ELLIPSES P2

DEFINITION OF AN ELLIPSE A set of all points (x,y) in a plane whose distance from two fixed points (foci) in the plane have a constant sum. The line through the foci is called the focal axis (major axis). The point midway on the focal axis between the foci is the center.

CENTER — the point on the focal axis midway between the foci.

FOCI — plural of focus, the fixed points equidistant from the center and located on the focal axis (major axis).

VERTICES — the points where the ellipse intersects its axis.

CHORD — a line segment with endpoints on an ellipse.

Major Axis — the chord lying on the focal axis.

Minor Axis — the chord through the center perpendicular to the focal axis.

Semi-major axis — the major axis length is 2a, the number a is the semi-major axis.

Semi-minor axis — the length of the minor axis is 2b, the number b is the semi-minor axis.

ELLIPSES P4

DEFINITION OF AN ELLIPSE A set of all points (x,y) in a plane whose distance from two fixed points in the plane have a constant sum. The fixed points are the foci of the ellipse. The line through the foci is the focal axis (major axis). The point midway on the focal axis between the foci is the center.

CENTER — the point on the focal axis midway between the foci.

FOCI — plural of focus, the fixed points equidistant from the center and located on the focal axis (major axis).

VERTICES — the points where the ellipse intersects its axis.

CHORD — a line segment with endpoints on an ellipse.

Major axis — the chord lying on the focal axis.

Minor axis — the chord through the center perpendicular to the focal axis.

Semi-major axis — the major axis length is 2a, the number a is the semi-major axis.

Semi-minor axis — the length of the minor axis is 2b, the number b is the semi-minor axis.

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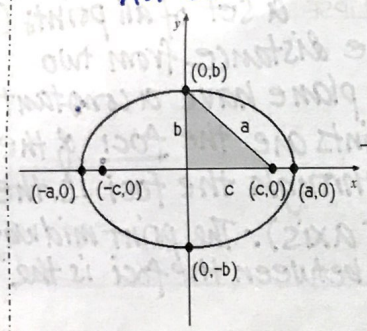
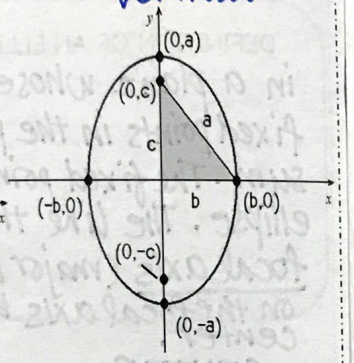
Pythagorean Relations

horizontal



vertical



Ellipses with Center (0, 0)

	hor.	ver.
Equation	$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$	$\frac{y^2}{a^2}+\frac{x^2}{b^2}=1$
Focal Axis	X-axis	y-axis
Foci	$(\pm c, 0)$	$(0, \pm c)$
Vertices maj / min	$(\pm a, 0)$ / $(0, \pm b)$	$(0, \pm a)$ / $(\pm b, 0)$
Semi-major	a	a
Semi-minor	b	b
Pythagorean Relation	$a^2=b^2+c^2$	$a^2=b^2+c^2$

$a > b$

Graphing Basic Ellipses

EX #1: $\frac{x^2}{25}+\frac{y^2}{9}=1$

$25 = 9 + c^2$

$16 = c^2$

Major axis: X-axis horizontal

Center: (0,0)

Major vertices: (5,0), (-5,0)

Minor vertices: (0, 3), (0,-3)

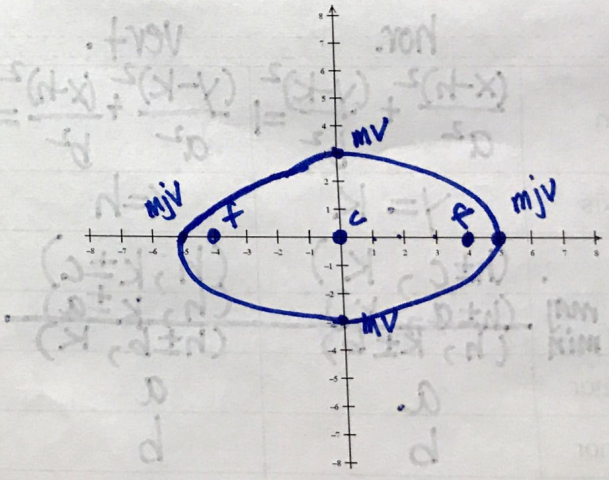
Foci: (4,0), (-4,0)

$a = 5$

$b = 3$

$c = 4$

hor.



