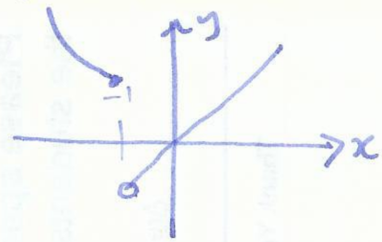
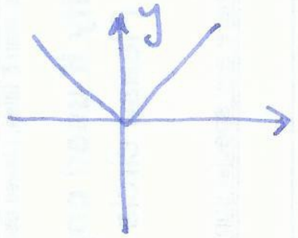
Alternate method: use a graphing calculator.

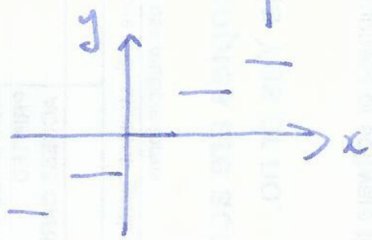


Examples $f(x) = \begin{cases} x^2 & \text{if } x \leq -1 \\ x & \text{if } x > 1 \end{cases}$

$f(x) = |x| = \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{if } x < 0 \end{cases}$



$f(x) = \lfloor x \rfloor =$ greatest integer less than x



$f(x) = \frac{1}{x}$

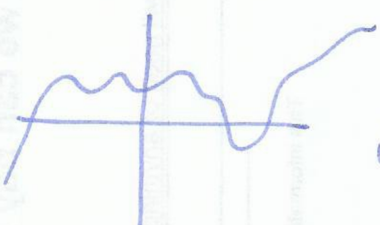
$f(x) = \sqrt{x}$.

Warning: a graph of a function $f: \mathbb{R} \to \mathbb{R}$ is a subset of the plane ($\mathbb{R}^2$) $\mathbb{R} \times \mathbb{R}$

not all subsets of the plane are graphs of functions!

e.g.

$\leftarrow$ not a graph!

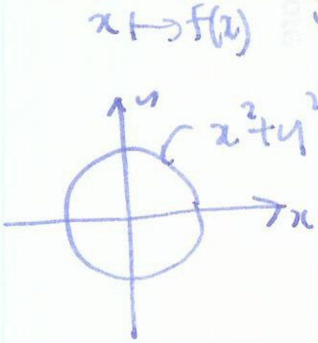


graph.

vertical line test: a curve in the plane is a graph iff every vertical line hits the curve at most once.

Warning: not every equation defines a function!

$f: \mathbb{R} \to \mathbb{R}$, $x \mapsto f(x)$ $\quad y = f(x)$ defines a function.



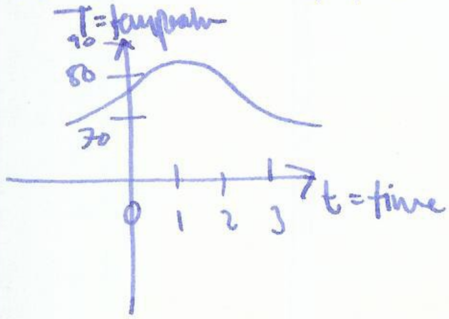
$x^2 + y^2 = 1$ $\leftarrow$ can't write this as $y = f(x)$

$y^2 = 1 - x^2$

$y = \pm\sqrt{1 - x^2}$!

§2.3 Information from graphs

we can read off the values of the function from its graph.



Qs : · find $T(0)$, $T(1)$, $T(2)$, $T(1.5)$

· for which t is $T(t) = 80$? 90?

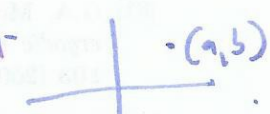
· where is T increasing?

decreasing?

