

Parabola Focus Hunt

Use equations, vertices, foci, and directrices to describe parabolas.

HIGH SCHOOL • MA.912.GR.7

MA.912.GR.7 "Apply geometric and algebraic representations of conic sections."

NAME _____

DATE _____

FOCUS FORMULA

In $(x-h)^2 = 4p(y-k)$, the vertex is (h,k) , the focus is $(h,k+p)$, and the directrix is $y=k-p$. Here p is the directed distance from the vertex to the focus, so divide the coefficient by 4. For a horizontal parabola, use $(y-k)^2 = 4p(x-h)$, focus $(h+p,k)$, and directrix $x=h-p$.

WORKED EXAMPLE

Find the vertex, focus, and directrix of $(x-11)^2 = 28(y+13)$.

1. Compare $4p = 28$, so $p = 7$.
2. The vertex is $(11,-13)$.
3. The focus is $(11,-13+7) = (11,-6)$.
4. The directrix is $y = -13-7 = -20$.

Answer: Vertex (11,-13), focus (11,-6), directrix $y = -20$.

PRACTICE 6 problems

- 1** Find the vertex, focus, and directrix of $(x+4)^2 = 16(y-5)$.

ANSWER _____

- 2** Find the vertex, focus, and directrix of $(y-9)^2 = -32(x+4)$.

ANSWER _____

- 3** Write the equation of the parabola with vertex $(8,-4)$ and focus $(8,5)$.

ANSWER _____

- 4** Write the equation of the parabola with vertex $(-5,3)$ and directrix $x = -9$.

ANSWER _____

- 5** Rewrite $x^2 - 10x - 8y + 9 = 0$ in standard form. Then find the vertex, focus, and directrix.

ANSWER _____

- 6** A parabola has focus $(3,-9)$ and directrix $y = -15$. Write its equation.

ANSWER _____

APPLY IT Show your work

- 1** A concert spotlight reflector has a cross section modeled by $(x-2)^2 = -16(y-9)$, where the coordinates are measured in centimeters. The bulb must be placed at the focus. Where should the bulb be placed?

WORK SPACE

ANSWER _____

- 2** A student robotics team makes a parabolic Wi-Fi reflector modeled by $(y+1)^2 = 16(x-4)$, where the coordinates are measured in centimeters. The receiver belongs at the focus. Where should the team place the receiver?

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

Rewrite $y^2 - 10y + 16x + 9 = 0$ in standard form. Then find the vertex, focus, and directrix.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	Find the vertex, focus, and directrix of $(x+4)^2 = 16(y-5)$.	Vertex $(-4,5)$, focus $(-4,9)$, directrix $y = 1$.
2	Find the vertex, focus, and directrix of $(y-9)^2 = -32(x+4)$.	Vertex $(-4,9)$, focus $(-12,9)$, directrix $x = 4$.
3	Write the equation of the parabola with vertex $(8,-4)$ and focus $(8,5)$.	$(x-8)^2 = 36(y+4)$
4	Write the equation of the parabola with vertex $(-5,3)$ and directrix $x = -9$.	$(y-3)^2 = 16(x+5)$
5	Rewrite $x^2 - 10x - 8y + 9 = 0$ in standard form. Then find the vertex, focus, and directrix.	Standard form: $(x-5)^2 = 8(y+2)$. Vertex $(5,-2)$, focus $(5,0)$, directrix $y = -4$.
6	A parabola has focus $(3,-9)$ and directrix $y = -15$. Write its equation.	$(x-3)^2 = 12(y+12)$

PART 2 • APPLY IT

- (2,5)** Since $4p = -16$, $p = -4$. The vertex is $(2,9)$, so the focus is $(2,9-4) = (2,5)$.
- (8,-1)** Since $4p = 16$, $p = 4$. The vertex is $(4,-1)$, so the focus is $(4+4,-1) = (8,-1)$.

CHALLENGE

Standard form: $(y-5)^2 = -16(x-1)$. Vertex $(1,5)$, focus $(-3,5)$, directrix $x = 5$.

Accept equivalent standard-form equations and correctly expanded equivalent equations. For each parabola, accept answers with the same vertex, focus, and directrix even if the student lists them in a different order.