Week 2
Term 1
2019

HAWKER COLLEGE
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**Learning Brief MM3:**
**Further differentiation and applications**

# Goals

By the end of this week, you should be able to:

- Learn and use the chain rule for differentiation
- Find the derivatives of exponential functions of the forms: $y = e^x$, and $y = e^{f(x)}$
- Use the class-pad calculators to find the derivatives of exponential functions.
- Use derivatives to solve practical problems

# Theoretical Components

***STEP 1***
Resources:
Maths Quest Year 12 Chapter 7

**Chain Rule Proof**

$$\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$$

https://www.khanacademy.org/math/ap-calculus-ab/product-quotient-chain-rules-ab/chain-rule-proof-ab/v/chain-rule-proof

Read and make notes examples 13, 14 and 15 from Chapter 7

**What is base e?**
Read through to get an insight on the number 'e':
http://bit.ly/w8OiD

http://www.mathopolis.com/questions/q.php?id=2011&site=1&ref=/numbers/e-eulers-number.html&qs=2011_2012_2013

**Derivative of $y = e^x$, and $y = e^{f(x)}$ from first principles**
See the following page

Read and make notes examples 16 - 19 from Chapter 7

# Practical Components

***STEP 2***

**The Chain Rule**

- Exercise 7D

**The Derivative of $e^x$ and $e^{f(x)}$**

- Exercise 7E

If you need to remind yourself of exponential functions and their graphs review:
https://mathspace.co/learn/ac-methods-12/calculus-of-exponential-functions-3232/

# Investigation

***STEP 3***
Complete the custom task **Further Exponentials** on mathspace.co
Due date: Monday 18 February

# QFO

Quiz/Forum/Other

**Remember to scan in when you come to the Maths Area and when you leave.**

Derivative of $f(x) = e^x$ from first principles:

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}, h \neq 0$$

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

$$= \lim_{h \to 0} \frac{e^x e^h - e^x}{h}$$

$$= \lim_{h \to 0} \frac{e^x(e^h - 1)}{h}$$

$$= e^x \lim_{h \to 0} \frac{e^h - 1}{h}$$

Note that $\lim_{h \to 0} \frac{e^h - 1}{h}$ can be deduced by using a calculator and substituting values of *h* close to zero.

| $h$ | $\frac{e^h - 1}{h}$ |
|---|---|
| 0.01 | 1.0050 |
| 0.0001 | 1.000 05 |
| 0.000 001 | 1.000 000 |

That is, $\lim_{h \to 0} \frac{e^h - 1}{h} = 1$.

Therefore, $f'(x) = e^x \times 1$
$= e^x$

**If $f(x) = e^x$ then $f'(x) = e^x$.**

*Note*: $e^x$ is the only function which has itself as a derivative.