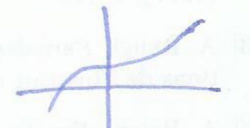
<u>interval notation</u> (a,b) means $x \in \mathbb{R}$ $a < x < b$

$[a,b]$ mean $x \in \mathbb{R}$ $a \leq x \leq b$

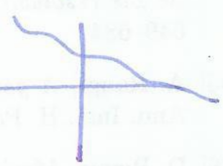
<u>warning</u> sometimes (a,b) is an interval, sometime it is a point



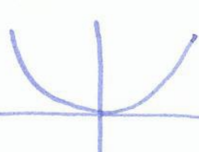
<u>Def^{n}</u> $f(x)$ is <u>increasing</u> on an interval $I = (a,b)$ if $x_1 < x_2$ implies that $f(x_1) < f(x_2)$



$f(x)$ is <u>decreasing</u> on an interval I if $x_1 < x_2$ implies that $f(x_1) > f(x_2)$

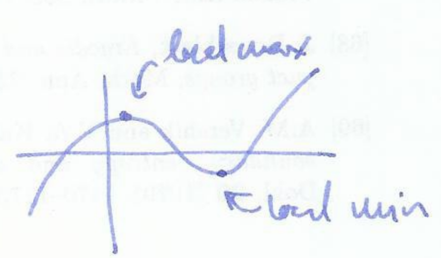


<u>Example</u> · $f(x) = x^2$



increasing $[0,\infty)$

decreasing $(-\infty, 0]$



· $f(x) = x^2 - 4$

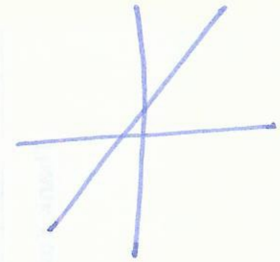
· $f(x) = x^2 - 2x + 4 = (x-1)^2 + 2$.

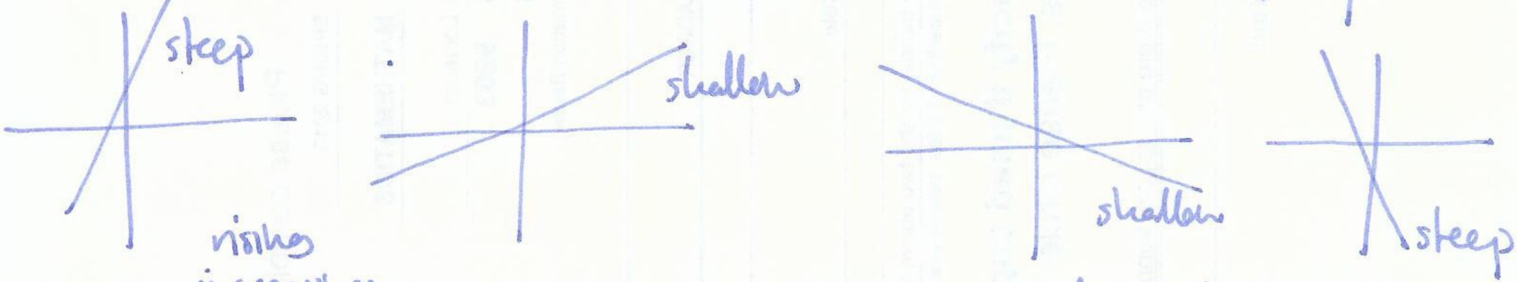
<u>Def^{n}</u> $f(x)$ has a local $\begin{smallmatrix}\text{max}\\ \text{min}\end{smallmatrix}$ at $x=a$ if $f(a) \geq f(x)$ for all x close to a

$f(a) \leq f(x)$.

