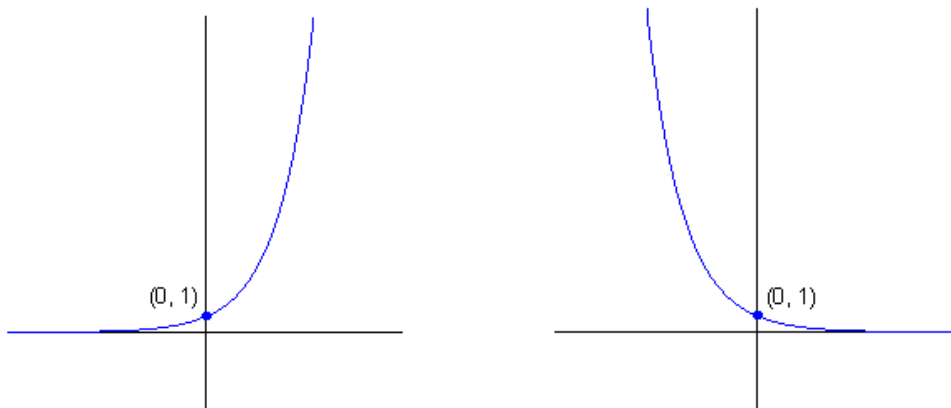


Math 150 Lecture Notes Exponential Functions

The **exponential function** with base a is defined for all real numbers x by $f(x) = a^x$ where $a > 0$ and $a \neq 1$.

The exponential function $f(x) = a^x$ ($a > 0, a \neq 1$) has domain $(-\infty, \infty)$ and range $(0, \infty)$.

The line $y = 0$ (the x -axis) is a horizontal asymptote of f . The graph of f has one of the following shapes.



The **natural exponential function** is the exponential function $f(x) = e^x$ with base e . It is often referred to as **the** exponential function.

Compound interest is calculated by the formula $A(t) = P\left(1 + \frac{r}{n}\right)^{nt}$ where

$A(t)$ = amount after t years

P = principal

r = interest rate per year

n = number of times interest is compounded per year

t = number of years

Continuously compounded interest is calculated by the formula $A(t) = Pe^{rt}$ where

$A(t)$ = amount after t years

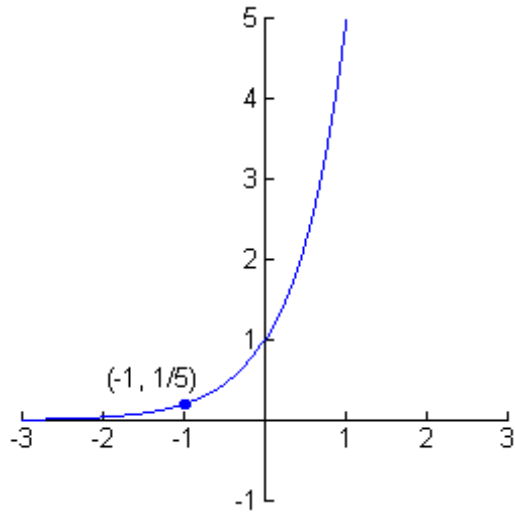
P = principal

r = interest rate per year

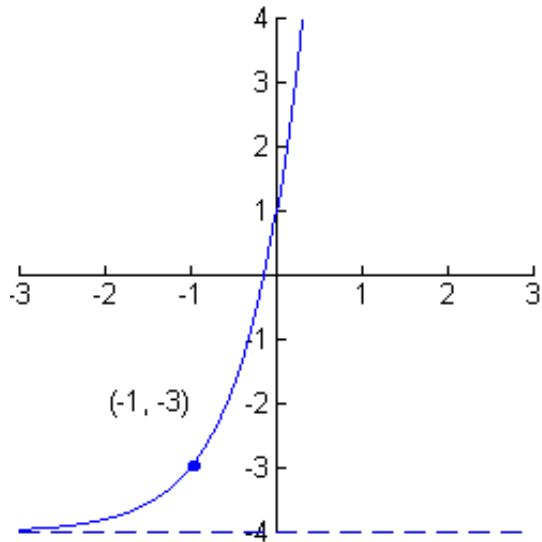
t = number of years

Example 1: Use a calculator to evaluate the function $f(x) = \left(\frac{3}{4}\right)^{2x}$ at the values $f(0.7)$, $f(\sqrt{7}/2)$, $f(1/\pi)$, $f(2/3)$. Round your answer to three decimal places.

