**Stage 2 Mathematical Methods**

**Differential Calculus Test**

**Topic 1: Subtopics 1.1, 1.2, 1.5**

**Total Marks – 59**

**This Skills and Applications Task is to be completed without a calculator or notes.**

1. (10 marks)

Differentiate the following. There is no need to simplify your answers.

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(2 marks)

1. (5 marks)

Find, from first principles, if

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(5 marks)

1. (4 marks)

Find the equation, in the form , of the **TANGENT** to at the point where .

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(4 marks)

1. (14 marks)

The function has a stationary point at .

1. Explain why .

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(1 mark)

1. Hence show that .

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(2 marks)

1. Find and classify the stationary points of . (Make sure you include a sign diagram.)

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(4 marks)

1. Find the x-coordinates of the points of inflection of and use a sign diagram to determine what shape change is occurring at these points.

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(3 marks)

1. Classify the points you found in part (d) as horizontal or non-horizontal inflection points.

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(2 marks)

1. Sketch the graph of labelling all the information from parts (c), (d) and (e).

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(2 marks)

1. (17 marks)

A particle moves in a straight line such that its position seconds after it has passed through the origin, , is given by metres,.

1. Find expressions for the velocity and acceleration of the particle after seconds.

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(2 marks)

1. Find when the particle is at rest and its position at these times.

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(4 marks)

1. Hence or otherwise, determine the time when the particle **PASSES THROUGH** the origin.

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(1 mark)

1. Draw sign diagrams for and and determine the time(s) when the particle’s speed is **INCREASING**.

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(4 marks)

1. Draw a diagram to illustrate the motion of the particle.

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(2 marks)

1. Calculate the total distance travelled by the particle in the first 3 seconds of its motion.

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(4 marks)

1. (9 marks)

Consider the function where is the height of a tree years after it was planted.

1. Find the height of the tree at the time that it was planted.

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(1 mark)

1. Determine how much the tree had grown in the first 3 years of its life.

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(2 marks)

1. Find the rate at which the tree is growing after 5 years.

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(2 marks)

1. Is for all values of ? What is the significance of this result?

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(2 marks)

1. Is for all values of ? What is the significance of this result?

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(2 marks)