

# 7.1 Exponential Growth & Decay Functions Review

Sketch each graph. Note domain, range, and asymptotes.

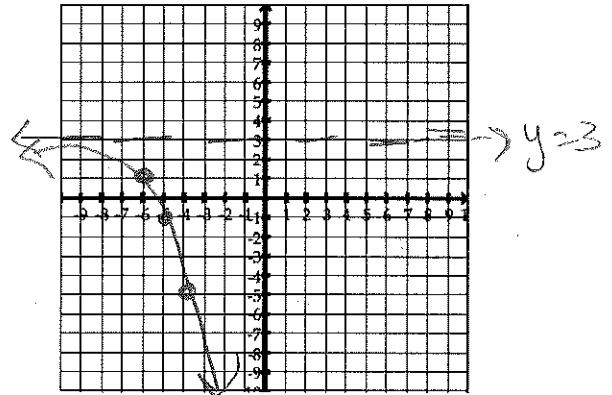
1.  $f(x) = -4(2)^{x+5} + 3$  h.a.  $y=3$

parent function:  $2^x$

transformations:

x	y
-1	$\frac{1}{2}$
0	1
1	2

$x-5$	$-4y+3$
-6	1
-5	-1
-4	-5



D:  $\mathbb{R}$  R:  $y < 3$

Asymptote:  $y = 3$

2. Write the equation of the parent function,  $f(x) = 5^x$  reflected over the  $y$ -axis, vertically stretched (s.f. = 5) and shifted up 4. Then graph.

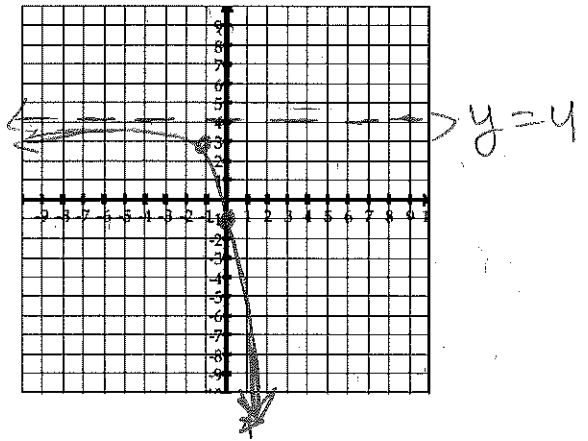
Equation:  $g(x) = -5(5)^x + 4$  typo - x-axis

Parent:  $5^x$

transformations:

x	y
-1	$\frac{1}{5}$
0	1
1	5

$x$	$-5y+4$
-1	3
0	-1
1	-21



D:  $\mathbb{R}$  R:  $y < 4$

Asymptote:  $y = 4$

3. You take 325 mg of ibuprofen. The amount of medicine in your bloodstream decreases by 29% per hour. Write an exponential equation to model the amount of ibuprofen in your blood stream  $t$  hours after initial dose. How long will it take for you to have 100 mg remaining in your bloodstream?

$A(t) = a(1-r)^t$   
 $A(t) = 325(1-.29)^t$

$y_1 = 325(.71)^x$   
 $y_2 = 100$   
 window:  $y_{max} = 150$

graph trace intersect  
 3.44 hours

4. The population  $P$  (in thousands) of Austin can be approximated by  $y = 494.29(1.03)^t$ , where  $t$  = the number of years since the beginning of the decade. Does this model represent growth or decay? What is the percent annual increase or decrease? How many years into the decade does the population reach 590,000?

Growth b/c base > 1  
 % growth = 3%

$y_1 = 494.29(1.03)^x$   
 $y_2 = 590$   
 window:  $y_{max} = 700$

5.99 years  
 until 590,000 population

## 7.2 Solving Exponential Equations & Inequalities Review

### Property of Equality for Exponential Functions

If  $b$  is a positive number other than 1, then  $b^x = b^y$  if and only if  $x = y$ .

**Example 1:** Solve  $4^{x-1} = 2^{x+5}$

$$\begin{aligned} (2^2)^{x-1} &= 2^{x+5} \\ 2^{2x-2} &= 2^{x+5} \\ 2x-2 &= x+5 \\ -x & \quad -x \\ \hline x-2 &= 5 \\ +x & \quad +x \\ \hline x &= 7 \end{aligned}$$

**Example:** Solve  $5^{2x-1} > \frac{1}{125}$

$$\begin{aligned} 5^{2x-1} &= 5^{-3} \\ 2x-1 &= -3 \\ 2x &= -2 \\ x &= -1 \end{aligned}$$

### Exercises

Solve each equation.

1.  $4^{x+1} = 8^{2x+3}$

$$\begin{aligned} (2^2)^{x+1} &= (2^3)^{2x+3} \\ 2^{2x+2} &= 2^{6x+9} \\ 2x+2 &= 6x+9 \\ -4x & \quad -4x \\ -4x+2 &= 9 \\ -4x &= 7 \\ x &= -\frac{7}{4} \end{aligned}$$

2.  $\left(\frac{1}{64}\right)^{x-2} = 16^{3x+1}$

$$\begin{aligned} (4^{-3})^{x-2} &= (4^2)^{3x+1} \\ 4^{-3x+6} &= 4^{6x+2} \\ -3x+6 &= 6x+2 \\ -9x &= -4 \\ x &= \frac{4}{9} \end{aligned}$$

3.  $27^{2x-5} < \left(\frac{1}{9}\right)^{5x}$

$$\begin{aligned} (3^3)^{2x-5} &< (3^{-2})^{5x} \\ 3^{6x-15} &< 3^{-10x} \\ 6x-15 &< -10x \\ -6x & \quad -6x \\ -6x-15 &< -10x \\ -6x & < -4x-15 \\ x &< \frac{15}{16} \end{aligned}$$

4.  $\left(\frac{1}{2}\right)^{x-3} > 8^{2x}$

$$\begin{aligned} (2^{-1})^{x-3} &> (2^3)^{2x} \\ 2^{-x+3} &> 2^{6x} \\ -x+3 &> 6x \\ x &< \frac{3}{7} \end{aligned}$$

7. **BUSINESS** Ahmed's consulting firm began with 23 clients. After 7 years, he now has 393 clients. Write an exponential equation describing the firm's growth.

How many years until Ahmed has 500 clients?

8 years

$$\begin{aligned} A(t) &= a(1+r)^t \\ 393 &= 23(1+r)^7 \\ \frac{393}{23} &= (1+r)^7 \\ \sqrt[7]{\frac{393}{23}} &= 1+r \\ \sqrt[7]{\frac{393}{23}} - 1 &= r \\ r &= 0.5 \end{aligned}$$

8. **BANKING** The certificate of deposit that Siobhan bought on her birthday pays interest according to the formula  $A = 1200 \left(1 + \frac{0.052}{12}\right)^{48}$ . What is the annual interest rate?

How many times per year was the interest compounded?

What was the amount invested?

How long did she own the CD?

$$\begin{aligned} A &= P \left(1 + \frac{r}{n}\right)^{nt} \\ r &= 5.2\% \end{aligned}$$

12 times per year

\$ 1200

t = 4 years

$$\begin{aligned} 48 &= nt \\ 48 &= 12(t) \\ \frac{48}{12} &= \frac{12(t)}{12} \\ 4 &= t \end{aligned}$$