Example 2: Find the exponential function $f(x) = a^x$ whose graph is given.



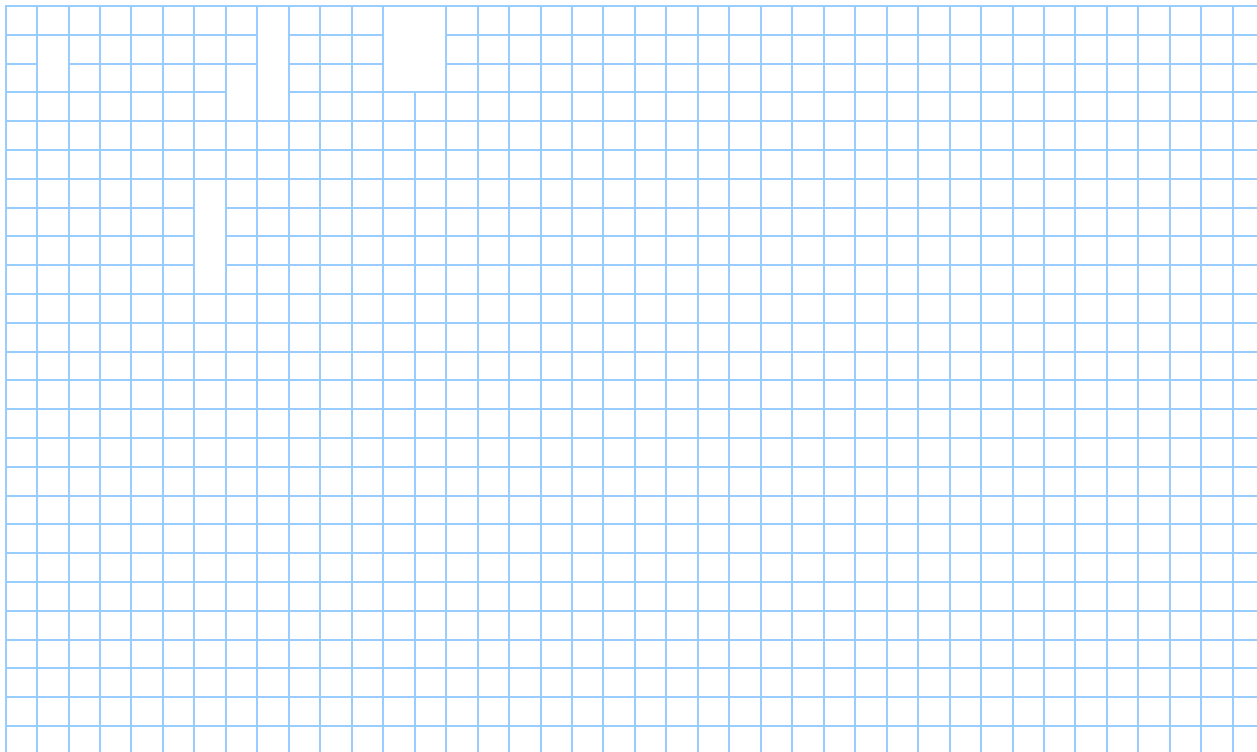
Example 3: Which of the following is the function graphed below?



$$f(x) = 5^x \quad f(x) = -5^x \quad f(x) = 5^x + 3$$

$$f(x) = 5^{x+1} - 4 \quad f(x) = 5^{-x} \quad f(x) = 5^{x-3}$$

Example 4: Graph the function using transformations of the parent function: $y = e^{x-3} + 4$
State the domain, range, and asymptote.



Example 5: Assume that a population of rabbits behaves according to the logistic growth model

$$n(t) = \frac{300}{0.05 + \left(\frac{300}{n_0} - 0.05 \right) e^{-0.55t}}$$

where n_0 is the initial rabbit population.

- If the initial population is 50 rabbits, what will the population be after 12 years?
- Draw graphs of the function $n(t)$ for $n_0 = 50, 500, 2000, 8000,$ and $12,000$ in the viewing rectangle $[0, 15]$ by $[0, 12,000]$.
- From the graphs in part (b), observe that, regardless of the initial population, the rabbit population seems to approach a certain number as time goes on. What is that number? (This is the number of rabbits that the island can support.)