Week 7/8/9
Term 1
2021

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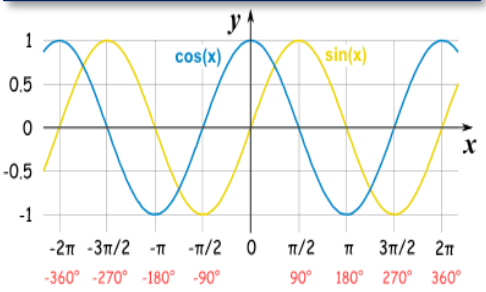
SMM3
Further differentiation and applications

Goals



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

- Review chain rule, product and quotient rules
- Find the derivatives of trigonometric functions – Sine, Cosine and Tangent.
- Use the class-pad calculators to find the derivatives of trigonometric functions. Set CAS to RAD
- Use derivatives to solve practical problems
- Identify turning points and points of inflection
- Find the second derivative and use this to sketch curves and to solve optimisation problems

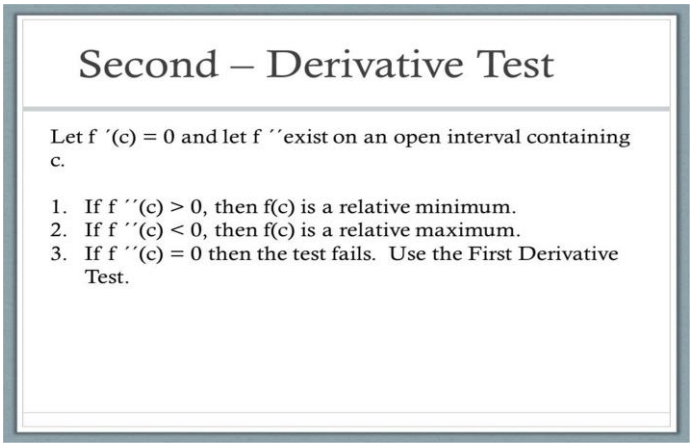
Theoretical Components

STEP 1
Resources:
Maths Quest Year 12 Chapter 7

Derivatives of Trigonometric functions
Read and make notes examples 24 - 26

Product rule
Read and make notes example 27 and 28

Quotient Rule
Read and make notes examples 29 and 30


Second – Derivative Test

Let f ′(c) = 0 and let f ′′exist on an open interval containing c.

1. If f ′′(c) > 0, then f(c) is a relative minimum.
2. If f ′′(c) < 0, then f(c) is a relative maximum.
3. If f ′′(c) = 0 then the test fails. Use the First Derivative Test.

Second Derivative
https://mathspace.co/teach2/chapter/38966/1974/
Second Derivative and Concavity
https://mathspace.co/teach2/chapter/38967/1975/
Classification of turning and stationary points
https://mathspace.co/teach2/chapter/38968/1976/
Optimisation Using Calculus
https://mathspace.co/teach2/chapter/38970/1978/

Practical Components

STEP 2
Derivative of Trigonometric Functions
Do Exercise 7G

Practise Product and Quotient Rules
Do Exercise 7H
Do Exercise 7I

Mixed Problems on Differentiation
Exercise 7J Q1 - 3

Second Derivative and Concavity
https://mathspace.co/teach2/chapter/38967/6673/
Classification of turning and stationary points
https://mathspace.co/teach2/chapter/38968/6681/
Optimisation Using Calculus
https://mathspace.co/teach2/chapter/38970/6707/

Investigation

STEP 3
Begin preparing for the test in Week 8.

Complete a summary sheet – one-page A4 handwritten-notes – to be handed up with the test.

See next page for Week 9 Investigation

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Week 9 Investigation

Questio 1.

(a) Develop a three-step Chain Rule for the derivative $\frac{dy}{dx}$, where y is a function of $u, and\ u\ is\ a\ function\ of\ v, and\ v\ is\ a\ function\ of\ x.$

(b) Hence differentiate $y = \frac{1}{1+\sqrt{1-x^2}}$ using your three-step chain rule from part (a).

Question 2.

Parametric Differentiation: In many later situations, a curve will be specified by two equations giving x and y in terms of some third variable t, called a *parameter*. For example,

$$x = 2t, \qquad y = t^2$$

specifies the parabola $y = \frac{1}{4}x^2$, as can be seen by eliminating t from the two equations. In this situation it is very simple to calculate dy/dx directly using *parametric differentiation*. The formula below is another version of the chain rule, because 'the dt's just cancel out'.

13 PARAMETRIC FUNCTIONS: $\dfrac{dy}{dx} = \dfrac{dy/dt}{dx/dt}$

WORKED EXERCISE: In the example above, $\dfrac{dy}{dx} = \dfrac{2t}{2}$

$= t.$

Question for you:

Now, if $x = \frac{1}{\sqrt{5t^2-2t}}$ and $y = e^{2t^2} - e^{-7}$.

Calculate $\frac{dy}{dx}$ using the method above. Give your answer in the simplest form.