

## 5.2 The Derivative of the General Exponential Function

### *Key Ideas*

- If  $f(x) = b^x$ , then  $f'(x) = b^x \times \ln b$
- If  $f(x) = b^{g(x)}$ , then  $f'(x) = b^{g(x)} \times \ln b \times g'(x)$
- $\lim_{h \rightarrow 0} \frac{b^h - 1}{h} = \ln b$
- When you are differentiating a function that involves an exponential function, use the rules given above, along with the sum, difference, product, quotient, and chain rules as required.

**Example 1:** Determine the derivatives of

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

b)  $f(x) = 5^{3x-2}$

c)  $f(x) = 3^x x^6$

**Example 2:** On January 1, 1850, the population of Weaverville was 50 000. The size of the population since then can be modelled by the function  $P(t) = 50\,000(0.98)^t$ , where  $t$  is the number of years since January 1<sup>st</sup>, 1850.

a) What was the population of Weaverville on January 1, 1900?

b) At what rate was the population of Weaverville changing on January 1, 1900? Was it increasing or decreasing at that time?