8.8 Factor by Grouping

* If a polynomial has 4 terms, you can factor by grouping. (Not all expressions can be factored this way.)

* Just like in 8.6, you look for common binomial factors.
  First - group the 1st 2 terms & 2nd 2 terms
  Second - Factor GCF & look for a common binomial

Example 1: $x^3 - 2x^2 + 3x - 6$

$(x^3 - 2x^2) + (3x - 6)$

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

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

Example 2: $b^3 + 8b^2 - 3b - 24$

$(b^3 + 8b^2) - (3b - 24)$

$b^2(b+8) - 3(b+8)$

* (Watch your signs)

$(b^2-3)(b+8)$

* Always check with FOIL

Got it #1 a) $8t^3+14t^2+20t+35$

$(8t^3+14t^2)+(20t+35)$

$2t^2(4t+7)+5(4t+7)$

$(2t^2+5)(4t+7)$

* Always look for a GCF 1st - Review Problem 2 on pg. 530

* Got it #2) $6h^4+9h^3+12h^2+18h$

$3h(2h^3+3h^2+4h+6)$

$3h(2h^3+3h^2)+(4h+6)$

$3h(h^2(2h+3)+2(2h+3)$

$3h(h^2+2)(2h+3)$

* Review Problem 3 on pg. 530

* Got it 3? $60x^3+34x^2+4x$

$2x(30x^2+17x+2)$

Product of 60 } 1285
Sum of 17 }

$2x(30x^2+12x+5x+2)$

$2x(6x(5x+2)+1(5x+2)$

$2x(6x+1)(5x+2)$

Name _____ Class _____ Date _____

8-8 Practice

Form G

Factoring by Grouping

Find the GCF of the first two terms and the GCF of the last two terms for each polynomial.

1. $12x^3 + 3x^2 + 20x + 5$

2. $6v^3 + 42v^2 + 5v + 35$

3. $8t^3 + 36t^2 + 2t + 9$

4. $10s^3 + 35s^2 + 6s + 21$

5. $9m^3 - 6m^2 + 12m - 8$

6. $8w^3 + 6w^2 - 28w - 21$

7. $7r^3 + 16r^2 - 9r - 72$

8. $21x^3 - 28x^2 - 6x + 8$

Factor each expression.

9. $8j^3 + 4j^2 + 10j + 5$

10. $2m^3 + 8m^2 + 9m + 36$

11. $10s^3 + 25s^2 + 8s + 20$

12. $6x^3 + 9x^2 + 2x + 3$

13. $21x^3 + 6x^2 - 28x - 8$

14. $8w^3 + 12w^2 + 10w + 15$

15. $18r^3 - 12r^2 + 21r - 14$

16. $36n^3 - 27n^2 - 8n + 6$

17. $110b^3 + 77b^2 - 60b - 42$

18. $64d^3 - 40d^2 - 24d + 15$

19. $10s^3 + 80s^2 - 7s - 56$

20. $25j^3 + 15j^2 - 5j - 3$

21. $24c^3 - 84c^2 + 10c - 35$

22. $27f^3 + 9f^2 - 24f - 8$

Name _____ Class _____ Date _____

8-8 Practice (continued) Form G

Factoring by Grouping

Factor completely.

23. $32x^3 + 8x^2 + 48x + 12$

24. $45w^4 - 36w^3 + 15w^2 - 12w$

25. $32k^4 - 16k^3 + 12k^2 - 6k$

26. $6g^3 + 18g^2 + 60g + 180$

27. $30b^4 - 45b^3 - 10b^2 + 15b$

28. $32m^3 + 72m^2 - 80m - 180$

29. $63j^4 + 84j^3 - 18j^2 - 24j$

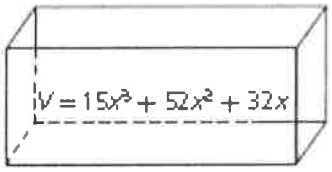
30. $96n^3 - 240n^2 - 168n + 420$

31. $12e^4 + 18e^3 + 36e^2 + 54e$

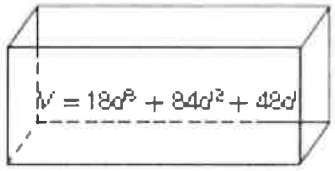
32. $60a^5 - 72a^4 - 210a^3 + 252a^2$

Find linear expressions for the possible dimensions of each rectangular prism.

33.



34.



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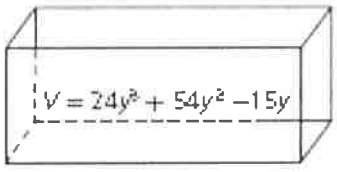

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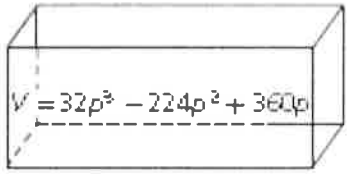


37. A shipping box in the shape of a rectangular prism has a volume of $12x^3 + 32x^2 + 20x$. What linear expressions can represent possible dimensions of the box?

38. Error Analysis Describe and correct the error made in factoring completely.

$16x^4 + 24x^3 + 64x^2 + 96x = 4x(4x^3 + 6x^2 + 16x + 24)$

$= 4x[2x^2(2x + 3) + 8(2x + 3)]$

$= 4x(2x^2 + 8)(2x + 3)$

39. Open-Ended Write a 3-term expression for the volume of a rectangular prism that you can factor by grouping. Factor your polynomial.

