Factoring Review

In Grade 10, you learned many ways of factoring:

1. GCF factoring
2. Difference of Squares factoring
3. Simple trinomial factoring
4. Complex trinomial factoring

This is a review of these methods of factoring to aid us in the next topic of sinusoidal functions, rational expressions and trigonemtirc identities.

GCF Factoring

The greatest common factor of two numbers (x and y) is defined as the largest factor that can be evenly divided into each number (x and y).

Example 1: Find the GCF of the numbers 20 and 50.

Solution: The factors of 20 are 1, 2, 4, 5, 10, 20.
Because $1 \times 20 = 20$; $2 \times 10 = 20$; $4 \times 5 = 20$

The factors of 50 are 1, 2, 5, 10, 25, 50.
Because $1 \times 50 = 50$; $2 \times 25 = 50$; $5 \times 10 = 50$

Therefore, 10 is the largest factor that is common to both 20 and 50, therefore it is the GCF.

Example 2: Find the GCF of the terms $9x^{10}y^8z^9$ and $12x^9y^8z^{10}$ and $18x^8y^9$

Solution: The factors of $9x^{10}y^8z^9$ are $1, 3, 9, x^{10}, y^8, z^9$

The factors of $12x^9y^8z^{10}$ are $1, 2, 3, 4, 6, 12, x^9, y^8, z^{10}$

The factors of $18x^8y^9$ are $1, 2, 3, 6, 9, 18, x^8, y^9$

Therefore, the GCF is $3x^8y^8$

GCF factoring is a method where you find the GCF of all your terms and factor it out of the brackets (divide each term by the GCF).

Example 3: Factor $15a+12b+6c$

Solution:

$$3\left(\frac{15a}{3}+\frac{12b}{3}+\frac{6c}{3}\right)$$

$$3(5a+4b+2c)$$

Example 4: Factor x^3+x^2+x

Solution:

$$x\left(\frac{x^3}{x}+\frac{x^2}{x}+\frac{x}{x}\right)$$

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

Example 5: Factor $x^3y^4-x^4y^6+x^2y^3$

Solution:

$$x^2y^3\left(\frac{x^3y^4}{x^2y^3}-\frac{x^4y^6}{x^2y^3}+\frac{x^2y^3}{x^2y^3}\right)$$

$$x^2y^3(xy-x^2y^3+1)$$

Example 6: Factor $64c^6-56c^3+88c^2$

Solution:

$$8c^2\left(\frac{64c^6}{8c^2}-\frac{56c^3}{8c^2}+\frac{88c^2}{8c^2}\right)$$

$$8c^2(8c^4-7c+11)$$

Example 7: Factor $-5x+500$

Solution:

$$-5\left(\frac{-5x}{-5}+\frac{500}{-5}\right)$$

Factoring: greatest common factor (gcf)

Factor the following expressions by using the greatest common factor.

1) $-5x^3 + 6x$

2) $12x^3 + 4x^2 - 14x$

3) $-2x^3 + 22x$

4) $-312x^3 - 234x^2 + 260x$

5) $96x^3 - 192x^2 + 24x$

6) $-175x^2 + 75x$

7) $-189x^2 + 105x$

8) $24x^3 + 21x$

9) $-6x^3 - 9x$

10) $150x^4 - 175x^2$

11) $9x^2 + 60$

12) $x^2 - 7x^4 + x^6$

13) $z^6 + z^2$

14) $6x^3 + x^2$

15) $270x^3 - 300x^2 - 30x$

16) $-42x^3 - 336$

17) $5x^5 + 2x^4 + 10x^3$

18) $-4x^2 + 12x$

19) $-18x^3 + 36x^2 - 90x$

20) $3x^4 - 16$

21) $9a^2 - 18a$

22) $16a^5b^3 + 32a^4b$

23) $x^2 + x4 + x3$

24) $3x^5 + 4x^4 - 5x^2$

25) $2x^3 - x$

26) $3a^5 - a^3$

27) $32b^2 + 16b$

28) $5x^3 - 7x^2$

29) $3x^2 - 10x^3$

30) $a^{5n} + a^{3n}$

31) $x^3 - 5x^2$

32) $9c - 3c^2$

33) $5x^4 - 12x^2$

34) $x^2 + x$

35) $6x^2 - 12x^3 - 18x^4$

36) $x^3y^4 + x2y^2$

37) $18b - 9b^2$

38) $2x^3 + 6x^2$

39) $12x^3 + 4x^2$

40) $x^5 + 3x^2$

Answers:

1. $x(-5x^2+6)$
2. $2x(6x^2+2x-7)$
3. $-2x(x^2-11)$
4. $-26x(12x^2+9x-10)$
5. $24x(4x^2-8x+1)$
6. $-25x(7x-3)$
7. $-3x(63x-35)$
8. $3x(8x^2+7)$
9. $-3x(2x^2+3)$
10. $25x^2(6x^2-7)$
11. $3(3x^2+20)$
12. $x^2(1-7x^2+x^4)$
13. $z^2(z^4+1)$
14. $x^2(6x+1)$
15. $30x(9x^2-10x-1)$
16. $-42(x^3+8)$
17. $x^3(5x^2+2x+10)$
18. $-4x(x-3)$
19. $-18x(x^2-2x+5)$
20. $3x^4-16$
21. $9a(a-2)$
22. $16a^4b(ab^2+2)$
23. $x^2(1+x^2+x)$
24. $x^2(3x^3+4x^2-5)$
25. $x(2x^2-1)$
26. $a^3(3a^2-1)$
27. $16b(2b+1)$
28. $x^2(5x-7)$
29. $x^2(3-10x)$
30. $a^{3n}(a^{2n}+1)$
31. $x^2(x-5)$
32. $3c(3-c)$
33. $x^2(5x^2-12)$
34. $x(x+1)$
35. $6x^2(1-2x-3x^2)$
36. $x^2y^2(xy^2+1)$
37. $9b(2-b)$
38. $2x^2(x+3)$
39. $4x^2(3x+1)$
40. $x^2(x^3+3)$

Difference of Squares Factoring (DOS)

The difference of squares method can only be used if your expression/equation is a binomial and both terms are perfect squares subtracted from each other, i.e. $x^2 - 49$.
When using this method you will end up with two brackets, one with a subtraction sign and one with an addition sign, and the square roots of the terms in each.

Example 1: Factor $x^2 - 49$

Solution: $(x-7)(x+7)$ because $\sqrt{x^2} = x$, $\sqrt{49} = 7$

Example 2: Factor $(xy)^2 - 4$

Solution: $(xy-2)(xy+2)$ because $\sqrt{(xy)^2} = xy$, $\sqrt{4} = 2$

Example 3: Factor $m^2n^2h^2 - 100$

Solution: $(mnh-10)(mnh+10)$ because $\sqrt{m^2n^2h^2} = mnh$, $\sqrt{100} = 10$

Example 4: Factor $x^3 - 49$

Solution: cannot use DOS factoring because x^3 is not a perfect square

Example 5: Factor $x^6 - 36$

Solution: $(x^3 - 6)(x^3 + 6)$ because $\sqrt{x^6} = x^3$, $\sqrt{36} = 6$

Example 6: Factor $81 - y^2$

Solution: $(9 - y)(9 + y)$ because $\sqrt{81} = 9$, $\sqrt{y^2} = y$

Example 7: Factor $16x^4 - 25$

Solution: $(4x^2 - 5)(4x^2 + 5)$ because $\sqrt{16x^4} = 4x^2$, $\sqrt{25} = 5$

FACTORING: Difference of squares

Factor the following expressions by using DOS.

