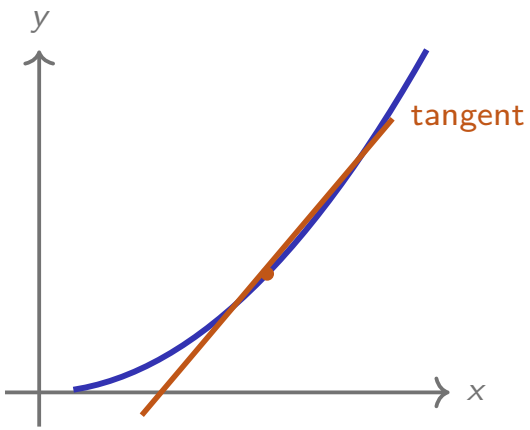
Exercise walk-through

# 2.8
# The Product Rule

AP Calculus AB

# What we will cover

1. Average vs instantaneous rate
2. The derivative as a limit
3. When a derivative exists
4. Basic derivative rules
5. Product & quotient rules
6. Trig, exp & log derivatives



# The product rule

A product is not the product of the derivatives. Use the **product rule** :

$$(uv)' = u'v + uv'.$$

> "Derivative of the first times the second, plus the first times the derivative of the second."

**Differentiate $f(x) = x^2 \sin x$**

$u = x^2$ $(u' = 2x)$, $v = \sin x$ $(v' = \cos x)$:

$$f'(x) = 2x \sin x + x^2 \cos x.$$

Read the structure first – a product needs the product rule.

# Unit 2 – key takeaways

**1 The derivative**

the limit of the secant slope – the tangent's gradient

**2 Existence**

differentiable $\Rightarrow$ continuous; corners and vertical tangents fail

**3 The rules**

power, constant multiple, sum; product and quotient

**4 Building blocks**

$\sin$, $\cos$, $e^x$, $\ln x$ – know them by heart

# Exercises 2.1·2.3

**2.1** State the product rule. [1]

**2.2** Differentiate $x\,e^x$. [2]

**2.3** State when you need the product rule. [1]

# Exercises 2.1·2.3

**2.1** State the product rule. [1]

**2.1**

- $(fg)' = f'g + fg'$

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**2.2** Differentiate $x\,e^x$. [2]

**2.2**

- $(1)e^x + x\,e^x = e^x(1+x)$

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**2.3** State when you need the product rule. [1]

**2.3**

- when differentiating a product of two functions of $x$

# Exercises 3.1·3.2

**3.1** $(fg)'$ equals [1]

- **A** $f'g'$
- **B** $f'g + fg'$
- **C** $f'g - fg'$
- **D** $f'/g'$

**3.2** $\dfrac{d}{dx}[x^2 \sin x]$ uses the [1]

- **A** power rule only
- **B** product rule
- **C** quotient rule
- **D** chain rule only

# Exercises 3.1·3.2

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**3.1 B**

- $f'g + fg'$.

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- **C** quotient rule
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**3.2 B**

- product rule.

# Exercise 3.3 (a)

**3.3** $y = x \cos x$.

(a) Identify $f$ and $g$. [1]

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(a) Identify $f$ and $g$. [1]

(a)

- $f = x$, $g = \cos x$

# Exercise 3.3 (b)

**3.3** $y = x \cos x$.

(b) Apply the product rule. [1]

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(b) Apply the product rule. [1]

(b)

- $(1) \cos x + x(-\sin x)$

# Exercise 3.3 (c)

**3.3** $y = x \cos x$.

(c) State $y'$. [1]

# Exercise 3.3 (c)

**3.3** $y = x \cos x$.

(c) State $y'$. [1]

(c)

- $y' = \cos x - x \sin x$