11.1 Activity

In this Investigation, you will create a graph of a set of points in a plane that are equidistant from a given line and a given point not on the line, and examine some of the special characteristics of your parabola.

1. Examine a piece of focus-directrix paper. What do you notice about the paper?

The paper is made up of concentric circles & horizontal lines. The distance between the horizontal lines is congruent and represents the distance between the circles.

2. On your piece of focus-directrix paper, draw a horizontal line that is two units below the point at the center of the circles. Label the center point "focus" and the line "directrix." You will use this focus and directrix to create a parabola.

3. In the figure shown below, a second point is shown in red. What can you say about the distance between this point and the focus and the distance between this point and the directrix?

The distance from the point to the focus and from the point to the directrix are both 1 unit. Therefore the point is equidistant from the focus+directrix

4. Use the circles and lines on the paper to help you locate at least ten more points that are equally distant from the focus and the directrix. Find points that are to the left and to the right of the focus. (Recall that the distance between a point and a line is the length of the perpendicular from the given point to the line.)

5. Connect the points with a smooth curve. Since all points on your curve are equidistant from a given point (the focus) and a given line (the directrix) all of the points you plotted lie on the graph of a parabola.

6. Describe your graph. The graph is "U" shaped and open upwards.

7 a. Does the graph show line symmetry? If so, describe the line of symmetry.

b. For a parabola, the line of symmetry of the graph is called the **axis of symmetry**. Draw the line of symmetry for your graph and label it "axis of symmetry."

a) Yes, the line of symmetry passes through the focus and is perpendicular to the directrix

8. Now draw a horizontal axis and vertical axis on your paper. Place the origin where your axis of symmetry intersects the parabola. This lowest point on this graph is the *minimum value* and is called the **vertex** of the parabola. Label the horizontal axis "x" and the vertical axis "y."

9. Does your graph represent a function? Explain.

Yes, it passes the Vertical Line Test (each input value has exactly one output value)

10 a. Examine only the portion of the graph where $x > 0$. Look at the curve from left to right. Is the graph increasing or decreasing? Increasing

b. Now examine only the portion of the graph where $x < 0$. Look from left to right at the curve. Is the graph increasing or decreasing? Decreasing

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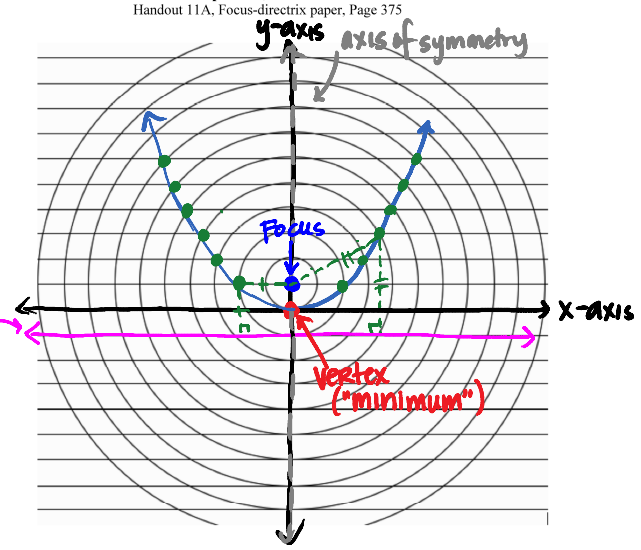

11 a. What happens to the height of the graph as x increases without bound? (Hint: to answer this question, look at the graph to see what happens to it as you move farther and farther to the right along the horizontal axis.) it increases w/o bound

b. What happens to the height of the graph as x decreases without bound? (Hint: to answer this question, look at the graph to see what happens to it as you move farther and farther to the left along the horizontal axis.) it increases w/o bound

If a parabola has a vertex at the origin, a focus at $(0, p)$, and a directrix $y = -p$, the standard-form equation of the parabola is $x^2 = 4py$. Notice that the value of p can be positive or negative as p represents the directed distance from the vertex to the focus.

12. Find an equation for your parabola in Question 8.

Since p=1, the equation for this parabola would be:

$x^2 = 4(1)y$

or just...

$\boxed{x^2 = 4y}$

13 a. Use another piece of focus-directrix paper. In this construction, draw the directrix two units *above* the focus at the center of the circles. Then construct the parabola with the given focus and directrix.

b. Again draw a horizontal axis and vertical axis on your paper with the origin at the vertex of your parabola.

↳ maximum

14. Does the parabola open up or down? down

15. What are the coordinates of the vertex of this parabola? (0,0)

16. Describe when the graph is increasing and when it is decreasing. (Hint: be sure to look at the curve from left to right as you describe the curve.)

when $x<0$, the curve is increasing. When $x>0$, the curve is decreasing

17. What is the directed distance from the vertex to the focus?

The directed distance from the vertex to the focus is -1

18. What is the value of p? $p=-1$

19. Write an equation for the parabola. $x^2=4py$

$x^2=4(-1)y$

$\boxed{x^2=-4y}$

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