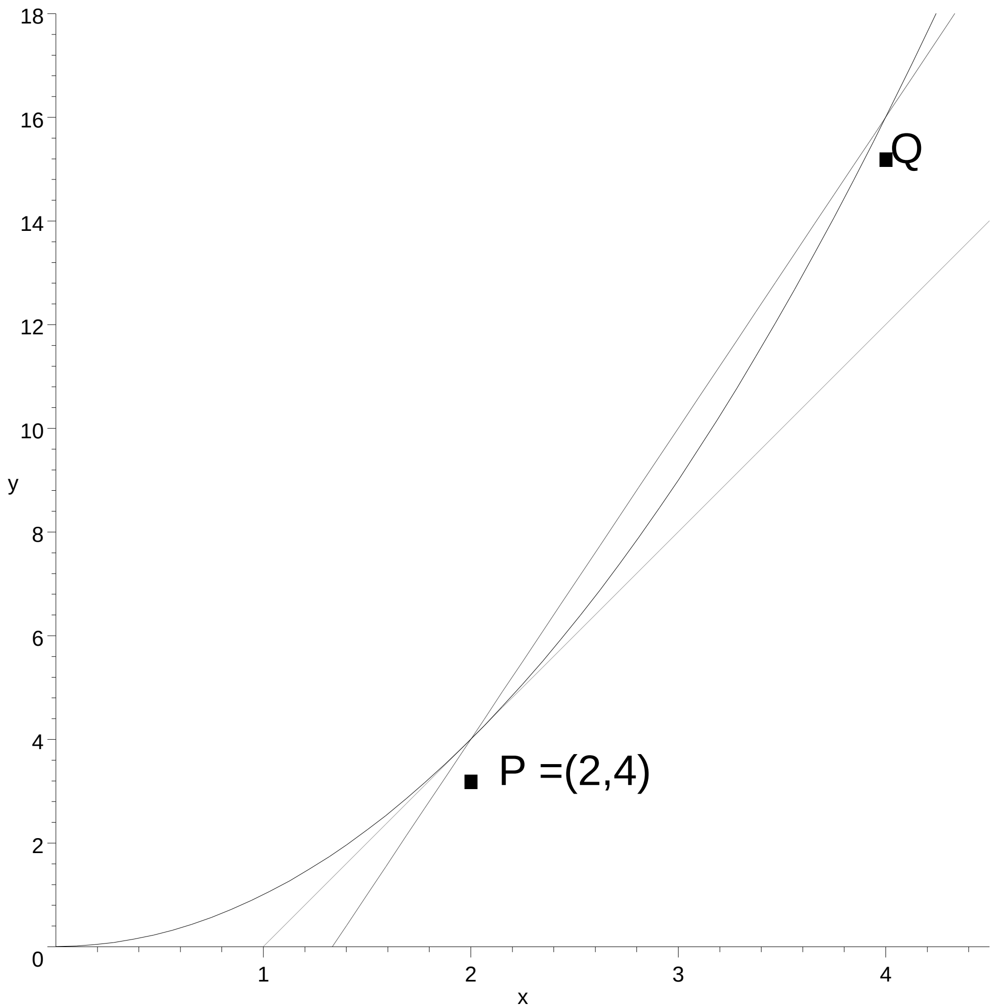
```
> read `/home/tkohl/maplestuff/secant`;
>
```

