

## Differentiation rules

### Derivative

$$y' \quad \frac{dy}{dx} \quad f'(x)$$

Slope of the curve

Slope of the tangent line

Rate of change

# Put power down, Power – 1

6.2	Derivative of $x^n$	$f(x) = x^n \Rightarrow f'(x) = nx^{n-1}$
	Derivative of $\sin x$	$f(x) = \sin x \Rightarrow f'(x) = \cos x$
	Derivative of $\cos x$	$f(x) = \cos x \Rightarrow f'(x) = -\sin x$
	Derivative of $\tan x$	$f(x) = \tan x \Rightarrow f'(x) = \frac{1}{\cos^2 x}$
	Derivative of $e^x$	$f(x) = e^x \Rightarrow f'(x) = e^x$
	Derivative of $\ln x$	$f(x) = \ln x \Rightarrow f'(x) = \frac{1}{x}$
	Chain rule	$y = g(u), u = f(x) \Rightarrow \frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$
	Product rule	$y = uv \Rightarrow \frac{dy}{dx} = u \frac{dv}{dx} + v \frac{du}{dx}$
	Quotient rule	$y = \frac{u}{v} \Rightarrow \frac{dy}{dx} = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$

## Simple differentiation

Find the derivative of the following functions.

1.  $y = 4x$

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2.  $y = 5x^3$

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3.  $y = 10\sqrt{x}$

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4.  $y = 20$

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5.  $y = \frac{9}{x^3}$

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6.  $y = 5x^3 + 4x - 29$

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7.  $y = 2(3x - 2)$

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8.  $y = \frac{4}{3}x^6 + 5x^2 + 2x$

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9.  $y = \frac{1}{3x^3} - 2x^2 - 5$

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### Find the gradient of the curve

1.  $y = 10x^3$  at  $x = 2$

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2.  $y = 4x^2 - 5x + 2$  at  $x = 1$

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3.  $y = \frac{3}{x^3} - 2x$  at  $x = 3$

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4.  $y = \frac{3}{\sqrt{x}} - 2x$  at  $x = 2$

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5.  $y = (x + 3)^3$  at  $x = -2$

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## Chain rule

Find  $y'$  of the following functions

1.  $y = (5x - 2)^3$

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2.  $y = 6(x^2 + 3x - 4)^2$

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3.  $y = \frac{5}{4x - x^2}$

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4.  $y = \frac{8}{(9x+3)^2}$

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5.  $y = \sqrt{x^2 + 3}$

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## Paper 1

1.  Consider  $f(x) = x^2 \sin x$ .

(a) Find  $f'(x)$ .

(b) Find the gradient of the curve of  $f$  at  $x = \frac{\pi}{2}$ .

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2.  Given that  $f(x) = \frac{1}{x}$ , answer the following.

(a) Find the first four derivatives of  $f(x)$ .

(b) Write an expression for  $f^{(n)}(x)$  in terms of  $x$  and  $n$ .

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