

# Algebra 1 · Factoring Polynomials · Worksheet Answer Key

Common Core A-SSE.A.2, A-SSE.B.3a · mathovore.fr

Each solution shows how the factors were found and, where useful, a check by multiplying. Compare your method as well as your answer, because many factoring errors are sign mistakes in the middle step.

## Algebra 1 Common Core: A-SSE.A.2 · A-SSE.B.3a

### Problem 1: GCF of a binomial

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The GCF of 6 and 9 is 3, and both terms contain  $x$ , so the GCF is  $3x$ .

$$6x^2 \div 3x = 2x \text{ and } 9x \div 3x = 3.$$

$$3x(2x+3)$$

### Problem 2: GCF with powers

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The GCF of 12 and 20 is 4. The lowest power of  $a$  is  $a^2$ . So the GCF is  $4a^2$ .

$$4a^2(3a-5)$$

### Problem 3: GCF of a trinomial

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The GCF of 8, 12 and 16 is 4, and the lowest power of  $x$  is  $x$ , so the GCF is  $4x$ .

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

### Problem 4: Factor $x^2 + bx + c$

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Find two numbers with product 15 and sum 8: the pairs are 1 and 15 (sum 16) and 3 and 5 (sum 8). Use 3 and 5.

$$(x+3)(x+5)$$

|           |                      |           |
|-----------|----------------------|-----------|
|           | <b>x</b>             | <b>+5</b> |
| <b>x</b>  | <b>x<sup>2</sup></b> | <b>5x</b> |
| <b>+3</b> | <b>3x</b>            | <b>15</b> |

Check:  $5x + 3x = 8x$ .

### Problem 5: Both numbers negative

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The product 20 is positive and the sum  $-9$  is negative, so both numbers are negative. The pair  $-4$  and  $-5$  has product 20 and sum  $-9$ .

$$(x-4)(x-5)$$

### Problem 6: Opposite signs

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The product  $-35$  is negative, so the numbers have opposite signs. The pair 7 and  $-5$  has product  $-35$  and sum 2.

$$(x+7)(x-5)$$

### Problem 7: Larger negative number

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Find two numbers with product  $-28$  and sum  $-3$ . The pair  $-7$  and 4 works:  $(-7)(4) = -28$  and  $-7 + 4 = -3$ .

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

### Problem 8: Difference of squares

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$x^2 - 49 = x^2 - 7^2$ , which fits  $a^2 - b^2 = (a+b)(a-b)$ .

$$(x-7)(x+7)$$

### Problem 9: Difference of squares with a coefficient

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$25x^2 = (5x)^2$  and  $16 = 4^2$ , so  $a = 5x$  and  $b = 4$ .

$$(5x-4)(5x+4)$$

### Problem 10: Perfect square trinomial

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The first term is  $x^2$  and the last is  $6^2$ . The middle term is  $2 \cdot x \cdot 6 = 12x$ , so the pattern  $a^2 + 2ab + b^2$  applies.

$$(x+6)^2$$

### Problem 11: Perfect square with a coefficient

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$4x^2 = (2x)^2$  and  $25 = 5^2$ . The middle term is  $-2(2x)(5) = -20x$ , so the pattern  $a^2 - 2ab + b^2$  applies.

$$(2x-5)^2$$

### Problem 12: Factor $ax^2 + bx + c$

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$ac = 2 \cdot 3 = 6$ . Two numbers with product 6 and sum 7 are 1 and 6.

Split the middle term:  $2x^2 + x + 6x + 3$ . Group:  $x(2x+1) + 3(2x+1)$ .

