

# 5.2 Extreme Values and Critical Points

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_ Total: 9 marks

KEY WORDS critical point 临界点 • extreme value theorem 极值定理

## Objective

Build the skills to answer exam questions on **the Extreme Value Theorem and critical points**.

You must be able to:

- state the **Extreme Value Theorem** 极值定理
- find the **critical points** 临界点 of a function

## 1 Worked examples

Study these first. Each one shows the method for a question type used later.

### ■ EVT and critical points

**Extreme Value Theorem:** a function continuous on a closed interval  $[a, b]$  attains a global maximum and minimum.

**Critical points** are where  $f'(x) = 0$  or  $f'$  does not exist — the candidates for local extrema.

### ■ Example

$f(x) = x^2 - 4x$ :  $f'(x) = 2x - 4 = 0$  gives the critical point  $x = 2$ .

## 2 Practice

2.1 State the Extreme Value Theorem. [1]

2.2 State what a critical point is. [1]

2.3 Find the critical point of  $f(x) = x^2 - 4x$ . [2]

## 3 Exam-style questions

3.1 A critical point occurs where [1]

- A  $f = 0$
- B  $f' = 0$  or  $f'$  does not exist
- C  $f'' = 0$
- D  $x = 0$

3.2 The EVT guarantees extrema when  $f$  is continuous on [1]

- A an open interval
- B a closed interval
- C all real numbers
- D no interval

3.3  $f(x) = x^2 - 6x$ .

(a) Find  $f'(x)$ . [1]

(b) Set  $f' = 0$ . [1]

(c) State the critical point. [1]

## Solutions

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**2.1** a function continuous on a closed interval attains a global max and min.

**2.2** a point where  $f' = 0$  or  $f'$  does not exist.

**2.3**  $f'(x) = 2x - 4 = 0$ , so  $x = 2$ .

**3.1** B.

**3.2** B.

**3.3** (a)  $2x - 6$ . (b)  $2x - 6 = 0$ . (c)  $x = 3$ .