$$f := x \rightarrow x^2$$

$$d := h \rightarrow \frac{f(2+h) - f(2)}{h}$$

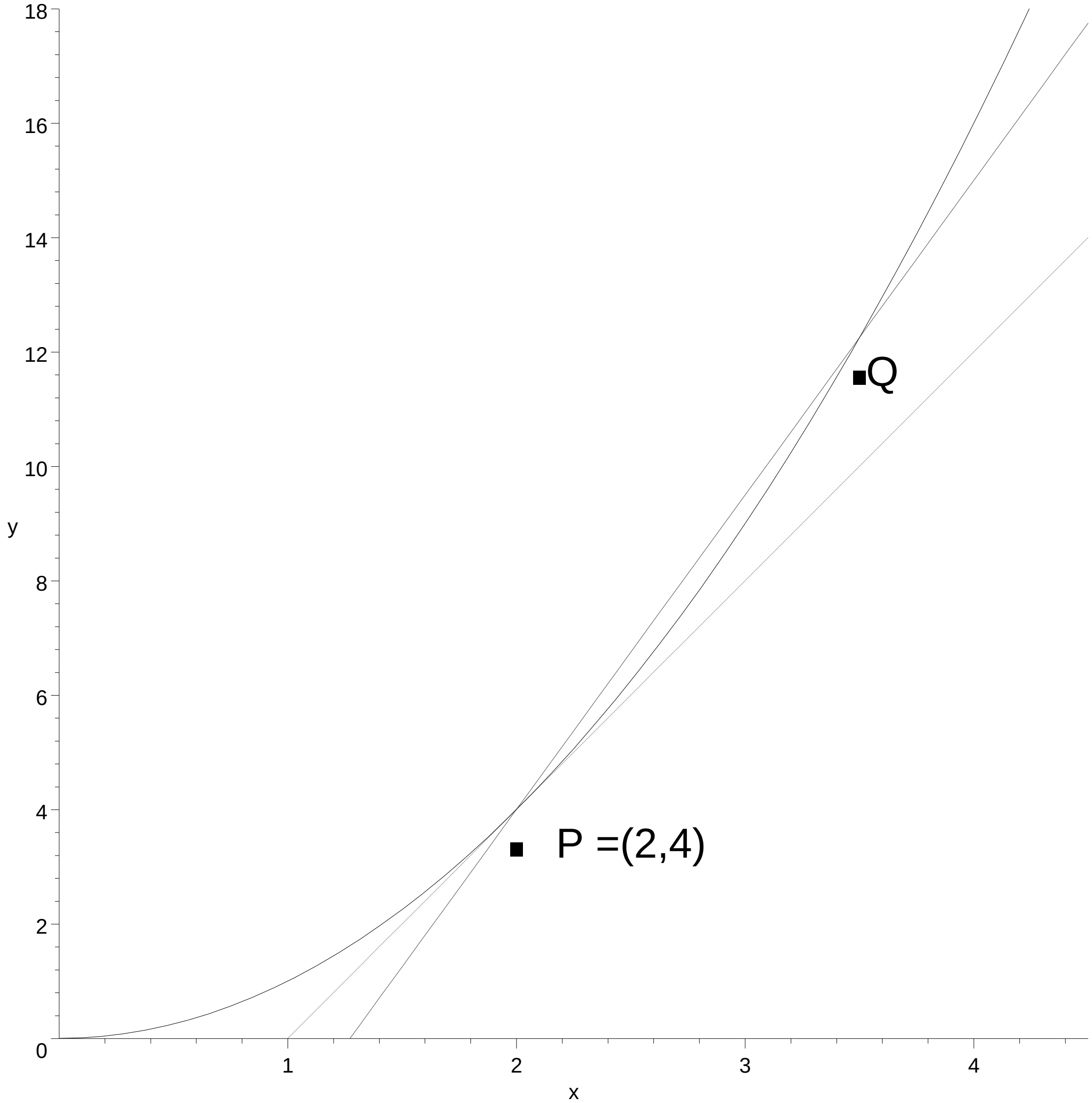
```
> # Here we're examining f(x)=x^2 at the point (2,4) to demonstrate
  why the slope at the point (2,4) as 4,
> # or, more to the point, how the slope of the secant line
  approaches that of the tangent line as h -> 0.
>
> # As I claimed already, the slope of the tangent line to the graph
  of y=x^2 at the point (2,4) is 4,
> # since the derivative is 2x, letting x=2 gives the value of 4 for
  the slope.
>
> #Let's look at the secant line vs. tangent line picture when h=2
  (i.e. Q=(4,16) )
> drawit(2);
```




```
> # What is the difference quotient here? (i.e. the slope of the
  secant line PQ)
> d(2);
```

