

1. Consider the function  $f(x) = x^3$ .

(a) Find an expression for the slope  $m(x)$  of the line through the points  $(1, 1)$  and  $(x, f(x))$  (i.e. the slope of the secant line through the two points).

(b) The function  $m(x)$  from part (a) is not defined at  $x = 1$ , but  $\lim_{x \rightarrow 1} m(x)$  exists. (This is the slope of the tangent line to the curve  $y = f(x)$  at  $x = 1$ .) Find  $\lim_{x \rightarrow 1} m(x)$  and give an equation for the tangent line to  $y = f(x)$  through the point  $(1, 1)$ .

2. Consider the function

$$g(x) = \begin{cases} x + 1 & x < 1 \\ 1 & x = 1 \\ x^2 - 4x + 5 & x > 1 \end{cases} .$$

(a) What is  $\lim_{x \rightarrow 1^+} g(x)$ ?

(b) What is  $\lim_{x \rightarrow 1^-} g(x)$ ?

(c) Does  $\lim_{x \rightarrow 1} g(x)$  exist, and if so, what is its value?

(d) Sketch a graph of  $y = g(x)$  on the axes below.

