

Scholarship Calculus 2012

Exemplar: Written response question

The following exemplar would be one third of one question. A candidate would expect to spend 10 to 15 minutes writing an answer.

QUESTION EXEMPLAR

- (c) Write half a page on the following, including diagrams or examples where appropriate.

Describe the **limitations** of the second derivative test for maxima and minima of continuous functions.

Assessment schedule

For 0 to 3 marks, of a possible 8 for the question as a whole.

Evidence Statement

[A] explains that 2DT only applies where $f'(x) = 0$, and that other points can be max/min

- gives an example of such a function (possibly as a graph)

[B] explains that 2DT is inconclusive if $f'(x) = 0$ and $f''(x) = 0$

- gives an example of such a function (possibly as a graph)
- explains how to otherwise test such a point
- describes in detail how to apply the 2DT
- compares 2DT with the first derivative test in a meaningful way
- practical limitation of having to find and evaluate the (often difficult) second derivative
- other statements not equivalent to the above, not anticipated here (as determined by Panel Leader).
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[X] Forgive *one* incorrect statement; more incorrect statements reduce mark by 1.

Teachers and candidates should note: Markers shall not infer a candidate's intended meaning from an ambiguous or poorly worded response.

- 3: 3 statements: [A] and [B] and one other •
2: 2 statements: one of [A] and [B], and one other •
1: 1 statement: one of [A] and [B]
0: neither [A] or [B] (possibly with some other •)

Below is a candidate response sufficient for 3 marks (marking indicated in red). Note that the first sentence does not sufficiently describe how to apply the second derivative test to get a •, nor does the last sentence sufficiently make a comparison to the first derivative test.

(c)

The second derivative test uses the sign of $f''(c)$ at points where $f'(c) = 0$ to test if the point is a max or min. It also finds points of inflection. [X] If the function has $f''(c) = 0$, then the second derivative test is inconclusive; [B] we can't tell if it's max or min. For example, $f(x) = x^4$ has a minimum at $x = 0$ but $f''(0) = f'(0) = 0$. •
A function can also have maxima and minima at points where $f'(c)$ is undefined, which cannot be tested because then $f''(c)$ is undefined also. [A]

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If a function is complicated, then finding the second derivative to use this test might be hard or annoying to do •, and the first derivative test would be easier to use. //