

## Past-paper walk-through

Profit-Maximizing Behavior in Perfectly Competitive Factor Markets ■ 5.3

eXercise

## Questions in this set

- 2025 Set 1 Q1
- 2024 Set 2 Q2
- 2023 Set 1 Q1
- 2023 Set 2 Q2
- 2022 Set 1 Q2
- 2021 Set 1 Q2
- 2019 Set 2 Q1
- 2018 Q1
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- 2014 Q2

## Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- **//** separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = “or words to that effect” – the wording need not match.

# Question 1

2025 Set 1 ■ Q1

Voda Reservoir is a profit-maximizing firm and the only producer of bottled water in a country. Currently, Voda Reservoir is earning negative economic profit.

**(a)(i)** Draw a correctly labeled graph for Voda Reservoir and show each of the following. The profit-maximizing quantity, labeled  $Q_M$ .

**(a)(ii)** The profit-maximizing price, labeled  $P_M$ .

**(a)(iii)** The average total cost curve consistent with Voda Reservoir earning negative economic profit, labeled ATC.

**(a)(iv)** The area of deadweight loss, shaded completely.

# Question 1

2025 Set 1 ■ Q1

Voda Reservoir is a profit-maximizing firm and the only producer of bottled water in a country. Currently, Voda Reservoir is earning negative economic profit.

**(b)** Suppose the government requires Voda Reservoir to produce the socially optimal quantity of bottled water. On your graph in part A, show the socially optimal quantity of bottled water, labeled  $Q_S$ .

## Question 1

2025 Set 1 ■ Q1

Voda Reservoir is a profit-maximizing firm and the only producer of bottled water in a country. Currently, Voda Reservoir is earning negative economic profit.

**(c)** Suppose instead the government grants a per-unit subsidy to Voda Reservoir. What will happen to Voda Reservoir's profit-maximizing quantity of bottled water? Explain.

## Question 1

2025 Set 1 ■ Q1

Voda Reservoir is a profit-maximizing firm and the only producer of bottled water in a country. Currently, Voda Reservoir is earning negative economic profit.

**(d)** Suppose new producers have entered the bottled-water market and Voda Reservoir continues to operate in the bottled-water market. Will the demand for Voda Reservoir's bottled water become more elastic, become less elastic, or stay the same as new producers enter the market?

# Question 1

2025 Set 1 ■ Q1

Voda Reservoir is a profit-maximizing firm and the only producer of bottled water in a country. Currently, Voda Reservoir is earning negative economic profit.

**(e)(i)** Voda Reservoir hires workers in a perfectly competitive labor market. If the demand for bottled water increases, what will happen to Voda Reservoir's demand for labor? Explain.

**(e)(ii)** The government implements a new regulation that increases the minimum age required for a worker to be employed in a bottled-water factory. What will happen to the market wage in the short run? Explain.

# Solution 1

(a)(i)

## Mark scheme

- Draw a correctly labeled graph for Voda Reservoir (a monopolist) with Price/Cost on the vertical axis and Quantity on the horizontal axis. Show a downward-sloping demand curve (D) and a downward-sloping marginal revenue curve (MR) lying below D, plus a rising marginal cost curve (MC). Label the profit-maximizing quantity  $Q_M$  at the intersection of MR and MC (where  $MR = MC$ ). Points: 1 point for the correctly drawn D and MR curves (D downward-sloping, MR downward-sloping and below D); 1 point for the rising MC curve and  $Q_M$  correctly labeled where  $MR = MC$ .

## Solution 1

(a)(ii)

## Mark scheme

- From  $Q_M$ , draw a vertical line up to the demand curve D; the corresponding price on the vertical axis is the profit-maximizing price, labeled  $P_M$ . The graph must show  $P_M$  read off the D curve directly above  $Q_M$ .

## Solution 1

(a)(iii)

## Mark scheme

- Draw the average total cost (ATC) curve so that it lies ABOVE the demand curve D at  $Q_M$  (i.e.,  $ATC > P_M$  at  $Q_M$ ), which is consistent with Voda Reservoir earning negative economic profit (a loss). The MC curve must pass through the minimum point of the ATC curve.

