An exponential function has form $f(x) = a^x$ where $a > 0$ and $a \neq 1$

Exponent Rules For $a \neq 0, b \neq 0$	
Product Rule	$a^x \times a^y = a^{x+y}$
Quotient Rule	$a^x \div a^y = a^{x-y}$
Power Rule	$\left(a^x\right)^y = a^{xy}$
Power of a Product Rule	$(ab)^x = a^x b^x$
Power of a Fraction Rule	$\left(\dfrac{a}{b}\right)^x = \dfrac{a^x}{b^x}$
Zero Exponent	$a^0 = 1$
Negative Exponent	$a^{-x} = \dfrac{1}{a^x}$
Fractional Exponent	$a^{\frac{x}{y}} = \sqrt[y]{a^x}$

Example 1   Graph each function. Describe the domain, range, horizontal asymptote, and whether the function is increasing or decreasing.
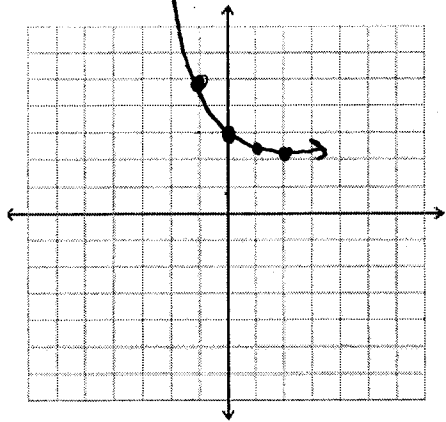
A. $y = 3^x$
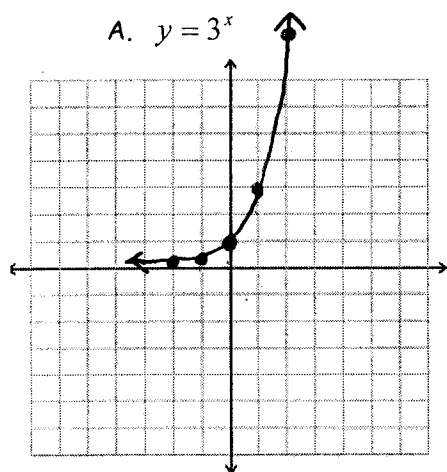
x	y		
-2	$3^{-2} = \frac{1}{3^2} = \frac{1}{9}$		
-1	$3^{-1} = \frac{1}{3^1} = \frac{1}{3}$		
0	$3^0 = 1$		
1	$3^1 = 3$		
2	$3^2 = 9$		

D: $(-\infty, \infty)$
R: $(0, \infty)$
H.A. $y = 0$
increasing

B. $y = \left(\dfrac{1}{3}\right)^x = \left(3^{-1}\right)^x = 3^{-x}$ reflect $y = 3^x$ over y-axis
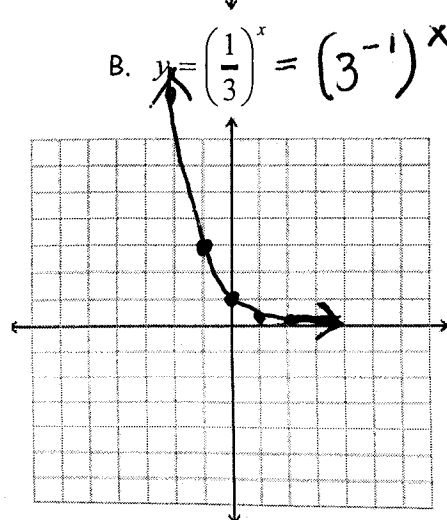
D: $(-\infty, \infty)$
R: $(0, \infty)$
H.A. $y = 0$
decreasing

1

c. $y = \left(\dfrac{1}{3}\right)^x + 2 = 3^{-x} + 2$ $y = 3^x$

reflect over y-axis
up 2

$D: (-\infty, \infty)$
$R: (2, \infty)$
H.A. $y = 2$
decreasing

Example 2   Given $y = -\left(\dfrac{1}{4}\right)^x - 3$, list the transformations applied to $y = 4^x$.

$$y = -(4)^{-x} - 3$$

reflect over y-axis
reflect over x-axis
down 3

Example 3   The number of milligrams D of a certain drug in the bloodstream h hours after administration is given by $D = 5e^{-0.4h}$.

    a. How many mg are present after 1 hour?

$$D = 5e^{-0.4(1)} = 3.352 \text{ mg}$$

    b. How many mg are present after 6 hours?

$$D = 5e^{-0.4(6)} = .454 \text{ mg}$$

2