Sec. 3.1: Exponential Functions and Their Graphs

The **exponential function *f* with base *b*** is denoted by

$$f(x) = b^x$$

where $b > 0$, $b \neq 1$ and x is any real number.

Ex. 1: Evaluate Exponential Functions. Round your result to three decimal places if needed.

Given:

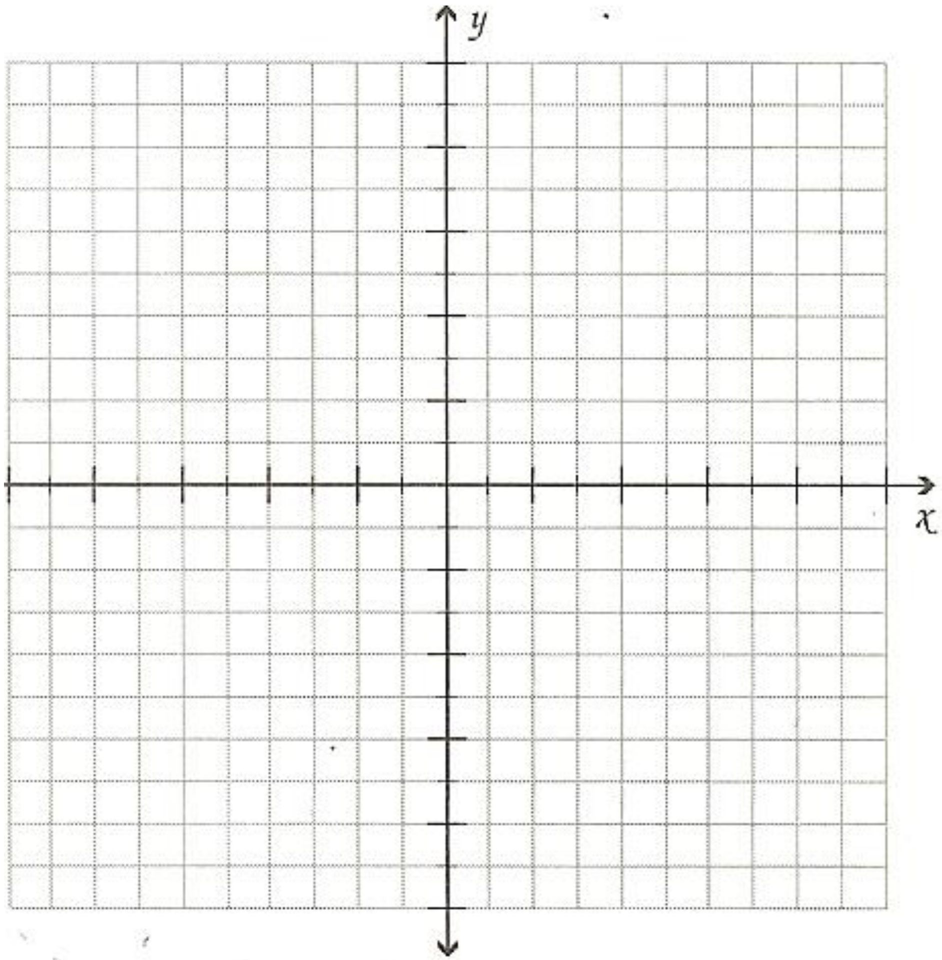
$$f(x) = 3^x,\ g(x) = \left(\frac{1}{4}\right)^x,\ h(x) = 10^{x-2}$$

