**Definition of Differential**

$$dy = f'(x)\,dx \quad (\text{ where } dx = \Delta x = x_2 - x_1)\,.$$

**Example 1.** If $y = x^2$, compute $\Delta y$ and $dy$ if $x = 2$ and $dx = \Delta x = 0.01$.

**Example 2.** Suppose that for a certain resistor, resistance varies with temperature as $R = 3.5 + 0.002T^2$ ohms. If $T$ is measured to be 100 degrees celsius, with a possible error of $\pm 0.1$ degrees celsius, what is the approximate maximum error in $R$?

**Relative error**. The quantity $\frac{dy}{y}$ is called relative error.

**Example 3**. In example 2, what is the approximate relative error?

**Example 4**. A protective coat of thickness 0.5 mm is applied evenly to the surface of a metal sphere of radius 20 cm. Find the approximate number of cubic centimeters of coating used.