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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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# Level 2 Mathematics CAS, 2008

## 90807 Demonstrate an understanding of calculus methods

Credits: Four
2.00 pm Monday 24 November 2008

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

Make sure you have the Formulae Sheet L2-MATHF.

You should answer ALL the questions in this booklet.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–9 in the correct order and that none of these pages is blank.

**YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.**

| *For Assessor's use only* | **Achievement Criteria** | | |
|---|---|---|---|
| **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
| Demonstrate an understanding of calculus methods. ☐ | Demonstrate an understanding of a range of calculus methods. ☐ | Demonstrate an understanding of a range of calculus methods in solving problems. ☐ |
| **Overall Level of Performance** ☐ | | |

You are advised to spend 55 minutes answering the questions in this booklet.

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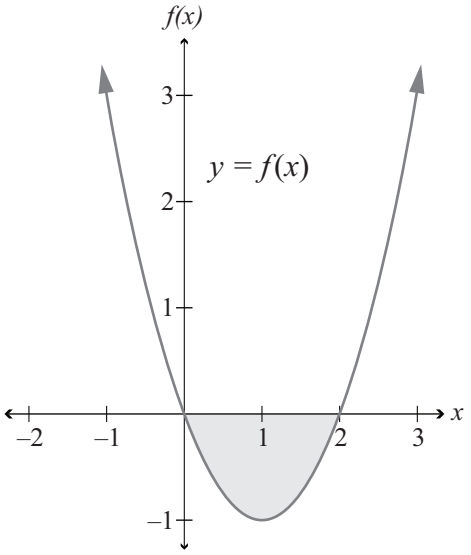
## QUESTION ONE

The diagram shows the graph of

$$f(x) = x^2 - 2x$$

Find the shaded area of the region enclosed between $f(x)$ and the $x$ axis.




## QUESTION TWO

A water park has a small water slide.
The height $y$ m of the small water slide above the pool at a horizontal distance $x$ m from the start of the slide can be modelled by the function:

$$y = 0.38x^4 - 2.9x^3 + 7x^2 - 6.1x + 3.3, \quad 0 \le x \le 3.5$$

(a) Calculate the gradient of the slide when $x = 0.2$.

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(b) There is padding at various points along the slide. One edge of the padding is at a tangent to the slide at the point where $x = 1.8$.

Find the equation of the line representing this edge of the padding.

(c) A and B are the two minimum turning points of the function that represents the water slide.

$$y = 0.38x^4 - 2.9x^3 + 7x^2 - 6.1x + 3.3$$

A and B are joined by a straight support rail.

Calculate the length of this rail.