Find: $a)\ f(-\sqrt{2}\,)$ $\qquad b)\ g(\pi)$ $\qquad c)\ h(-6.4)$

Graphs of Exponential Functions

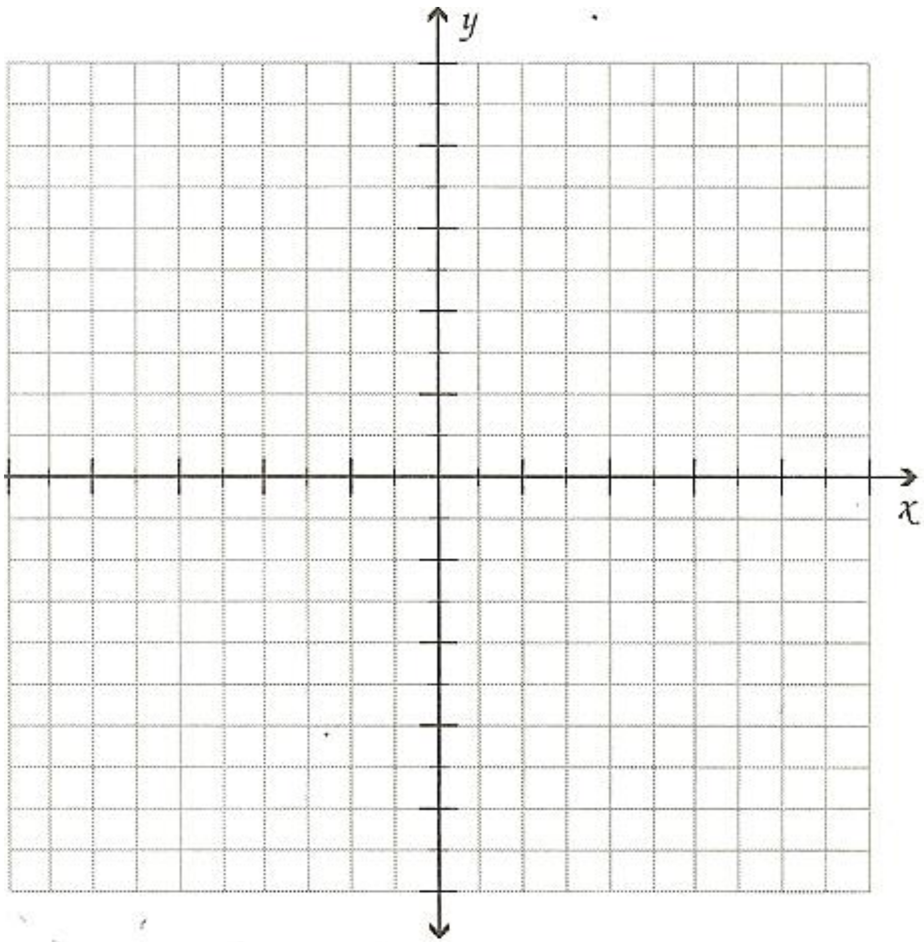
Ex. 2: Graph each function.

$a) \quad f(x) = 5^x$



Graphs of Exponential Functions

b) $f(x) = \left(\frac{2}{3}\right)^{x}$



Characteristics of Exponential Functions

$$\boldsymbol{f(x) = b^x}, \quad \boldsymbol{b > 0}, \quad \boldsymbol{b \neq 1}$$

Domain: Range:

Intercept: Horizontal Asymptote:

f(x) is increasing if *b > 1*.

f(x) is decreasing if *0 < b < 1*.

