5.5 / The Candidates Test

Watch the lesson ➤

Using the candidates test to determine absolute (global) extrema

Learning goal

Find absolute maximum and minimum values on a closed interval with the Candidates Test, and write every value.

Key ideas

01 $g(x) = x^2 - 2x + 3$ on $[-1, 4]$ has no peak, but it still has a maximum, at an **end**. Continuous on $[a, b]$: a max exists. Inside, it is at a critical point; otherwise at an endpoint.

02 Candidates: critical points and **endpoints**. For g: $g'(x) = 2x - 2$, so $x = -1,\ 1,\ 4$, and $g(-1) = 6$, $g(1) = 2$, $g(4) = 11$: absolute max 11 at $x = 4$, absolute min 2 at $x = 1$. This is the **Candidates Test**.

03 What to write: 1. list the candidates; 2. write every value; 3. "The absolute max of g is 11, at $x = 4$."

04 A sign change of f' gives only a **relative** extremum. Absolute: compare all candidates.

Remember

Candidates Test
Absolute extrema on $[a, b]$: evaluate f at every critical point and both endpoints, then compare.

absolute maximum value
The largest value of f on the whole interval.

Class notes

5.5 / Write it clearly

What earns the point on the AP Exam, and the mistakes that lose it.

Common mistakes

The mistake code is used in the answers and in My Mistakes

01 Ends never checked

✗ f' changes sign at 1, so the absolute max is $f(1) = 5$.

✓ Candidates are critical points and endpoints: $f(3) = 9 > 5$, so the absolute max is 9, at $x = 3$.

5.5 / Guided examples

Watch, pause, and write the reasoning. Full solutions are in the video.

Problem types

Read the problem, name the type, then use its method

Type	Method	Problems
Candidates, every value, compare	Critical points inside $[a, b]$ and both endpoints; f at each; the largest and the smallest.	E01, E02, E03 · Practice 1, 2, 3, 4, 5, 6

Example 01

Video · E01

Let $f(x) = 2x^3 - 9x^2 + 12x$ on $[0, 3]$.
Find the absolute maximum and minimum values of f. Justify your answer.

> List every candidate, write every value, then compare.

Example 02

Video · E02

Let $f(x) = e^x - 2x$ on $[0, 2]$. What is the absolute minimum value of f?

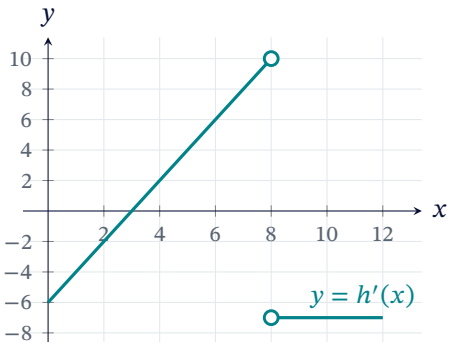
A. 0
B. 1
C. $2 - 2\ln 2$
D. $e^2 - 4$

> $f'(x) = e^x - 2$: where is the curve $y = e^x$ below the line $y = 2$?

Example 03

Video · E03

h is continuous on $[0, 12]$. The graph of h' is shown; h' does not exist at $x = 8$. The table gives values of h:
x: 0, 3, 8, 12
$h(x)$: 13, 4, 29, 1
Find the absolute maximum and minimum values of h on $[0, 12]$. Justify your answer.



x	0	3	8	12
$h(x)$	13	4	29	1

VIDEO COMPLETE Check your example answers at the end of this booklet.

5.5 / Example answers

The Candidates Test

E01 $f'(x) = 6x^2 - 18x + 12 = 6(x-1)(x-2)$
Candidates: $x = 0,\ 1,\ 2,\ 3$ (critical points and endpoints).
$f(0) = 0, \quad f(1) = 5, \quad f(2) = 4, \quad f(3) = 9$
The absolute maximum value is 9, at $x = 3$. The absolute minimum value is 0, at $x = 0$.

E02 (C) $f'(x) = e^x - 2 = 0 \ \rightarrow \ x = \ln 2, \quad 0 < \ln 2 < 2$
$f' < 0$ left of $\ln 2$, $f' > 0$ right of it: down, then up, so the minimum is at $x = \ln 2$.
$f(\ln 2) = e^{\ln 2} - 2\ln 2 = 2 - 2\ln 2$
Answer C.

E03 Candidates from h': $h' = 0$ at $x = 3$; h' does not exist at $x = 8$ (a jump), but $h(8)$ is defined; the ends 0, 12.
$h(0) = 13, \quad h(3) = 4, \quad h(8) = 29, \quad h(12) = 1$
Largest 29: absolute max 29 at $x = 8$. Smallest 1: absolute min 1 at $x = 12$, an end.
$x = 3$: h' goes $-$ to $+$, only a relative min ($4 > 1$).