# Solution 1

**(a)(iv)**

## Mark scheme

- Shade the deadweight loss completely: the triangular area bounded between the demand curve (D) and the marginal cost curve (MC), from  $Q_M$  out to the quantity where D intersects MC (the allocatively efficient quantity). This region represents the value lost to society because the monopolist produces less than the efficient quantity.

# Solution 1

(b)

## Mark scheme

- On the same graph, label the socially optimal quantity  $Q_S$  at the intersection of the demand curve (D) and the marginal cost curve (MC) — the allocatively efficient quantity where price equals marginal cost.  $Q_S$  must lie to the right of  $Q_M$ .

# Solution 1

(c)

## Mark scheme

- Voda Reservoir's profit-maximizing quantity of bottled water will INCREASE. Explain with ONE of: (1) the per-unit subsidy decreases the firm's marginal cost, shifting the MC curve to the right (down), so it intersects the MR curve at a greater quantity; OR (2) the per-unit subsidy increases the firm's marginal revenue, shifting the MR curve to the right, so it intersects the MC curve at a greater quantity.

# Solution 1

(d)

## Mark scheme

- The demand for Voda Reservoir's bottled water will become MORE ELASTIC. As new producers enter the bottled-water market, more substitutes become available for Voda Reservoir's product, making its individual demand more sensitive to price changes (more elastic).

# Solution 1

(e)(i)

## Mark scheme

- Voda Reservoir's demand for labor will INCREASE. Explanation: the increase in demand for bottled water increases the price and marginal revenue of bottled water, which increases the marginal revenue product of labor ( $MRP = MR \times MPL$ ), shifting the labor demand curve to the right.

# Solution 1

(e)(ii)

## Mark scheme

- The market wage will INCREASE in the short run. Explanation: raising the minimum age required to work in a bottled-water factory decreases the supply of workers, shifting the labor supply curve to the left, which raises the equilibrium market wage.

## Question 2

2024 Set 2 ■ Q2

2. The table provided shows the short-run production function for Lowen Feline, a profit-maximizing firm that produces cat food.

| Number of Workers | Total Quantity of Cat Food<br>(bags) |
|-------------------|--------------------------------------|
| 0                 | 0                                    |
| 1                 | 5                                    |
| 2                 | 12                                   |
| 3                 | 18                                   |
| 4                 | 23                                   |
| 5                 | 27                                   |
| 6                 | 30                                   |
| 7                 | 32                                   |

## Question 2

|   |    |
|---|----|
| 8 | 33 |
| 9 | 32 |

Lowen Feline sells as many bags of cat food as it wants at a market price of \$10 per bag and hires as many workers as it wants at a market wage of \$18.

- (a) Lowen Feline's fixed cost is \$90. Calculate the average fixed cost if Lowen Feline hires 6 workers. Show your work.
- (b) Assume labor is the only variable input to Lowen Feline. Calculate the marginal cost if Lowen Feline increases output from 27 to 30 units. Show your work.
- (c) With the hiring of which worker do diminishing marginal returns begin? Explain using numbers.
- (d) Determine the profit-maximizing number of workers Lowen Feline will hire. Explain using marginal analysis.

## Question 2

(e) In the long run, a rival company, Gato Food, increases its production from 40 to 50 units, and its total cost increases from \$600 to \$900. Over the output range of 40 to 50 units, is Gato Food experiencing economies of scale, diseconomies of scale, or constant returns to scale? Explain using numbers.

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**Begin your response to this question at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number.**

## Solution 2

(a)

### Mark scheme

- Average Fixed Cost = Total Fixed Cost / Quantity of Output =  $90/30 = 3$ . (6 workers correspond to 30 units of output on Lowen Feline's production schedule.)

## Solution 2

(b)

## Mark scheme

- Marginal Cost = Change in Total Variable Cost / Change in Output =  $(108 - 90) / (30 - 27) = 18/3 = 6$ . (Equivalently, Marginal Cost = Change in Total Cost / Change in Output =  $(198 - 180) / (30 - 27) = 18/3 = 6$ .)