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

### Problem 13: $ax^2 + bx + c$ , negative middle

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$ac = 24$ . Two numbers with product 24 and sum  $-10$  are  $-4$  and  $-6$ .

$$3x^2 - 4x - 6x + 8 = x(3x-4) - 2(3x-4).$$

$$(3x-4)(x-2)$$

### Problem 14: $ax^2 + bx + c$ , negative constant

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$ac = -90$ . Two numbers with product  $-90$  and sum 1 are 10 and  $-9$ .

$$6x^2 + 10x - 9x - 15 = 2x(3x+5) - 3(3x+5).$$

$$(2x-3)(3x+5)$$

### Problem 15: Factor by grouping

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Group the first two and last two terms:  $(x^3 + 4x^2) + (3x + 12)$ . Factor each group:  $x^2(x+4) + 3(x+4)$ .

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

### Problem 16: GCF then difference of squares

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Pull out the GCF 2:  $2(x^2-16)$ . Then  $x^2-16=(x-4)(x+4)$ .

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

### Problem 17: GCF then perfect square

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The GCF is  $3x$ :  $3x(x^2+6x+9)$ . The trinomial is a perfect square:  $x^2+6x+9=(x+3)^2$ .

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

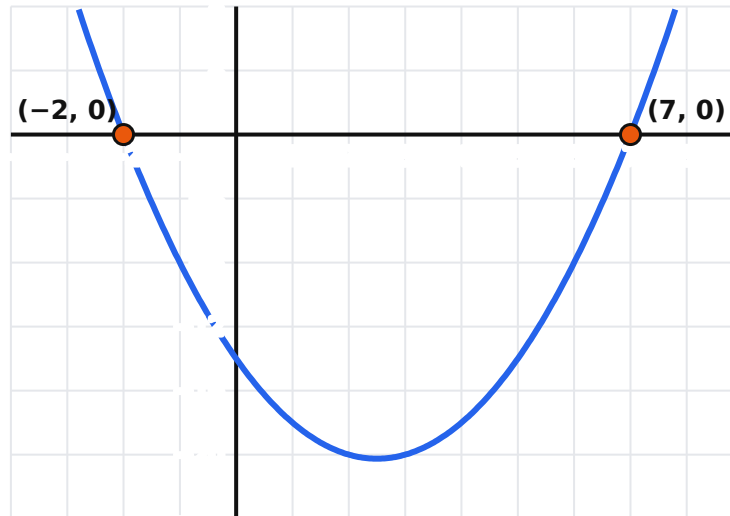
### Problem 18: Zeros of a quadratic

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Find two numbers with product  $-14$  and sum  $-5$ :  $-7$  and  $2$ .

$(x-7)(x+2)=0$ . By the zero product property,  $x-7=0$  or  $x+2=0$ .

$$x=7 \text{ or } x=-2$$



The zeros match the x-intercepts.

### Problem 19: Zeros with a leading coefficient

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$ac=-12$ . Two numbers with product  $-12$  and sum  $1$  are  $4$  and  $-3$ .

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

Set each factor to zero:  $2x-3=0$  gives  $x=\frac{3}{2}$ , and  $x+2=0$  gives  $x=-2$ .

$$x=\frac{3}{2} \text{ or } x=-2$$

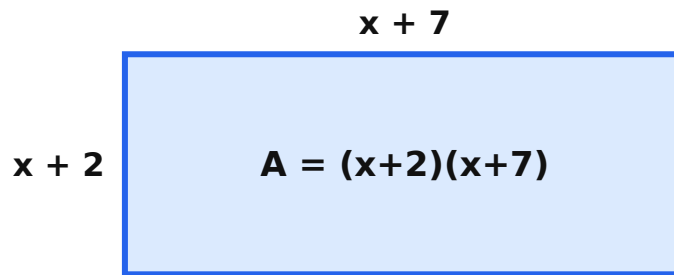
## Problem 20: Dimensions of a rectangle

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Numbers with product 14 and sum 9 are 2 and 7, so the area factors as  $(x+2)(x+7)$ . The width is  $x+2$  and the length is  $x+7$ .

If  $x+2=5$ , then  $x=3$ , so the length is  $3+7=10$  feet and the area is  $5 \times 10 = 50$  square feet.  
Check:  $9+27+14=50$ .