§ 1.10 lines and slopes

special functions: straight line functions, linear functions.
the graph of a straight line/linear function is a line

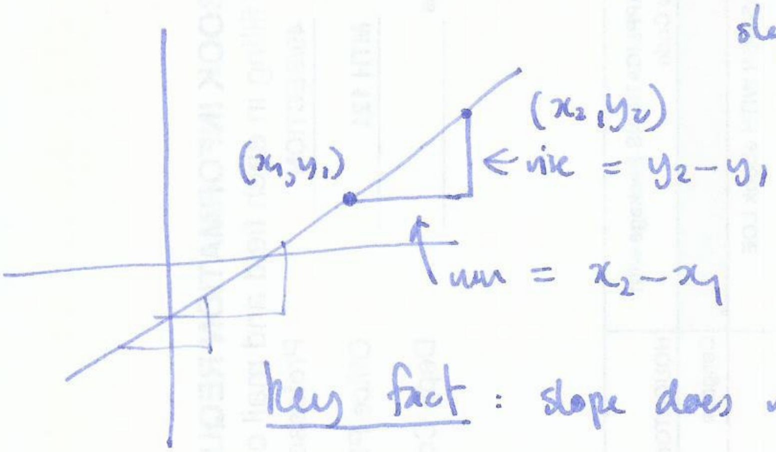




rising
increasing
positive slope

decreasing
negative slope.

how to find the <u>slope</u> of a line



$$\text{slope } m = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$$

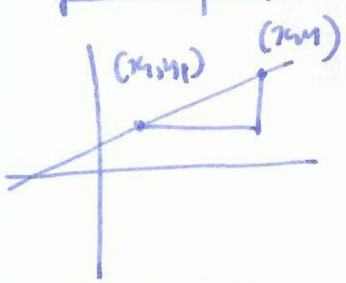
$$= \frac{\text{vertical change}}{\text{horizontal change}}$$

<u>Key fact</u>: slope does not depend on choice of points!

<u>Example</u> draw and find slope of line through $(2,1)$ and $(8,5)$.

<u>Equations for lines</u>

- <u>point slope form</u>: if you know a point (x_1, y_1) and the slope m.



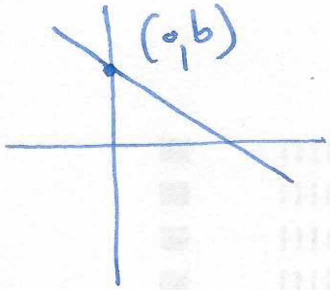
(x, y) general point on line

$$m = \frac{\text{rise}}{\text{run}} = \cancel{\frac{x - x_1}{y - y_1}} \; \frac{y - y_1}{x - x_1}.$$

Eq. $\boxed{y - y_1 = m(x - x_1)}$

<u>Example</u> do $(2,1)$ $(8,5)$.

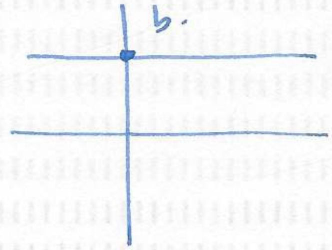
slope-intecept form of the equation for a line.



$$y - b = m(x - 0)$$

$$\boxed{y = mx + b.}$$

special lines:



horizontal lines

slope $m = 0$

$y = b$

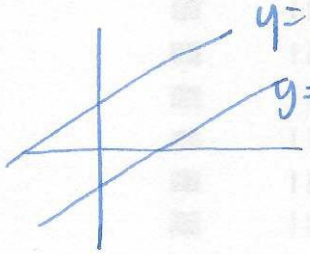
vertical lines

$x = c$

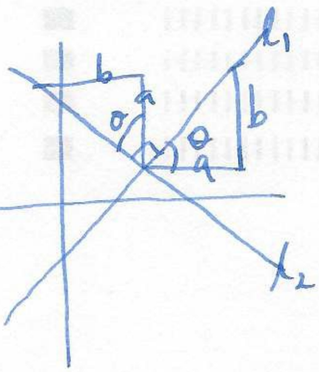
General equation of a line: $Ax + By + C = 0$

not both $A, B = 0$.

Parallel lines: two lines are parallel if and only if they have the same slope.



Perpendicular lines two lines are perpendicular iff $m_1 = -\frac{1}{m_2}$.



why? similar triangles. $m_1 = \frac{b}{a}$.

$m_2 = -\frac{a}{b}$.