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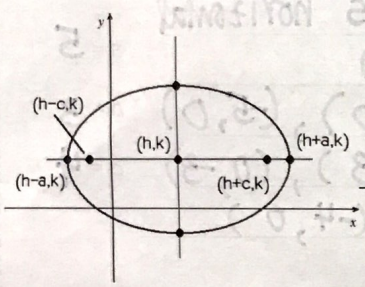
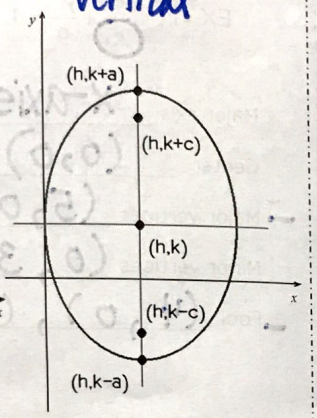
Ellipses with Center (h, k)

horizontal



vertical



	hor.	vert.
Equation	$\frac{(x-h)^2}{a^2}+\frac{(y-k)^2}{b^2}=1$	$\frac{(y-k)^2}{a^2}+\frac{(x-h)^2}{b^2}=1$
Focal Axis	$y=k$	$x=h$
Foci	$(h\pm c, k)$	$(h, k\pm c)$
Vertices (maj)	$(h\pm a, k)$	$(h, k\pm a)$
Vertices (min)	$(h, k\pm b)$	$(h\pm b, k)$
Semi-major	a	a
Semi-minor	b	b
Pythagorean Relation	$a^2=b^2+c^2$	$a^2=b^2+c^2$

$a > b$

Finding Vertices and Foci

EX #2: $9(x+3)^2+4(y+2)^2=36$ vertical

$\frac{36}{36}$

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

Major axis $x=-3$

Center $(-3,-2)$

Major vertices $(-3,1)$, $(-3,-5)$

Minor vertices $(-1,-2)$, $(-5,-2)$

Foci $(-3,-2+\sqrt{5})$, $(-3,-2-\sqrt{5})$

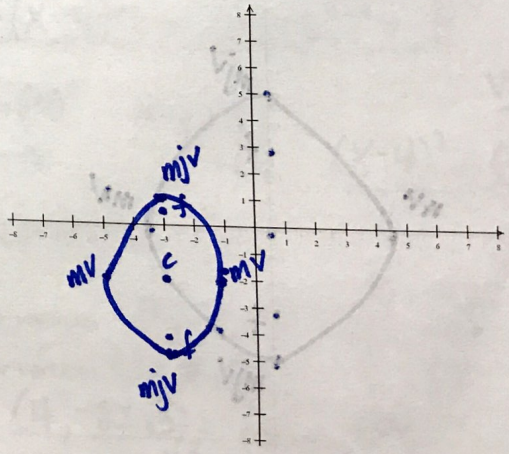
$a = 3$

$b = 2$

$c = \sqrt{5}$

$9-4=c^2$

$5=c^2$



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Finding an Equation of an Ellipse

EX #3: Find the equation in standard form for an ellipse whose foci are $(0,3)$ and $(0,-3)$ with a major axis length 10.

vertical

Equation: $\frac{(x)^2}{16} + \frac{y^2}{25} = 1$

Major axis y-axis

Center (0,0)

Major vertices (0, 5) (0,-5)

Minor vertices (4,0) (-4,0)

Foci (0,3) (0,-3)

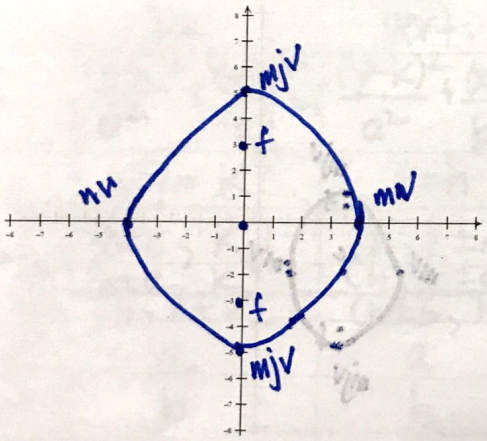
$a = 5$

$b = 4$

$c = 3$

$25 - 9 = b^2$

$16 = b^2$



Eccentricity

Eccentricity $e = \frac{c}{a}$ where a is the semi-major axis, c is the distance from the center to either foci, b is the semi-minor axis

EX #4: Prove that the graph of the equation is an ellipse, find its vertices, foci and eccentricity.