## Solution 2

(c)

### Mark scheme

- Diminishing marginal returns to labor begin with the hiring of the 3rd worker. Explanation using numbers: the marginal product of the 1st worker is 5 bags, the marginal product of the 2nd worker increases to 7 bags, and the marginal product of the 3rd worker decreases to 6 bags — since marginal product starts falling with the 3rd worker, that is where diminishing marginal returns begin.

## Solution 2

(d)

### Mark scheme

- The profit-maximizing number of workers is 7. Explanation using marginal analysis: a firm hires labor up to the point where the marginal revenue product (MRP) of the last worker is at least equal to the marginal factor cost (MFC) of that worker (the wage). The MRP of the 7th worker (20) is greater than the MFC of the 7th worker (wage = 18), so hiring the 7th worker adds to profit; hiring an 8th worker would decrease profit because the MRP of the 8th worker (10) is less than the MFC of the 8th worker (wage = 18). So Lowen Feline stops hiring at 7 workers.

## Solution 2

(e)

## Mark scheme

- Gato Food is experiencing diseconomies of scale. Explanation using numbers: as output rises from 40 to 50 units, long-run average total cost rises from 15 *per unit* ( $600 / 40 = 15$ ) to 18 per unit ( $900 / 50 = 18$ ). Because long-run average total cost increases as output increases over this range, Gato Food is experiencing diseconomies of scale.

# Question 1

2023 Set 1 ■ Q1

1. RKB is a profit-maximizing monopoly that produces a new, patented electronic device. RKB is earning positive economic profit.
  - (a) Draw a correctly labeled graph for RKB, and show each of the following.
    - (i) The profit-maximizing quantity, labeled  $Q_M$
    - (ii) The profit-maximizing price, labeled  $P_M$
    - (iii) The average total cost curve consistent with RKB earning positive economic profit
    - (iv) The area representing the deadweight loss, shaded completely
  - (b) The government wants RKB to produce the allocatively efficient quantity. Would the government impose a binding price ceiling, a binding price floor, a per-unit tax, or a lump-sum tax?
  - (c) Suppose that the government does not impose the policy you identified in part (b). Consumers now become aware of research that confirms the use of this new device harms users' vision. Given widespread consumer awareness of this research, what will happen to RKB's profit-maximizing quantity in the short run? Explain.

# Question 1

- (d) Assume that RKB hires workers in a perfectly competitive labor market.
- (i) Draw a correctly labeled graph for the labor market, showing the equilibrium wage and quantity of labor, labeled  $W_E$  and  $Q_E$ , respectively.
  - (ii) Suppose immigration increases the number of workers in this labor market. On your graph in part (d)(i), show the new equilibrium wage and quantity of labor, labeled  $W_2$  and  $Q_2$ , respectively.
  - (iii) RKB uses the optimal combination of capital and labor in its production process. The firm rents capital at \$500 per unit, and the last unit of capital rented has a marginal product of 2,500 units. If the marginal product of the last unit of labor hired is 1,000 units, calculate the wage rate. Show your work.
-

## Question 1

**Begin your response to this question at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number.**

# Solution 1

## (a) Mark scheme

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- Draw one correctly labeled monopoly graph (axes: Price/Cost vertical, Quantity horizontal) showing all five required elements, 1 point each: (1) a downward-sloping Demand (D) curve and a downward-sloping Marginal Revenue (MR) curve, with MR below D; (2) an upward-sloping Marginal Cost (MC) curve and the profit-maximizing quantity, labeled  $Q_M$ , where  $MR = MC$ ; (3) the profit-maximizing price, labeled  $P_M$ , found on the D curve directly above  $Q_M$ ; (4) an Average Total Cost (ATC) curve drawn below  $P_M$  at  $Q_M$  (so the firm earns positive economic profit), with the MC curve passing through the minimum point of the ATC curve; (5) the deadweight loss area — bounded by the D curve, the

## Solution 1

MC curve, and the vertical line at  $Q_M$ , out to the allocatively efficient quantity where  $D = MC$  — shaded completely.