6

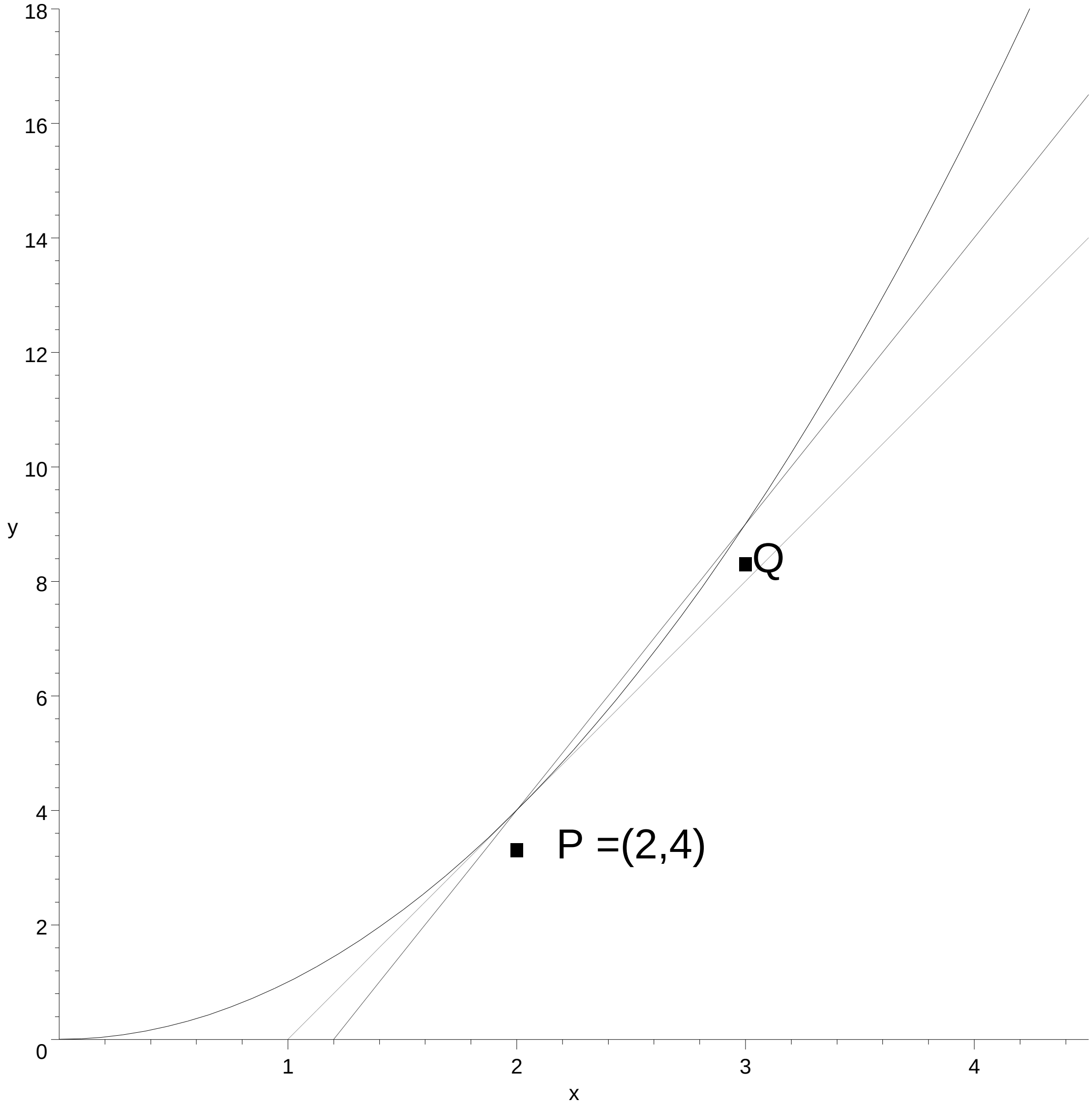
```
> # This is not surprising since the secant line and tangent line
  have clearly different slopes just from
> # looking at the picture.
>
> #Let's look at the secant line vs. tangent line picture when h=1.5
  (i.e. Q=(3.5,12.25))
> drawit(1.5);
```




```
> # What’s the difference quotient now?
> d(1.5);
```

