

**Definition 1.1**

An **exponential function**  $f$  is given by  $f(x) = a^x$ , where  $x$  is any real number,  $a > 0$ , and  $a \neq 1$ . The number  $a$  is called the base.

**Example 1.2**

Graph  $y = 3^x$ . Describe domain, range, asymptotes, increasing, decreasing, and concavity.

Graph  $y = \left(\frac{1}{2}\right)^x$ .

## Definition 1.3

$$e = \lim_{h \rightarrow \infty} \left(1 + \frac{1}{h}\right)^h = \lim_{h \rightarrow 0} (1 + h)^{1/h} \approx 2.718281828459$$

## Theorem 1.4

The derivative of  $f(x) = e^x$  is

$$f'(x) =$$

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$$f'(x) =$$

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## Example 1.5

Find  $\frac{dy}{dx}$  for the following functions

1  $y = 6e^{-5x}$

2  $y = \frac{e^x + 7}{x^2}$

3  $y = x^3 e^x$

4  $y = \sqrt{e^x - x}$

5  $y = e^{\sqrt{x^3 - 5}}$

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**Example 1.6**Graph  $y = 1 - e^{-x}$ .

**Example 1.7**

A company's total cost, in millions of dollars, is given by  $C(t) = 100 - 50^{-t}$ , where  $t$  is in years since the start-up date. Find the following:

- 1 The marginal cost,  $C'(t)$
- 2  $C'(0)$
- 3  $C'(4)$
- 4 Find  $\lim_{t \rightarrow \infty} C(t)$  and  $\lim_{t \rightarrow \infty} C'(t)$ .