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Worksheet #1 *Factoring Polynomials: GCF and Factoring by Grouping*

Find the GCF (greatest common factor) of the expressions.

EX $5x^2y^2,\ 30x^3y$

The GCF is $5x^2y$

EX $2x(x+5),\ 15(x+5)$

The GCF is $(x+5)$

EXERCISES: Find the GCF of the expressions.

1. $x^2,\ -x^6$
2. $t^4,\ t^7$
3. $2x^2,\ 12x$
4. $36x^4,\ 18x^3$
5. $u^2v,\ u^3v^2$
6. $x^6y^4,\ -xy$
7. $9y^8z^4,\ -12y^5z^4$
8. $-15x^6y^3,\ 45xy^3$
9. $14x^2,\ 1,\ 7x^4$
10. $5y^4, 10x^2y^2$
11. $28a^4b^2,\ 14a^3,\ 42a^2b^5$
12. $16x^2y,\ 12xy^2,\ 36x^2$
13. $2(x+3),\ 3(x+3)$
14. $14(x-5),\ 3x(x-5)$
15. $x(7x+5),\ 7x+5$
16. $x-4,\ y(x-4)$

Solutions:

1. x^2 **3.** $2x$ **5.** u^2v **7.** $3y^5z^4$ **9.** 1 **11.** $14a^2$ **13.** $(x+3)$ **15.** $(7x+5)$

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Factor out the GCF from each expression using the DISTRIBUTIVE PROPERTY (backwards).

EX $12x^3y^2 - 36x^2y + 6x$

GCF is $6x$, $\Rightarrow 6x\left(2x^3y^2 - 6xy + 1\right)$

EXERCISES:
Factor out the GCF from each expression using the distributive property.

17. $3x + 3$
18. $5y - 5$
19. $6x + 36$
20. $4x - 28$
21. $8t - 16$
22. $4u - 12$
23. $25x - 10$
24. $14y - 7$
25. $24y^2 - 18$
26. $8x^3 + 12$
27. $x^2 + x$
28. $x^3 - x$
29. $25u^2 - 14u$
30. $36t^4 + 24t^2$
31. $2x^4 + 6x^3$
32. $9z^6 + 27z^4$
33. $27x^2 + 9y^2$
34. $12x^2 - 5x^3$
35. $12x^2 - 2x$
36. $12u^7 - 9u^5$
37. $10r^3 - 35r$
38. $-144a^8 + 24a^6$
39. $12x^2 + 16x - 8$
40. $9 - 3y - 15y^2$
41. $100 - 75z - 50z^2$
42. $42t^3 - 21t^2 + 7$
43. $9x^4 + 6x^3 + 18x^2$
44. $32a^5 - 2a^3 + 6a$
45. $5u^3 + 5u^2 + 5u$
46. $11y^3 - 22y^2 + 11y$
47. $16a^3b^3 + 24a^4b^3$
48. $9x^4y + 24x^2y$
49. $10ab + 10a^2b$
50. $21x^2y^5 + 35x^6y$
51. $15m^4n^3 - 25m^7n + 30m^4n^8$
52. $4xy + 8x^2y - 24x^4y^5$

Solutions:

17. $3(x+1)$ 19. $6(x+6)$ 21. $8(t-2)$ 23. $5(5x-2)$ 25. $6(4y^2-3)$ 27. $x(x+1)$ 29. $u(25u-14)$
31. $2x^3(x+3)$ 33. $9(3x^2+y^2)$ 35. $2x(6x-1)$ 37. $5r(2r^2-7)$ 39. $4(3x^2+4x-2)$ 41. $25(4-3z-2z^2)$
43. $3x^2(3x^2+2x+6)$ 45. $5u(u^2+u+1)$ 47. $8a^3b^3(2+3a)$ 49. $10ab(1+a)$ 51. $5m^4n(3n^2-5m^3+6n^7)$

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EX **Factor out a positive GCF from this expression.**

$$15 - 5x = 5(3 - x)$$

Factor out a negative GCF from this expression.

$$15 - 5x = -5(-3 + x)$$
$$= -5(x - 3)$$

BOTH ARE CORRECT!

EXERCISES:

Factor out the GCF from each expression using the distributive property. Factor each TWICE…

1st: Factor out a POSITIVE GCF.
2nd: Factor out a NEGATIVE GCF.

53. $5 - 10x$

54. $3 - 6x$

55. $-10x - 3000$

56. $-3x^2 + 4$ **

57. $-x^2 + 5x + 10$ **

58. $-4x^2 - 8x + 20$

59. $4 + 12x - 2x^2$

60. $8 - 4x - 12x^2$

** The only positive common factor is one. For this problem, just do the the 2nd part by factoring out a negative one.

Solutions:

53. $5(1 - 2x), -5(2x - 1)$ 55. $10(-x - 300), -10(x + 300)$ 57. $-1(x^2 - 5x - 10)$ 59. $2(2 + 6x - x^2), -2(x^2 - 6x - 2)$

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Factor out the common binomial factor.

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

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

EX $7x(x-3)-4(3-x)$

Factor out a **negative one** to make this binomial $(x-3)$.

$=7x(x-3)+4(x-3)$

$=(x-3)(7x+4)$

EXERCISES:

Factor out the common binomial factor from each expression using the distributive property.

61. $x(x-3)+5(x-3)$

62. $x(x+6)+3(x+6)$

63. $y(q-5)-10(q-5)$

64. $a^2(b+2)-b(b+2)$

65. $x^3(y+4)+y(y+4)$

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

67. $(a+b)(a-b)+a(a+b)$

68. $y^2(x-y)-4(y-x)$

Solutions:

61. $(x-3)(x+5)$ 63. $(q-5)(y-10)$ 65. $(y+4)(x^3+y)$ 67. $(a+b)(2a-b)$

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Factoring by Grouping

- This is a strategy that we can use to factor polynomials that have FOUR terms.
- This strategy has three steps:
  - **(1)** **Draw parentheses** to make TWO groups
  - **(2)** **Factor out the GCF from each** of the two groups
  - **(3)** **Factor out the common binomial** factor (if there is one).

Use factoring by grouping to factor these polynomials.

EX $ax + 2x - 2a - 4$

$(ax + 2x) - (2a + 4)$

$x(a + 2) - 2(a + 2)$

$(a + 2)(x - 2)$

EXERCISES:
Factor by grouping.

69. $t^3 - 3t^2 + 2t - 6$

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

71. $16x^3 + 8x^2 + 2x + 1$

72. $4u^3 - 2u^2 - 6u + 3$

73. $x^3 - 3x - x^2 + 3$

74. $x^3 + 7x - 3x^2 - 21$

75. $3x^2 + x^3 - 18 - 6x$

76. $5x^2 + 10x^3 + 4 + 8x$

77. $ky^2 - 4ky + 2y - 8$

78. $ay^2 + 3ay + 3y + 9$

79. $3a + ab + 3c + bc$

80. $x^2 - 2x + xy - 2y$

81. $h^2 - hk + hr - kr$

82. $p^3 + 2p^2 + 4p + 8$

83. $p^2 - 2pq + pr - 2qr$

84. $3hk - 2k - 12h + 8$

Solutions:
69. $(t - 3)(t^2 + 2)$ 71. $(2x + 1)(8x^2 + 1)$ 73. $(x - 1)(x^2 - 3)$ 75. $(x + 3)(x^2 - 6)$ 77. $(y - 4)(ky + 2)$
79. $(a + c)(3 + b)$ 81. $(h - k)(h + r)$ 83. $(p - 2q)(p + r)$