

# 5.1 Parabolas

$$y = x^2$$

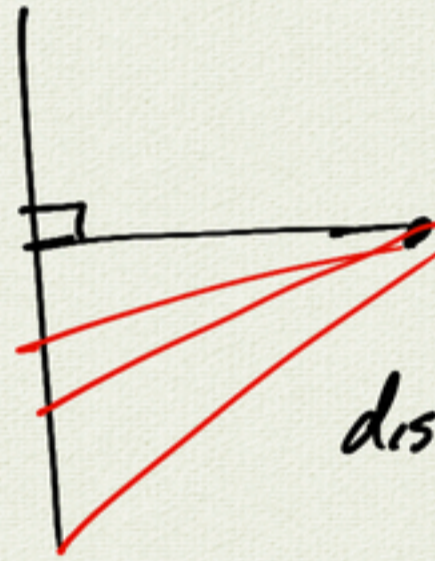
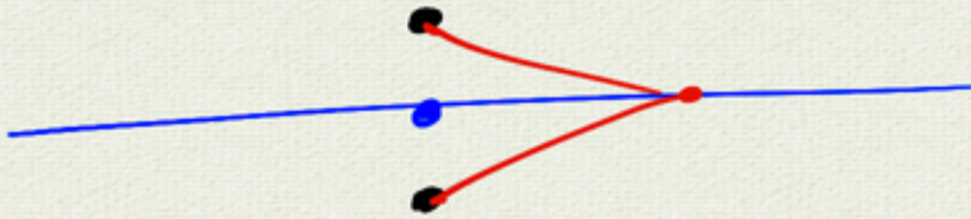


geometry

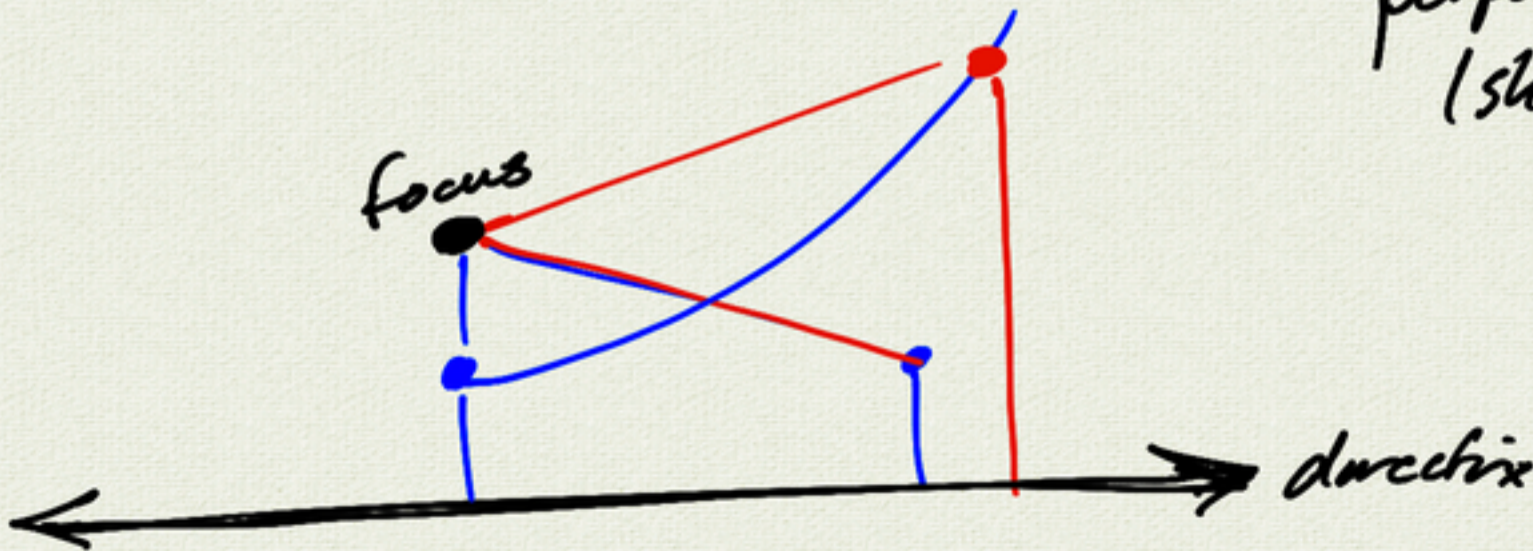


circle:

set of all points  
equidistant from some  
center

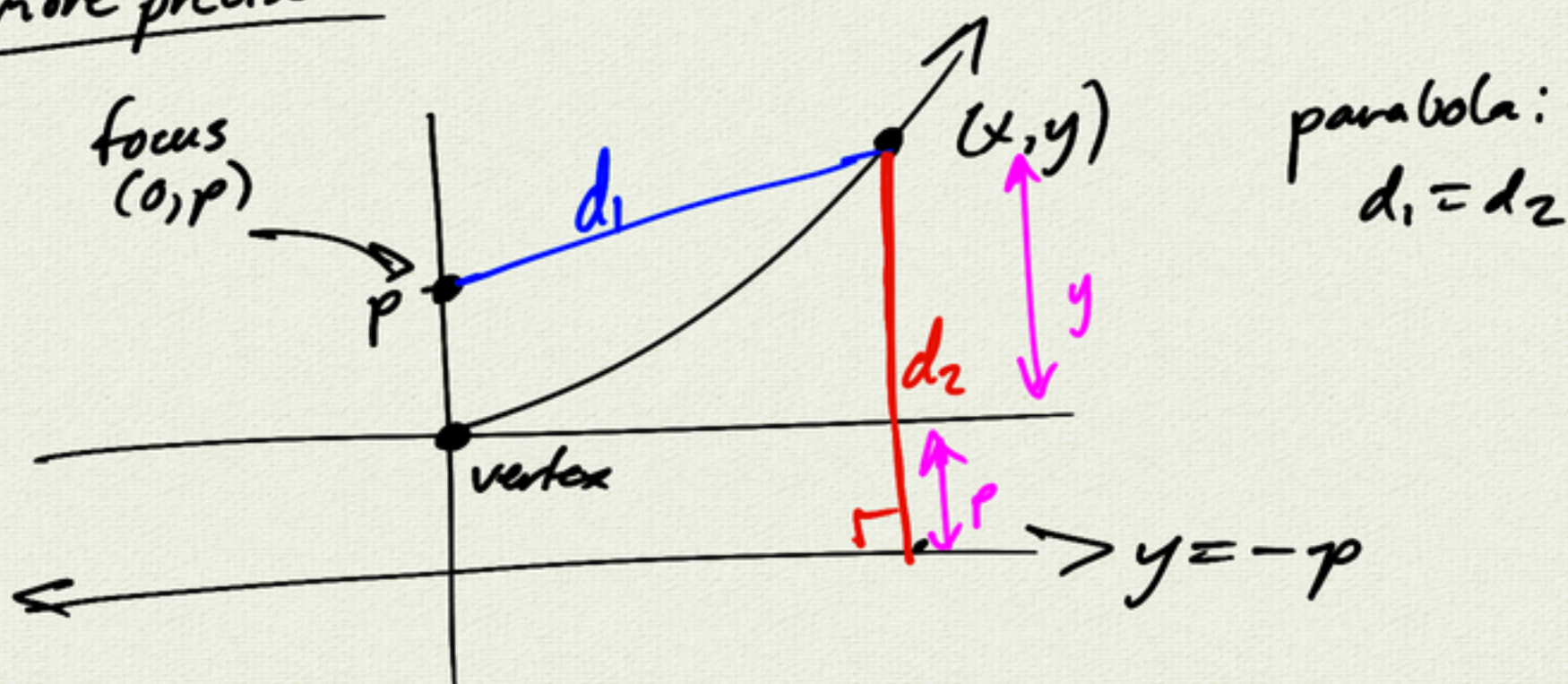


distance to  
line?  
perpendicular  
(shortest)



parabola: set of points equidistant  
from a point and a line  
focus directrix

more precise



parabola  $\Rightarrow d_1 = d_2$

$$\sqrt{x^2 + (y-p)^2} = y+p$$

$$x^2 + (y-p)^2 = (y+p)^2$$

$$x^2 + \underline{y^2} - 2py + \underline{p^2} = \underline{y^2} + 2py + \underline{p^2}$$