5.500000000

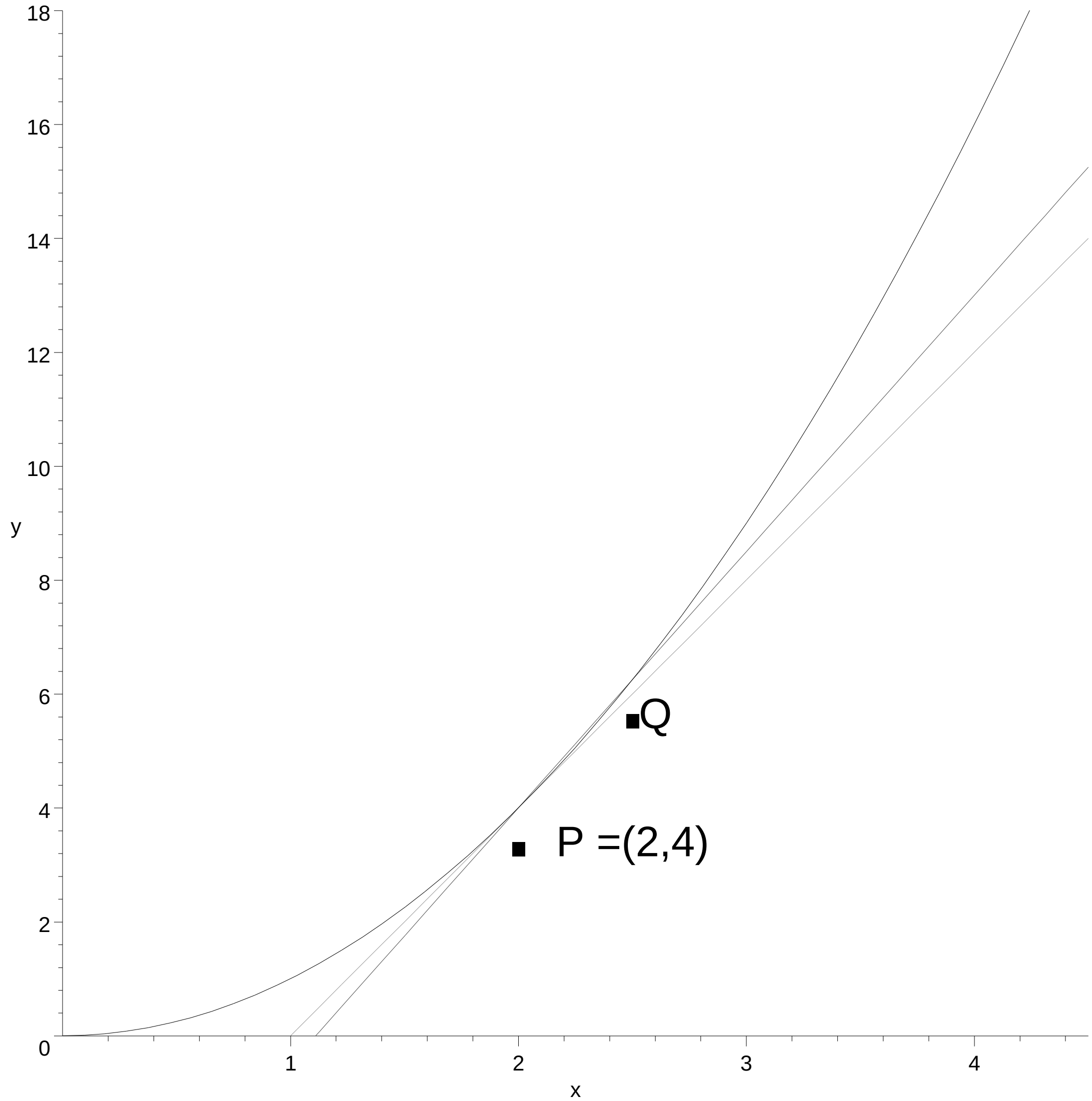
```
> # OK, a little closer to 4 than before but still not quite there
  yet.
>
>
> #Let’s look at the secant line vs. tangent line picture when h=1 (
  Q=(3,9) )
> drawit(1);
```




```
> # What's the difference quotient now?
> d(1);
```

