Exercise walk-through

Using the First Derivative Test to Determine Relative (Local) Extrema ▪ 5.4

eXercise

You must be able to

- use the sign change of f' to classify a **local extremum 局部极值**

Method — First Derivative Test

At a critical point, look at how f' changes:

- $+$ to $-$ $\rightarrow$ local **maximum**;
- $-$ to $+$ $\rightarrow$ local **minimum**;
- no sign change $\rightarrow$ neither.

Method — Example

$f'(x) = 2x - 4$ at $x = 2$: f' goes $-$ (for $x < 2$) to $+$ (for $x > 2$), so $x = 2$ is a local minimum.

Practice 2.1 ▪ 1 mark

State the sign change for a local maximum.

Solution 2.1

Method: First Derivative Test

Worked steps

f' changes from $+$ to $-$ **B1**.

Practice 2.2 ▪ 1 mark

State the sign change for a local minimum.

Solution 2.2

Method: First Derivative Test

Worked steps

f' changes from $-$ to $+$ **B1**.

Practice 2.3 ▪ 2 marks

For $f'(x) = 2x - 4$, classify $x = 2$.

Solution 2.3

Worked steps

f' goes $-$ to $+$, so $x = 2$ is a local minimum **M1** **A1**.

Exam-style 3.1 ▪ 1 mark

A local maximum occurs where f' changes

A $-$ to $+$

B $+$ to $-$

C stays $+$

D stays $-$

Solution 3.1

Method: First Derivative Test

A $-$ to $+$

B $+$ to $-$ ✓

C stays $+$

D stays $-$

Worked steps

B.

Exam-style 3.2 ▪ 1 mark

A local minimum occurs where f' changes

A $+$ to $-$

B $-$ to $+$

C stays 0

D never

Solution 3.2

Method: First Derivative Test

A $+$ to $-$

B $-$ to $+$ ✓

C stays 0

D never

Worked steps

B.

Exam-style 3.3 ▪ 1 mark

$f'(x) = 2x - 4$, critical at $x = 2$.
(a) State the sign of f' for $x < 2$.
(b) State the sign for $x > 2$.
(c) Classify $x = 2$.

Solution 3.3

Method: First Derivative Test

Worked steps

(a) negative **B1**. (b) positive **B1**. (c) local minimum **B1**.