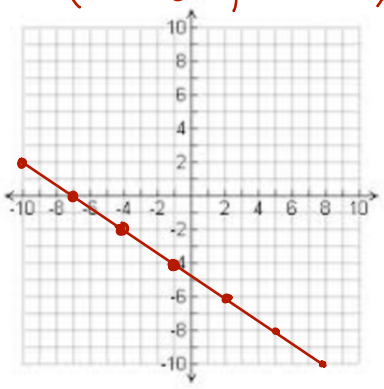
Key

1. Write a vector equation describing a line passing through $P_1(-5, 3)$ and parallel to $\mathbf{a} = \langle 3, -2 \rangle$.

$\vec{r}_0 + t\vec{v} = \langle -5, 3 \rangle + t\langle 3, -2 \rangle = \langle -5+3t, 3-2t \rangle$

2. Find the parametric equations for a line parallel to $\mathbf{q} = \langle 3, -2 \rangle$ and passing through the point at (-1, -4). Then make a table of values and graph the line.

t	x	y
-3	-10	2
-2	-7	0
-1	-4	-2
0	-1	-4
1	2	-6
2	5	-8
3	8	-10



$\langle -1, -4 \rangle + t\langle 3, -2 \rangle$

$\langle -1+3t, -4-2t \rangle$

$x = t$

$y = -5+3t$

3. Write parametric equations of $y = 3x - 5$.

slope $= \frac{3}{1}$ y-int $(0, -5) \rightarrow \langle 0, -5 \rangle + t\langle 1, 3 \rangle = \langle t, -5+3t \rangle$

4. Write an equation in slope-intercept form of the line whose parametric equations are $x = 3 + 2t$ and $y = -1 - 4t$.

$\langle 3+2t, -1-4t \rangle = \underbrace{\langle 3, -1 \rangle}_{\text{point}} + t\underbrace{\langle 2, -4 \rangle}_{\text{slope}}$ $\quad m = \frac{-4}{2} = -2$

$y - y_1 = m(x - x_1)$

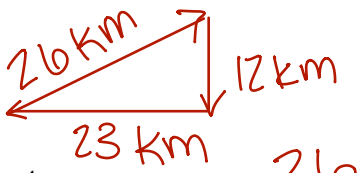
$y+1 = -2(x-3) \rightarrow y+1 = -2x+6 \rightarrow y = -2x+5$

A weather report shows that a tornado was sighted 12 km south and 23 km west of Stephenville. The storm is reported to be moving directly towards you at a speed of 82 km/hr.

a. What distance from your town was the tornado sighted?

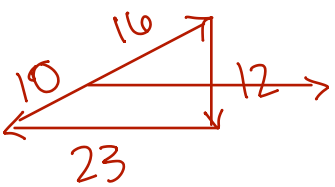
b. Approximately how much time (in minutes and hours) will elapse before the violent storm arrives in Stephenville?

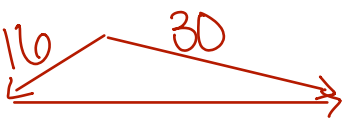
c. After traveling for 10 km on the tornado's original course, the wind patterns change and the storm begins moving due east at 82 km/hr. How long will it take for the storm to be at least 30 km away?



$\sqrt{12^2+23^2} = 26\text{ km}$

$\frac{26\text{ km}}{82\text{ km}} \left| \frac{1\text{ h}}{} \right. = 0.32\text{ hr} = 19\text{ min}$





$\sqrt{16^2+30^2} = 34$

$\frac{34\text{ km}}{82\text{ km}} \left| \frac{1\text{ hr}}{} \right. = 0.41\text{ hr} \approx 25\text{ min}$

Station 4:

1. (34, -8)
2. (3, 3)
3. (-0.5, 2)

Word Problem: 128 pine bark, 48 hardwood

Find the required information and graph the conic section:

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

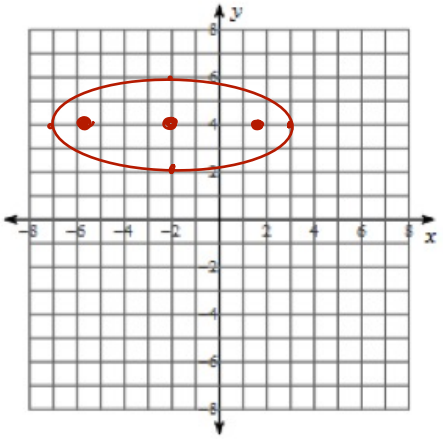
x−h y−k

$c^2 = a^2 - b^2$

$c^2 = 25 - 4 = \sqrt{21}$

$a = 5$ major $b = 2$ minor

Horiz.



(h, k)

Classify the conic section: ellipse **Center:** (−2, 4)

Vertices: (−7, 4)(3, 4) **Foci:** (−2 + √21, 4) (−2 − √21, 4)

(h ± a, k) (h ± c, k)

Find the required information and graph the conic section: $y = 2x^2 - 8x + 4$

vert

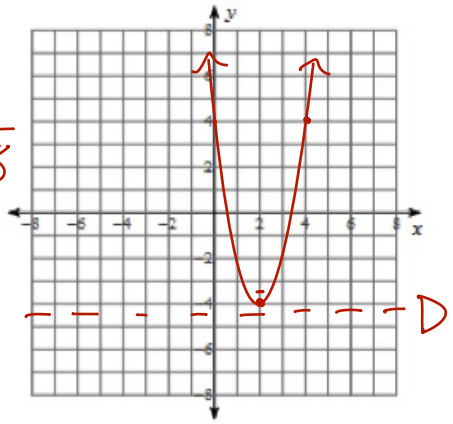
$[y = 2(x^2 - 4x + 2)] + 4$ $y + 4 = 2(x^2 - 4x + 2 + 2)$

$y + 4 = 2(x-2)^2$ $y = 2(x-2)^2 - 4$ $\frac{1}{4p} = 2$ $p = \frac{1}{8}$

$h = 2$ $k = -4$

$x = 0$, $y = 2(-2)^2 - 4$ (0, 4)

$= 8 - 4 = 4$



Classify the conic section: Parabola **Vertex:** (2, −4)

Focus: $(2, -\frac{31}{8})$ **Directrix:** $y = -\frac{33}{8}$

(h, k + p) $y = k - p$

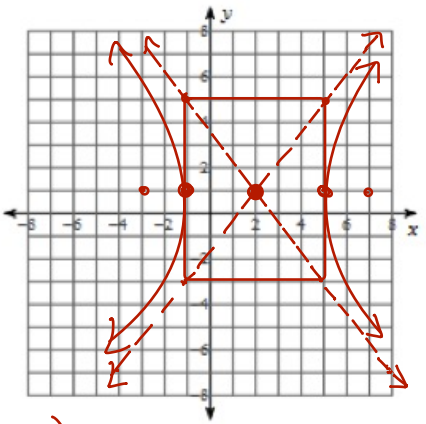
Find the required information. Then graph the conic section.

Horiz ← $\frac{(x-2)^2}{9} - \frac{(y-1)^2}{16} = 1$

h k

$c^2 = a^2 + b^2 = \sqrt{9 + 16} = \sqrt{25}$

$a = 3$ $b = 4$ $c = 5$



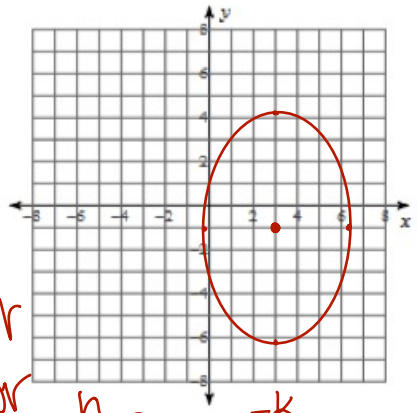
(h ± c, k)

Classify the conic section: Hyperbola **Foci:** (−3, 1)(7, 1)

Vertices: (−1, 1)(5, 1) **Asymptotes:** $\frac{4}{3}, -\frac{4}{3}$ **Center:** (2, 1)