5

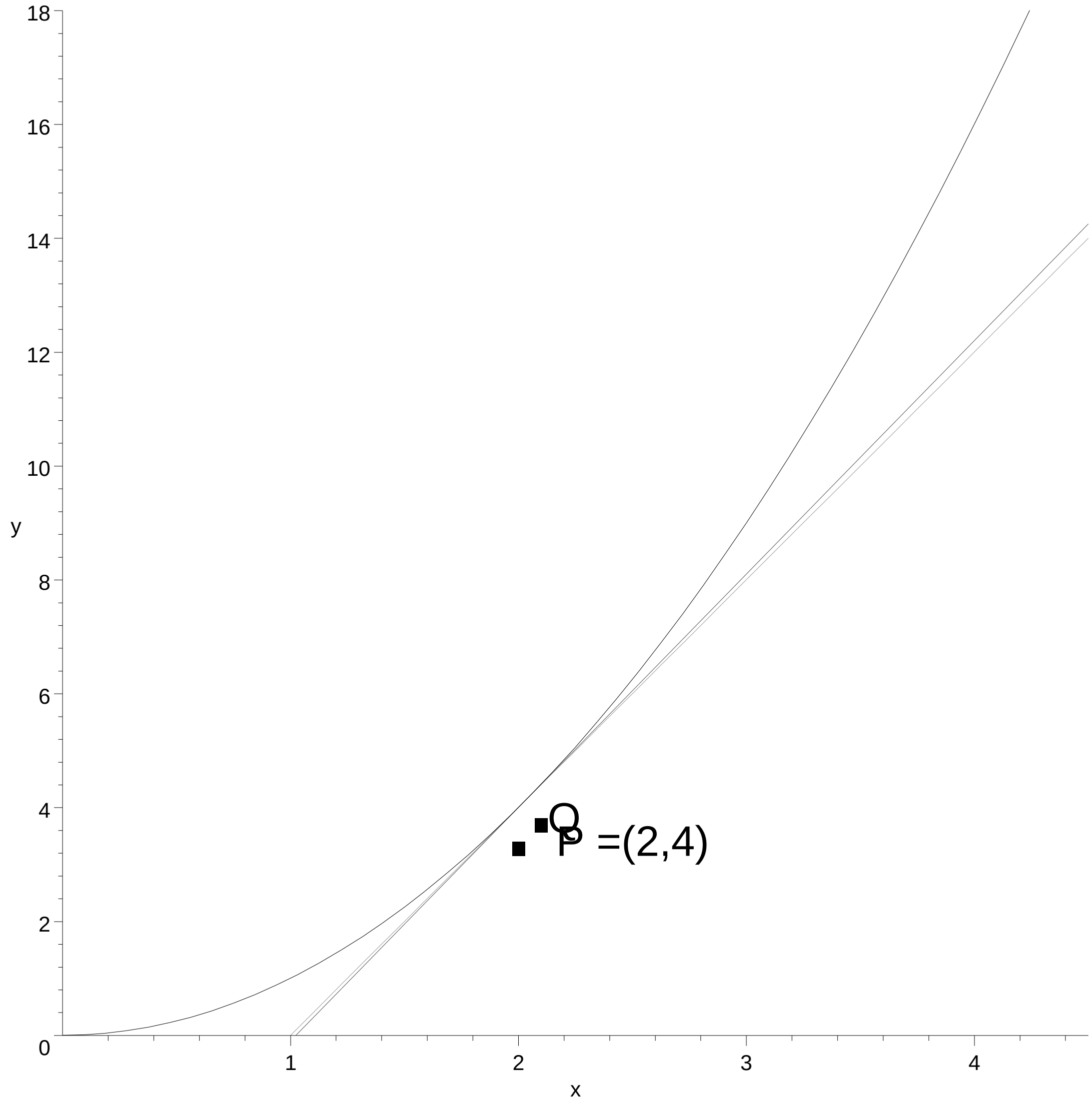
```
> # Let's keep going...
> #Let's look at the secant line vs. tangent line picture when h=0.5
  ( Q=(2.5,6.25) )
> drawit(0.5);
```




```
> # What's the difference quotient now?
> d(0.5);
```