$$x^2 = 4py$$

$$y = \boxed{\frac{1}{4p}} x^2$$

parabola

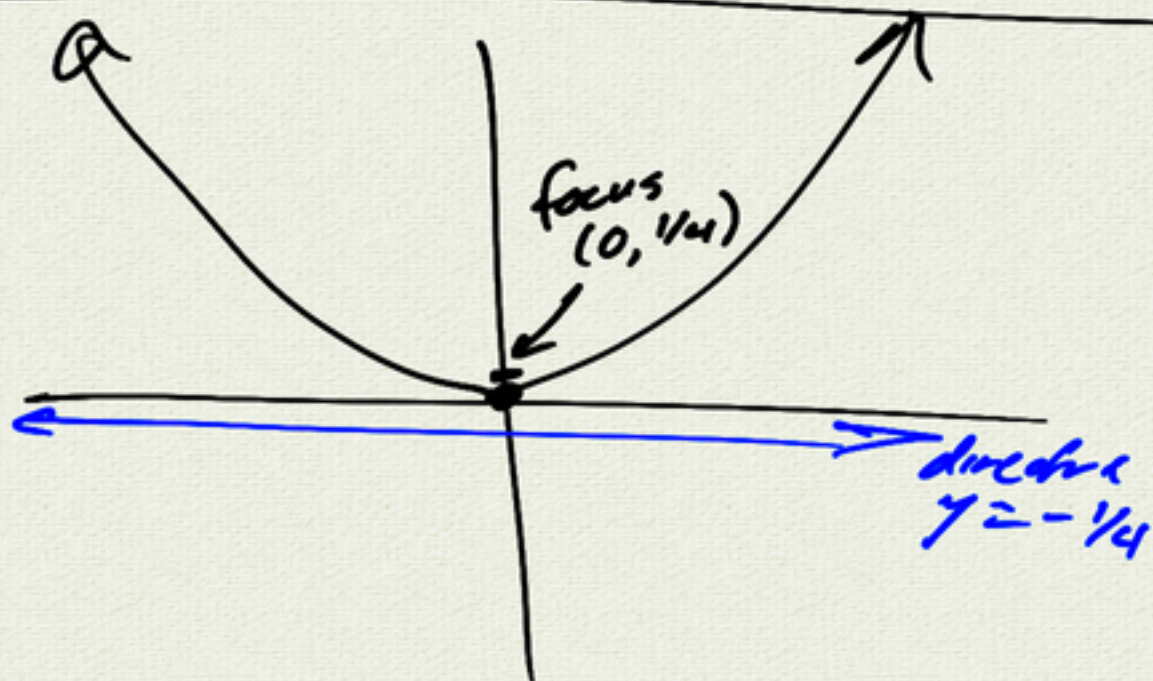
example:

$$y = x^2$$

$$y = \boxed{\frac{1}{4p}} x^2$$

$$\Rightarrow \frac{1}{4p} = 1$$

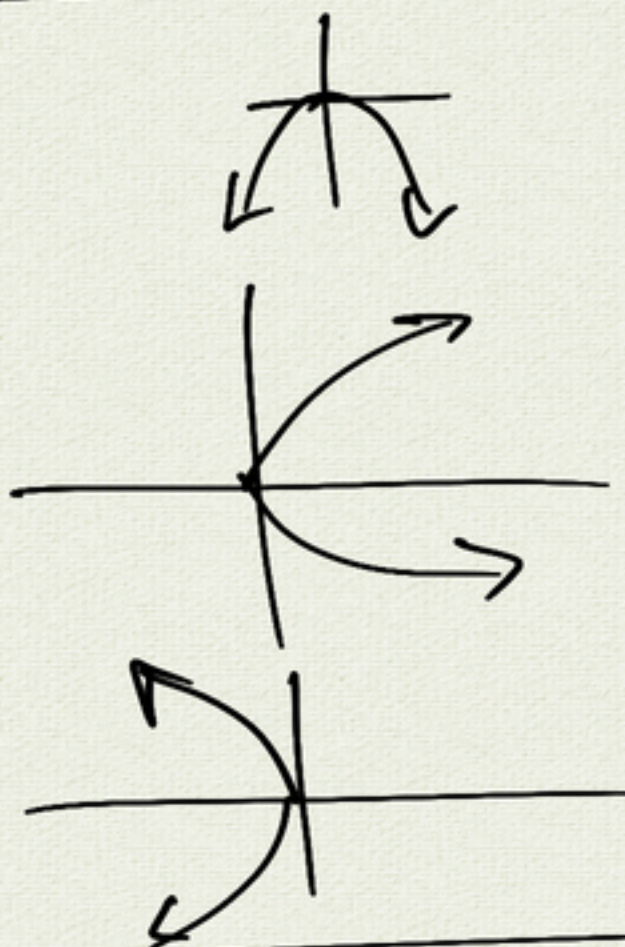
$$p = \frac{1}{4}$$



$$y = -x^2$$

$$x = y^2$$

$$x = -y^2$$



vertex  $(h, k)$

$$y - k = \frac{1}{4p} (x - h)^2$$

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

vertical shift

$$y = \frac{1}{4p} x^2$$

$$y - k = \frac{1}{4p} (x - h)^2$$

book:

$$x^2 = 4py$$

$$(x - h)^2 = 4p(y - k)$$

?

