

# 1.6 Polynomial Functions and End Behavior

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

**KEY WORDS** end behavior 端点行为 • limit notation 极限记号 • function 函数  
• polynomial 多项式 • leading term 首项

## Objective

Build the skills to answer exam questions on **polynomial functions and end behavior**.

**You must be able to:**

- describe the **end behavior** 端点行为 of a polynomial from its leading term
- use **limit notation** 极限记号 such as  $\lim_{x \rightarrow \infty} p(x) = \infty$

## 1 Worked examples

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

### ■ End behavior

The **end behavior** of a polynomial is set by its **leading term**  $a_n x^n$ :

- **even**  $n$ ,  $a_n > 0$ : both ends up.
- **odd**  $n$ ,  $a_n > 0$ : left end down, right end up.

### ■ Limit notation

“Output increases without bound as  $x$  increases” is written  $\lim_{x \rightarrow \infty} p(x) = \infty$ . For  $p(x) = x^3$ :  $\lim_{x \rightarrow \infty} p(x) = \infty$  and  $\lim_{x \rightarrow -\infty} p(x) = -\infty$ .

## 2 Practice

**2.1** State what determines a polynomial’s end behavior. [1]

**2.2** For  $p(x) = x^3$ , state the end behavior as  $x \rightarrow \infty$  and as  $x \rightarrow -\infty$ . [2]

**2.3** Write the limit notation for “output increases without bound as  $x$  increases”. [1]

## 3 Exam-style questions

**3.1** The end behavior of a polynomial is determined by its [1]

- |   |   |
|---|---|
| A | B |
| C | D |
- A** constant term  
**B** leading term  
**C** middle term  
**D** zero

**3.2** For  $p(x) = -2x^4$ , as  $x \rightarrow \infty$  the output [1]

- |   |   |
|---|---|
| A | B |
| C | D |
- A**  $\rightarrow \infty$   
**B**  $\rightarrow -\infty$   
**C**  $\rightarrow 0$   
**D** oscillates

**3.3**  $p(x) = x^3$ .

- (a) State  $\lim_{x \rightarrow \infty} p(x)$ . [1]  
(b) State  $\lim_{x \rightarrow -\infty} p(x)$ . [1]  
(c) State whether both ends go the same way. [1]