**length 10 ft, area 50 square feet**



The factored dimensions.

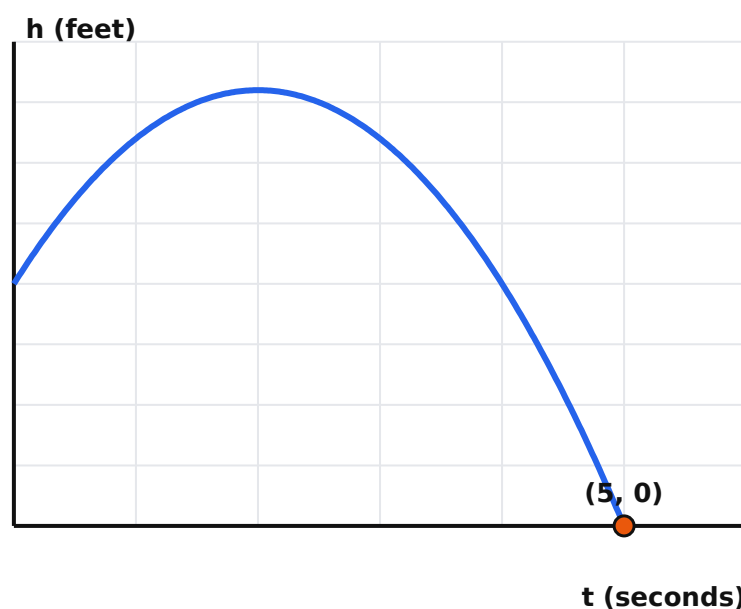
## Problem 21: When does the ball land?

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Pull out the GCF  $-16$ :  $-16(t^2-4t-5)$ . Then  $t^2-4t-5=(t-5)(t+1)$ .

$-16(t-5)(t+1)=0$  gives  $t=5$  or  $t=-1$ . Time cannot be negative, so the ball lands after **5 seconds**.

Check:  $-16(25)+64(5)+80=-400+320+80=0$ .



The ball lands at  $t=5$ .

## Problem 22: Consecutive integers

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Let the integers be  $n$  and  $n+1$ . Then  $n(n+1)=156$ , which gives  $n^2+n-156=0$ .

Numbers with product  $-156$  and sum 1: 13 and  $-12$ . So  $(n+13)(n-12)=0$ , and  $n=-13$  or  $n=12$ .

The integers are positive, so  $n=12$ . Check:  $12 \times 13 = 156$ .

**12 and 13**

## Problem 23: Is it factored completely?

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The product is correct:  $(2x)^2-6^2=4x^2-36$ . But each binomial still has a common factor of 2:  $2x-6=2(x-3)$  and  $2x+6=2(x+3)$ .

A better first step is the GCF:  $4(x^2-9)$ .

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

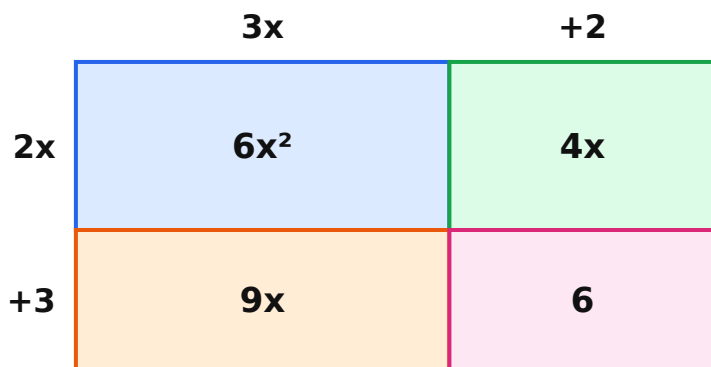
## Problem 24: Banner dimensions

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$ac=36$ . Two numbers with product 36 and sum 13 are 4 and 9.

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

$$(2x+3)(3x+2)$$



The sides are  $2x+3$  and  $3x+2$ .