

Conics

Lesson 5: Introduction to Conics

ApexMath

Notes

Conic sections are curves formed when a plane cuts through a cone. The four conics are:

Circle, Ellipse, Parabola, Hyperbola

They appear in real life: - Circles: wheels, planets - Ellipses: planetary orbits - Parabolas: satellite dishes - Hyperbolas: navigation systems

General quadratic form:

$$Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$$

- If $A = C$ and $B = 0$, it's a circle. - If A and C have the same sign but not equal, it's an ellipse. - If only one of A or C is present, it's a parabola. - If A and C have opposite signs, it's a hyperbola.

Deep Walkthrough Examples

Example A. Classify a conic

Classify $x^2 + y^2 - 4x + 6y - 12 = 0$.

Step 1. Identify coefficients: $A = 1, B = 0, C = 1$.

Step 2. Compare A and C : Both are equal and $B = 0$, so it's a circle.

Final Answer: *Circle*

Example B. Classify another conic

Classify $9x^2 + 4y^2 - 36 = 0$.

Step 1. Identify coefficients: $A = 9, C = 4$.

Step 2. Same sign, not equal: This is an ellipse.

Final Answer: *Ellipse*

Example C. Classify another conic

Classify $x^2 - y^2 = 16$.

Step 1. Identify coefficients: $A = 1, C = -1$.

Step 2. Opposite signs: This is a hyperbola.

Final Answer: *Hyperbola*

Example D. Classify another conic

Classify $y - x^2 = 0$.

Step 1. Identify coefficients: $A = 1, C = 0$.

Step 2. Only one squared variable: This is a parabola.

Final Answer: *Parabola*

Common Mistakes to Avoid

- Forgetting that signs of A and C determine ellipse vs hyperbola.
 - Thinking $A = C$ always means ellipse (it means circle only if $B = 0$).
 - Forgetting parabola has only one squared term.
 - Confusing standard form type with general form.
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Worksheet Problems

1. Identify the conic: $x^2 + y^2 + 6x - 8y + 9 = 0$ (general form)
 2. Identify the conic: $\frac{(x-2)^2}{16} + \frac{(y+1)^2}{9} = 1$ (standard form)
 3. Identify the conic: $x^2 - 9y^2 = 36$ (general form)
 4. Identify the conic: $y = 2(x - 1)^2 + 3$ (standard form)
 5. Identify the conic: $4x^2 + 4y^2 - 16x + 24y - 36 = 0$ (general form)
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Detailed Answer Key with Explanations

1. Circle

Explanation: $A = C = 1$ and $B = 0$. Both squared terms are present and equal. This fits the circle criteria in the general quadratic form.

2. Ellipse

Explanation: $A = 1, C = 1$ for the standard form question: $\frac{(x-2)^2}{16} + \frac{(y+1)^2}{9} = 1$. Both squared terms present, same sign, different denominators, so it's an ellipse.

3. Hyperbola

Explanation: $A = 1, C = -9$. Squared terms have opposite signs, which is the key indicator of a hyperbola.

4. Parabola

Explanation: Only one squared term is present in $y = 2(x - 1)^2 + 3$, so it's a parabola.

5. Circle

Explanation: $A = C = 4$ and $B = 0$. Both squared terms are present and equal. This is a circle.

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