1) $4x^2 - 9$

2) $25x^2 - 121$

3) $x^2 - 25$

4) $x^2 - 1$

5) $25 - x^2$

6) $x^2 - 100$

7) $2x^2 - 9$

8) $196x^2 - 1$

9) $4a^2 - 121$

10) $9y^2 - 16$

11) $1 - 100x^2$

12) $36 - 194c^2$

13) $0.01x^2 - 16$

14) $16x^2 + 9$

15) $x^2 - 16$

16) $y^2 - 49$

17) $4x^2 - 1$

18) $81x^2 - 4$

19) $16x^2 - 121$

20) $49x^2 - 36$

21) $1 - 9x^2$

22) $16 - 81x^2$

23) $x^2y^2 - 100$

24) $x^2y^2 - 25$

25) $x^2 - 4$

26) $25 - x^2y^2$

27) $64 - x^2y^2$

28) $4x^2 - y^2$

29) $49x^2 - 16y^4$

30) $a^2 - 1$

31) $c^2 - 16$

32) $a^2 - 36$

33) $b^2 - 9$

34) $y^2 - 81$

Answers:

1. $(2x-3)(2x+3)$
2. $(5x-11)(5x+11)$
3. $(x-5)(x+5)$
4. $(x-1)(x+1)$
5. $(5-x)(5+x)$
6. $(x-10)(x+10)$
7. can't factor by DOS
8. $(14x-1)(14x+1)$
9. $(2a-11)(2a+11)$
10. $(3y-4)(3y+4)$
11. $(1-10x)(1+10x)$
12. can't factor using DOS
13. $(0.1x-4)(0.1x+4)$
14. can't factor using DOS
15. $(x-4)(x+4)$
16. $(y-7)(y+7)$
17. $(2x-1)(2x+1)$

18. $(9x-2)(9x+2)$

19. $(4x-11)(4x+11)$

20. $(7x-6)(7x+6)$

21. $(1-3x)(1+3x)$

22. $(4-9x)(4+9x)$

23. $(xy-10)(xy+10)$

24. $(xy-5)(xy+5)$

25. $(x-2)(x+2)$

26. $(5-xy)(5+xy)$

27. $(8-xy)(8+xy)$

28. $(2x-y)(2x+y)$

29. $(7x-4y^2)(7x+4y^2)$

30. $(a-1)(a+1)$

31. $(c-4)(c+4)$

32. $(a-6)(a+6)$

33. $(b-3)(b+3)$

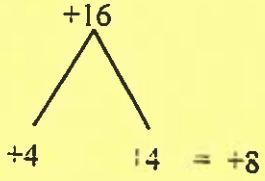
34. $(y-9)(y+9)$

Simple Trinomial Factoring

This method of factoring can only be used if you have trinomial expression where the leading coefficient is equal to 1. i.e. $x^2+8x+16$.
When using this method you need two find two numbers that multiply to give you the ending coefficient and add to give you the middle coefficient. Those two numbers are placed in two brackets with the square root of the first term. It may be useful to set up a diagram to organize your thoughts.

Example 1: Factor $x^2+8x+16$

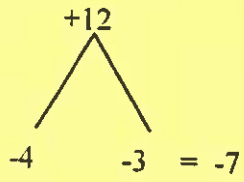
Solution:



therefore, $(x+4)(x+4)$

Example 2: Factor $z^2 - 7z + 12$

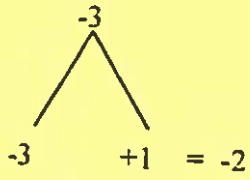
Solution:



therefore, $(z-4)(z-3)$

Example 3: Factor $a^2 - 2a - 3$

Solution:



therefore, $(a-3)(a+1)$

Example 4: Factor $x^2 + 6x - 2$

Solution: cannot factor by simple trinomial method, there are no two numbers that multiply to give you -2 and add to give you +6.

Factoring: simple trinomials

Factor the following expressions.