# Solution 1

(b)

## Mark scheme

- The government would impose a binding price ceiling, set at the price where  $D = MC$  (the allocatively efficient price/quantity), to induce RKB to produce the allocatively efficient quantity.

# Solution 1

(c)

## Mark scheme

- The profit-maximizing quantity will decrease. Explanation: widespread consumer awareness that the device harms vision reduces demand for RKB's device, so the D curve shifts left; this causes the MR curve to shift left as well, so the new MR intersects the (unchanged) MC curve at a lower quantity than before.

## Solution 1

(d)(i)

## Mark scheme

- Draw a correctly labeled graph of a perfectly competitive labor market: Wage on the vertical axis, Quantity of Labor on the horizontal axis, a downward-sloping labor demand curve ( $D_L$ ) and an upward-sloping labor supply curve ( $S_L$ ), intersecting at the equilibrium wage, labeled  $W_E$ , and equilibrium quantity of labor, labeled  $Q_E$ .

# Solution 1

(d)(ii)

## Mark scheme

- On the graph from part (d)(i), shift the labor supply curve rightward (to  $S'_L$ ) to represent immigration increasing the number of workers. Show the new equilibrium at a lower wage, labeled  $W_2$ , and a higher quantity of labor, labeled  $Q_2$ , at the intersection of  $D_L$  and  $S'_L$  (with  $W_2 < W_E$  and  $Q_2 > Q_E$ ).

## Solution 1

**(d)(iii) Mark scheme**

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- Use the optimal (cost-minimizing) input combination rule:  

$$\frac{\text{Marginal Product of Capital}}{\text{Rental Price}} = \frac{\text{Marginal Product of Labor}}{\text{Wage Rate}}.$$
 Substitute:  

$$\frac{2,500}{\$500} = \frac{1,000}{\text{Wage Rate}}, \text{ so } 5 = \frac{1,000}{\text{Wage Rate}}, \text{ giving Wage Rate} = \$200.$$

## Question 2

2023 Set 2 ■ Q2

2. Keepdry produces and sells rain jackets in a perfectly competitive product market at the price of \$5 per jacket and hires all the workers it needs in a perfectly competitive labor market at the wage rate of \$15. Labor is the only variable input, and the firm's production schedule is provided in the table.

| Number of Workers | Quantity of Output |
|-------------------|--------------------|
| 0                 | 0                  |
| 1                 | 9                  |
| 2                 | 20                 |
| 3                 | 27                 |
| 4                 | 32                 |
| 5                 | 34                 |

## Question 2

|   |    |
|---|----|
| 6 | 35 |
|---|----|

- (a) Calculate the marginal revenue product of the second worker. Show your work.
  - (b) Diminishing marginal returns will begin with the hiring of which worker?
  - (c) Determine the profit-maximizing number of workers the firm should hire. Explain using marginal analysis.
  - (d) Assuming Keepdry's fixed cost is \$40, calculate Keepdry's economic profit when hiring the profit-maximizing number of workers. Show your work.
  - (e) Suppose Keepdry's fixed cost increases to \$80. Will the profit-maximizing number of workers hired in the short run increase, decrease, or stay the same? Explain.
-

## Question 2

**Begin your response to this question at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number.**

## Solution 2

(a)

## Mark scheme

- MRP of the 2nd worker =

$$55. \text{MRP}(2\text{nd worker}) = \text{Marginal Product} \times \text{Marginal Revenue} = (20 - 9) \times 5 = 11 \times 5 = 55.$$

## Solution 2

(b)

### Mark scheme

- Diminishing marginal returns begin with the hiring of the 3rd worker (that is where the marginal product of labor starts to decline).

