

Exercise walk-through

The Production Function ■ 3.1

eXercise

You must be able to

- define the **production function** 生产函数 as the relationship between inputs and output
- distinguish the **short run** 短期 from the **long run** 长期
- calculate **total**, **marginal**, and **average product**
- explain the **law of diminishing marginal returns** 边际报酬递减

Method — Production function and time

The production function links **inputs** to **output**. In the **short run** at least one input is **fixed**; in the **long run** all inputs are variable.

Method — Product measures

Total product (TP) is total output; **marginal product** $MP = \frac{\Delta TP}{\Delta L}$; **average product** $AP = \frac{TP}{L}$.

Method — Diminishing marginal returns

Adding more of a variable input to fixed inputs eventually makes **marginal product fall**.

Practice 2.1 ■ 2 marks

State the difference between the short run and the long run.

Solution 2.1

Method: Production function and time

Worked steps

in the short run at least one input is fixed; in the long run all inputs are variable
B1 **B1**.

Practice 2.2 ■ 2 marks

Total product rises from 20 to 26 when a fourth worker is hired. Find the marginal product of the fourth worker.

Solution 2.2

Method: Product measures

Worked steps

$$MP = \frac{\Delta TP}{\Delta L} = \frac{26 - 20}{1} = 6 \text{ units } \text{M1} \text{A1}.$$

Practice 2.3 ■ 1 mark

State the law of diminishing marginal returns.

Solution 2.3

Method: Diminishing marginal returns

Worked steps

as more of a variable input is added to fixed inputs, its marginal product eventually falls **B1**.

Exam-style 3.1 ■ 1 mark

In the short run, at least one input is

A variable

B fixed

C zero

D free

Solution 3.1

Method: Production function and time

A variable

B fixed 

C zero

D free

Worked steps

B.

Exam-style 3.2 ■ 1 mark

Diminishing marginal returns means marginal product eventually

- A** rises
- B** falls
- C** stays constant
- D** is always zero

Solution 3.2

Method: Diminishing marginal returns

A rises

B falls 

C stays constant

D is always zero

Worked steps

B.

Exam-style 3.3 ■ 1 mark

A factory adds workers to a fixed set of machines. Output for 1, 2, 3, 4 workers is 10, 22, 30, 34 units.

- (a) Find the marginal product of the third worker.
- (b) Find the marginal product of the fourth worker.
- (c) State whether diminishing marginal returns have set in.

Solution 3.3

Method: Diminishing marginal returns

Worked steps

(a) $30 - 22 = 8$ units **B1**. (b) $34 - 30 = 4$ units **B1**. (c) yes — marginal product is falling **B1**.