1) $x^2 + 10x + 21$

2) $x^2 + 3x + 2$

3) $x^2 - 6x + 8$

4) $x^2 - 5x - 14$

5) $x^2 - 5x + 4$

6) $y^2 - 10y + 16$

7) $x^2 - 11x + 30$

8) $d^2 + 20d + 80$

9) $x^2 + 15x + 54$

10) $a^2 + 12a + 35$

11) $b^2 - 13b + 42$

12) $x^2 + 15x + 26$

13) $a^2 - 4a - 21$

14) $x^2 + 18x - 77$

15) $x^2 - x - 56$

16) $g^2 + 9g + 14$

17) $x^2 + x - 110$

18) $x^2 + 11x + 24$

19) $x^2 + 4x + 12$

20) $x^2 + 4x - 21$

21) $y^2 - 8y + 12$

22) $x^2 + 8x - 15$

23) $x^2 - x - 20$

24) $x^2 - x - 72$

25) $x^2 + 4x - 5$

26) $x^2 + 15x + 50$

27) $x^2 + 4x - 32$

28) $x^2 + 7x + 6$

29) $x^2 + 12x + 11$

30) $x^2 + 12x + 20$

31) $x^2 + 2x - 35$

32) $x^2 - 18x + 72$

33) $x^2 - 15x + 56$

34) $x^2 - 6x - 16$

35) $x^2 - 8x + 15$

36) $x^2 + x - 72$

37) $x^2 - 16x + 39$

38) $x^2 + 22x + 121$

39) $x^2 + 13x + 12$

40) $x^2 - 3xy + 2y^2$

41) $x^2 - 14xy + 24y^2$

42) $x^2 + 5xy + 6y^2$

43) $x^2 + 2xy - 63y^2$

44) $x^2 + 8xy - 33y^2$

45) $x^2 - 8x + 16$

46) $x^2 - 12x + 20$

47) $x^2 - 12x + 11$

48) $c^2 + c - 20$

49) $x^2 + 12x + 36$

50) $x^2 - x - 6$

51) $x^2 + 12x + 35$

52) $x^2 - 9x + 18$

53) $y^2 - 13y + 42$

54) $x^2 + 6x - 40$

55) $x^2 + x - 132$

56) $x^2 - 8xy + 33y^2$

57) $a^2 - 10ab - 24b^2$

58) $m^2 - 3mn + 2n^2$

59) $x^2 + 15xy + 44y^2$

60) $t^2 + 23t + 42$

61) $y^2 - 12y + 36$

62) $b^2 - 4b - 45$

63) $n^2 + 3n - 18$

64) $c^2 - 10c + 21$

ANSWERS:

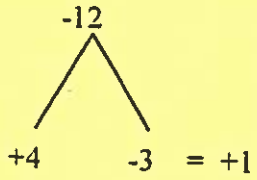
1. $(x + 3)(x + 7)$
2. $(x + 2)(x + 1)$
3. $(x - 4)(x - 2)$
4. $(x - 7)(x + 2)$
5. $(x - 4)(x - 1)$
6. $(y - 2)(y - 8)$
7. $(x - 5)(x - 6)$
8. cant factor
9. $(x + 9)(x + 6)$
10. $(a + 5)(a + 7)$
11. $(b - 6)(b - 7)$
12. $(x + 2)(x + 13)$
13. $(a - 7)(a + 3)$
14. cant factor
15. $(x - 8)(x + 7)$
16. $(g + 7)(g + 2)$
17. $(x - 10)(x + 11)$
18. $(x + 8)(x + 3)$
19. cant factor
20. $(x + 7)(x - 3)$
21. $(y - 2)(y - 6)$
22. cant factor
23. $(x - 5)(x + 4)$
24. $(x - 9)(x + 8)$
25. $(x + 5)(x - 1)$
26. $(x + 5)(x + 10)$
27. $(x + 8)(x - 4)$
28. $(x + 6)(x + 1)$
29. $(x + 11)(x + 1)$
30. $(x + 10)(x + 2)$
31. $(x + 7)(x - 5)$
32. $(x - 6)(x - 12)$
33. $(x - 8)(x - 7)$
34. $(x - 8)(x + 2)$
35. $(x - 3)(x - 5)$
36. $(x - 8)(x + 9)$
37. $(x - 13)(x - 3)$
38. $(x + 11)(x + 11)$
39. $(x + 12)(x + 1)$
40. $(x - 2y)(x - y)$
41. $(x - 12y)(x - 2y)$
42. $(x + 3y)(x + 2y)$
43. $(x - 7y)(x + 9y)$
44. $(x - 3y)(x + 11y)$
45. $(x - 4)(x - 4)$
46. $(x - 10)(x - 2)$
47. $(x - 11)(x - 1)$
48. $(c + 5)(c - 4)$
49. $(x + 6)(x + 6)$
50. $(x - 3)(x + 2)$
51. $(x + 5)(x + 7)$
52. $(x - 3)(x - 6)$
53. $(y - 6)(y - 7)$
54. $(x + 10)(x - 4)$
55. $(x + 12)(x - 11)$
56. cant factor
57. $(a - 12b)(a + 2b)$
58. $(m - 2n)(m - n)$
59. $(x + 11y)(x + 4y)$
60. $(t + 2)(t + 21)$
61. $(y - 6)(y - 6)$
62. $(b + 5)(b - 9)$
63. $(x - 3)(x + 6)$
64. $(c - 7)(c - 3)$

