Section 1: Introduction to differentiation

Crucial points

1. **Use notation carefully**

   Make sure that you are familiar both with the notation $\frac{dy}{dx}$ (used when you are given y as a function of x) and the notation $f'(x)$ (used when you are given a function $f(x)$).

2. **Use notation in the same way that it is used in the question**
   Example: Differentiate $v = t^2 + 2t$.

   ✗ ***Wrong*** $\frac{dy}{dx} = 2t + 2$.

   ✓ ***Right*** $\frac{dv}{dt} = 2t + 2$, or $\frac{d}{dt}(t^2 + 2t) = 2t + 2$.

   The expression you are differentiating has variables v and t, not y and x, so you are finding $\frac{dv}{dt}$, not $\frac{dy}{dx}$.

3. **When calculating a gradient or tangent to a curve, make sure you get the coordinates the right way round**
   Example: Find the gradient of the curve $y = x^2 + 2x - 3$ when it crosses the x–axis.

   ✗ ***Wrong*** $\frac{dy}{dx} = 2x + 2$. When $x = 0$, $\frac{dy}{dx} = 2 \times 0 + 2 = 0$.

   ✓ ***Right*** $\frac{dy}{dx} = 2x + 2$. Curve crosses x axis when $y = 0$,
   $\Rightarrow x^2 + 2x - 3 = (x - 1)(x + 3) = 0$
   $\Rightarrow x = 1$, $\frac{dy}{dx} = 2 \times 1 + 2 = 4$,
   or $x = -3$, $\frac{dy}{dx} = 2 \times (-3) + 2 = -4$.

4. **Remember the relationship between the gradients of perpendicular lines**
   When finding the gradient of a normal, you need to first find the gradient of the tangent using differentiation, and then use the relationship $m_1 m_2 = -1$.
   Always show clearly that you are using this relationship.

5. **Draw a diagram if needed**
   Questions on tangents and normals may go on to ask for other coordinate geometry work such as finding where lines cross. If this is the case, a diagram is very helpful.