**Activity 5.7.2a Parabolas in the Coordinate Plane**

Definition: A **parabola** is the locus of points in a plane that are equidistant from a fixed point (called the **focus**) and a given line (called the **directrix**).

In the figure below, the directrix has equation *y* = – 1. The focusis *F*(0,1).



1. Use the distance formula to find:

*P*1*Q*1 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ *P*1*F* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*P*2*Q*2 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ *P*2*F* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
*P*3*Q*3 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ *P*3*F* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
*P*4*Q*4 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ *P*4*F* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What do you notice about the pairs of distances found in question 1?
2. Point *V*(0,0) is the vertex of this parabola.

a. Show that *V* lies on the parabola.

b. *V* is the midpoint of which line segment?
3. Draw a smooth curve through the points *P*1, *P*2, *P*3, *P*4 and *V*. This curve is the parabola with focus (0, 1) and directrix *y* = – 1.
4. The parabola you drew has an equation of the form *y* = *ax*2. Use the table below to experiment with various values of *a* until you find one that fits all five points on your parabola. (The case of *a* = 1 has been done for you. Add extra columns if needed.)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Point | *x*-value | *a* = 1 | *a* = \_\_\_\_ | *a* = \_\_\_\_ | *a* = \_\_\_\_ | *a* = \_\_\_\_ |
|  |  | *y =* 1*x*2 | *y =* \_\_\_\_*x*2 | *y =* \_\_\_\_*x*2 | *y =* \_\_\_\_*x*2 | *y =* \_\_\_\_*x*2 |
| *P*1 (–4, 4) | –4 | 16 |  |  |  |  |
| *P*1 (–2, 1) | –2 | 4 |  |  |  |  |
| *V* (0, 0) | 0 | 0 |  |  |  |  |
| *P*1 (2, 1) | 2 | 4 |  |  |  |  |
| *P*1 (4, 4) | 4 | 16 |  |  |  |  |

1. Record the value of *a* you found in question 5: *a* = \_\_\_\_\_\_\_