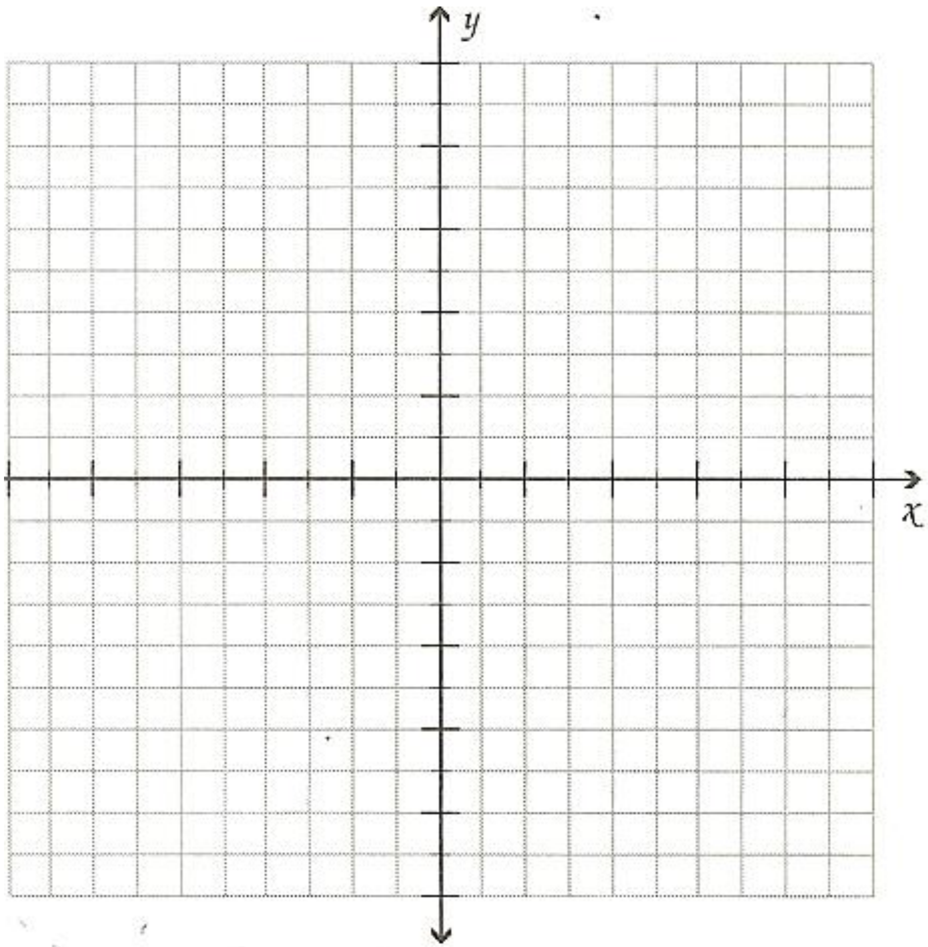
One-to-One Function: Yes or No

Transformations Involving Exponential Functions

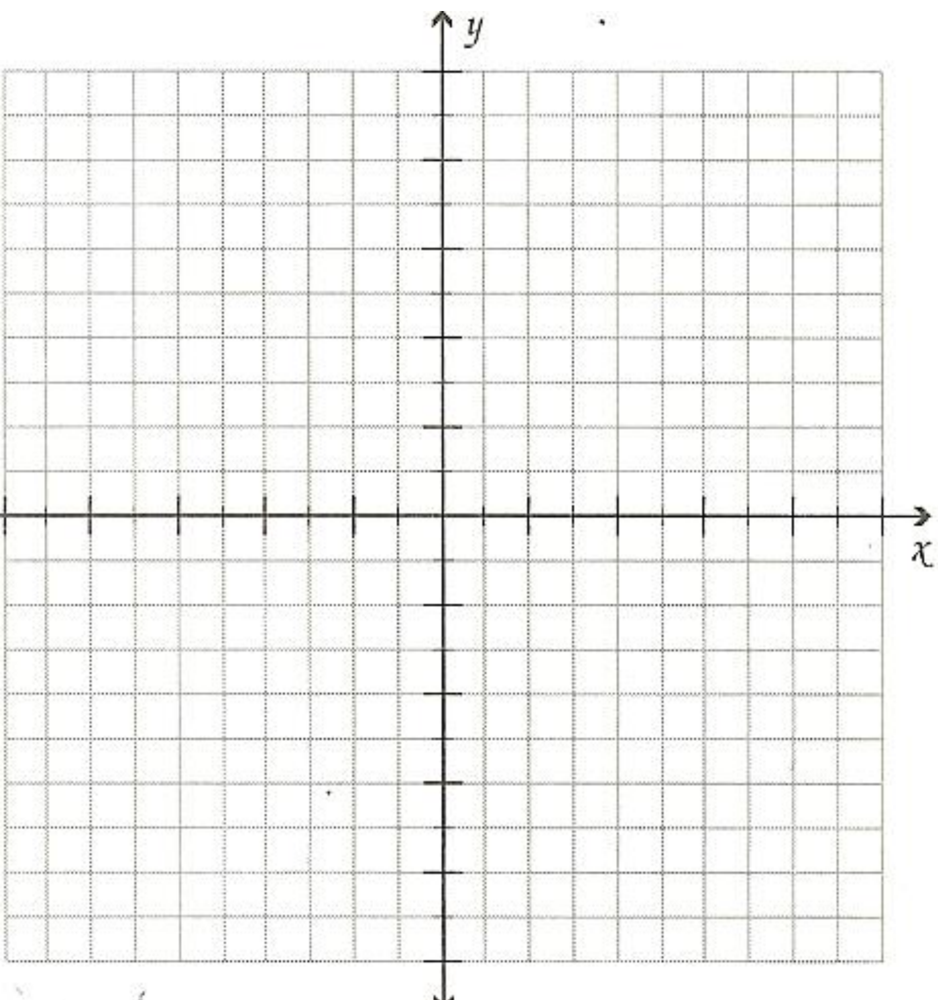
$$f(x) = a \cdot b^{(x-h)} + k$$

Ex.3: Graph each function. Then state the domain and range.