Complex Trinomial Factoring

This method of factoring can only be used if you have trinomial expression where the leading coefficient is greater than 1. i.e. $2x^2 + x - 6$.
When using this method you need two find two numbers that multiply to give you the product of the leading coefficient and the ending coefficient and add to give you the middle coefficient. Those two numbers replace the middle term in the original expression. You then factor out a number from the first two terms and another number from the last two terms. You should end up with the exact same two brackets, and you factor out the common bracket to give you the final answer. It may be useful to set up a diagram to organize your thoughts.

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

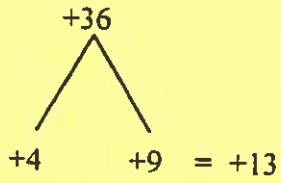
Solution:



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

Example 2: Factor $6x^2 + 13x + 6$

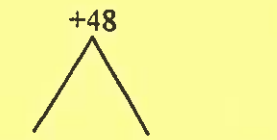
Solution:



$$6x^2 + 13x + 6$$
$$= 6x^2 + 4x + 9x + 6$$
$$= 2x(3x + 2) + 3(3x + 2)$$
$$= (3x + 2)(2x + 3)$$

Example 3: Factor $4a^2 - 19a + 12$

Solution:



$= -19$

$$4a^2 - 19a + 12$$

$$= 4a^2 - 3a - 16a + 12$$

$$= a(4a - 3) - 4(4a - 3)$$

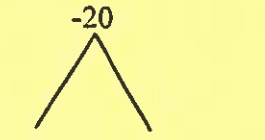
$$= (4a - 3)(a - 4)$$

Example 4: Factor $2x^2 + 6x - 2$

Solution: cannot factor by complex trinomial method, there are no two numbers that multiply to give you -4 and add to give you +6.

Example 5: Factor $4z^2 - 19z - 5$

Solution:



$= -19$

$$4z^2 - 19z - 5$$

$$= 4z^2 - 20z + 1z - 5$$

$$= 4z(z - 5) + 1(z - 5)$$

$$= (z - 5)(4z + 1)$$

Factoring: Complex trinomials

1. $3x^2 + 20x - 7$
2. $2x^2 - 5x + 3$
3. $4x^2 + 21x + 5$
4. $5x^2 - 28x - 12$
5. $2x^2 - 7x + 3$
6. $5x^2 + 32x - 64$
7. $4x^2 - 3x - 7$
8. $3x^2 + 4x + 1$
9. $2x^2 + 19x + 45$
10. $3x^2 - 13x - 56$
11. $4x^2 - 25x - 21$
12. $5x^2 - 39x - 54$
13. $6x^2 - 41x + 30$
14. $2x^2 - 3x - 27$
15. $3x^2 + 8x + 5$
16. $4x^2 + 7x - 2$
17. $4x^2 - 11x - 45$
18. $5x^2 + 31x + 30$
19. $2x^2 - 3x - 35$
20. $3x^2 - 11x - 42$
21. $5x^2 - 39x + 28$
22. $4x^2 - 13x + 9$
23. $3x^2 + 17x - 6$
24. $5x^2 + 52x + 63$
25. $6x^2 - 55x + 9$
26. $2x^2 - 7x - 72$
27. $3x^2 + 28x + 49$
28. $5x^2 + 39x - 8$
29. $4x^2 - 9x - 28$
30. $3x^2 - 23x + 30$
31. $2x^2 + 13x + 15$
32. $5x^2 - 11x - 12$
33. $4x^2 - x - 3$
34. $3x^2 + 28x + 9$

