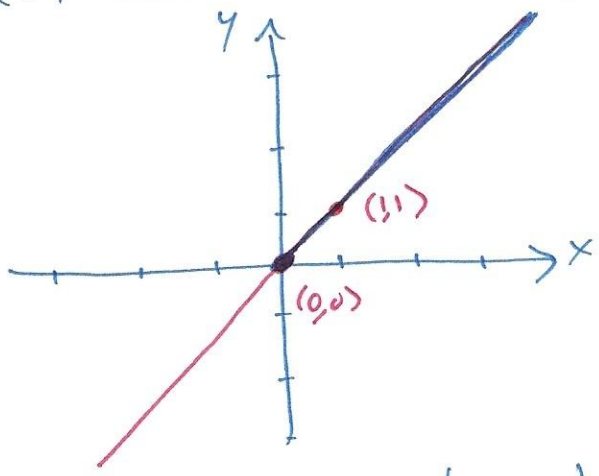
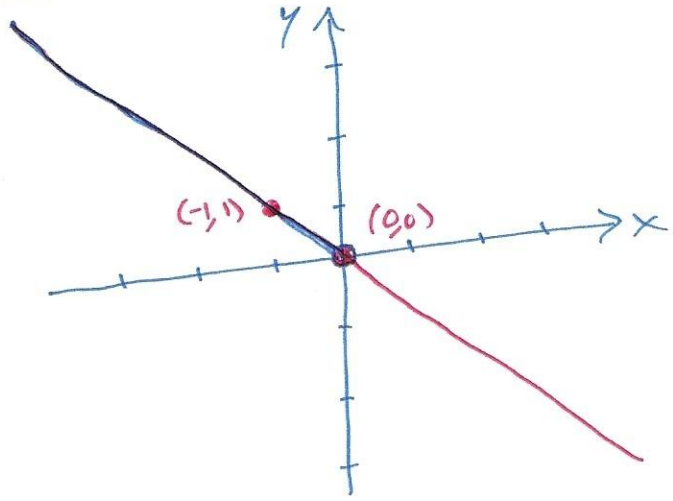
Section 2.5

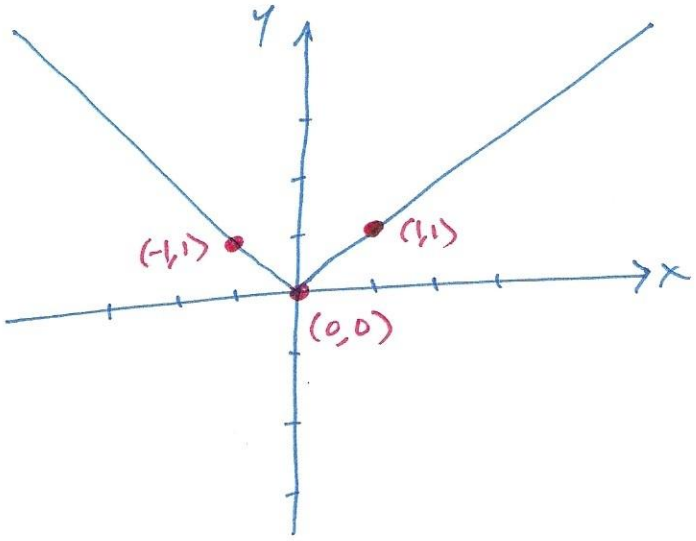
To graph $f(x) = |x|$ we first consider the graph of $y = x$, for $x \geq 0$. This is a line with slope $m = 1$, and x- and y-intercept at the origin. We need a second point on the line so we choose $x = 1$ and find that $y = 1$, so this is the point $(1,1)$.



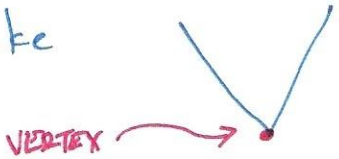
Next we consider the graph of $y = -x$, for $x < 0$. This is a line with slope $m = -1$, and x- and y-intercept at the origin. We need a second point on the line so we choose $x = -1$ and find that $y = -(-1) = 1$, so this is the point $(-1,1)$.



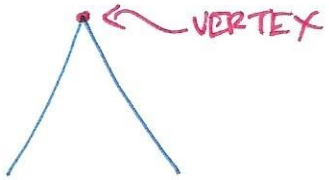
Combining the graph of $y=x$ for $x \geq 0$ and the graph of $y=-x$ for $x<0$, we obtain the graph of $f(x)=|x|$.



For any absolute value function $f(x)=a|x-h|+k$, the graph will look like



or



We obtain a V-shape if $a>0$ and a Λ-shape if $a<0$.

The vertex of the absolute value graph is the point (h,k).

The absolute value graph always has one y-intercept.

It may have zero, one or two x-intercepts.

To graph an absolute value function, we need the vertex, the y-intercept, any x-intercepts, and the point on the opposite of the vertex from the y-intercept (which can be obtained using the symmetry of the graph).

eg Sketch the graph of $f(x) = |x+3| - 2$.

Here $a=1$, $h=-3$, $k=-2$. So the vertex is the point $(-3,-2)$.

The y-intercept is found by setting $x=0$, so

$$f(0) = |0+3| - 2 = 3-2 = 1$$

and hence y-intercept is $(0,1)$.

Thus the point on the other side of the vertex from the y-intercept is $(-6,1)$.

