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## HYPERBOLA

$x^2$  1st

$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$

$y^2$  1st

$\frac{(y-k)^2}{b^2} - \frac{(x-h)^2}{a^2} = 1$

FORMULA FOR C:  $c^2 = a^2 + b^2$

You need to find:

- center  $(h, k)$
- 2 vertices (only the ones you used in the graph)
- 2 foci ( $c^2 = a^2 + b^2$  and then add  $c$  to the coordinate of the center based on which variable is listed 1st in the problem)
- 2 asymptotes:  $(y-k) = \pm \frac{b}{a}(x-h)$

Steps for graphing hyperbolas:

1. Plot the center
2. Plot points using  $a$  &  $b$
3. Draw a box using those 4 points
4. Draw diagonals (asymptotes) through the corners of box
5. Sketch branches of hyperbola using vertices & asymptotes

$x^2$  1st  $\curvearrowright \curvearrowleft$

$y^2$  1st  $\curvearrowleft \curvearrowright$

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Graph. List center, vertices, foci & asymptotes.

1.  $\frac{(y-4)^2}{36} - \frac{(x-3)^2}{9} = 1$   $y^2$  1st so  $\curvearrowleft \curvearrowright$

center:  $(3, 4)$   
 $a=3$  left/right  
 $b=6$  up/down

vertices:  $(3, 10) + (3, -2)$   
 foci:  $(3, 4 \pm 3\sqrt{5})$   
 $c^2 = a^2 + b^2$   
 $c^2 = 9 + 36$   
 $\sqrt{c^2} = \sqrt{45} = 3\sqrt{5} \Rightarrow c = \pm 3\sqrt{5}$

asymptotes:  $(y-4) = \pm \frac{6}{3}(x-3)$   
 $(y-4) = \pm 2(x-3)$

2.  $\frac{x^2}{9} - \frac{(y+2)^2}{25} = 1$   $x^2$  1st so  $\curvearrowright \curvearrowleft$

center  $(0, -2)$   
 $a=3$  L/R  
 $b=5$   $\uparrow/\downarrow$

vertices:  $(-3, -2) + (3, -2)$   
 foci:  $(0 \pm \sqrt{34}, -2)$   
 $c^2 = 9 + 25$   
 $c^2 = 34$   
 $c = \pm \sqrt{34}$

asymptotes:  $(y+2) = \pm \frac{5}{3}x$

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Rewrite the hyperbola in standard form

1.  $4x^2 - 25y^2 - 8x + 250y - 721 = 0$

$(4x^2 - 8x) + (-25y^2 + 250y) = 721$

$4(x^2 - 2x + 1) - 25(y^2 - 10y + 25) = 721 + 4 - 625$

$(-2/2)^2 = (-1)^2 \quad (-10/2)^2 = (-5)^2$

$\frac{4(x-1)^2}{100} - \frac{25(y-5)^2}{100} = \frac{100}{100}$

$\frac{(x-1)^2}{25} - \frac{(y-5)^2}{4} = 1$

2.  $9y^2 - 4x^2 - 90y - 24x = -153$

$(9y^2 - 90y) + (-4x^2 - 24x) = -153$

$9(y^2 - 10y + 25) - 4(x^2 + 6x + 9) = -153 + 225 - 36$

$(-10/2)^2 = (-5)^2 \quad (6/2)^2 = (3)^2$

$\frac{9(y-5)^2}{36} - \frac{4(x+3)^2}{36} = \frac{36}{36}$

$\frac{(y-5)^2}{4} - \frac{(x+3)^2}{9} = 1$

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Classify Conics in General Form

- 1) circle → Same leading coefficients with same sign  
ex:  $4x^2 + 4y^2 - 3x + 7y - 9 = 0$
- 2) ellipse → different leading coefficients but same sign  
ex:  $4x^2 + 5y^2 - 3x + 7y - 9 = 0$
- 3) parabola → Only 1 variable is squared  
ex:  $4y^2 - 3x + 7y - 9 = 0$
- 4) hyperbola → leading coefficients are opposite signs  
ex:  $4x^2 - 5y^2 - 3x + 7y - 9 = 0$

**How to Identify a Conic Section in General Form**

**Level 1**

- "Is there only one squared term?"
- If 'yes,' it is a **parabola**.
- If 'no,' go to Level 2.

**Level 2**

- "Are the coefficients of the squared terms equal?"
- If 'yes,' it is a **circle**.
- If 'no,' go to Level 3.

**Level 3**

- "Are the coefficients of the squared terms opposite in sign?"
- If 'yes,' it is a **hyperbola**.
- If 'no,' go to Level 4.

**Level 4**

- It is an **ellipse**.

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Quiz	INB
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#3-4	p. 22
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#7/8/9	p. 20/17/23
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