4.500000000

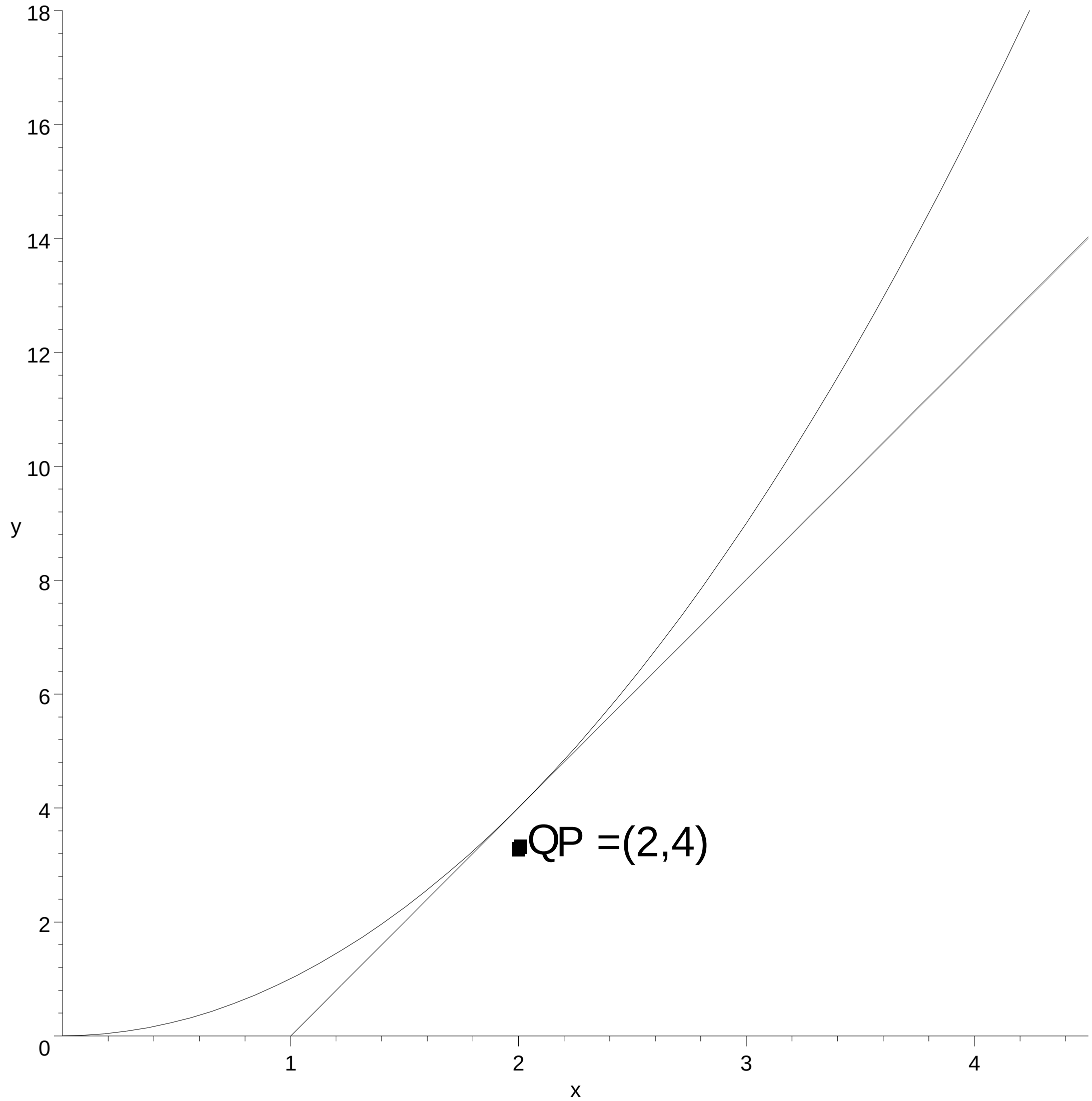
```
> # Notice how the secant line compares with the tangent line, there
  slopes are very close.
>
> #Let's look at the secant line vs. tangent line picture when h=0.1
  ( Q=(2.1,4.41) )
> drawit(0.1);
```