$$a)\ f(x) = 3^{2-x} + 1$$



$$b)\ g(x) = -\left(\frac{1}{4}\right)^{x-3} + 1$$



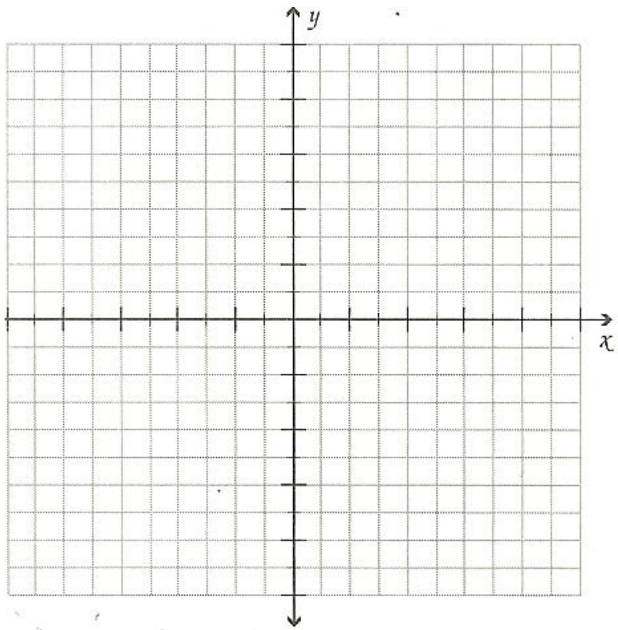
The Natural Base *e*

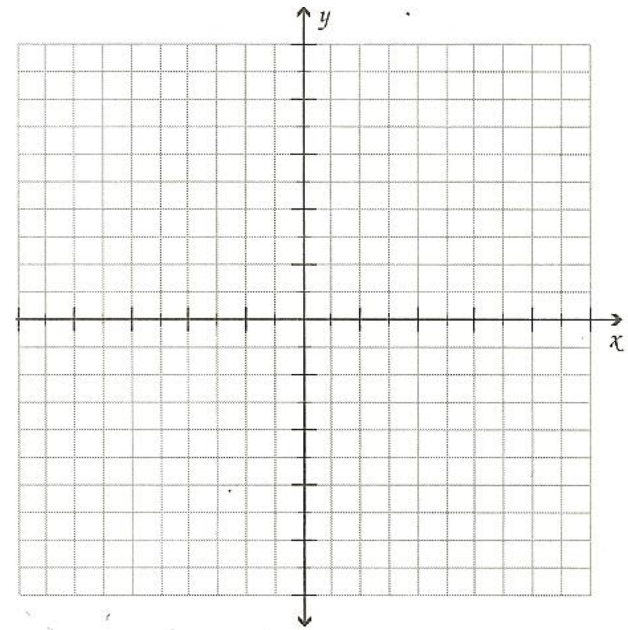
In many applications, the most convenient choice for a base is the irrational number: $e \approx 2.718281828\ldots$

The function, $f(x) = e^{x}$ is called natural exponential function.

To evaluate: $e^{-3} =$ $\qquad$ $e^{2.5} =$

To graph: $f(x) = e^{x}$ $\qquad$ $g(x) = e^{-x}$





Applications: Formulas for Compound Interest

After ***t*** years, the balance ***A*** in an account with principal ***P*** and annual interest rate ***r*** (in decimal form) is given by:

1) For ***n*** compoundings per year: $A = P\left(1+\frac{r}{n}\right)^{nt}$

2) For continuous compounding: $A = Pe^{rt}$

Ex.4: If you deposit \$12,000 into a savings account that pays 6.75% interest, compounded continuously, while another account pays 7% interest, compounded quarterly. Which one of these accounts yields a better return over 5 years?