**9B Differentiating Exponentials**

ex

ln(x)

ax

1. Find given that:
2. Find given that:
3. Find given that:

**9C (Part 2) The Chain Rule**

1. Given that , find using the chain rule.
2. Given that , find
3. Given that , find the gradient of the curve at .

**9D The Product Rule**

1. Given that , find .
2. Given that , show that , where and are constants to be found.

**9E The Quotient Rule**

1. Given that , find
2. A curve has equation .

The curve has a stationary point at . Find the coordinates of , to 3 significant figures.

**9A Differentiating Sine & Cosine**

Small angle notes

Differentiating Sine from First Principles

Differentiating Sin(kx) from First Principles

1. Find given that:
2. A curve has equation:

Find the stationary points on the curve in the interval .

**9F Trigonometric Derivatives**

1. Given that , find
2. Given that , find .
3. Given that , find .
4. Given that , find .
5. Differentiate:
6. Differentiate:
7. Differentiate:
8. Differentiate:

No Arc derivatives on new Spec

**9C (Part 1) dx/dy**

1. Find the value of at the point on the curve with equation

**9G Differentiating Parametric Equations**

1. Find the gradient at the point where , on the curve given parametrically by:

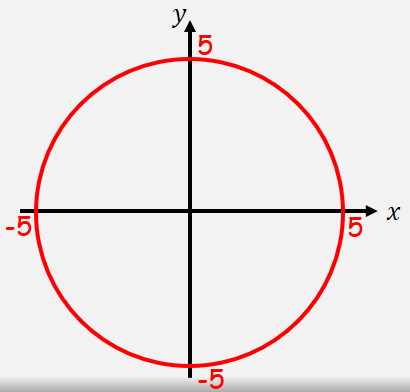
, ,

1. Find the equation of the normal at the point , where , to the curve with parametric equations and .

**9H Implicit Differentiation**

1. Differentiate the following equation implicitly:
2. Below is a sketch of the circle with equation , , .

Find the gradient of the curve where



1. Find in terms of and when:
2. Given that , find the value of at the point (1,1)
3. Find the value of at the point (1,1), when:

**9I Concave & Convex Functions**

1. Find the interval on which the function is concave.
2. Show that the function is convex for all real values of .
3. The curve has equation
4. Show that C is concave on the interval and convex on the interval
5. Find the coordinates of the point of inflection

**9J Chain Rule in Context**

1. Given that the area of a circle is related to its radius by the formula , and that the rate of change of its radius in is given by , find when
2. The volume of a hemisphere is related to its radius by the formula , and the total surface area is given by the formula . Given that the rate of increase of volume, in , , find the rate of increase of the surface area, .
3. In the decay of radioactive particles, the rate at which particles decay is proportional to the number of particles remaining. Write down a differential equation for the rate of change of the number of particles.
4. Newton’s law of cooling states that the rate of loss of temperature of a body is proportional to the excess temperature of the body compared to its surroundings. Write an equation that expresses this law.
5. The head of a snowman of radius loses volume by evaporation at a rate proportional to its surface area. Assuming that the head is spherical, that the volume of a sphere is given by and that the surface area is, write down a differential equation for the rate of change of radius of the snowman’s head.