ANSWERS:

1. $(3x - 1)(x + 7)$
2. $(2x + 1)(x - 3)$
3. $(4x + 1)(x + 5)$
4. $(5x + 2)(x - 6)$
5. $(x - 3)(2x - 1)$
6. $(x + 8)(5x - 8)$
7. $(4x - 7)(x + 1)$
8. $(3x + 1)(x + 1)$
9. $(2x + 9)(x + 5)$
10. $(3x + 8)(x - 7)$
11. $(4x + 3)(x - 7)$
12. $(5x + 6)(x - 9)$
13. $(6x - 5)(x - 6)$
14. $(x + 3)(2x - 9)$
15. $(x + 1)(3x + 5)$
16. $(4x - 1)(x + 2)$
17. $(4x + 9)(x - 5)$
18. $(x + 5)(5x + 6)$
19. $(2x + 7)(x - 5)$
20. $(3x + 7)(x - 6)$
21. $(5x - 4)(x - 2)$
22. $(4x - 9)(x - 1)$
23. $(3x - 1)(x + 6)$
24. $(5x + 7)(5x + 9)$
25. $(6x - 1)(x - 9)$
26. $(2x + 9)(x - 8)$
27. $(x + 7)(3x + 7)$
28. $(5x - 1)(x + 8)$
29. $(4x + 7)(x - 4)$
30. $(3x - 5)(x - 6)$
31. $(2x + 3)(x + 5)$
32. $(x - 3)(5x + 4)$
33. $(4x + 3)(x - 1)$
34. $(3x + 1)(x + 9)$

Factoring: All Types

Most of the time the question will not tell you what type of factoring you should use, and sometimes you need to factor the expression using more than one method. A good rule of thumb is to try to factor using the GCF method first, and then determine if any other type of factoring can be used to further break down the expression.

Example 1: Factor completely $4x^2 - 24x + 36$

Solution: First, look for a GCF, which there is of 4.
$4(x^2 - 6x + 9)$

Second, see if the bracket can be factored using any other method, which it can, by the simple trinomial method.
$4(x-3)(x-3)$

Third, see if the new brackets can be factored, which they cannot. So, you are done! The final answer is: $4(x-3)(x-3)$

Example 2: Factor completely $y^2 + 10y + 25$

Solution: First, look for a GCF, which there is none.

Second, see if it can be factored using any other method, which it can, by the simple trinomial method.
$(y+5)(y+5)$

Third, see if the brackets can be factored, which they cannot. So, you are done! The final answer is: $(y+5)(y+5)$

Example 3: Factor completely $49x^2-1$

Solution: First, look for a GCF, which there is none.

Second, see if the bracket can be factored using any other method, which it can, by the difference of squares method.
$(7x-1)(7x+1)$

Third, see if the brackets can be factored, which they cannot. So, you are done! The final answer is: $(7x-1)(7x+1)$

Example 4: Factor completely $14x^3-7x^2+21x$

Solution: First, look for a GCF, which there is of 7x.
$7x(2x^2-x+3)$

Second, see if the bracket can be factored using any other method, which they cannot (it looks like a complex trinomial, but that method doesn't work). So, you are done! The final answer is: $7x(2x^2-x+3)$

Example 5: Factor completely $8x^2-29x-12$

Solution: First, look for a GCF, which there is none.

Second, see if the bracket can be factored using any other method, which it can, by the complex trinomial method.
$(8x+3)(x-4)$

Third, see if the new brackets can be factored, which they cannot. So, you are done! The final answer is: $(8x+3)(x-4)$

Example 6: Factor completely $12z^2-32z+16$

Solution: First, look for a GCF, which there is of 4.

