# Earth

## Question - Differentiation notation

If you are given a function $f(x)$ and told $y = f(x)$ then list as many different notations as you can for the derivative of $f$ with respect to $x$.

## Question - Differentiation of powers of $x$

Using the standard results/formulae, what is $\frac{dy}{dx}$ if $y = 2x^3$? What if instead $y = \frac{2}{x^3}$?

## Question - Differentiation to find gradients

Given that $y = 5x^2 + 3x$ find the gradients of $y$ when $x = -2$ and when $x = 6$.

## Question - Differentiation of standard functions

Using a list/table of standard derivatives find the derivative of the following:

(i) $\sin(x)$

(ii) $\sin(2x)$

(iii) $\sin(3x)$

(iv) $\cos(x)$

(v) $-\cos(x)$

(vi) $-2\cos(x)$

(vii) $-\cos(2x)$

(viii) $\sqrt{x}$

(ix) $\frac{1}{\sqrt{x}}$

## Follow-up - Differentiation of standard functions

Can you create a new question or two yourself of the same type as one of these above, and then do it?

*Note: creating your own questions is a great way to see how well you understand a topic*

## Question - Differentiation, trigonometry and graph sketching

Suppose that $f(t) = \sin(t)$, by calculating the derivative of $f$ (with respect to time, $t$) work out at which values of $t$ the gradient of $f$ is zero.

What does the curve of $f$ look like at these points?

How would your answers to these questions have been different if $f(t) = 50\sin(t)$?

## Question - Differentiation of real-world formulae

If a charge $V$, is described by this formula

$$V = \frac{Q}{4\pi\epsilon_0 r}$$

as a function of distance $r$, then calculate

$$-\frac{\mathrm{d}V}{\mathrm{d}r}$$

(you may assume that $Q$, $\pi$ and $\epsilon_0$ are constants).

*This is a difficult question. Hint: if may help to imagine/choose/fix values of $Q, \pi, e$ to help you realize they don't really affect the answer. e.g. imagine $Q = 1$, $\pi = 3$, $\epsilon_0 = 2$ and do the question. Then go back and change their values and see how the answer changes, to realize why they don't make the question more complicated.*