

Differentiation

We often have to differentiate functions. For functions of the form $f(x) = Ax^m$ it is as simple as multiplying by the power and subtracting one from the power.

Example:

$$\frac{d}{dx} 7x^5 = 35x^4$$

This extends to multiples and sums of powers of x . If we remember that $x = x^1$, $2 = 2x^0$ and that when differentiating for these functions too we multiply by the power and subtract one from the power then,

$$\frac{d}{dx} (3x^4 - 5x^2 + 3x - 2) = 12x^3 - 10x + 3$$

The process is the same for all powers of x , fractions and negative powers included:

$$\frac{d}{dx} 3x^{\frac{5}{4}} = 3 * \frac{5}{4} x^{\frac{5}{4}-1} = \frac{15}{4} x^{\frac{1}{4}}$$

$$\frac{d}{dx} 5x^{-3} = -15x^{-4}$$

Whatever form the question is given it we must expression the function to be differentiated in the form Ax^m . For example,

$$f(x) = 5\sqrt[4]{x^3}$$

We write this as $f(x) = 5x^{\frac{3}{4}}$ then $\frac{d}{dx} f(x) = \frac{d}{dx} 5x^{\frac{3}{4}} = \frac{15}{4} x^{-\frac{1}{4}}$

These are some more examples,

$$\frac{d}{dx} (3\sqrt[5]{x^6} - 2\sqrt[4]{x^7} + 4\sqrt[3]{x}) = \frac{d}{dx} (3x^{\frac{6}{5}} - 2x^{\frac{7}{4}} + 4x^{\frac{1}{3}}) = \frac{18}{5}x^{\frac{1}{5}} - \frac{7}{2}x^{\frac{3}{4}} - \frac{4}{3}x^{-\frac{2}{3}}$$

Differentiation is used to find rates of change (when we differentiate with respect to time), gradients, slopes, tangents and normals.