

Mathematics Application and interpretation

HL 5.9 Teachers Notes #1 -Further rules of differentiations

The Chain rule of differentiation

Learning objective

Students will be confident to

Core: Investigate and apply chain rule in simple context problems.
Proficient: Apply mathematics in complex problems.
Mastery: Apply mathematics in challenging problems.

Session plan

Plan of the day	Assessment Strategies	Differentiation			
Warm up: Students will solve an Exam style question. https://teacher.desmos.com/activitybuilder/custom/61f4f90e64b0000a17ee58bd Lesson introduction Students will be introduced to the lesson learning objectives, success criteria. Inquiry time: 10 min - ATL Focus -Thinking skills. Desmos classroom activity on investigating the chain rule, finding the derivative of $(ax + b)^n$. Investigation link: https://teacher.desmos.com/activitybuilder/custom/61ec0d6a6cc14c0a0888dd7b Differentiated Solved Examples Drill-Differentiated Practice of the day (POD) <i>HL students are encouraged to work on the proficient and mastery level directly.</i> <table border="1"> <tr> <td>POD CORE</td><td>POD PROFICIENT</td><td>POD MASTERY</td></tr> </table>	POD CORE	POD PROFICIENT	POD MASTERY	Self-assessment where students will self-assess their work using a green pen.	The examples solved and Tasks assigned are differentiated to three levels core, proficient and mastery. ELL: -Translated khan academy -Visuals mind maps -Desmos activities (Translated) -Khan academy videos
POD CORE	POD PROFICIENT	POD MASTERY			

Pause and reflect: 5 min

IB Profile: Reflective IB student

Students will reflect on their learning outcomes and experiences throughout the session, stating which level they were able to achieve and what action plans they need to take for improvement and development, using WWW: What went well? and EBI: Even better if...

Warmup/starter

Duration: 5 minutes

Students will review prior knowledge on differentiation through exam style question –Level easy

Teachers code

<https://teacher.desmos.com/activitybuilder/custom/61f4f90e64b0000a17ee58bd>



Exploration-Desmos Activity

Use Desmos classroom activity, students will explore the chain rule, where they will explore how to differentiate composite functions.

First principles of differentiation prior knowledge is recommended.

The exploration will enhance students' inquiry, reasoning and reflection skills.

<https://teacher.desmos.com/activitybuilder/custom/61ec0d6a6cc14c0a0888dd7b>



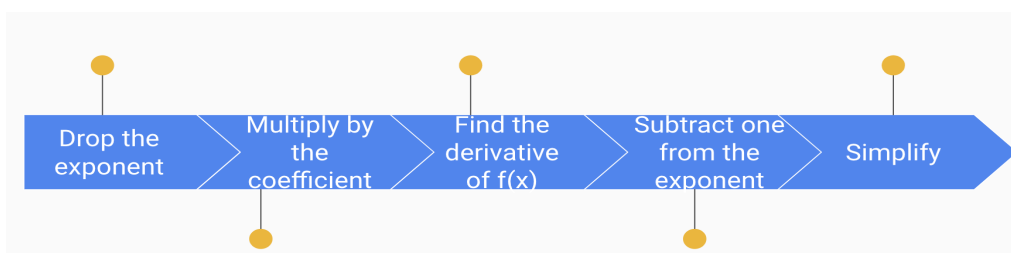
The chain rule

if $y = g(u)$ where $u = f(x)$, then $\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$

if $y = (f(x))^n$, then $f'(x) = nf'(x)(f(x))^{n-1}$

Steps to find the derivative using the chain rule

$$f(x) = a(f(x))^n$$



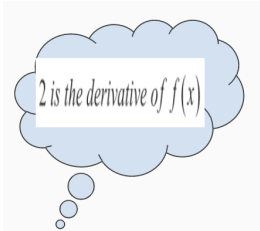
Step1: Convert any radical sign into an exponent.

Step2: Drop the exponent, multiply with coefficient of the function and find the derivative of the function $f(x)$. Finally, subtract the exponent by 1.

$$f'(x) = anf'(x)(f(x))^{n-1}$$

Step 3: Simplify

Differentiated Worked Examples

Example 2.1 find $\frac{dy}{dx}$ if: $y = (x^2 - 3x)^5$	Solution Step1: Convert any radical sign into an exponent. Step2: Drop the exponent, multiply with coefficient of the function, find the derivative of the function $f(x)$. Finally, subtract the exponent by 1. $y = 5 \cdot (2x - 3)(x^2 - 3x)^{5-1}$ Step 3: Simplify. $y = (10x - 15)(x^2 - 3x)^4$
Example 2.2 Find $\frac{dy}{dx}$ if $y = \frac{5}{(2x+5)^2}$	Solution Step1: Convert any radical sign into an exponent. $y = 5(2x + 5)^{-2}$ Step2: Drop the exponent, multiply with coefficient of the function, find the derivative of the function $f(x)$. Finally, subtract the exponent by 1. 

	$\frac{dy}{dx} = 5(-2)(2)(2x + 5)^{-2-1}$ -2 is the dropped exponent Step 3: Simplify $\frac{dy}{dx} = -20(2x + 5)^{-3}$ $\frac{dy}{dx} = -\frac{20}{(2x+5)^3}$
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Example 2.3 Find $\frac{ds}{dt}$ for $s = (4t^2 + 3t)^2 + \sqrt{2t + 2}$	Solution Step1: Convert any radical sign into an exponent. $s = (4t^2 + 3t)^2 + (2t + 2)^{\frac{1}{2}}$ Step2: Drop the exponent, multiply with coefficient of the function ,find the derivative of the function $f(x)$. Finally, subtract the exponent by 1. $s' = 2(8t + 3)(4t^2 + 3t)^{2-1} + \frac{1}{2}(2)(2t + 2)^{\frac{1}{2}-1}$
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	Step 3: Simplify $s' = (16t + 6)(4t^2 + 3t) + (2t + 2)^{-\frac{1}{2}}$ $s' = (16t + 6)(4t^2 + 3t) + \frac{1}{\sqrt{2t+2}}$
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Practice of the day-POD

Core

Find the derivative of $f(x)$

1. $f(x) = (3x + 1)^2$
2. $f(x) = 2(4x^2 + 5x)^2$
3. $f(x) = (2x^3 + 4x + 6)^2$

Answer key

1. $f'(x) = 6(3x + 1)$
2. $f'(x) = 4(8x + 5)(4x^2 + 5x)$
3. $f'(x) = 2(6x^2 + 4)(2x^3 + 4x + 6)$

Proficient

Find the derivative of $f(x)$

1. $f(x) = \frac{1}{(2x-1)^2}$
2. $f(x) = \sqrt{x^3 + 4x + 5}$

Answer key

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

$$f'(x) = \frac{3x^2+4}{2\sqrt{x^3+4x+5}}$$

Mastery

Find $\frac{dy}{dx}$ for

$$y = \frac{5}{\left(x + \sqrt[2]{x^3}\right)^2}$$

Answer key

$$y' = \frac{-10-15\sqrt{x}}{\left(x + \sqrt[2]{x^3}\right)^3}$$

Pause and reflect

IB Learner profile focus: Reflective.

Students will reflect on their learning outcomes and experience throughout the session, stating which level they were able to achieve and what are the actions they need to take for development using WWW and EBI.

WWW: What went well.

EBI: Even better if.