## Solution 2

(c)

### Mark scheme

- The profit-maximizing number of workers is 4. Using marginal analysis, a firm hires an additional worker as long as  $MRP \geq MFC$  (the wage). The MRP of the 4th worker is 25, *which is greater than the marginal factor cost of 15*, so hiring the 4th worker adds to profit. The MRP of the 5th worker is only 10, *which is less than the 15 wage/MFC*, so hiring the 5th worker would decrease profit. Therefore the firm hires 4 workers.

## Solution 2

(d)

## Mark scheme

- Economic profit = 60.  $Economic Profit = Total Revenue - Total Cost = Total Revenue - Total Fixed Cost - Total Variable Cost = (5 \times 32) - 40 - (15 \times 4) = 160 - 40 - 60 = 160 - 100 = 60.$

## Solution 2

(e)

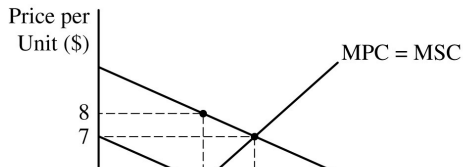
### Mark scheme

- The number of workers hired will stay the same (4 workers). An increase in fixed cost does not affect the marginal factor cost (wage) of hiring labor or the marginal revenue product of labor, and fixed costs do not enter the marginal hire/no-hire decision, so the profit-maximizing quantity of labor is unchanged in the short run.

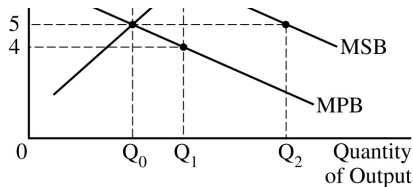
## Question 2

2022 Set 1 ■ Q2

2. Bueno is a firm that produces and sells guava, a type of fruit. The market for guava is perfectly competitive. The marginal private benefit (MPB), marginal private cost (MPC), marginal social benefit (MSB), and marginal social cost (MSC) curves are illustrated in the graph provided.



## Question 2



- (a) Identify the kind of market failure represented by this graph.
- (b) Using numbers from the graph, identify the marginal external benefit.
- (c) Assume the guava market is in short-run equilibrium and Bueno hires workers in a perfectly competitive labor market at a wage of \$20 per hour. The marginal product of the last worker hired was 6 units of guava per hour.
- Calculate the change in Bueno's profit per hour from the last worker hired. Show your work.
  - Suppose that the government decides to provide a per-unit subsidy to consumers who buy guava. How would the per-unit subsidy affect Bueno's marginal revenue product curve? Explain.

## Question 2

(d) Instead of hiring workers in a perfectly competitive labor market, assume Bueno hires workers in a monopsony labor market. Will the number of workers hired increase, decrease, or stay the same? Explain.

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**Begin your response to this question at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number.**

## Solution 2

(a)

### Mark scheme

- A positive consumption externality (positive externality in consumption): the marginal social benefit of guava exceeds the marginal private benefit (demand) curve, meaning third parties benefit from others' consumption.

## Solution 2

(b)

### Mark scheme

- The marginal external benefit is \$3 – the vertical (dollar) gap between the marginal-social-benefit curve and the private demand (marginal-private-benefit) curve at the relevant quantity, as read from the graph.

## Solution 2

(c)(i)

## Mark scheme

- Change in profit per hour  $= \text{MRP} - \text{MFC} = (\$5 \times 6) - \$20 = \$30 - \$20 = \$10$ . Marginal revenue product  $\text{MRP} =$  marginal product  $\times$  price  $= 6 \times \$5 = \$30$ ; marginal factor cost  $\text{MFC} =$  wage  $= \$20$  since the labor market is perfectly competitive. Hiring the last worker raised profit per hour by \$10.

## Solution 2

(c)(ii)

## Mark scheme

- Bueno's MRP curve would shift up (to the right). The per-unit subsidy to consumers increases demand for guava, raising the price received/paid for guava; since  $MRP = MP \times P$ , a higher guava price raises MRP for each worker, shifting the MRP curve upward.