$$4x^2 + y^2 - 32x + 16y + 124 = 0$$

complete the square

$4x^2 - 32x + y^2 + 16y = -124$

$4(x^2 - 8x + 16) + (y^2 + 16y + 64) = -124 + 4(16) + 64$

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

$-8 \cdot \frac{1}{2} = (-4)^2 = 16$

$16 \cdot \frac{1}{2} = 8^2 = 64$

vertical

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

center (4, -8)

$a = 2$

$b = 1$

$c = \sqrt{3}$

$4 - 1 = c^2$

$3 = c^2$

Major vertices $(4, -8 \pm 2) = (4, -6)\ (4, -10)$

Minor vertices $(4 \pm 1, -8) = (5, -8)\ (3, -8)$

Foci $(4, -8 \pm \sqrt{3}) = (4, -8 + \sqrt{3})\ (4, -8 - \sqrt{3})$

Eccentricity $e = \frac{\sqrt{3}}{2}$

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Name _____ Date _____ Period _____

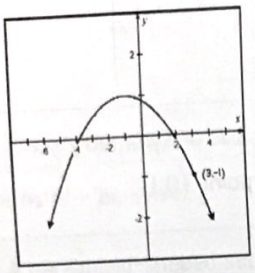
Parabolas

Warm-up 9/6 1-6, #12

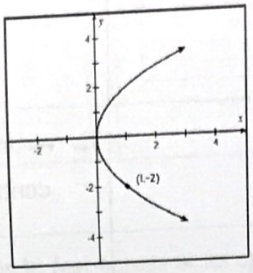
Problems 1 – 6, the graph of a parabola is given. Match each graph to its equation.

A. $(y-2)^2=(x+2)$	B. $(x-1)^2=4(y+1)$	C. $y^2=-4x$
D. $y^2=4x$	E. $(x-2)^2=-4(y-2)$	F. $(x+1)^2=-8(y-1)$

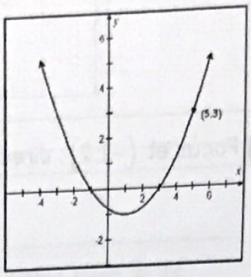
1. F



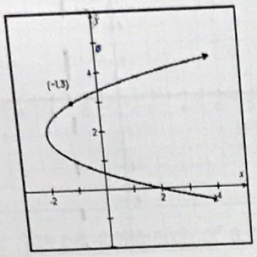
2. D



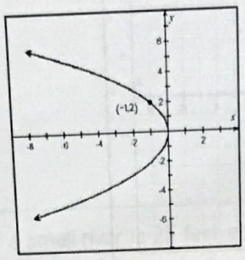
3. B



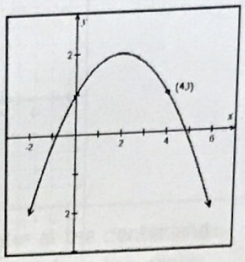
4. A



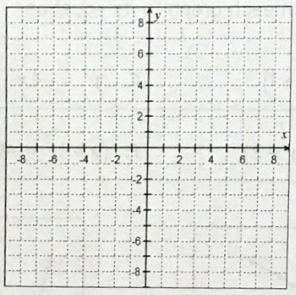
5. C



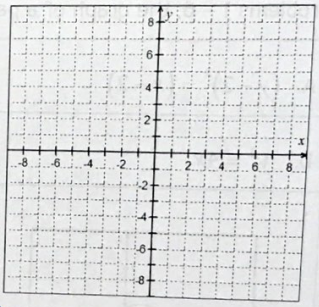
6. E



9. Focus at $(1,3)$; directrix $x=-3$



10. Vertex at $(4,-2)$; focus at $(6,-2)$

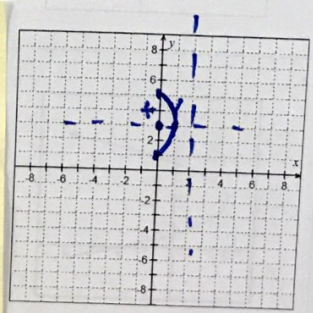


11. Focus at $(-2,2)$; directrix $y=6$

12. vertex at $(1,3)$; axis of symmetry $y=3$; containing the point $(0,1)$

h,k

$(y-k)^2=4p(x-h)$
$(y-3)^2=4p(x-1)$
$(1-3)^2=4p(0-1)$
$4=4p(-1)$
$-1=p$
$(y-3)^2=-4(x-1)$ ✓



Problems 13 – 16, find the

a. Graph the equation.

13. $(y-1)^2=8(x+2)$

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