Differentiation

Intro

The presentation will consist of some practice questions on differentiation and tangent lines.

Derivatives

Find the derivative of each of the following functions:

- $f(x) = 2x^2 - 3x^5$. This one is very simple:

$$f'(x) = 2 \times 2x^1 - 3 \times 5x^4 = 4x - 15x^4$$

- $f(x) = 3x + 1 - \frac{1}{x}$. We first rewrite $f(x) = 3x + 1 - x^{-1}$, now we have:

$$f'(x) = 3 + 0 - (-1)x^{-2} = 3 + \frac{1}{x^2}$$

- $f(x) = \frac{x^4}{2} + \frac{4}{x^2}$. We rewrite $f(x) = \frac{1}{2}x^4 + 4x^{-2}$, we have:

$$f'(x) = \frac{1}{2} \times 4x^3 + 4 \times (-2)x^{-3} = 2x^3 - \frac{8}{x^3}$$

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- $f(x) = \frac{2}{3x} - \frac{3}{2x^2}$. Rewrite $f(x) = \frac{2}{3}x^{-1} - \frac{3}{2}x^{-2}$, so we get:

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- $f(x) = \frac{5}{x} + 3x^2 - \frac{1}{3x^4}$. We rewrite $f(x) = 5x^{-1} + 3x^2 - \frac{1}{3}x^{-4}$, so we have:

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Gradients

Find the gradient of $f(x) = 3x^2 - 5x + 1$ at $(1, -1)$. We first find the gradient function (derivative):

$$f'(x) = 3 \times 2x^1 - 5 + 0 = 6x - 5$$

Now we want to find the gradient at $(1, -1)$, so when $x = 1$. The gradient is

$$f'(1) = 6 \times 1 - 5 = 1$$

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Find the gradient of $f(x) = \frac{1}{x^3} - \frac{1}{x^2}$ at $(1, 0)$. We want to find the gradient function, so we first rewrite $f(x) = x^{-3} - x^{-2}$, so we get

$$f'(x) = -3x^{-4} - (-2)x^{-3} = -\frac{3}{x^4} + \frac{2}{x^3}$$

Now we want to find the gradient at $(1, 0)$, so when $x = 1$. We substitute $x = 1$ into the gradient function and we get that the gradient is

$$f'(2) = -\frac{3}{1^4} + \frac{2}{1^3} = -1$$

Gradients

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Now we want to find the gradient at $(1, 0)$, so when $x = 1$. We substitute $x = 1$ into the gradient function and we get that the gradient is

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Find the tangent line to the graph of $f(x) = \frac{1}{3}x^3 - 2x$ at $(0, 0)$. We first need to find the gradient of the function at this point, so we find the gradient function:

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So the gradient at $(1, 2)$ is

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So the gradient of the tangent line will be 5, so it will be of the form $y = 5x + c$. To find c we use the point $(1, 2)$ and we get that $2 = 5 \times 1 + c$, so $c = -3$. So the tangent line to the graph of $f(x) = 3x + 1 - \frac{2}{x}$ at $(1, 2)$ will have the equation:

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