Name Key Class Date

8-8 Practice

Form G

Factoring by Grouping

Find the GCF of the first two terms and the GCF of the last two terms for each polynomial.

1. $12x^3 + 3x^2 + 20x + 5$

   $3x^2, 5$

2. $6v^3 + 42v^2 + 5v + 35$

   $6v^2, 5$

3. $8t^3 + 36t^2 + 2t + 9$

   $4t^2, 1$

4. $10s^3 + 35s^2 + 6s + 21$

   $5s^2, 3$

5. $9m^3 - 6m^2 + 12m - 8$

   $3m^2, 4$

6. $8w^3 + 6w^2 - 28w - 21$

   $2w^2, -7$

7. $7r^3 + 10r^2 \quad 9r \quad 72$

   $r^2, -9$

8. $21x^3 - 28x^2 - 6x + 8$

   $7x^2, -2$

Factor each expression.

9. $8j^3 + 4j^2 + 10j + 5$

   $(4j^2 + 5)(2j + 1)$

10. $2m^3 + 8m^2 + 9m + 36$

    $(2m^2 + 9)(m + 4)$

11. $10s^3 + 25s^2 + 8s + 20$

    $(5s^2 + 4)(2s + 5)$

12. $6x^3 + 9x^2 + 2x + 3$

    $(3x^2 + 1)(2x + 3)$

13. $21x^3 + 6x^2 - 28x - 8$

    $(3x^2 - 4)(7x + 2)$

14. $8w^3 + 12w^2 + 10w + 15$

    $(4w^2 + 5)(2w + 3)$

15. $18r^3 - 12r^2 + 21r - 14$

    $(6r^2 + 7)(3r - 2)$

16. $36n^3 - 27n^2 - 8n + 6$

    $(9n^2 - 2)(4n - 3)$

17. $110b^3 + 77b^2 - 60b - 42$

    $(11b^2 - 6)(10b + 7)$

18. $64d^3 - 40d^2 - 24d + 15$

    $(8d^2 - 3)(8d - 5)$

19. $10s^3 + 80s^2 - 7s - 56$

    $(10s^2 - 7)(s + 8)$

20. $25j^3 + 15j^2 - 5j - 3$

    $(5j^2 - 1)(5j + 3)$

21. $24c^3 - 84c^2 + 10c - 35$

    $(12c^2 + 5)(2c - 7)$

22. $27f^3 + 9f^2 - 24f - 8$

    $(9f^2 - 8)(3f + 1)$

Name _____ Class _____ Date _____

8-8 Practice (continued) Form G

Factoring by Grouping

Factor completely.

23. $32x^3 + 8x^2 + 48x + 12$
$4(2x^2 + 3)(4x + 1)$

24. $45w^4 - 36w^3 + 15w^2 - 12w$
$3w(3w^2 + 1)(5w - 4)$

25. $32k^4 - 16k^3 + 12k^2 - 6k$
$2k(8k^2 + 3)(2k - 1)$

26. $6g^3 + 18g^2 + 60g + 180$
$6(g^2 + 10)(g + 3)$

27. $30b^4 - 45b^3 - 10b^2 + 15b$
$5b(3b^2 - 1)(2b - 3)$

28. $32m^3 + 72m^2 - 80m - 180$
$4(2m^2 - 5)(4m + 9)$

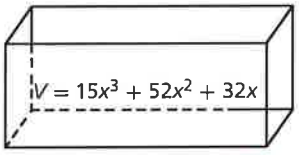
29. $63j^4 + 84j^3 - 18j^2 - 24j$
$3j(7j^2 - 2)(3j + 4)$

30. $96n^3 - 240n^2 - 168n + 420$
$12(4n^2 - 7)(2n - 5)$

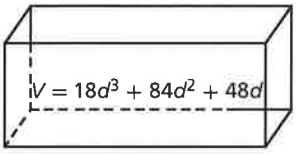
31. $12e^4 + 18e^3 + 36e^2 + 54e$
$6e(e^2 + 3)(2e + 3)$

32. $60a^5 - 72a^4 - 210a^3 + 252a^2$
$6a^2(2a^2 - 7)(5a - 6)$

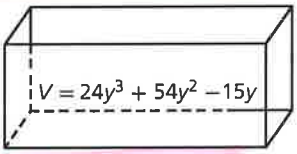
Find linear expressions for the possible dimensions of each rectangular prism.

33.


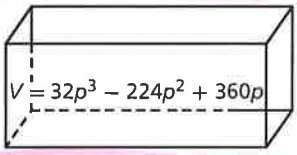
$x, 5x + 4, 3x + 8$

34.


$6d, 3d + 2, d + 4$

35.


$3y, 4y - 1, 2y + 5$

36.


$8p, 2p - 5, 2p - 9$

37. A shipping box in the shape of a rectangular prism has a volume of $12x^3 + 32x^2 + 20x$. What linear expressions can represent possible dimensions of the box?
$4x, 3x + 5, x + 1$

38. **Error Analysis** Describe and correct the error made in factoring completely.

$16x^4 + 24x^3 + 64x^2 + 96x = 4x(4x^3 + 6x^2 + 16x + 24)$
$4x[2x^2(2x + 3) + 8(2x + 3)]$
$= 4x(2x^2 + 8)(2x + 3)$

In the first step, the GCF is $8x$, not $4x$.

39. **Open-Ended** Write a 3-term expression for the volume of a rectangular prism that you can factor by grouping. Factor your polynomial.
Answers may vary. Sample: $x^5 + 4x^4 + 3x^3 = x^3(x + 3)(x + 1)$