

The tangent

How to draw a tangent

Drawing a tangent to a circle is easy – we just draw a straight line through a point on the circle which is perpendicular to the diameter at that point (Figure 1).

However, drawing a tangent to a curve in general is more difficult – see Figure 2.

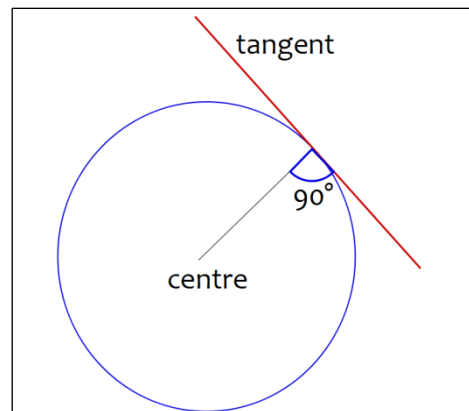


Figure 1

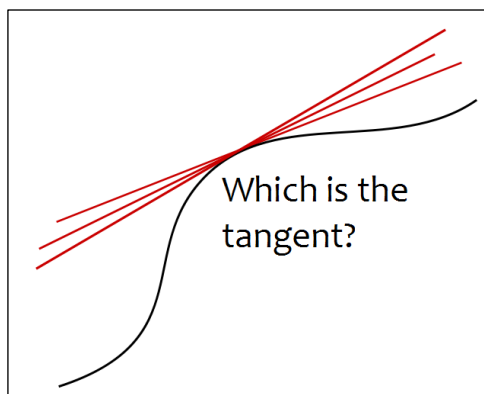


Figure 2

The generic tangent

One way to get a line which is close to a tangent is to draw through two points on the curve of a function, one at ordinate point x , and one at $x+h$, as shown in Figure 3. The quantity h is something we can change to get different results. This is clearly not exactly correct, so we are calling it the 'generic tangent' to distinguish it from the real tangent.

It is interesting to see the effect of varying the value of h . Figures 4, 5 and 6 show the generic tangent at $x=1$ on the curve of x^3 , with $h=1$, 0.5 and 0.1 respectively.

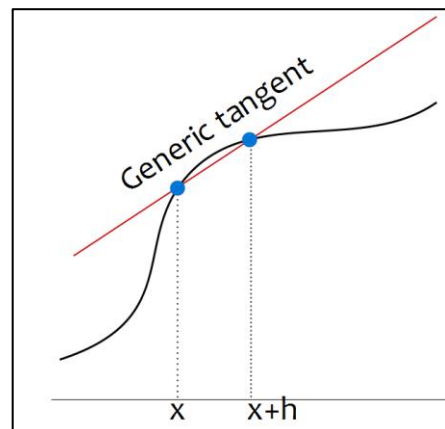
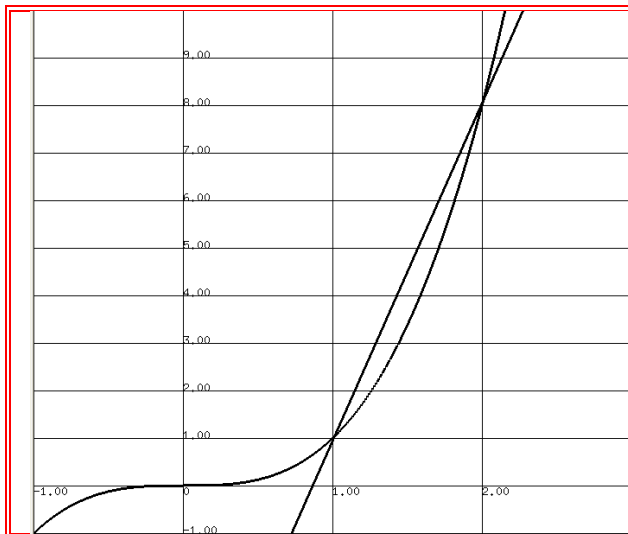


Figure 3



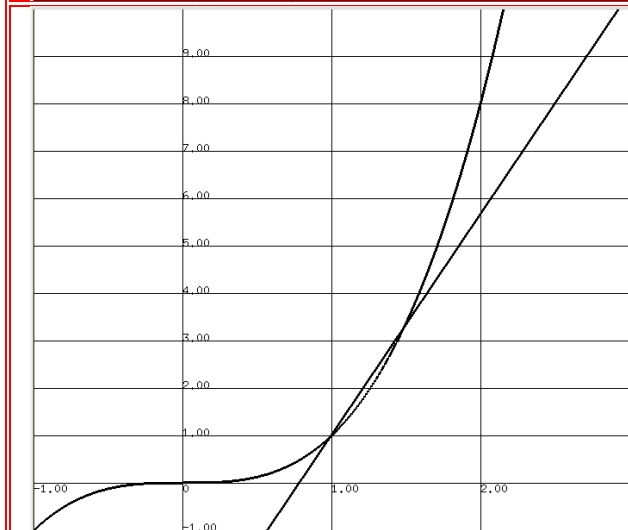
Generic tangent at $x=1$ to the graph of x^3 with $h=1$

Clearly values of h of 0.5 or more give a gross inaccuracy, while $h = 0.1$ or less is good enough.

Exercise 1

a) Sketch the graphs of x^2 , $\sin(x)$ and 2^x separately. Try to picture what their tangents will look like as x changes.

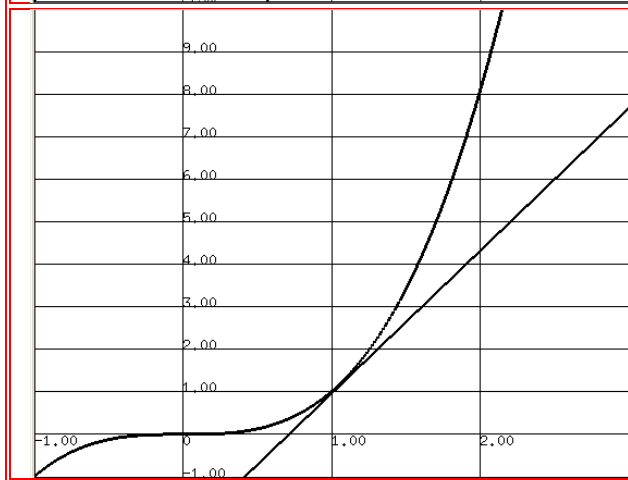
b) Using suitable software, draw the three functions in part (a), and display the tangents. Is that what you thought?



$h=0.5$

Generic tangent to a straight line

Suppose you use this technique on a straight line. Choose two points on a line, at x and $x+h$, and draw a line through them. What do you get?



$h=0.1$

Exercise 2

Using suitable software, draw $|\sin(x)|$ (maybe written as $\text{abs}(\sin(x))$, the absolute value of $\sin(x)$). Make the software draw the tangent. Does it work everywhere?