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$$(y-2)^2 = -\frac{4}{3}(x+2)$$

$$= -\frac{4}{3}x - \frac{8}{3}$$

$$(y-2)^2 + \frac{8}{3} = -\frac{4}{3}x$$

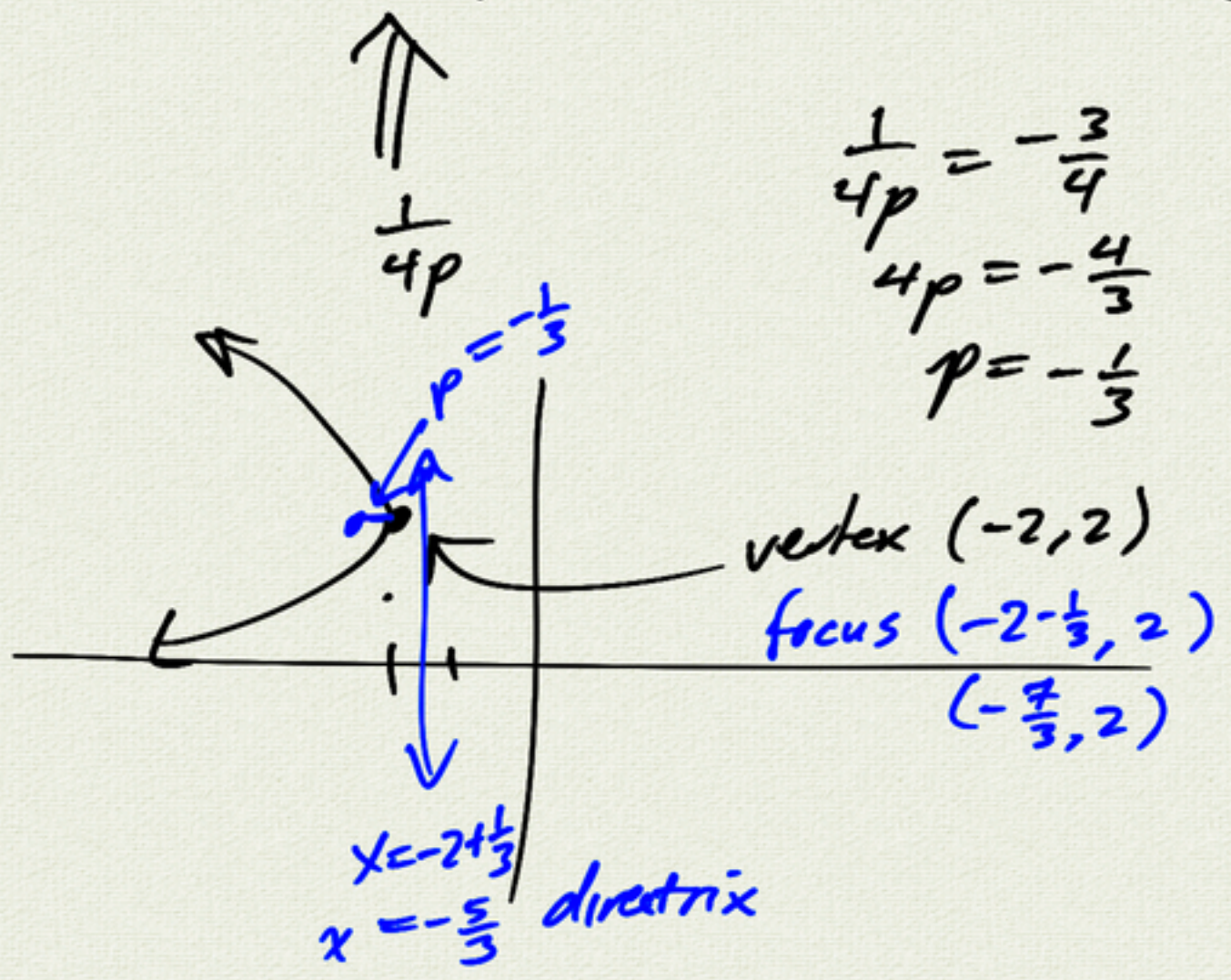
$$x = \left(-\frac{3}{4}\right)(y-2)^2 + \left(-\frac{3}{4}\right)\left(\frac{8}{3}\right)$$

$$x = -\frac{3}{4}(y-2)^2 - 2$$

$$x+2 = -\frac{3}{4}(y-2)^2$$

vertex (-2, 2)

$$\frac{1}{4p} = -\frac{3}{4}$$
$$4p = -\frac{4}{3}$$
$$p = -\frac{1}{3}$$



$$(39) \quad \boxed{x^2 + 8x} + 4y + 20 = 0$$

$$(x^2 + 8x + 16) + 4y + 20 = 16$$

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

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

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

$$(x+a)^2 = x^2 + \boxed{2a}x + a^2$$

