**Course Methods Year 12**

Student name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Teacher name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Task type: Response**

**Time allowed for this task: \_\_\_\_\_45\_\_\_\_\_\_ mins**

**Number of questions: \_\_\_\_\_8\_\_\_\_\_\_**

**Materials required:** Calculator with CAS capability (to be provided by the student)

Standard items: Pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: Drawing instruments, templates, notes on one unfolded sheet of
A4 paper, and up to three calculators approved for use in the WACE examinations

**Marks available: \_\_49\_\_\_\_ marks**

**Task weighting: \_\_10\_\_%**

**Formula sheet provided: Yes**

**Note: All part questions worth more than 2 marks require working to obtain full marks.**

**Q1 (3.1.7) (9 marks)**

Use the product rule and/or quotient rule to differentiate the following.(Simplify)

1.  (3 marks)

|  |
| --- |
| **Solution** |
|   |
| **Specific behaviours** |
| 🗸 demonstrates use of product rule🗸 differentiates correctly🗸 simplifiesNOTE: Zero for answer only as done by classpad |

1.  (3 marks)

|  |
| --- |
| **Solution** |
| (May leave denominator in expanded form) |
| **Specific behaviours** |
| 🗸 demonstrates use of quotient rule🗸 differentiates correctly🗸 simplifiesNOTE: Zero for answer only as done by classpad |

1.  (3 marks)

|  |
| --- |
| **Solution** |
|   |
| **Specific behaviours** |
| 🗸 demonstrates use of product **and** chain rules correctly🗸 differentiates correctly for entire function🗸Simplifies correctlyNOTE: Zero for answer only as done by classpad |

**Q2 (3 marks)**

Determine the equation of the tangent to  at the point .

|  |
| --- |
| **Solution** |
|   |
| **Specific behaviours** |
| 🗸 uses chain rule to differentiate 🗸 solves for constant🗸states equation |

**Q3 (3.1.8) (8 marks)**

Consider the functions and their derivatives with values given for the following x values.

|  |  |  |  |
| --- | --- | --- | --- |
| X value | -1 | 3 | 7 |
|   | 5 | 2 | -4 |
|  | 0 | 1 | -2 |
|   | 2 | 5 | -3 |
|  | -1 | -2 | 6 |

Determine the following **derivatives** at the given x values.’

1.  at  (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| 🗸 uses product rule🗸states result |

1.  at  (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| 🗸 demonstrates chain rule🗸 subs values correctly🗸states final result |

1. at  (3 marks)

|  |
| --- |
| **Solution** |
|    |
| **Specific behaviours** |
| 🗸 demonstrates quotient **and** chain rule🗸 subs values correctly🗸states final result |

**Q4 (3.1.14, 3.1.15) (7 marks)**

Use calculus techniques to determine the **exact** coordinates of any stationary points on the following curves and use the second derivative test to determine the nature of the stationary point.

1.  (3 marks)

|  |
| --- |
| **Solution** |
|  (4,-1) inflection |
| **Specific behaviours** |
| 🗸 determines first derivative🗸 equates to zero and solves for stationary pt and states y value🗸determines value of second derivative and states horizontal inflection |

1.  (4 marks)

|  |
| --- |
| **Solution** |
|   |
| **Specific behaviours** |
| 🗸 determines first derivative and equates to zero🗸 solves for stationary pts including y value🗸 determines second derivative for stationary pts🗸identifies nature for each stationary point |

**Q5 (3.1.12) (7 marks)**

The displacement of a body from an origin O, at time  seconds, is  metres

where , .

Determine the following.

1. The velocity function. (2 marks)

|  |
| --- |
| **Solution** |
|   |
| **Specific behaviours** |
| 🗸 differentiates🗸 expresses in terms of t |

1. The times and displacements when the body is at rest. (3 marks)

|  |
| --- |
| **Solution** |
|   |
| **Specific behaviours** |
| 🗸 equate velocity to zero 🗸 solves for time🗸determines displacement |

1. The distance travelled in the first 12 seconds. (2 marks)

|  |
| --- |
| **Solution** |
| t=0 x=18t=5.5 x=-12.25 turns aroundt=12 x=30Distance equals 18 +12.25 +12.25 +30=72.5 metres |
| **Specific behaviours** |
| 🗸 determines distance from start to turning pt🗸 determines total distance, no need for units. |

1.  and explain its meaning. (2 marks)

|  |
| --- |
| **Solution** |
| Acceleration of 2 at t=1 second |
| **Specific behaviours** |
| 🗸 states acceleration at time t=1 (accept rate of change of v at t=1)🗸 states 2 for second derivative |

**Q6 (3.1.10) (3 marks)**

If  use the small increments formula  to determine the approximate percentage change in  when  decreases by .

|  |
| --- |
| **Solution** |
|   |
| **Specific behaviours** |
| 🗸 uses increments formula 🗸 obtains expression for approx. percentage change for y in terms of x🗸obtains approx. percentage change for y |

**Q7 (3.1.11) (6 marks)**

A colony of bacteria is represented as a circle on a petri dish and is increasing in such a way that the number of bacteria present is given by  where ,  being the radius of the circle of bacteria.

1. Determine  and explain its meaning. (3 marks)

|  |
| --- |
| **Solution** |
|  Rate of change of N at x=2 (SCSA preferred answer) |
| **Specific behaviours** |
| 🗸 states derivative in terms of x🗸 states value at x=2(accept approx.)🗸describes as rate of change **at x=2** (accept gradient of tangent at x=2) |

1. Determine  and explain its meaning. (3 marks)

|  |
| --- |
| **Solution** |
|  Rate of change of at x=2 (SCSA preferred answer) |
| **Specific behaviours** |
| 🗸 states second derivative in terms of x🗸 states value at x=2(accept approx.)🗸describes as rate of change of  **at x=2** (accept gradient of dy/dx at x=2) |

**Note must mention at x=2 otherwise max 4 out of 6 marks**

**Q8 (3.1.16) (4 marks)**

Consider a closed hollow cylinder with end radius  and length .



If the outside of the cylinder has a surface area of  determine the dimensions of the radius and length, nearest cm, to maximise the capacity of the cylinder **using calculus techniques**.

|  |
| --- |
| **Solution** |
|   |
| **Specific behaviours** |
| 🗸 states constraint equation in terms of r and h🗸 differentiates V and equates to zero🗸 solves for r and h, **must be in decimal** form but do not penalise if not rounded to nearest cm🗸uses second derivative test to show local max |