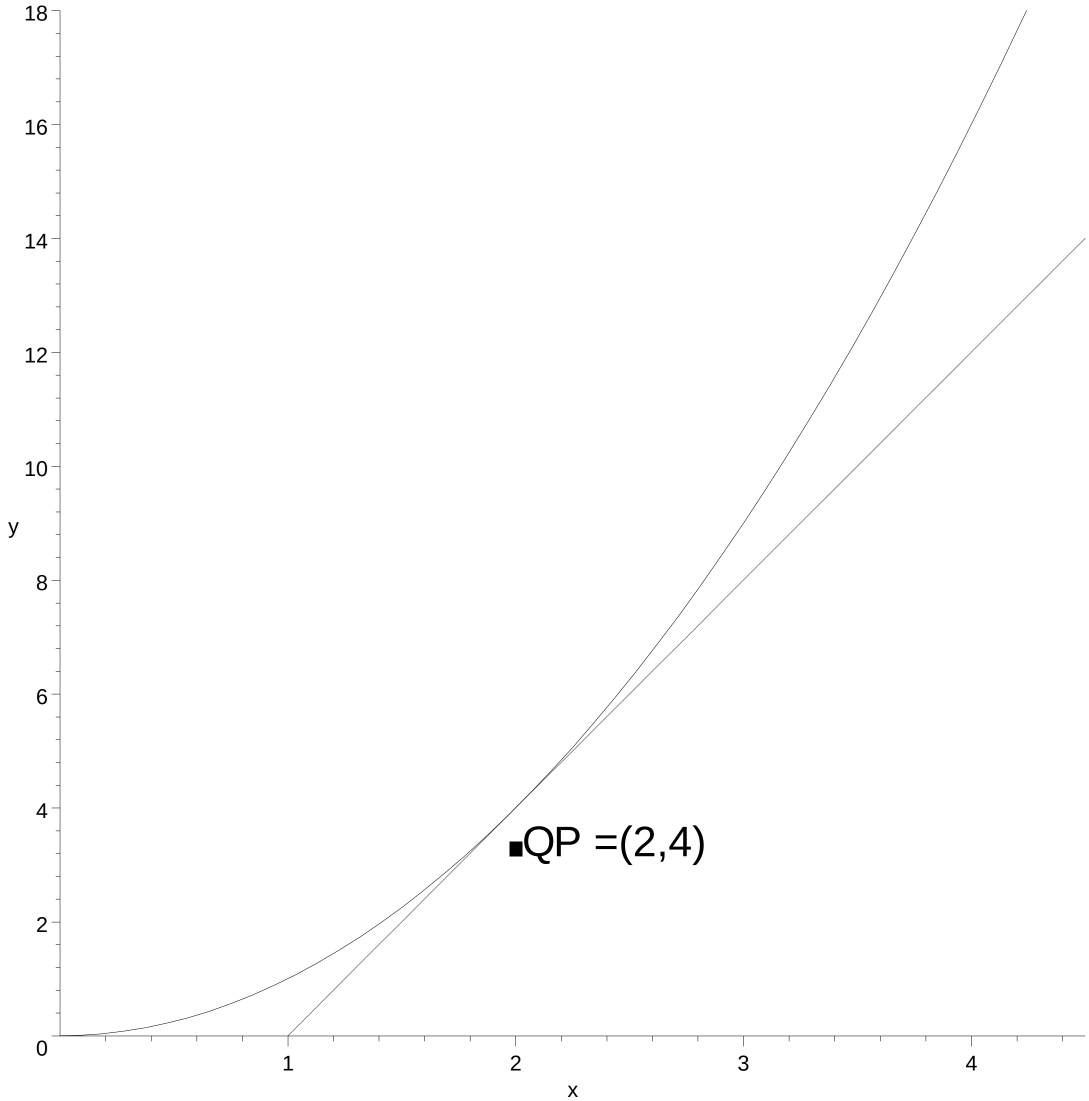

```
> # What’s the difference quotient now?
> d(0.1);
```

4.100000000

```
> # Again, this definitely going somewhere, the smaller we make h,
  (i.e. the closer Q is to P) the more the secant line
> # comes into position with the tangent line.
>
> #Let’s look at the secant line vs. tangent line picture when
  h=0.01 (Q = (2.01,4.0401);
> drawit(0.01);
```

