4.2 Exponential Functions

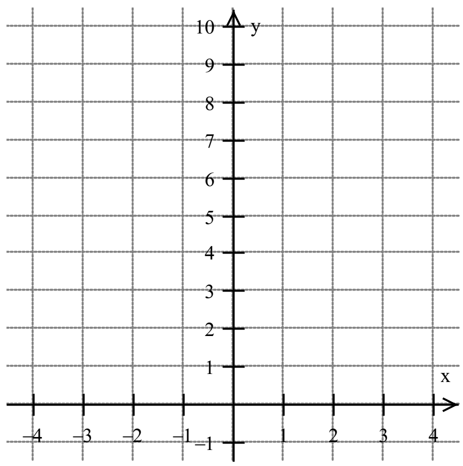
Exponential Functions: $f(x) = b^x$ or $y = b^x$, $b > 0$ and $b \neq 1$, x is □

❖ Graphing Exponential Functions

Ex. Graph each function by making a table or coordinates.

(a) $f(x) = 3^x$

x	$y = 3^x$
-2	
-1	
0	
1	
2	



Domain: ____________________

Range: ______________________

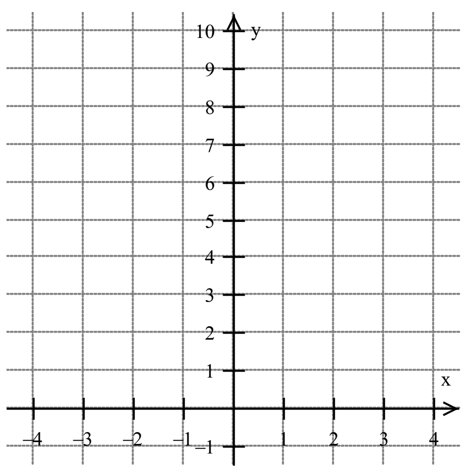
x-intercept: ________________

y-intercept: ________________

H.A.: ______________________

(b) $f(x) = \left(\frac{1}{3}\right)^x$

x	$y = (1/3)^x$
-2	
-1	
0	
1	
2	



Domain: ____________________

Range: ______________________

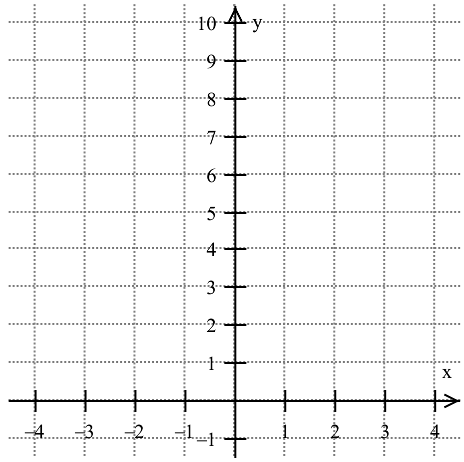
x-intercept: ________________

y-intercept: ________________

H.A.: ______________________

(c) $f(x) = 3^{-x}$

x	$y = 3^{-x}$
-2	
-1	
0	
1	
2	



Domain: ___________________

Range: ___________________

x-intercept: _________________

y-intercept: _________________

H.A.: ______________________

Properties of Exponential Graphs of the Form $f(x) = b^x$**:** (p.416)

1) Domain: ___________________

   Range: ____________________

2) The point that all graphs pass through: ________________

   x-intercept: _________________

   y-intercept: _________________

3) $b > 1$: $f(x) = b^x$ is an __________________ exponential function.

4) $0 < b < 1$: $f(x) = b^x$ is an ______________ exponential function.

5) One-to-One Function; has an inverse function

6) Horizontal Asymptote: __________________

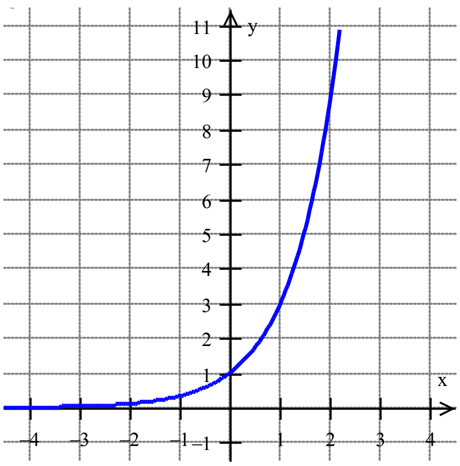
An *increasing* exponential function is also called an **exponential growth function**.
A *decreasing* exponential function is also called an **exponential decay function**.

