1.8 Production, Productivity and the Law of Diminishing Returns

Total Marks

AQA 7136 · Calculators not allowed · about 60 minutes · Write-in edition

Name: _____ Date: ____ / ____ / _____

Answer all questions in full sentences where indicated. Diagrams should be drawn and labelled carefully. No calculator is allowed. Show working for any arithmetic.

1 Multiple choice: In a short-run production setting for a small bakery in Sheffield, which statement best describes marginal product (MP) of labour?

(a) Select the single best option. **(1)**

- ☐ A: MP is the additional total output produced when the last worker is employed
- ☐ B: MP is the total output divided by the number of workers
- ☐ C: MP is the total output of the bakery in a year
- ☐ D: MP is the maximum possible output when all factors are variable

(Total for Question 1 is 1 mark)

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2 Explain in two concise points the difference between 'production' and 'productivity' for a manufacturing firm in Sheffield that increases staff.

(Total for Question 2 is 3 marks)

3 Briefly state and explain the three types of returns to scale (increasing, constant, decreasing) as the long-run counterpart to short-run diminishing returns, giving one short example for each type.

(Total for Question 3 is 3 marks)

4 Explain why diminishing marginal returns occur in the short run when a firm increases a variable factor such as labour while holding some factors fixed. In your answer, include reference to the behaviour of MP and AP, the role of fixed factors, the point at which diminishing returns begin, and at least two evaluative considerations that could limit or modify the basic theory in practice. You may draw a diagram to support your answer; label any diagram clearly. (12 marks)

(Total for Question 4 is 12 marks)

5 Define total product as used in the short-run production context for a firm such as a small bakery in Manchester.

(Total for Question 5 is 1 mark)

6 Define marginal product (MP) of a variable factor in the context of a factory adding extra workers.

(Total for Question 6 is 1 mark)

7 Define average product (AP) of labour for a florist employing several part-time staff in Leeds.

(Total for Question 7 is 1 mark)

8 Define the law of diminishing marginal returns as it applies to the short run for a small manufacturing firm.

(Total for Question 8 is 1 mark)

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9 Table 1: Completing marginal and average product. A local printer increases labour in the short run. The table below shows units of labour and total product (TP) per day. Complete the MP and AP columns for workers 1 to 4, and state at which worker the law of diminishing marginal returns first sets in for this printer.

(a) Table 1 data, fill MP and AP. Table: Labour (workers) 0, 1, 2, 3, 4. TP (prints/day): 0, 9, 20, 30, 40. Compute MP for workers 1-4 and AP for workers 1-4. **(3)**

(b) State the worker number at which diminishing marginal returns first set in for this printer and explain briefly why that point qualifies. **(1)**

(Total for Question 9 is 4 marks)

10 Table 2: Identifying the point of diminishing returns and completing TP. A small cafe records output of sandwiches per hour as it varies staff on the counter. Labour (workers) 0, 1, 2, 3, 4. MP given: -, 7, 6, 4, 2. TP for labour 0 is 0. Complete TP for workers 1-4, state AP for worker 4 to one decimal place, and identify at which worker diminishing marginal returns first set in.

(a) Compute TP for workers 1-4 using the MP column, then compute AP for worker 4 and state the point at which diminishing marginal returns first set in. **(3)**

(b) State in one sentence what the MP sequence in this table tells you about productivity per additional worker. **(1)**

(Total for Question 10 is 4 marks)

11 Diagram question: Draw a diagram showing Total Product (TP), Marginal Product (MP) and Average Product (AP) curves for a short-run production process where a variable labour input is combined with fixed capital. On labelled axes, sketch a TP curve that rises at a decreasing rate after a point, and draw MP and AP curves consistent with that TP. Indicate clearly on your diagram the point where MP = AP and the point where TP is maximised.



(Total for Question 11 is 6 marks)

12 Define labour productivity as used in macro and micro contexts, for example when comparing output per worker across factories.

(Total for Question 12 is 1 mark)

Mark scheme · 1.8 Production, Productivity and the Law of Diminishing Returns

Question 1

(a) selecting option A **B1**

(a) Answer: A

Question 2

production refers to the total quantity of goods produced (total product), e.g. number of widgets made **B1**

productivity refers to output relative to input, e.g. output per worker or per hour **B1**

a correct contrast: production can increase simply by using more inputs, while productivity is about how efficiently inputs are used and can rise even if production stays the same **B1**

Answer: Production is the total quantity produced; productivity is output per unit of input. Production can rise by adding more workers, whereas productivity measures efficiency and can rise without increasing total production.

Question 3

increasing returns to scale: when all inputs are increased by a given proportion output increases by a greater proportion, example: a factory doubles inputs and more than doubles output due to specialisation **B1**

constant returns to scale: when all inputs increase by a given proportion output increases by the same proportion, example: a firm doubles all inputs and output doubles **B1**

decreasing returns to scale: when all inputs increase by a given proportion output increases by a smaller proportion, example: coordination problems as firm becomes too large cause less efficient expansion **B1**

Answer: Increasing: outputs rise by more than inputs, e.g. gains from specialisation. Constant: outputs rise in same proportion as inputs, e.g. a firm doubles all inputs and output doubles. Decreasing: outputs rise by less, e.g. management/coordination issues in a very large firm.

