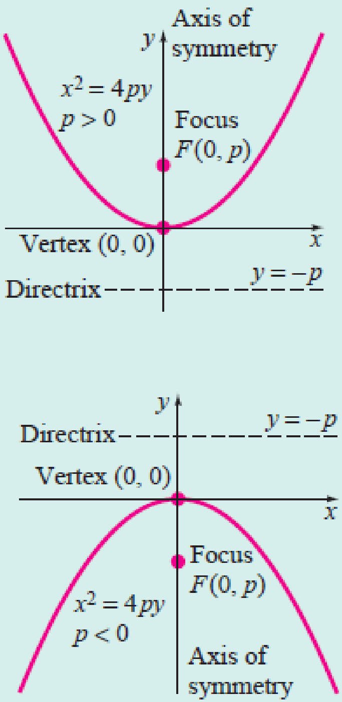
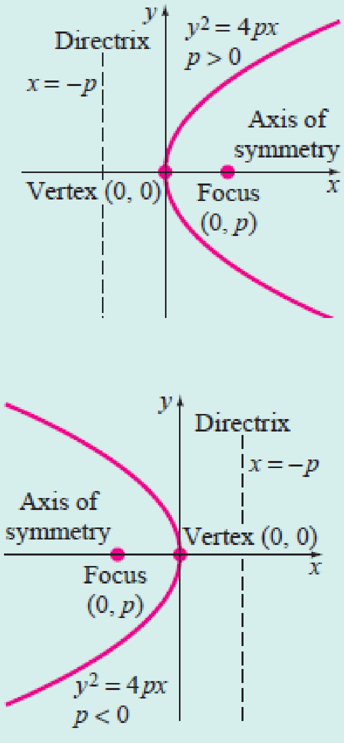
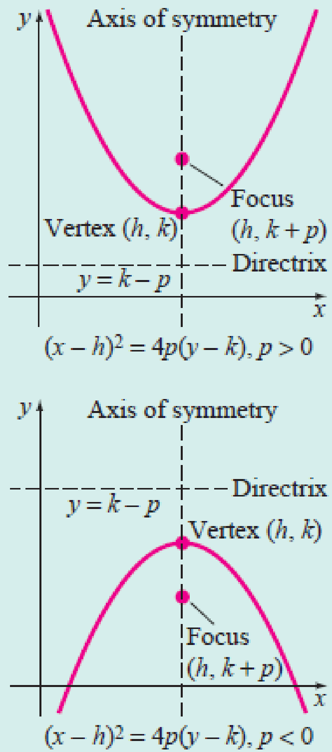
Parabola with Vertex at the Origin

	Vertical Axis of Symmetry	**Horizontal Axis of Symmetry**
Graph	Figure 9.1.5  	Figure 9.1.6 
Equation	$x^2 = 4py$	$y^2 = 4px$
Direction of opening	Upward if $p > 0$, downward if $p < 0$	To the right if $p > 0$, to the left if $p < 0$
Vertex	(0, 0)	(0, 0)
Focus	(0, p)	(p, 0)
Directrix	The line $y = -p$	The line $x = -p$
Axis of symmetry	y-axis	x-axis

Parabolas with Vertex at (h, k)

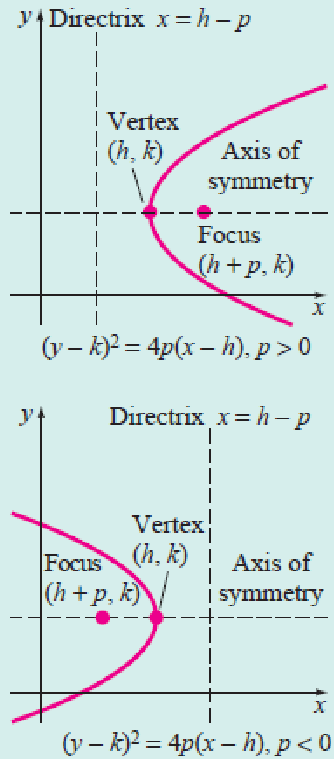
<table>
<tr><th></th><th>Vertical Axis of Symmetry</th><th>Horizontal Axis of Symmetry</th></tr>
<tr><td>Graph</td><td>

Figure 9.1.11



</td><td>

Figure 9.1.12



</td></tr>
<tr><td>Equation</td><td>$(x - h)^2 = 4p(y - k)$</td><td>$(y - k)^2 = 4p(x - h)$</td></tr>
<tr><td>Direction of opening</td><td>Upward if $p > 0$, downward if $p < 0$</td><td>To the right if $p > 0$, to the left if $p < 0$</td></tr>
<tr><td>Vertex</td><td>(h, k)</td><td>(h, k)</td></tr>
<tr><td>Focus</td><td>$(h, k + p)$</td><td>$(h + p, k)$</td></tr>
<tr><td>Directrix</td><td>The line $y = k - p$</td><td>The line $x = h - p$</td></tr>
<tr><td>Axis of symmetry</td><td>The line $x = h$</td><td>The line $y = k$</td></tr>
</table>

▶ Parabola with vertical axis of symmetry:

Equation	$(x - h)^2 = 4p(y - k)$
Opening	Upward if $p > 0$, downward if $p < 0$
Vertex	(h, k)
Focus	$(h, k + p)$
Directrix	$y = k - p$
Axis of symmetry	$x = h$

If the vertex is at the origin, then $(h, k) = (0, 0)$.

▶ Parabola with horizontal axis of symmetry:

Equation	$(y - k)^2 = 4p(x - h)$
Opening	To the right if $p > 0$, to the left if $p < 0$
Vertex	(h, k)
Focus	$(h + p, k)$
Directrix	$x = h - p$
Axis of symmetry	$y = k$

If the vertex is at the origin, then $(h, k) = (0, 0)$.