Transformations of Exponential Functions

Ex. Given the graph of $f(x) = 3^x$.

i) Use the transformations of this graph to graph the given function.
ii) Give equations of the asymptotes.
iii) Use the graphs to determine each function's domain and range.

(a) $f(x) = 3^x + 2$

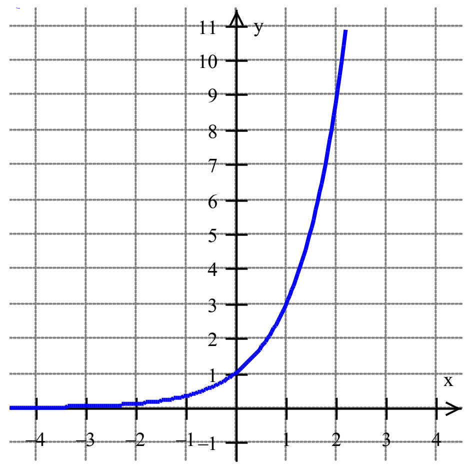


H.A.: ____________________

Domain: ________________

Range: _________________

(b) $f(x) = 3^{x-1}$



H.A.: __________________

Domain: _______________

Range: ________________

❖ **The Natural Base *e***

$$e = \left(1 + \frac{1}{n}\right)^n \approx 2.718281827\ldots \quad \text{as } n \to \infty$$

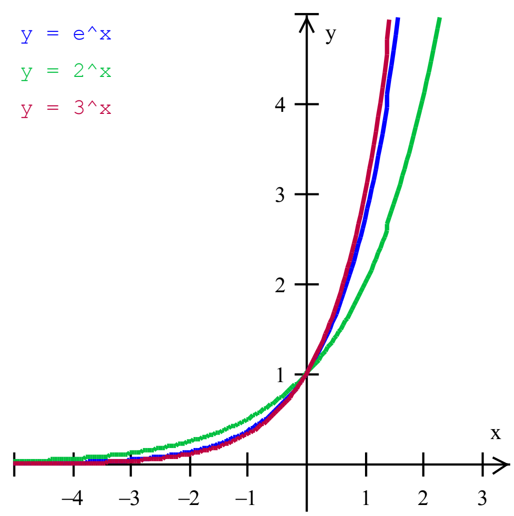
e = irrational number

Natural Exponential Function: $f(x) = e^x$

The graph of $f(x) = e^x$ has the same characteristics as any other exponential functions with base "*b*".

Ex. Evaluate $f(x) = e^x$ for $f\left(\sqrt{7}\right)$ and $f(-3)$.

Round to 4 decimal places.



❖ Compound Interest

Compound Interest: interest computed on your original investment as well as on any accumulated interest.

Simple Interest: $I = Prt$

Formulas for Compound Interest

1.) **Compound Interest:** Compound interest is paid *n* times a year.

$$A = P\left(1+\frac{r}{n}\right)^{nt}$$

2.) **Continuous Compounding:** the number of compounding periods increases infinitely.

$$A = Pe^{rt}$$

***A*:** Accumulated amount of money invested after *t* years
***P*:** Principal (original amount invested)
***r*:** Annual Percentage (Interest) Rate
***t*:** years
***n*:** Compounding Periods per year

Annually	$n = 1$
Semi-annually	$n = 2$
Quarterly	$n = 4$
Monthly	$n = 12$
Weekly	$n = 52$
Daily	$n = 365$

Ex. Find the accumulated value of an investment of \$5000 for 10 years at an interest rate of 6.5% if the money is

a) compounded quarterly

b) compounded continuously

Ex. (#56) The population of Canada in 2010 was approximately 34 million with an annual growth rate of 0.804%. At this rate, the population $P(t)$ (in Millions) can be approximated by $P(t) = 34(1.00804)^t$, where t is the time in years since 2010. (*Source: www.cia.gov*)

(a) Is the graph of P an increasing or decreasing exponential function?

(b) Evaluate $P(0)$ and interpret its meaning in the context of this problem.

(c) Evaluate $P(5)$ and interpret its meaning in the context of this problem. Round the population value to the nearest million.