Question 4

Level 1 Basic statements about diminishing marginal returns with limited explanation, little or no reference to MP/AP behaviour, and minimal or no evaluation. **1-4**

Level 2 Clear explanation of why diminishing marginal returns occur, including description of MP falling and relationship to AP, reference to fixed factors, and at least one valid evaluative point or qualification. **5-8**

Level 3 Detailed explanation linking fixed factors, congestion of resources and falling MP, clear discussion of MP/AP interactions and the onset point, plus at least two well-developed evaluative considerations such as time horizons, managerial response, training/technology, and measurement issues; diagrammatic support where helpful. **9-12**

Indicative content:

- Start from the short-run definition: at least one factor (capital, plant) is fixed while labour is variable, so output must be produced using more of the variable factor with the same fixed stock.
- Explain that initially MP may rise due to specialisation and division of labour, so TP increases at an increasing rate, but as more units of the variable factor are added congestion and limited fixed inputs make each additional worker less effective, so MP falls.
- Describe how AP behaves: AP may rise while MP exceeds AP, reaches a maximum where MP = AP, and then falls as MP falls below AP. The point where MP starts to fall marks the start of diminishing marginal returns, and the point where MP becomes zero corresponds to TP maximum.
- Give economic mechanisms: limited number of machines, overcrowding, increased waiting times for use of equipment, and reduced capital per worker lead to lower marginal productivity.
- Include evaluative points: the timing of diminishing returns depends on technology and the degree of fixedness of inputs, managerial organisation and training can delay or mitigate diminishing returns, and measurement/short-run definitions matter (seasonality, part-time hours).
- Consider external factors: if firms can substitute other inputs or use overtime, the short run may be extended; also average versus marginal measures can give different policy implications.
- Conclude with a balanced judgement: the law is a useful short-run regularity for many production processes but its practical onset and severity depend on specific firm-level features, time horizon and scope for adjustment.

Question 5

a numerical or verbal definition that total product is the total quantity of output produced by the firm using a given amount of the variable factor and fixed factors in the short run **B1**

Answer: The total quantity of output produced using the given combination of inputs in the short run.

Question 6

a correct definition that MP is the additional output produced by adding one more unit of the variable factor, holding other inputs constant **B1**

Answer: The extra output produced by adding one more unit of the variable factor, holding other inputs fixed.

Question 7

AP is defined as total product divided by the number of units of the variable factor, e.g. output per worker **B1**

Answer: Total product divided by the number of workers, i.e. output per worker.

Question 8

a correct definition that as more units of a variable factor are added to fixed factors, eventually the additional output from each extra unit of the variable factor will start to fall **B1**

Answer: As more of a variable factor is added to fixed factors, the extra output from each additional unit eventually falls.

Question 9

(a) MP values: worker1 = 9, worker2 = 11, worker3 = 10, worker4 = 10 **M1**

(a) AP values: worker1 = 9.0, worker2 = 10.0, worker3 = 10.0, worker4 = 10.0 (allow exact decimals or fractions equivalent) **M1**

(a) values calculated correctly and internally consistent with TP **B1**

(a) Answer: MP: 9, 11, 10, 10. AP: 9.0, 10.0, 10.0, 10.0.

(b) diminishing marginal returns begins at worker 3 because MP rises from 9 to 11 for worker 2 but then falls to 10 for worker 3, so the additional output from the extra worker begins to decline at worker 3 **B1**

(b) Answer: Diminishing marginal returns set in at worker 3, because MP increases from 9 to 11 at worker 2 then falls to 10 at worker 3, showing the start of a decline in the extra output per additional worker.

Question 10

(a) TP values: worker1 = 7, worker2 = 13, worker3 = 17, worker4 = 19 (TP is cumulative sum of MPs) **M1**

(a) AP at worker4 = TP(4) / 4 = 19 / 4 = 4.8 **M1**

(a) diminishing marginal returns begin at worker 2 because MP falls from 7 (worker 1) to 6 (worker 2), so the first fall occurs at worker 2 (accept 'after worker 1') **B1**

(a) Answer: TP: 7, 13, 17, 19. AP at worker 4 = 4.8. Diminishing returns first set in at worker 2 (MP falls from 7 to 6).

(b) a clear statement that MP is falling from worker 2 onward so each additional worker contributes less extra output, indicating falling marginal productivity **B1**

(b) Answer: The MP sequence shows that from the second worker onward each extra worker adds less output than the previous one, indicating falling marginal productivity.

Question 11

axes labelled correctly: Labour (horizontal) and Output or Total Product (vertical) **B1**

TP curve drawn with correct general shape: rises, slope increases at first then decreases and eventually reaches a maximum **B1**

MP curve drawn showing it rises then falls more steeply than AP and intersects AP at AP's maximum **B1**

AP curve drawn with a single peak, below TP and with the peak where MP = AP **B1**

point where MP = AP clearly indicated (labelled) at AP maximum **B1**

TP maximum clearly indicated (labelled) and shown as where MP crosses zero or where TP flattens **B1**

Answer: Diagram with correctly labelled axes, TP rising then peaking, AP peaked where MP = AP, MP crosses zero at TP maximum.

Question 12

a correct definition stating productivity measures output per unit of input, commonly output per worker or output per hour **B1**

Answer: Productivity is a measure of output per unit of input, commonly output per worker or output per hour.