## QUESTION THREE

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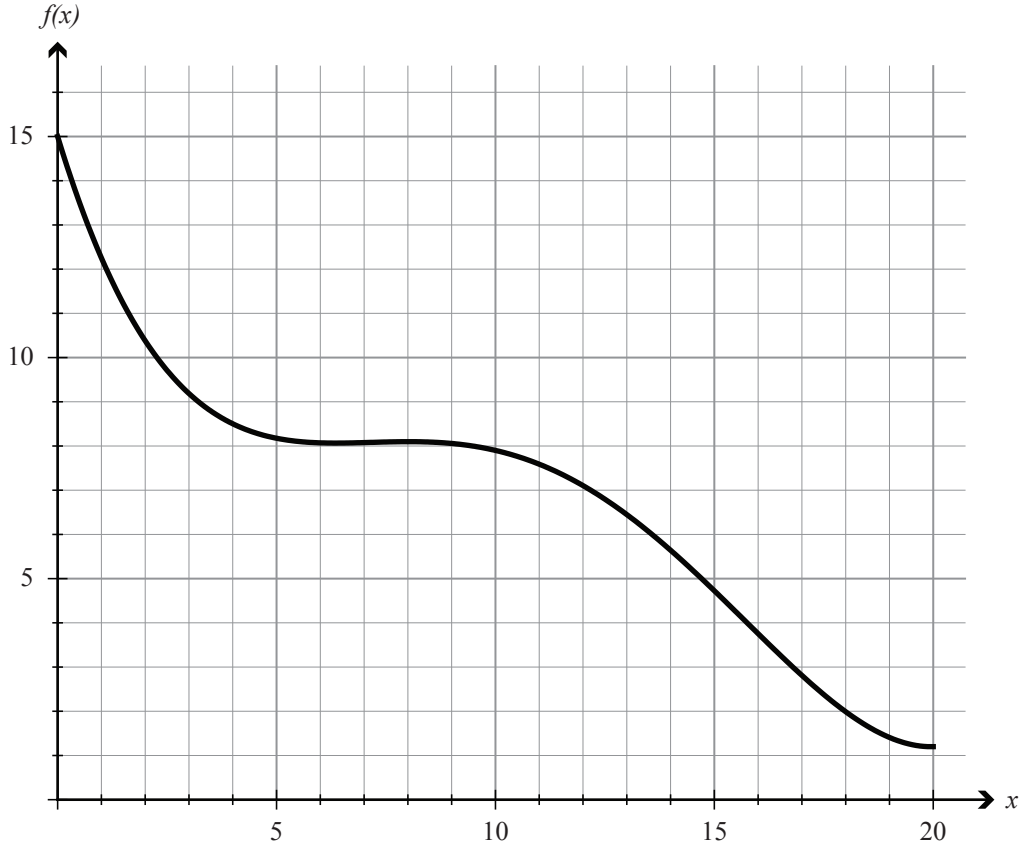
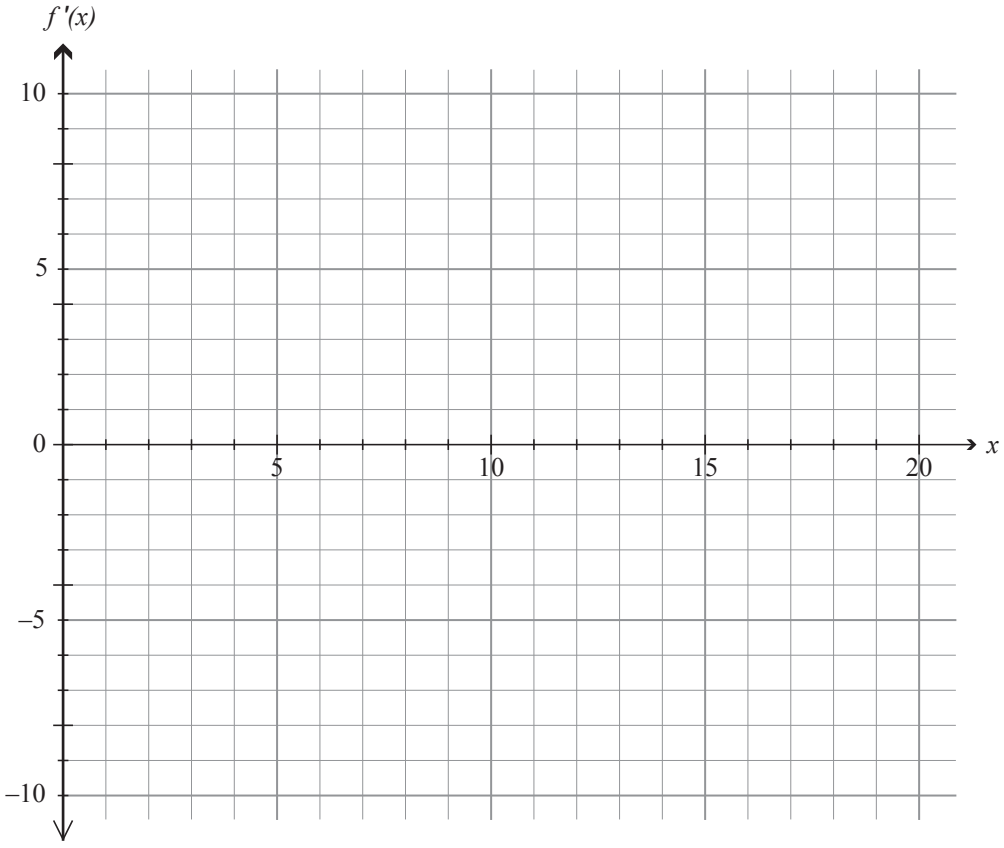
The height above the ground of another water slide is shown on the graph below.




On the axes below, sketch the gradient function for the function shown above.



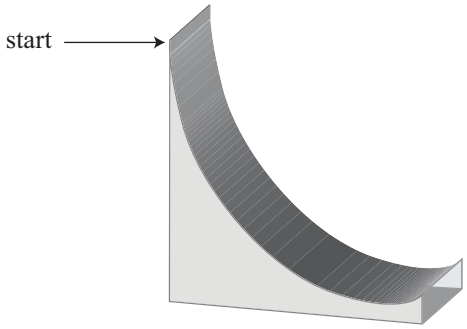
## QUESTION FOUR

Assessor's use only

Another water slide is planned. Its height $y$ m from the ground at horizontal distance $x$ m from the start of the water slide is to be modelled by the function:

$$y = 0.09x^2 - 1.3x + 5, \quad 0 \leq x \leq 9$$

The manager thinks the outside of the slide should be bordered with a fibreglass wall on both sides, all the way down to the ground, as shown in the diagram.




(Diagram not to scale)

Calculate the area of fibreglass needed for **both** sides.

## QUESTION FIVE

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(a) Jayla travels down a water slide. Her speed $v$ (m $s^{-1}$) at time $t$ seconds after she starts moving can be modelled by the function:

$$v = 0.01t^3 - 0.25t^2 + 2t + 0.1$$

How does the acceleration change in the seventh second, and by what amount?

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(b) Jayla travels down a section of another water slide. Her acceleration $a$ (m s$^{-2}$) at time $t$ seconds after she reaches the section can be modelled by the function:

$$a = 2t - 3$$

Her initial speed as she begins the section is 4.25 m s$^{-1}$.

Jayla claims that her minimum speed down the section must have been less than 1 m s$^{-1}$.

Comment on the validity of Jayla's statement.

**Use mathematical reasoning to justify your comments.**

## QUESTION SIX

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The height $y$ cm of the surface of a water slide at distance $x$ cm from one side is given by

$$y = \frac{1}{40}(x - 60)^2$$

At the same point, the height $y$ cm of the surface of the water in the water slide at distance $x$ cm from the same side of the slide is given by

$$y = \frac{1}{80}(x - 60)^2 + 20$$

Calculate the cross-sectional area of the water contained in the water slide at this point.

**Show how you found your solution.**

**Extra paper for continuation of answers if required.**
**Clearly number the question.**

Assessor's use only

| Question number | |
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