**Section 4.1—Exponential Functions**

**Exponential Functions**—any function whose equation contains a variable in the exponent

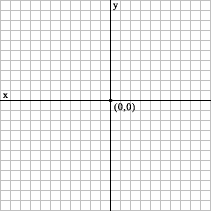
**Exponential Function**—definedby

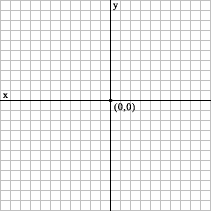
where b is a positive constant other than 1 ( and ) and x is any real number.

**Examples**:

|  |  |  |  |
| --- | --- | --- | --- |
| Exponential Functions | | NOT Exponential Functions | |
|  | base of 2 |  | variable in base, not in exponent |
|  | base of 10 |  | base must be positive constant other than 1 |
|  | base of 3 |  | base must be positive |
|  | base of |  | variable in both base and exponent |

**Example**—The exponential function  models the average amount spent, , in dollars, at a shopping mall after x hours. Find the average amount spent to the nearest dollar, after three hours at a shopping mall.

**Example**—Graph .

**Example**—Graph 

**Characteristics of Exponential Functions of the Form **

1. The domain of  consists of all real numbers: . The range of  consists of all positive real numbers: .
2. The graphs of all exponential functions of the form  pass through the point (0, 1) because . The y-intercept is 1. There is no x intercept.
3. If b > 1,  has a graph that goes up to the right and is an increasing function. The greater the value of b, the steeper the increase.
4. If ,  has a graph that goes down to the right and is a decreasing function. The smaller the value of b, the steeper the decrease.
5.  is one-to-one and has an inverse that is a function.
6. The graph of  approaches, but does not touch, the x-axis. The x-axis, or y = 0, is a horizontal asymptote.

An irrational number, symbolized by the letter e, appears as the base in many applied exponential functions.

e ≈ 2.718281827

**Example**—The exponential function  models the gray wolf population of the Western Great Lakes x years after 1978. If trends continue, project the gray wolf’s population in the recovery area in 2012.

**Compound Interest**—interest computed on an original investment as well as on any accumulated interest

**Principal**—the amount invested

**Compounded Semiannually**—when compound interest is paid twice a year; the compounding period is 6 months

**Compounded Quarterly**—when compound interest is paid four times a year; the compounding period is three months

**Continuous Compounding**—where the number of compounding periods increases infinitely

**Formula 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 the following formulas:

1. for n compoundings per year: 
2. for continuous compounding: 

**Example**—A sum of $10,000 is invested at an annual rate of 8%. Find the balance in the account after 5 years subject to:

1. quarterly compounding
2. continuous compounding