(h ± a, k) $\pm\frac{b}{a}$

Find the required information and graph: $7x^2 + 3y^2 - 42x + 6y - 39 = 0$



$7(x^2 - 6x) + 3(y^2 + 2y) - 39 = 0$

$7(x^2 - 6x + 9) + 3(y^2 + 2y + 1) - 39 = 0 + 7(9) + 3(1)$

$7(x-3)^2 + 3(y+1)^2 - 39 = 66$

$7(x-3)^2 + 3(y+1)^2 = 105$

vert

y-major

x-minor

Classify the conic section: ellipse **Center:** $(3, -1)$

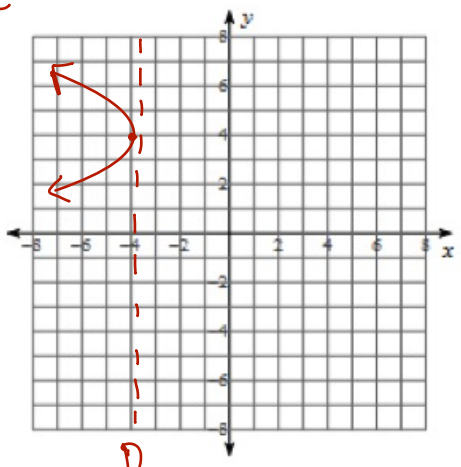
Vertices: $(3, -1+\sqrt{35})$ $(3, -1-\sqrt{35})$ $(h, k \pm a)$ **Foci:** $(3, -1+\sqrt{20})$ $(3, -1-\sqrt{20})$ $(h, k \pm c)$

$\frac{(x-3)^2}{15} + \frac{(y+1)^2}{35} = 1$ (h, −k)

$b = \sqrt{15}$ $a = \sqrt{35}$ $c^2 = 35 - 15 = \sqrt{20} = c$

Find the required information and graph the conic section:

$4y^2 + x - 32y + 68 = 0$



$x = -4y^2 + 32y - 68 = -4(y^2 - 8y + 16) - 4$

$x = -4(y-4)^2 - 4$

k −h

(h, k)

Classify the conic section: Parabola **Vertex:** $(-4, 4)$

(h+p, k) **Focus:** $(\frac{-65}{16}, 4)$ **Directrix:** $-63/16$

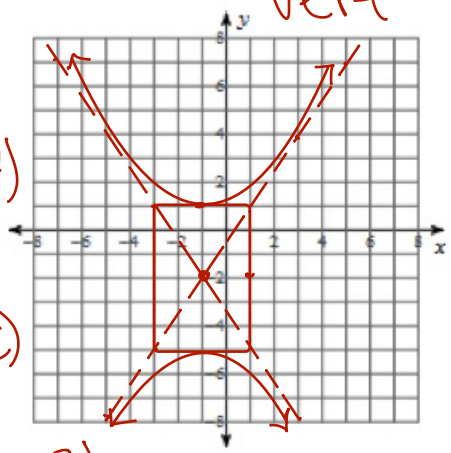
D

$D = h - p = -4 - \frac{1}{4(4)} = -4 + \frac{1}{16} = \frac{-64}{16} + \frac{1}{16} = \frac{-63}{16}$

$\frac{1}{4p} = -4$ $p = \frac{-1}{16}$

Find the required information. Then graph the conic section.

$-9x^2 + 4y^2 - 18x + 16y - 29 = 0$



vert

$-9(x^2 + 2x + 1) + 4(y^2 + 4y + 4) = 29 + (-9)1 + 4(4)$

$-9(x+1)^2 + 4(y+2)^2 = 36$ (h, k)

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

$-\frac{(x+1)^2}{4} + \frac{(y+2)^2}{9} = 1$ $c = \sqrt{3^2 + 2^2} = \sqrt{13}$ $(h, k \pm c)$