$4(3z^2 - 8z + 4)$

Second, see if the bracket can be factored using any other method, which it can, by the complex trinomial method. (make sure to keep the 4 you factored out in step 1)
$4(z-2)(3z-2)$

Third, see if the new brackets can be factored, which they cannot. So, you are done! The final answer is: $4(z-2)(3z-2)$

Example 7: Factor completely $-2x^2 - 6x + 36$

Solution: First, look for a GCF, which there is of -2.
$-2(x^2 + 3x - 18)$

Second, see if the bracket can be factored using any other method, which it can, by the simple trinomial method. (make sure to keep the -2 you factored out in step 1)
$-2(x-3)(x+6)$

Third, see if the new brackets can be factored, which they cannot. So, you are done! The final answer is: $-2(x-3)(x+6)$

Factoring: all types

Completely factor the following expressions using the appropriate method.

1) $2a^2b - 4ab^2$

2) $4 - x^2$

3) $a^2 + 8a + 16$

4) $2a^2 + 6a - ab - 3b$

5) $9x^2 + 100y^2$

6) $2y^3 - 128$

7) $z^2 - 7z + 12$

8) $y(3x - 2) + 4(2 - 3x)$

9) $16c^2 - 36$

10) $y^2 + 5y - 24$

11) $m^2 + 14m + 49$

12) $8x^4 - 4x^3 + 12x^2$

13) $128t^4 - 2t^2$

14) $27h^3 + 8$

15) $8x^2 + 6x - 9$

16) $4x^3 + 12x^2 - 8x$

17) $14x^3 - 7x^2 - 21x$

18) $x^2 + 2x - 35$

19) $3x^2 - 5x - 2$

20) $x^2 - 18x + 81$

21) $4x^2 - 25y^2$

22) $x^2 - 6x - 16$

23) $4y^2 + 7y - 2$

24) $5a^3 - 25a^2 + 15a$

25) $9x^2 - 16$

26) $x^2 - 64$

27) $a^2 + 12a + 27$

28) $6x^2 + 12x + 6$

29) $2x^3 - 20x^2 - 48x$

30) $12x^5 - 6x^3 + 3x^2$

31) $6y^2 - 54$

32) $4y^2 - 17y - 15$

33) $5x^2 - 5$

34) $y^5 + 3y^3 + 4y^2 + 12$

35) $x^2 - 7x - 18$

36) $x^2 - 8x + 16$

37) $3x^2 - 4x - 32$

38) $4x^2 + 2x - 20$

39) $3x^2 - 20x - 7$

40) $6x^2 + x - 12$

Answers:

1. $2ab(a - 2b)$
2. $(2 - x)(2 + x)$
3. $(a + 4)(a + 4)$
4. $(2a - b)(a + 3)$
5. NF
6. $2(y^3 - 64)$
7. $(z - 4)(z - 3)$
8. $(y - 4)(3x - 2)$
9. $(4c - 6)(4c + 6)$
10. $(y + 8)(y - 3)$
11. $(m + 7)(m + 7)$
12. $4x^2(2x^2 - x + 3)$
13. $2t^2(8t - 1)(8t + 1)$
14. NF
15. $(2x + 3)(4x - 3)$
16. $4x(x^2 + 3x - 2)$
17. $7x(2x - 3)(x + 1)$
18. $(x - 5)(x + 7)$
19. $(3x + 1)(x - 2)$
20. $(x - 9)(x - 9)$
21. $(2x - 5y)(2x + 5y)$
22. $(x - 8)(x + 2)$
23. $(4y - 1)(y + 2)$
24. $5a(a^2 - 5a + 3)$
25. $(3x - 4)(3x + 4)$
26. $(x - 8)(x + 8)$
27. $(a + 3)(a + 9)$
28. $6(x + 1)(x + 1)$
29. $2x(x - 12)(x + 2)$
30. $3x^2(4x^3 - 2x + 1)$

31. $6(y-3)(y+3)$
32. $(4y+3)(y-5)$
33. $5(x-1)(x+1)$
34. $(y^2+3)(y^3+4)$
35. $(x-9)(x+2)$
36. $(x-4)^2$
37. $(3x+8)(x-4)$
38. $2(2x+5)(x-2)$
39. $(3x+1)(x-7)$
40. $(2x+3)(3x-4)$