## Solution 2

(d)

### Mark scheme

- The number of workers hired will decrease. A monopsony faces an upward-sloping labor-supply curve, so its marginal factor cost  $MFC$  lies above (and is steeper than) the supply/wage curve –  $MFC$  rises as the firm hires more workers (it must raise the wage paid to ALL workers, not just the marginal one), whereas  $MFC$  (=wage) is constant in a perfectly competitive labor market. Since firms hire where  $MFC = MRP$ , the monopsony's higher  $MFC$  at any quantity means it hires fewer workers than a perfectly competitive firm would.

## Question 2

2021 Set 1 ■ Q2

Assume that Schmitt Inc. provides car parking services in a perfectly competitive output market and hires labor in a perfectly competitive input market. The market price per car parked is 10, the daily market wage per worker is 100, and fixed costs are \$50 per day. The table above shows the number of workers required to park different quantities of cars per day.

| Number of Workers | Number of Parked Cars |
|-------------------|-----------------------|
| 0                 | 0                     |
| 1                 | 8                     |
| 2                 | 20                    |
| 3                 | 34                    |
| 4                 | 45                    |
| 5                 | 54                    |
| 6                 | 60                    |
| 7                 | 63                    |

## Question 2

- (a)** Calculate the marginal revenue product of the second worker. Show your work.
- (b)** How many workers will Schmitt Inc. hire to maximize profit? Relative to this number of hired workers, explain why Schmitt Inc. will not hire one additional worker. Your answer must use marginal analysis and numbers from the table.
- (c)** Calculate the daily profit for Schmitt Inc. at the profit-maximizing quantity identified in part (b). Show your work.
- (d)(i)** Suppose new legislation requires each worker in the parking industry to purchase an individual insurance policy at the worker's expense in order to legally park cars. Will the market wage paid by a typical firm in this industry increase, decrease, or stay the same in the long run?
- (d)(ii)** For a typical firm in the industry, will the number of workers hired in the short run increase, decrease, or stay the same? Explain.

## Solution 2

(a)

## Mark scheme

- Marginal Revenue Product (MRP) of the 2nd worker = \$120. Work:

$$MRP = \frac{\Delta TR}{\Delta L} = \frac{(20 - 8)}{(2 - 1)} \times \$10 = 12 \times \$10 = \$120, \text{ equivalently}$$

$$\frac{\$200 - \$80}{2 - 1} = \$120 \text{ (using total output of 8 and 20 units at 1 and 2 workers respectively, and an output price of \$10).}$$

## Solution 2

(b)

### Mark scheme

- Schmitt Inc. will hire 4 workers. Explanation: a firm hires workers up to the point where  $MRP = \text{wage}$  (marginal factor cost), and stops before  $MRP$  falls below the wage. Schmitt will not hire a 5th worker because the  $MRP$  of the 5th worker is \$90 (computed as  $(54 - 45) \times \$10 = \$90$ ), which is less than the \$100 wage — hiring the 5th worker would cost \$100 but add only \$90 in revenue, reducing profit.

## Solution 2

(c)

## Mark scheme

- Daily profit = £0. Work:  $\text{Profit} = TR - TC = (£10 \times 45) - (£50 + 4 \times £100) = £450 - (£50 + £400) = £450 - £450 = £0$ , using output price £10 times the 45 units of output produced by the 4 hired workers, minus fixed cost £50 plus the wage bill of 4 workers at £100 each.

## Solution 2

**(d)(i)**

### Mark scheme

- The market wage will increase. Requiring each worker to purchase an individual insurance policy at their own expense raises the effective cost of working, so the market supply of labor decreases (shifts left/up), which raises the equilibrium market wage in the long run.

## Solution 2

(d)(ii)

### Mark scheme

- The number of workers hired by a typical firm will decrease. Explanation: the market supply of workers decreases because of the new insurance requirement, which drives up the market wage; a higher wage raises the marginal factor cost (marginal resource cost, MFC) faced by the typical firm, so the firm hires fewer workers at its new profit-maximizing point where  $MRP = MFC$ .

## Question 1

2019 Set 2 ■ Q1

Gigantic Pharmaceutical Corporation has a patent on a prescription drug, making it the only manufacturer of that prescription drug. Gigantic is currently earning a positive economic profit.