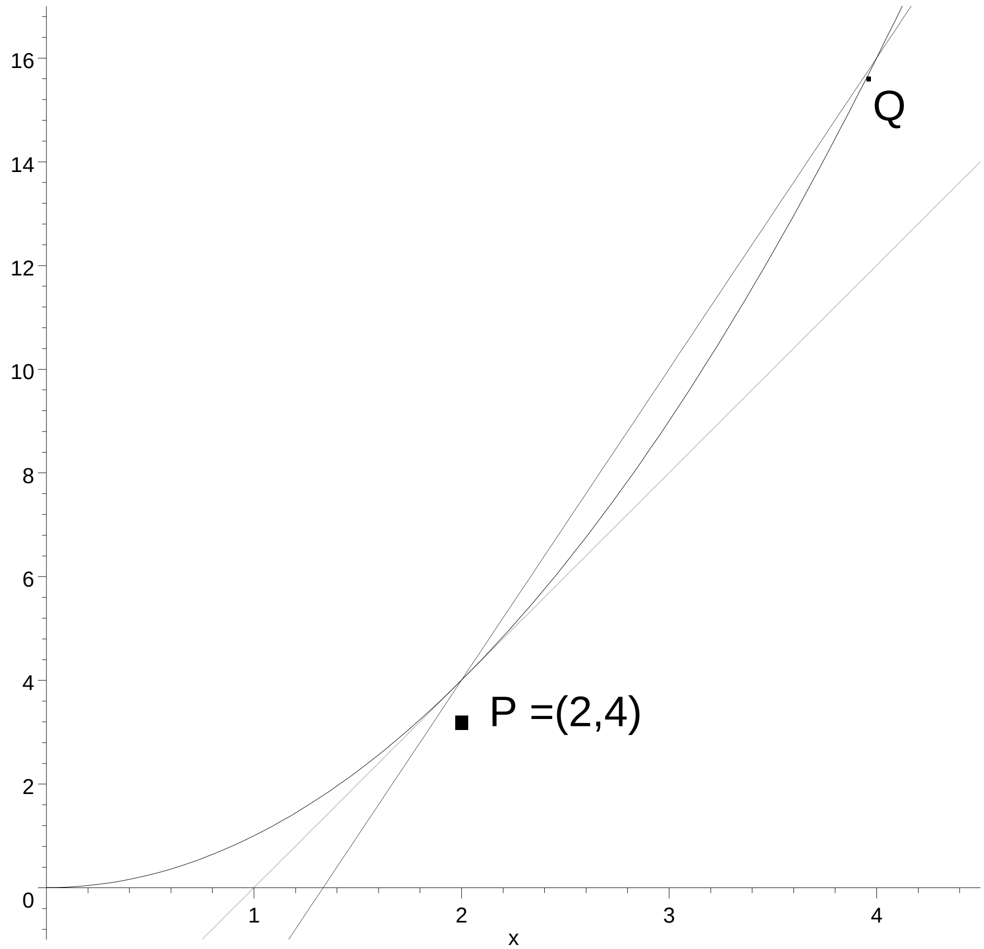



```
>
> #Let’s look at the secant line vs. tangent line picture when
  h=0.001
> drawit(0.001);
```




```
> #Now let's put this together and see the action as h goes from 2
  to 0 !
>
>
> anim(2);
```

Secant Line -> Tangent Line




```
> # The connection is clear, as h->0, Q -> P and the secant line
  becomes the tangent line.
>
> # Here, d(h), the difference quotient is
> d(h);
```

$$\frac{(2+h)^2-4}{h}$$

```
> # Let's simplify this...
> simplify(%);
```

$$4+h$$

```
> # Ah! so it's clear now what happens to d(h) as h -> 0, it tends
  to 4 which is the slope of the tangent
> # line at (2,4).
```

```
> 
> # Note, too that plugging in h=0 into the expression
> d(h);
```

$$\frac{(2+h)^2-4}{h}$$

```
> # seems to yield 0/0 which doesn’t make sense.
> # However, by simplifying, figuring out what happens as h -> 0
  becomes clear.
> 
> 
> 
> 
> 
> 
> 
> 
> 
```