



Name: _____

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Learning Objectives

- Solve quadratic equations by factoring, completing the square, and the quadratic formula
- Write quadratic functions in vertex form $a(x - h)^2 + k$
- Use the discriminant to classify roots (real, complex, repeated)
- Solve applied quadratic problems (projectile motion)

For each problem, identify which method is most efficient. Factoring is fastest when the polynomial factors nicely; use the quadratic formula otherwise.

1. Solve by factoring.

$$x^2 - 7x + 12 = 0$$

Answer: _____

2. Solve using the quadratic formula.

$$2x^2 - 5x - 3 = 0$$

Answer: _____

3. Complete the square to solve.

$$x^2 + 6x - 7 = 0$$

Answer: _____

4. Write in vertex form $a(x-h)^2 + k$ by completing the square.

$$f(x) = x^2 - 4x + 1$$

Answer: _____

5. Find the vertex, axis of symmetry, and x-intercepts.

$$f(x) = -2x^2 + 8x - 5$$

Answer: _____

6. Use the discriminant to classify the roots.

$$3x^2 - 4x + 5 = 0$$

Answer: _____



7. Solve.

$$(x + 3)^2 = 25$$

Answer: _____

8. A ball is thrown upward. Its height (in feet) is $h(t) = -16t^2 + 64t + 5$. Find the maximum height and when it is reached.

$$h(t) = -16t^2 + 64t + 5$$

Answer: _____

9. Solve by factoring.

$$6x^2 + x - 2 = 0$$

Answer: _____

10. Solve by any method.

$$x^2 - 5 = 0$$

Answer: _____





Problem 3 (completing the square) is the foundation for the quadratic formula — show the derivation. Problem 6 (discriminant): emphasize $\Delta > 0$ gives complex roots, not "no solution."

Solutions

1. Solve by factoring.

$$x^2 - 7x + 12 = 0$$

→ Find two numbers that multiply to 12 and add to -7: -3 and -4.

$$\rightarrow (x-3)(x-4)=0 \rightarrow x=3 \text{ or } x=4.$$

Answer: $x = 3$ or $x = 4$

2. Solve using the quadratic formula.

$$2x^2 - 5x - 3 = 0$$

→ $a=2, b=-5, c=-3$. Discriminant: $25+24=49$.

$$\rightarrow x=(5\pm 7)/4. x=12/4=3 \text{ or } x=-2/4=-1/2.$$

Answer: $x = 3$ or $x = -\frac{1}{2}$

3. Complete the square to solve.

$$x^2 + 6x - 7 = 0$$

→ Move constant: $x^2+6x=7$.

→ Add $(6/2)^2=9$ to both sides: $x^2+6x+9=16$.

$$\rightarrow (x+3)^2=16 \rightarrow x+3=\pm 4 \rightarrow x=1 \text{ or } x=-7.$$

Answer: $x = 1$ or $x = -7$

4. Write in vertex form $a(x-h)^2 + k$ by completing the square.

$$f(x) = x^2 - 4x + 1$$

$$\rightarrow x^2-4x+1 = (x^2-4x+4)-4+1 = (x-2)^2-3.$$

→ Vertex: $(h, k) = (2, -3)$. Opens upward ($a=1 > 0$).

Answer: $f(x) = (x - 2)^2 - 3$, vertex $(2, -3)$

5. Find the vertex, axis of symmetry, and x-intercepts.

$$f(x) = -2x^2 + 8x - 5$$

→ Vertex x-coord: $h=-b/2a=-8/-4=2$. $k=-2(4)+8(2)-5=3$.

→ Vertex $(2, 3)$. Opens downward ($a=-2 < 0$).

$$\rightarrow x\text{-intercepts: } -2x^2+8x-5=0 \rightarrow x=(-8\pm\sqrt{64-40})/(-4)=(4\pm\sqrt{6})/2.$$

Answer: Vertex $(2, 3)$, $x = \frac{4 \pm \sqrt{6}}{2}$



6. Use the discriminant to classify the roots.

$$3x^2 - 4x + 5 = 0$$

→ Discriminant: $b^2 - 4ac = 16 - 60 = -44$.

→ $\Delta < 0$ → two complex (non-real) roots.

→ $x = (4 \pm \sqrt{-44})/6 = (4 \pm 2i\sqrt{11})/6 = (2 \pm i\sqrt{11})/3$.

Answer: $\Delta = 16 - 60 = -44 < 0 \Rightarrow 2$ complex roots

7. Solve.

$$(x + 3)^2 = 25$$

→ Take square root of both sides: $x + 3 = \pm 5$.

→ $x - 3 = 2$ or $x - 5 = -8$.

Answer: $x = 2$ or $x = -8$

8. A ball is thrown upward. Its height (in feet) is $h(t) = -16t^2 + 64t + 5$. Find the maximum height and when it is reached.

$$h(t) = -16t^2 + 64t + 5$$

→ Maximum at vertex: $t = -b/2a = -64/(-32) = 2$ seconds.

→ $h(2) = -16(4) + 64(2) + 5 = -64 + 128 + 5 = 69$ feet.

Answer: $t = 2$ s, $h_{\max} = 69$ ft

9. Solve by factoring.

$$6x^2 + x - 2 = 0$$

→ Find factors of $ac = -12$ that add to 1: +4 and -3.

→ $6x^2 + 4x - 3x - 2 = 0 \rightarrow 2x(3x + 2) - 1(3x + 2) = 0 \rightarrow (2x - 1)(3x + 2) = 0$.

→ $x = 1/2$ or $x = -2/3$.

Answer: $x = \frac{1}{2}$ or $x = -\frac{2}{3}$

10. Solve by any method.

$$x^2 - 5 = 0$$

→ $x^2 = 5 \rightarrow x = \pm\sqrt{5}$.

→ Exact answers: $x = \sqrt{5} \approx 2.236$ and $x = -\sqrt{5} \approx -2.236$.

Answer: $x = \pm\sqrt{5}$

