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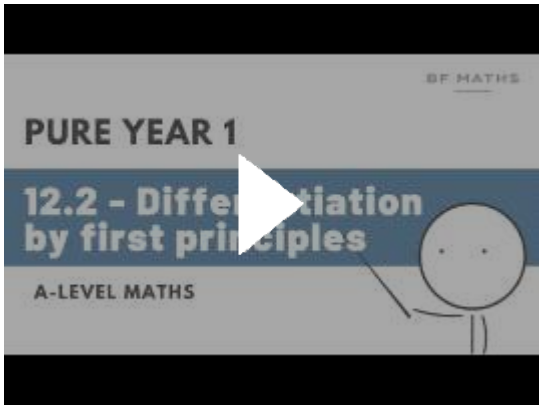
If you need help on this chapter:
A-Level Maths | Pure Year 1 | 12.2 Differentiation by First Principles Walkthrough | Edexcel



12.2 Finding the derivative

1) $f(x)=12x$

a) $f'(4)=12$

$$\lim_{h\to 0}\frac{f(4+h)-f(4)}{h}$$

$$\lim_{h\to 0}\frac{12(4+h)-12(4)}{h}$$

$$\lim_{h\to 0}\frac{48+12h-48}{h}=\frac{12h}{h}=12$$

b) $f'(-2)=12$

$$\lim_{h\to 0}\frac{f(-2+h)-f(-2)}{h}$$

$$\lim_{h\to 0}\frac{12(-2+h)-12(-2)}{h}$$

$$\lim_{h\to 0}\frac{-24+12h+24}{h}=\frac{12h}{h}=12$$

c) $f'(0)=12$

$$\lim_{h\to 0}\frac{f(0+h)-f(0)}{h}$$

$$\lim_{h\to 0}\frac{12(0+h)-12(0)}{h}$$

$$\lim_{h\to 0}\frac{0+12h-0}{h}=\frac{12h}{h}=12$$

2) $f(x)=2x^2$

a) $f'(3)=12$

$$\lim_{h\to 0}\frac{f(3+h)-f(3)}{h}$$

$$\lim_{h\to 0}\frac{2(3+h)^2-12(3)^2}{h}$$

$$\lim_{h\to 0}\frac{2(9+6h+h^2)-18}{h}$$

$$\lim_{h\to 0}\frac{18+12h+2h^2-18}{h}=\frac{12h+2h^2}{h}$$

$$\lim_{h\to 0}12+2h^2\to 12$$

b) $f'(-1)=-4$

$$\lim_{h\to 0}\frac{f(-1+h)-f(-1)}{h}$$

$$\lim_{h\to 0}\frac{2(-1+h)^2-2(-1)}{h}$$

$$\lim_{h\to 0}\frac{2(-1+h)(-1+h)-2(-1)^2}{h}$$

$$\lim_{h\to 0}\frac{-4h+2h^2}{h}=\lim_{h\to 0}-4+h=-4$$

c) $f'(0)=0$

$$\lim_{h\to 0}\frac{f(0+h)-f(0)}{h}$$

$$\lim_{h\to 0}\frac{2(0+h)^2-2(0)^2}{h}$$

$$\lim_{h\to 0}\frac{2(0+h)(0+h)-0}{h}$$

$$\lim_{h\to 0}\frac{2h^2}{h}=2h=0$$

3) $f(x)=8x$

$f(x+h)=8(x+h)$

$=8x+8h$

$$\lim_{h\to 0}\frac{8x+8h-8x}{h}=\frac{8h}{h}=8$$

$$\frac{dy}{dx}=8$$

4) $f(x)=3x^2$

$f(x+h)=3(x+h)^2$

$=3(x+h)(x+h)$

$=3(x^2+2xh+h^2)$

$=3x^2+6xh+3h^2$

$$\lim_{h\to 0}\frac{3x^2+6xh+3h^2-3x^2}{h}$$

$$\lim_{h\to 0}\frac{6xh+3h^2}{h}$$

$$\lim_{h\to 0}6x+3h\to 6x$$

$$\frac{dy}{dx}=6x$$

12.2 - Finding the derivative

5) $f(x) = x^3$

$f(x+h) = (x+h)^3$ use binomial expansion (Pure 1 Chapter 8) or $(x+h)(x+h)(x+h)$

$= x^3 + 3x^2h + 3xh^2 + h^3$

$$f'(x) = \lim_{h\to 0} \frac{x^3 + 3x^2h + 3xh^2 + h^3 - (x^3)}{h}$$

$$= \lim_{h\to 0} \frac{3x^2h + 3xh^2 + h^3}{h^3}$$

$$= \lim_{h\to 0} \frac{h(3x^2 + 3xh + h^2)}{h}$$

$$= 3x^2 + 3x(0) + (0)^2$$

$f'(x) = \underline{3x^2}$

6) $f(x) = 6 - 3x^2$

$f(x+h) = 6 - 3(x+h)^2$

$= 6 - 3(x^2 + 2xh + h^2)$

$= 6 - 3x^2 - 6xh - 3h^2$

$$f'(x) = \lim_{h\to 0} \frac{6 - 3x^2 - 6xh - 3h^2 - (6 - 3x^2)}{h}$$

$$= \lim_{h\to 0} \frac{6 - 3x^2 - 6xh - 3h^2 - 6 + 3x^2}{h}$$

$$= \lim_{h\to 0} \frac{h(-6x - 3h)}{h}$$

$f'(x) = -6x - 3(0) = -6x$ ← gradient function

When $x = 1$, $m = -6(1) = \underline{-6}$