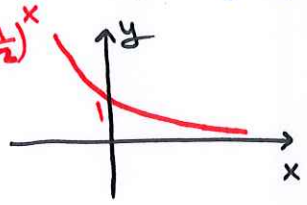
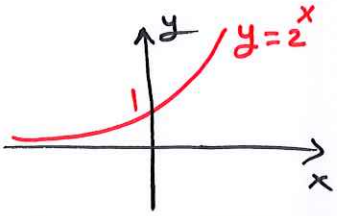
Exponential Functions

Exponential function has the form $f(x) = a^x$, $a > 0, a \neq 1$

- is always positive function with $D = \mathbb{R}$, $R = (0, \infty)$
- is called exponential decay if $0 < a < 1$



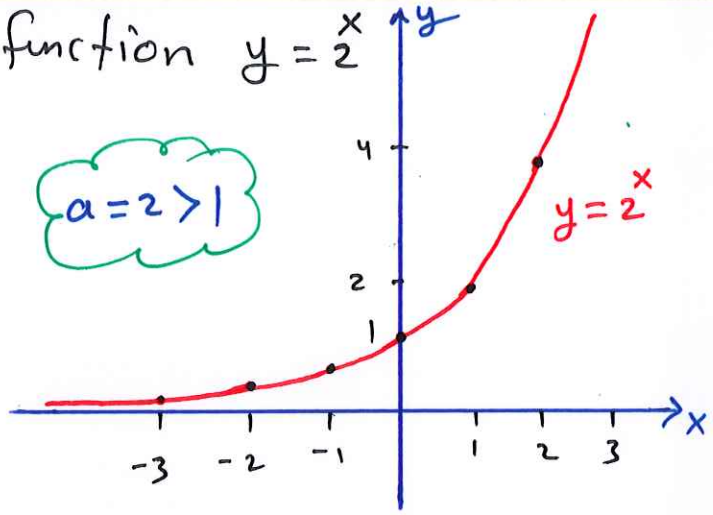
- is called exponential growth if $a > 1$



Exp Graph the exponential growth function $y = 2^x$

x	-3	-2	-1	0	1	2	3
y	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{2}$	1	2	4	8

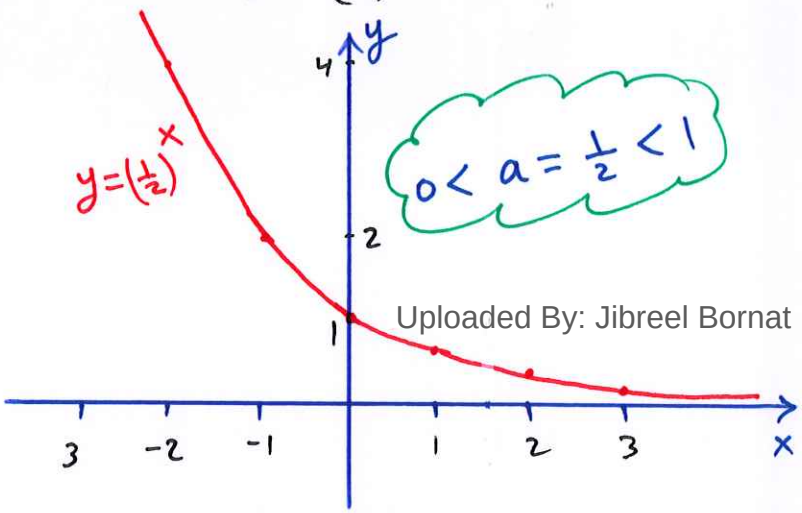
negative x-axis is the horizontal asymptote



Exp Graph the exponential decay function $y = (\frac{1}{2})^x = 2^{-x}$

x	-3	-2	-1	0	1	2	3
y	8	4	2	1	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$

positive x-axis is the horizontal asymptote



Remark Note that if $a = 1 \Rightarrow f(x) = 1^x = 1$

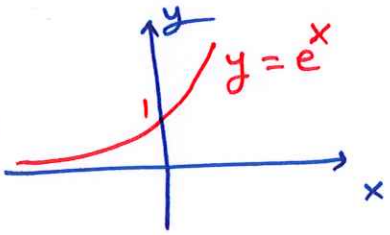
so the function becomes constant and not exponential

Exp Graph the exponential functions:

[1] $y = e^x$ [2] $y = 5^x$ [3] $y = 3e^x$ [4] $y = \left(\frac{3}{4}\right)^x$

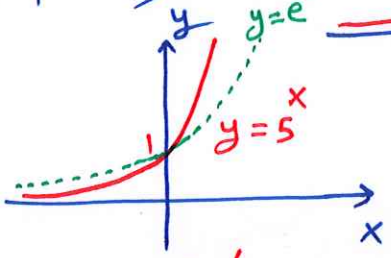
[5] $y = e^{-x}$ [6] $y = 2^{x-1}$ [7] $y = -e^x$ [8] $y = -5^{-x}$

[1] Since $e \approx 2.718 > 1 \Rightarrow$

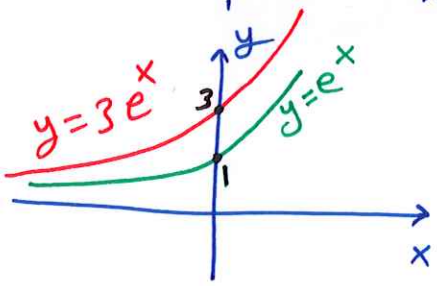


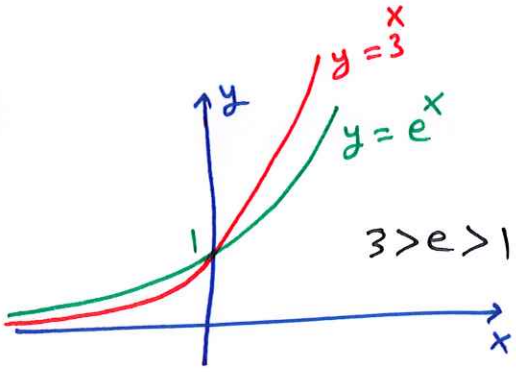
$a = e > 1$

[2] $a = 5 > 1 \Rightarrow$



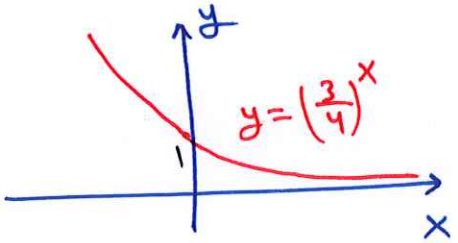
[3] $y = 3e^x$



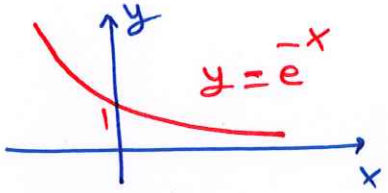


$3 > e > 1$

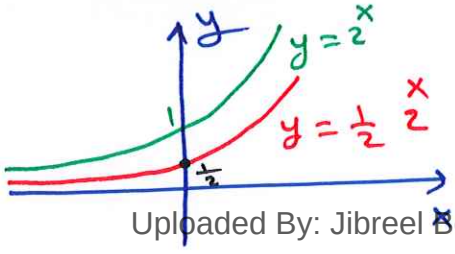
[4] $y = \left(\frac{3}{4}\right)^x \Rightarrow 0 < a = \frac{3}{4} < 1 \Rightarrow$



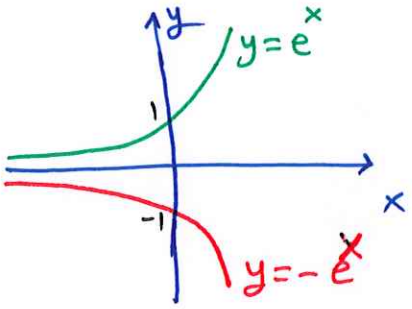
[5] $y = e^{-x} = \left(\frac{1}{e}\right)^x \Rightarrow 0 < a = \frac{1}{e} < 1 \Rightarrow$



[6] $y = 2^{x-1} = 2^x \, 2^{-1} = \frac{1}{2} \, 2^x$

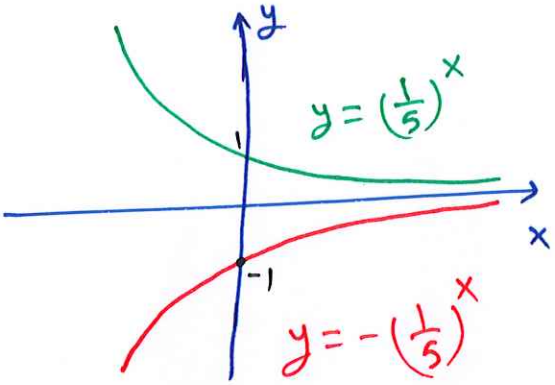


$a = 2 > 1$



[7] $y = -e^x$

[8] $y = -5^{-x} = -\left(\frac{1}{5}\right)^x \Rightarrow 0 < a = \frac{1}{5} < 1$



ممكن عمل جدول لكل رسمة