- (a)** Draw a correctly labeled graph for Gigantic and show each of the following.
- (i) The profit-maximizing quantity, labeled  $Q_G$
  - (ii) The profit-maximizing price, labeled  $P_G$
  - (iii) The average total cost curve, labeled ATC
  - (iv) The area representing the consumer surplus, shaded completely

# Question 1

2019 Set 2 ■ Q1

Gigantic Pharmaceutical Corporation has a patent on a prescription drug, making it the only manufacturer of that prescription drug. Gigantic is currently earning a positive economic profit.

**(b)(i)** Suppose the demand for the prescription drug increases, and Gigantic hires its warehouse workers in a perfectly competitive labor market. What will happen to Gigantic's demand for warehouse workers? Explain.

**(b)(ii)** What will happen to the wage rate Gigantic pays its warehouse workers and the number of warehouse workers it hires?

## Question 1

2019 Set 2 ■ Q1

Gigantic Pharmaceutical Corporation has a patent on a prescription drug, making it the only manufacturer of that prescription drug. Gigantic is currently earning a positive economic profit.

**(c)(i)** After Gigantic's patent expires, another firm enters the prescription drug market and produces an identical drug that sells for a lower price. What will happen to Gigantic's producer surplus?

**(c)(ii)** What will happen to the consumer surplus in this prescription drug market? Explain.

# Solution 1

## (a) Mark scheme

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- Correctly labeled monopoly graph for Gigantic, earning 1 point each for: (1) downward-sloping demand (D) and marginal revenue (MR) curves, with MR below D; (2) the profit-maximizing quantity  $Q_G$  shown where  $MR = MC$ ; (3) the profit-maximizing price  $P_G$  shown from the demand curve at  $Q_G$ , positioned above the average total cost (ATC) curve at that quantity; (4) a rising marginal cost (MC) curve that passes through the minimum point of the ATC curve; (5) the consumer surplus completely shaded as the triangular area bounded above by the demand curve D, below by the price  $P_G$ , and to the right by the vertical line at  $Q_G$  (from the price axis to where D meets that vertical line).

# Solution 1

**(b)(i)**

## Mark scheme

- Gigantic's demand for warehouse workers will increase. Because Gigantic hires labor in a perfectly competitive labor market, the increase in demand for the prescription drug raises the product's price, which raises the marginal revenue product of labor ( $MRP = MPL \times \text{price}$ ), shifting Gigantic's labor demand curve to the right.

# Solution 1

**(b)(ii)**

## Mark scheme

- The wage rate Gigantic pays its warehouse workers will not change (Gigantic is a wage-taker in a perfectly competitive labor market, facing a horizontal/perfectly elastic labor supply curve), while the number of warehouse workers it hires will increase, since the rightward shift in labor demand is met along that fixed wage.

## Solution 1

(c)(i)

### Mark scheme

- Gigantic's producer surplus will decrease. Once the patent expires and a rival firm sells an identical drug at a lower price, Gigantic loses its monopoly pricing power, so its producer surplus falls.

# Solution 1

(c)(ii)

## Mark scheme

- Consumer surplus in the prescription drug market will increase. The new entrant increases competition, which decreases the price and increases the quantity sold in the market, both of which enlarge the area of consumer surplus.

## Question 1

2018 ■ Q1

In the early twentieth century, limited transportation options and the lack of effective substitutes gave Single Cinema monopoly power in a small town. Assume that Single Cinema is a profit-maximizing firm and currently operates at a negative economic profit in the short run.

- (a)(i)** Draw a correctly labeled graph for Single Cinema, and show the following: The profit-maximizing price and quantity of tickets, labeled as  $P_m$  and  $Q_m$ , respectively.
- (a)(ii)** Draw a correctly labeled graph for Single Cinema, and show the following: The area representing the negative economic profit, shaded completely.

## Question 1

2018 ■ Q1

In the early twentieth century, limited transportation options and the lack of effective substitutes gave Single Cinema monopoly power in a small town. Assume that Single Cinema is a profit-maximizing firm and currently operates at a negative economic profit in the short run.