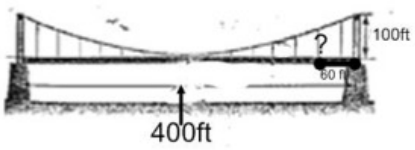
a=3

b=2

Classify the conic section: Hyperbola **Foci:** $(-1, -2+\sqrt{13})$ $(-1, -2-\sqrt{13})$

Vertices: $(-1, 1)(-1, -5)$ $(h, k \pm a)$ **Asymptotes:** $\pm 3/2$ $\pm b/a$ **Center:** $(-1, -2)$ (h, k)

21) The cables of a suspension bridge are in the shape of a parabola. The towers supporting the cables are 400ft apart and 100ft tall. If the supporting cable that runs from tower to tower is only 30 feet from the road at its closest point. Find the length of one of the vertical support cables that is 60 feet from the towers.



$(h,k)=(0,30)$

$(x,y)=(200,100)$

$100=a(200-0)^2+30$

$70=200^2a \quad \frac{70}{200^2}=a$

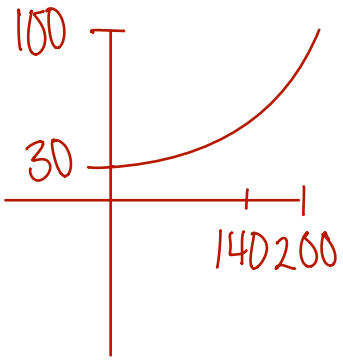
$y=a(x-h)^2+k$

$y=\frac{70}{200^2}(x)^2+30$

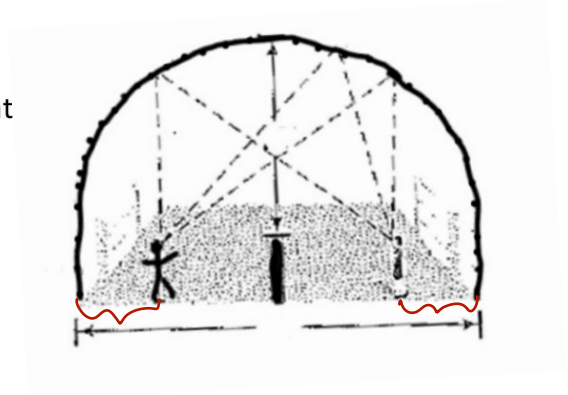
$x=140$

$y=\frac{70}{200^2}(140)^2+30$

$y=64.3$



Whispering Gallery: The figure below shows the specifications for an elliptical ceiling in a hall designed to be a whispering gallery. In an whispering gallery, a person standing at one focus of the ellipse can whisper and be heard by another person standing at the other focus, because all the sound waves that reach the ceiling from one focus are reflected to the other focus. If the hall below is 140 feet in length with 30 feet tall ceiling at its highest point. How far from the end walls will the foci point be?



$(h,k)=(0,0)$

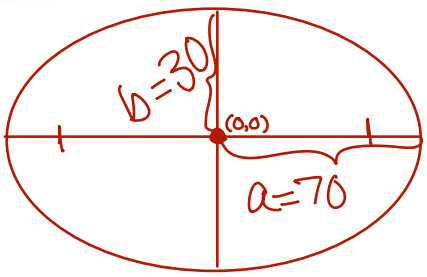
$\frac{(x-h)^2}{a^2}+\frac{(y-k)^2}{b^2}=1$

