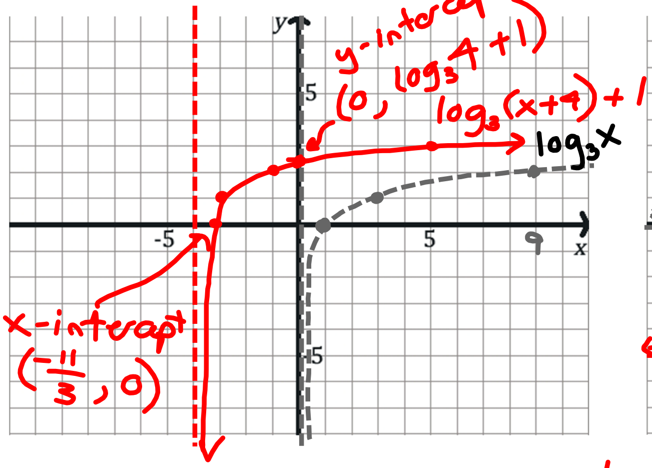
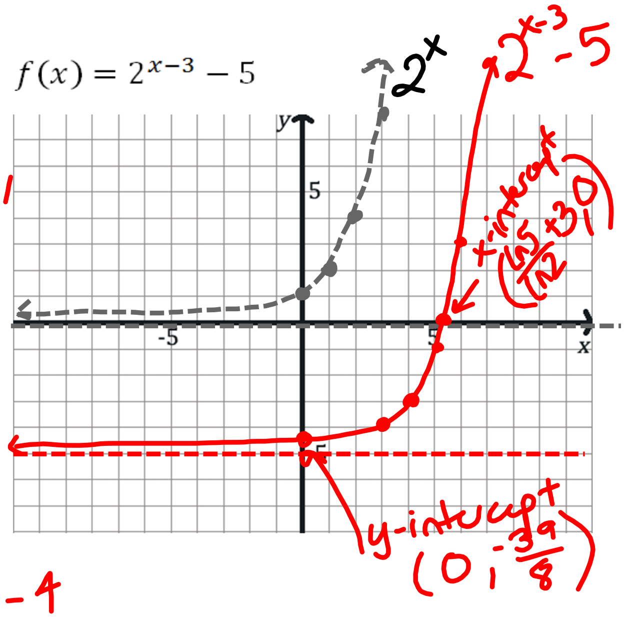
Graph

$f(x) = log_3(x+4)+1$



$f(x) = 2^{x-3} - 5$



$0 = \log_3(x+4)+1$

$\log_3(x+4) = -1$

$3^{-1} = x+4$

$x = \frac{1}{3} - 4$

$= -\frac{11}{3}$

$2^{x-3} - 5 = 0$

$2^{x-3} = 5$

$\ln 2^{x-3} = \ln 5$

$(x-3)\ln 2 = \ln 5$

$x-3 = \frac{\ln 5}{\ln 2}$

$x = \frac{\ln 5}{\ln 2} + 3$

4.6 Applications & Models

$P_0 = P(0)$

$P(t)=P_0e^{kt}$, $k>0$

Population Growth

$P(t)$ = population at time t
P_0 = initial population
k = exponential growth rate

Continuously Compounded Interest

$P(t)$ = amount of $ at time t
P_0 = initial investment
k = interest rate

How to find Growth Rate / Doubling Time:

$$P(t) = P_0 e^{kt}$$

We need to divide by P_0 in order to isolate the exponential expression before taking a log to get the variable out of the exponent.

$$\frac{P(t)}{P_0} = e^{kt}$$

$$\ln\left(\frac{P(t)}{P_0}\right) = kt$$

The **doubling time** T is the time it takes for the population to double. Note that this is independent of the initial population.

$$P(T) = 2P_0$$

$$2P_0 = P_0 e^{kT}$$

$$2 = e^{kT}$$

$$\ln 2 = kT$$

$$\boxed{T = \frac{\ln 2}{k}}$$

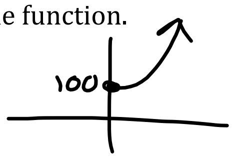
2. exponential growth rate of rabbits is 11.7% per day; initial population of 100 rabbits

$P_0 = 100$; $k = 0.117$ $\qquad P(t) = P_0 e^{kt}$

a. Find the exponential growth function.

$$P(t) = 100e^{0.117t}$$

b. Graph the function.



c. What will the population be after 7 days?

$$P(7) = 100e^{0.117 \cdot 7} = \boxed{226 \text{ rabbits}}$$

d. Find the doubling time.

$$T = \frac{\ln 2}{0.117} = \boxed{5.9 \text{ days}}$$

OR

$$\frac{200}{100} = \frac{100e^{0.117 \cdot T}}{100}$$

$$2 = e^{0.117T}$$

$$\ln 2 = \ln e^{0.117T}$$

$$\ln 2 = 0.117T$$

$$\frac{\ln 2}{0.117} = T$$

8. Interest Compounded Continuously $P(t) = P_0 e^{kt}$

Initial Investment $P_0 = \frac{P(5)}{e^{k\cdot 5}}$	Interest Rate $k = \frac{\ln 2}{T} = \frac{\ln\left(\frac{P(5)}{P_0}\right)}{5}$	Doubling Time $T = \frac{\ln 2}{k}$	Amount after 5 years $P(5) = P_0 e^{k\cdot 5}$
a. $35,000	6.2%	$\frac{\ln 2}{0.062} = 11.2$ yrs	$35000e^{0.062(5)} =$ $47,719.88
b. $5,000	$\frac{\ln\left(\frac{7130.90}{5000}\right)}{5} =$ 7.12	$\frac{\ln 2}{0.071} =$ 9.76 yrs	$7,130.90
c. $\frac{11414.71}{e^{0.084(5)}} =$ $7,499.99	8.4%	$\frac{\ln 2}{0.084} =$ 8.3 yrs	$11,414.71
d. $\frac{17539.32}{e^{(0.063)(5)}} =$ $12,800	$\frac{\ln 2}{11} = 6.32$	11 years	$17,539.32

10. **carbon dating**

a statue has lost 35% of its carbon-14; how old is it?
* the half-life of carbon-14 is 5750 years

the amount of time it takes for the amount to be cut in half

if it lost 35% it still has 65%

$P(t) = 0.65P_0$

$P(T) = \frac{1}{2}P_0$

$\frac{1}{2}P_0 = P_0 e^{k\cdot T}$

$\frac{1}{2} = e^{k\cdot T}$

$\ln\frac{1}{2} = k\cdot T$

$\frac{\ln\frac{1}{2}}{k} = T$ or $\frac{\ln\frac{1}{2}}{T} = k$

half-life

decay rate

$k = \frac{\ln\frac{1}{2}}{5750} \approx -0.000120547$

$0.65\cancel{P_0} = \cancel{P_0}e^{k\cdot t}$

$\ln 0.65 = k\cdot t$

$t = \frac{\ln 0.65}{-0.000120547}$

$= \boxed{3433 \text{ yrs}}$

HW #8 (due Fri. 10/3)

4.3 #1-8 all sketch graphs of logarithmic functions #9-33 odd evaluate log expressions without a calculator
#35-53 odd convert between logarithmic and exponential expressions #69-77 odd apply change of base formula & calculator to approximate log expressions #83-90 all graph logarithmic functions using transformations

4.4	# 31,33, 49-55 odd; 65-75 odd; 107	applying log rules
4.5	# 1-25 odd; #27-47	solving exponential equations odd solving logarithmic equations

Due Mon 10/6

4.6	#5,7,9,15,17	application problems

Test #3 - Wed 10/8