To determine any x-intercepts we set $f(x)=0$ so

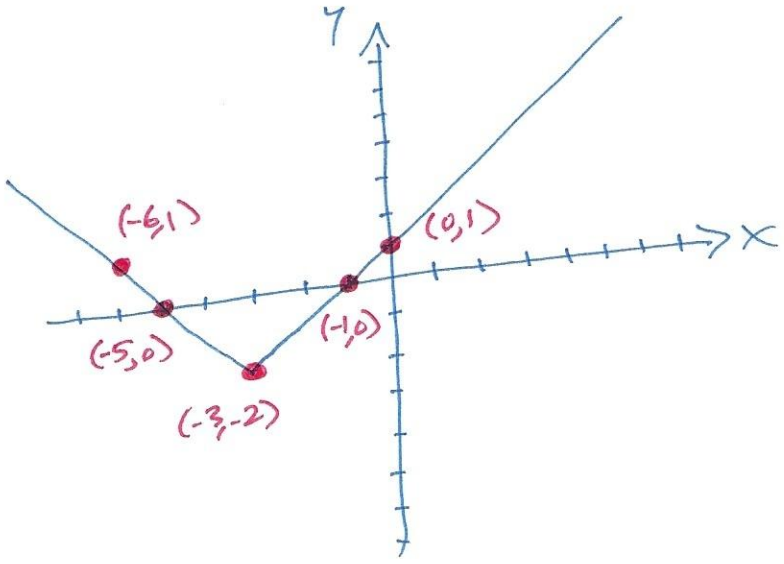
$$|x+3| - 2 = 0$$

$$|x+3| = 2$$

Then $x+3 = 2$ or $x+3 = -2$

$x = -1$ $\quad$ $x = -5$

Hence the x-intercepts are $(-1,0)$ and $(-5,0)$.



eg Sketch the graph of $f(x) = -|5-2x|$.

We can rewrite $f(x)$ in the form $f(x) = a|x-h|+k$ as follows:

$$f(x) = -\left|-2\left(x-\frac{5}{2}\right)\right| + 0$$

$$= -|-2| \cdot \left|x-\frac{5}{2}\right| + 0$$

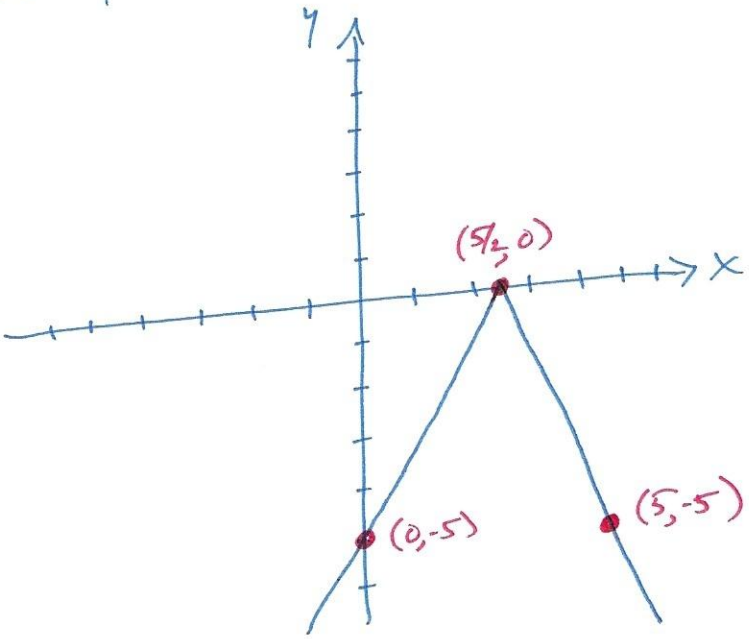
$$= -2\left|x-\frac{5}{2}\right| + 0$$

so $a=-2$, $h=\frac{5}{2}$, $k=0$. The vertex is $\left(\frac{5}{2}, 0\right)$ which is therefore also the only x-intercept.

Now we have $f(0) = -|5-2\cdot 0| = -|5| = -5$.

Thus the y-intercept is $(0,-5)$.

The point on the opposite side of the vertex from the y-intercept is $(5,-5)$.



Def'n: A **square root function** is any function that can be written in the form

$$f(x) = a\sqrt{x-h} + k$$

or

$$f(x) = a\sqrt{h-x} + k$$

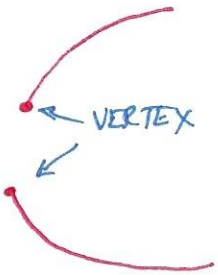
for $a \neq 0$.

The graph of a square root function is a **semi-parabola**

There are 4 cases:

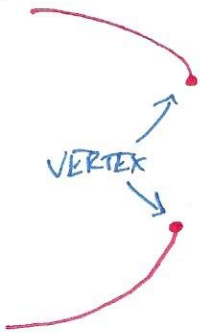
① if $a > 0$ and the square root is $\sqrt{x-h}$ then it opens upward to the right

② if $a < 0$ and the square root is $\sqrt{x-h}$ then it opens downward to the right



③ if $a > 0$ and the square root is $\sqrt{h-x}$ then it opens upward to the left

④ if $a < 0$ and the square root is $\sqrt{h-x}$ then it opens downward to the left



The domain of linear, quadratic and absolute value functions is $\mathbb{R}$. However, the domain of a square root function of the form $f(x) = a\sqrt{x-h} + k$ is $x \geq h$. The domain of a square root function of the form $f(x) = a\sqrt{h-x} + k$ is $x \leq h$.

The point (h,k) is still the vertex, but is now the point where the graph begins or ends.