

It's funny how some mathematicians spend
their whole lives proving theorems, when the
real theorem is the existence of the
friendships they make along the way



Level Two Calculus

There are three questions, worth a total of 24 marks.

Attempt ALL questions, showing all working.

Read questions carefully before attempting them.

Marks are available for partial answers.

The amount of time expected to be spent per question may not necessarily correlate “nicely” to the number of marks.

Diagrams may be used to support answers.

Candidates who do not provide diagrams for some questions may be disadvantaged.

Some marks are given for clarity and neatness of solutions or proofs.

Time Allowed: One Hour

Achieved: 8 marks

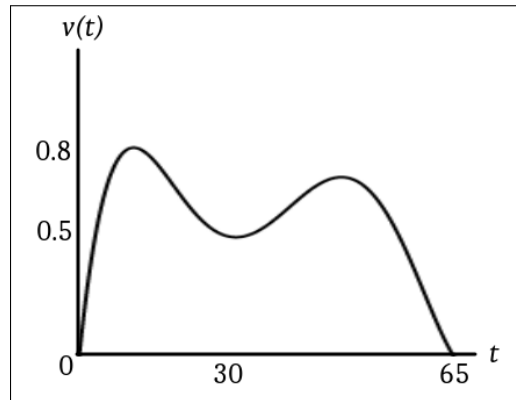
Merit: 14 marks

Excellence: 20 marks

Question:	1	2	3	Total
Points:	8	8	8	24
Score:				

Available Grades: *Not Achieved* *Achieved* *Merit* *Excellence*

1. The wombles of north Wellington are going on a trip to Days Bay to collect driftwood.
- (a) One of the younger wombles, Heretaunga, is currently studying NCEA level 2 calculus and decides to graph the velocity of the group as they drive south. He measures distance in kilometres and time in minutes. (3)



Draw the displacement function of the wombles over this time given that $s(0) = 0$.

- (b) Another young womble, Onslow, falls asleep and dreams that he can fly. Suppose that his height in the dream can be modelled by

$$h(t) = t^2 - 4t + 6.$$

- i. Find $h'(t)$. (2)
- ii. At which time(s) is Onslow neither climbing or descending? (3)
2. On another occasion another womble, old Uncle Lambton, reminisces about his childhood.
- (a) Uncle Lambton remembers that he once differentiated the function f of x given by (2)

$$f(x) = 3x^7 - 6x^3 + \sqrt{x} - \frac{3}{x}.$$

Follow in his footsteps and find $f'(x)$.

- (b) A little known fact about wombles is that they begin to shrink once they reach a certain age. (3)
- Suppose that Uncle Lambton's height when he was a years old is modelled by

$$H(a) = -0.001a^2 + 0.32a + 144.4.$$

At which age was his height at a maximum?

- (c) Uncle Lambton is startled when young Ava races past on her new bicycle. Suppose that her velocity can be modelled by the equation (3)

$$v(t) = 0.006t^3 - 0.18t^2 + 1.2t,$$

where t is in seconds and v is in metres per second. What is Ava's acceleration when $t = 10$?

3. Woburn Womble is showing off her integration skills to her friends.

- (a) Find y as a function of x if $y = 3$ when $x = 1$ and (2)

$$\frac{dy}{dx} = 7x^6 + 14x - \frac{6}{x^2}.$$

- (b) One of Woburn's friends, Epuni, gives her the function

$$y = \frac{1}{x}.$$

- i. Explain why this function cannot be integrated using the power rule. (3)

- ii. The antiderivative of x^{-1} which passes through $(1, 0)$ happens to be $\ln x$. Show, using calculus methods, that $y = \ln x$ does not have any local extrema. (3)