)(f-4)$

"Factor by grouping"

diff. of squares.

Examples 1–3 Factor each polynomial. **25–43. See margin.**

15. $q^2 - 121$
$(q + 11)(q - 11)$

18. $w^4 - 625$
$(w^2 + 25)(w + 5)(w - 5)$

21. $h^3 - 100h$
$h(h + 10)(h - 10)$

24. $x^2 - 4y^2$
$(x + 2y)(x - 2y)$

27. $6k^2h^4 - 54k^4$

30. $3r^3 - 192r$

33. $p^3r^5 - p^3r$

36. $3t^3 - 7t^2 - 3t + 7$

38. $4m^3 + 9m^2 - 36m - 81$

40. $3x^3 + x^2 - 75x - 25$

42. $x^4 + 6x^3 - 36x^2 - 216x$

16. $r^4 - k^4$
$(r^2 + k^2)(r + k)(r - k)$

19. $r^2 - 9t^2$
$(r + 3t)(r - 3t)$

22. $h^4 - 256$
$(h^2 + 16)(h + 4)(h - 4)$

25. $7h^4 - 7p^4$

28. $5a^3 - 20a$

31. $10q^3 - 1210q$

34. $8c^3 - 8c$

37. $a^2 - 49$

39. $3m^4 + 243$

41. $12a^3 + 2a^2 - 192a - 32$

43. $15m^3 + 12m^2 - 375m - 300$

17. $6n^4 - 6$
$6(n^2 + 1)(n + 1)(n - 1)$

20. $2c^2 - 32d^2$
$2(c + 4d)(c - 4d)$

23. $2x^3 - x^2 - 162x + 81$
$(x + 9)(x - 9)(2x - 1)$

26. $3c^3 + 2c^2 - 147c - 98$

29. $f^3 + 2f^2 - 64f - 128$

32. $3xn^4 - 27x^3$

35. $r^3 - 5r^2 - 100r + 500$