# 1.4 Transformations of Functions

## Parent Functions...

linear : $f(x) = x$

quadratic : $f(x) = x^2$

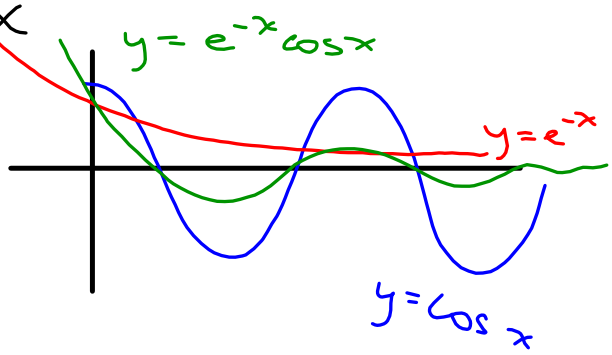
polynomial : $f(x) = ax^n + bx^{n-1} + cx^{n-2} \ldots + c$

radical : $f(x) = \sqrt{x}$

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

exponential : $f(x) = a(b^x)$

trig : $f(x) = \sin x$




3 types of transformation:

→ stretch x or y

→ reflections in x or y

→ translations in x or y

The general transformed function: $y = af(k(x - d)) + c$

where:

a → vertical stretch (factor of a)
if $a < 0$, reflection in x-axis

k → horizontal stretch (factor of $\frac{1}{k}$)
if $k < 0$, reflection in y-axis

d → horizontal shift... (x-3) moves 3 units right

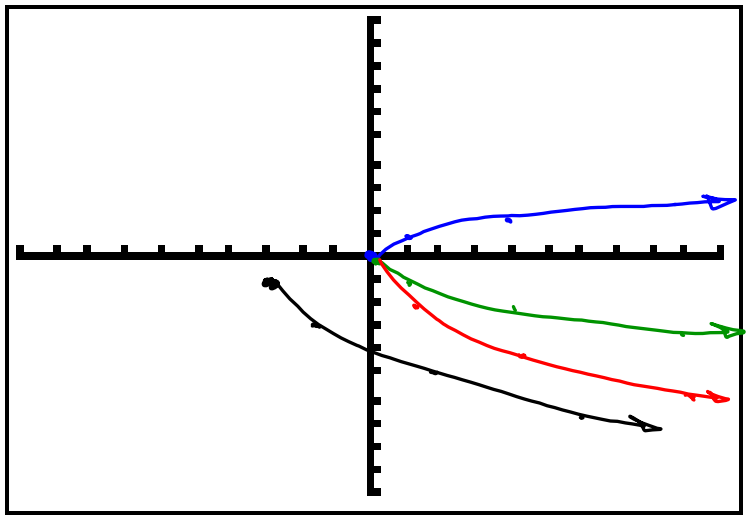
c → vertical shift... up is +ve

Order of transformation:

① stretch
② reflection
} in any order

③ translations... always last

Example 1: Graph $f(x) = -2\sqrt{x+3} - 1$, and describe the transformations in order



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

$f(x) = -\sqrt{x}$
reflection in x-axis

$f(x) = -2\sqrt{x}$
vert. stretch by 2x

$f(x) = -2\sqrt{x+3} - 1$
3 units left
1 unit down

Example 2: The point (10, 3) is on y = f(x)

Which corresponding point is on y = -f(2(x + 1)) - 4?

(10,3) → H.S by $\frac{1}{2}$ → (5,3)

(5,3) → reflection in x-axis → (5,-3)

(5,-3) → H. shift by 1 left → (4,-3)

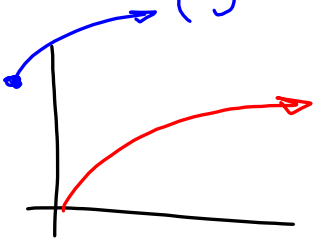
(4,-3) → V. shift down 4 → (4,-7)

Example 3: What is the domain and range of $\mathbf{y = 2\sqrt{x+3} + 13}$?

parent : $\sqrt{x}$

$D = \{x \in \mathbb{R} \mid x \geq 0\}$

$R = \{y \in \mathbb{R} \mid y \geq 0\}$



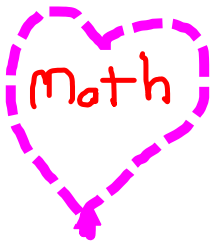
* V.S. factor of 2 does NOT affect D & R
* H. shift 3 left shifts domain left

$D: \{x \in \mathbb{R} \mid x \geq -3\}$

* V. shift 13 up shifts range up

$R: \{y \in \mathbb{R} \mid y \geq 13\}$

Tonight's homefun:

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