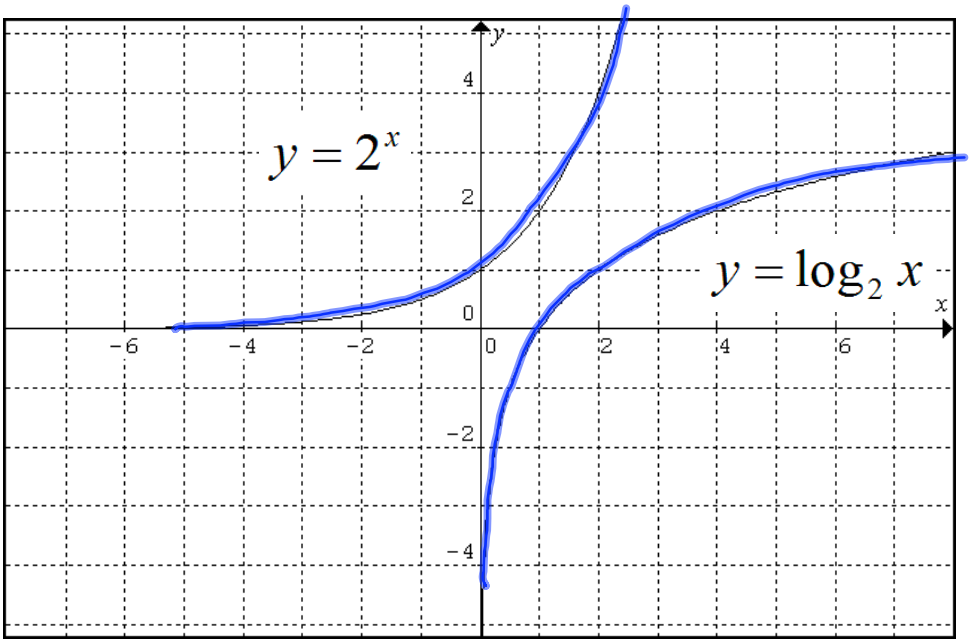
2.10 Logarithmic Functions

Let's compare the graphs of the following 2 equations



Analyze the following for each graph

	$y=2^x$	$y=\log_2 x$
Domain	$x \in R$	$x>0$
Range	$y>0$	$y \in R$
x-intercepts	None	1
y-intercepts	1	None

$y=\log_2 x$ has a graph which is the inverse of $y=2^x$.

Write the equation of the inverse of the function $f(x) = \left(\frac{1}{2}\right)^x$

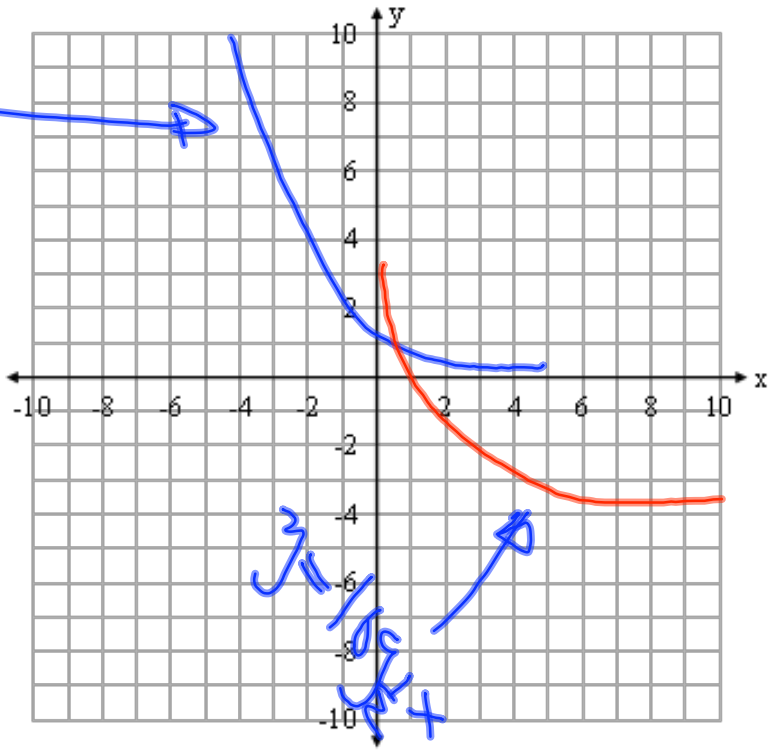
$x = \left(\frac{1}{2}\right)^y$ ← Solve for y.

$\log x = y \cdot \log\left(\frac{1}{2}\right)$

$\frac{\log x}{\log \frac{1}{2}} = y$ ← $y = \log_{\frac{1}{2}} x$

Sketch the graph of $f(x) = \left(\frac{1}{2}\right)^x$ and its inverse on the same axis

$y = \left(\frac{1}{2}\right)^x$



Example 2:
The speed of the wind, S, in km/h near the centre of a tornado is related to the distance that the tornado has travelled, d in kilometres. This relationship can be modeled by the equation **$S = 37 \log d + 96$**.

a) Using your graphing calculator graph the equation

$X:[0, 12, 2]$ $Y:[100, 140, 5]$

b) Estimate the speed of the tornado that has travelled 10km.

133 km/h.

Algebraically determine the distance travelled by a tornado if the speed of the wind at the centre is 140 km/h.

$$140 = 37 \log d + 96$$
$$44 = 37 \log d$$
$$\frac{44}{37} = \log_{10} d$$
$$10^{\left(\frac{44}{37}\right)} = d$$
$$d = 15.46 \text{ km}$$

Example 3:
The exponential function $P = 194(1.008)^n$ models the growth of Saskatoon's population since 1996.

a) Solve the equation for "n" to express "n" as a function of P.

$$P = 194(1.008)^n$$

$$\frac{P}{194} = (1.008)^n$$

$$\log\left(\frac{P}{194}\right) = n \cdot \log 1.008$$

$$\log P - \log 194 = n \cdot \log 1.008$$

$$\frac{\log P - \log 194}{\log 1.008} = n$$

b) Use you graphing calculator to graph the function from part "a".

X:[0,6,1]
Y:[-660,-440,50]

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