$\frac{x^2}{70^2}+\frac{y^2}{30^2}=1$

$c^2=a^2-b^2$

$c=\sqrt{70^2-30^2}$

$c=63.25$



foci - $(h\pm c,k)$ $(-63.25,0)(63.25,0)$

D (foci to wall) $=70-63.25=6.75$ ft

	Questions	Answers
1	Find the Dot Product of the Vectors. $\mathbf{u} = \langle -3, 0 \rangle$ $\mathbf{v} = \langle -4, -3 \rangle$	12
2	Find the Dot Product of the Vectors. $\mathbf{u} = \langle 5, -2 \rangle$ $\mathbf{v} = \langle -2, 9 \rangle$	-28
3	Find the Dot Product of the Vectors. $\mathbf{u} = 8\mathbf{i}$ $\mathbf{v} = 9\mathbf{j}$	0
4	Find the Angle Between the Vectors. $\mathbf{u} = -9\mathbf{i} - 2\mathbf{j}$ $\mathbf{v} = 3\mathbf{i} - 4\mathbf{j}$	$114.34°$
5	Find the Angle Between the Vectors. $\mathbf{u} = \langle -7, 7 \rangle$ $\mathbf{v} = \langle -6, -8 \rangle$	$98.13°$
6	Find the Angle Between the Vectors. $\mathbf{u} = \langle 9, -4 \rangle$ $\mathbf{v} = \langle 0, -8 \rangle$	$66.04°$

	Questions	Answers
7	Tell if the vectors are Parallel, Orthogonal or Neither $\mathbf{u} = \langle 4, 7 \rangle$ $\mathbf{v} = \langle 14, -8 \rangle$	Orthogonal
8	Tell if the vectors are Parallel, Orthogonal or Neither $\mathbf{u} = \langle 3, 6 \rangle$ $\mathbf{v} = \langle 6, 3 \rangle$	Neither
9	Tell if the vectors are Parallel, Orthogonal or Neither $\mathbf{u} = \langle -24, 16 \rangle$ $\mathbf{v} = \langle -6, 4 \rangle$	Parallel
10	Find the Resultant Vector. $\mathbf{f} = \langle 4, -1 \rangle$ $\mathbf{v} = \langle -9, 8 \rangle$ Find: $\mathbf{f} + \mathbf{v}$	$\langle -5, 7 \rangle$
11	Find the Resultant Vector. Given: $A = (8, -7)$ $B = (-7, -10)$ Find: $4\overrightarrow{AB}$	$\langle -60, -12 \rangle$
12	Find the Resultant Vector. Given: $A = (7, 1)$ $B = (10, -5)$ $C = (6, 8)$ $D = (3, -9)$ Find: $-\overrightarrow{AB} + \overrightarrow{CD}$	$\langle -6, -11 \rangle$

	Questions	Answers
13	Write the Resultant Vector as a Linear Combination. $\mathbf{u} = 14\mathbf{i} - 48\mathbf{j}$ Find: $\sqrt{3} \cdot \mathbf{u}$	$14\sqrt{3}$
14	Write the Resultant Vector as a Linear Combination. $\mathbf{a} = -10\mathbf{i} - 3\mathbf{j}$ $\mathbf{b} = 10\mathbf{i} - 5\mathbf{j}$ Find: $-\mathbf{a} + \mathbf{b}$	$20\mathbf{i} - 2\mathbf{j}$
15	Find the Magnitude of the Vector. $\overrightarrow{CD}$ where $C = (8, -10)$ $D = (10, 9)$	$\sqrt{365}$
16	Find the Magnitude of the Vector. $\overrightarrow{CD}$ where $C = (-2, 3)$ $D = (0, 6)$	$\sqrt{13}$
17	Find the Magnitude of the Vector. $\mathbf{r} = \langle 15, 36 \rangle$	39
18	Find the Magnitude of the Vector. $\mathbf{b} = \langle 4, -\sqrt{34} \rangle$	$5\sqrt{2}$

	Questions	Answers
19	Find the Magnitude of the Vector. $-9\mathbf{i} + 12\mathbf{j}$	15
20	Find the Direction Angle of the Vector. $\overrightarrow{PQ}$ where $P = (-6, 3)$ $Q = (10, -8)$	$325.49°$
21	Find the Direction Angle of the Vector. $\mathbf{k} = \langle 24, -32 \rangle$	$306.87°$
22	Find the Direction Angle of the Vector. $-10\mathbf{i} + \sqrt{69} \cdot \mathbf{j}$	$140.28°$
23	Find the Unit Vector in the opposite direction of a. $\mathbf{a} = \langle -13, 6\sqrt{22} \rangle$	$\left\langle \frac{13}{31}, -\frac{6\sqrt{22}}{31} \right\rangle$
24	Find the Unit Vector. Given: $T = (6, -1)$ $X = (6, -5)$	$\langle 0, -1 \rangle$