**(b)** Explain why Single Cinema continues to operate in the short run despite earning negative economic profit in the short run.

## Question 1

2018 ■ Q1

In the early twentieth century, limited transportation options and the lack of effective substitutes gave Single Cinema monopoly power in a small town. Assume that Single Cinema is a profit-maximizing firm and currently operates at a negative economic profit in the short run.

**(c)** Would Single Cinema's total revenue increase, decrease, or stay the same if it decides to sell one fewer ticket than  $Q_m$ ? Explain.

## Question 1

2018 ■ Q1

In the early twentieth century, limited transportation options and the lack of effective substitutes gave Single Cinema monopoly power in a small town. Assume that Single Cinema is a profit-maximizing firm and currently operates at a negative economic profit in the short run.

**(d)(i)** Single Cinema hires workers in a perfectly competitive labor market with a downward-sloping demand curve. Suppose the number of workers available in the market decreases. What will happen to the wage rate? Explain.

**(d)(ii)** Single Cinema hires workers in a perfectly competitive labor market with a downward-sloping demand curve. Suppose the number of workers available in the market decreases. What will happen to the marginal revenue product of the last worker hired? Explain.

# Solution 1

## (a)(i)

### Mark scheme

- Draw a correctly labeled monopoly graph for Single Cinema. Points earned:  
(1) a correctly labeled graph with a downward-sloping demand (D) curve and a marginal revenue (MR) curve drawn below/steeper than D; (2) a rising marginal cost (MC) curve that passes through the minimum point of the average total cost (ATC) curve; (3) the profit-maximizing quantity  $Q_m$  shown where  $MR = MC$  (MC crosses MR); (4) the profit-maximizing price  $P_m$  read off the demand curve directly above  $Q_m$  (go up from  $Q_m$  to D, then across to the price axis).

# Solution 1

**(a)(ii)**

## Mark scheme

- On the same monopoly graph, completely shade the rectangle representing negative economic profit: it lies between the ATC curve and price  $P_m$ , at quantity  $Q_m$ , with the ATC curve drawn above the demand curve (and thus above  $P_m$ ) at  $Q_m$  — since  $ATC > P_m$  at  $Q_m$ , the firm is making a loss. The shaded loss area =  $(ATC - P_m) \times Q_m$ .

# Solution 1

(b)

## Mark scheme

- Single Cinema keeps operating in the short run because price is greater than average variable cost ( $P > AVC$ ) — equivalently, total revenue exceeds total variable cost ( $TR > TVC$ ), or the firm's current economic loss is smaller than its fixed cost, which is what its loss would be if it shut down. Since operating produces a smaller loss than shutting down, the firm continues to operate despite the negative economic profit.

# Solution 1

(c)

## Mark scheme

- Total revenue will decrease if Single Cinema sells one fewer ticket than  $Q_m$ .  
Explanation (any one of): the monopolist is operating on the elastic portion of the demand curve at  $Q_m$ ; the quantity effect of losing a ticket sale is greater than the price effect of the higher price; the percentage change in quantity demanded is greater than the percentage change in price; or MR is positive at  $Q_m$  (since  $Q_m$  is where  $MR = MC > 0$ ), meaning revenue is still rising with quantity, so cutting quantity lowers revenue.

# Solution 1

(d)(i)

## Mark scheme

- The wage rate will increase. Because the number of workers available in the perfectly competitive labor market decreases, the market labor supply curve  $S$  shifts left to  $S'$ . With labor demand  $D$  unchanged, the new market equilibrium wage  $W'$  is higher than the original wage  $W$  (quantity of labor falls from  $Q$  to  $Q'$ ).

## Solution 1

### (d)(ii) Mark scheme

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- The marginal revenue product (MRP) of the last worker hired will increase.  
Explanation (any one of): the firm now hires fewer workers, so the marginal product of the last worker hired is higher (diminishing marginal product means fewer workers implies a higher marginal product); the market wage (marginal factor cost, MFC) increased, and a profit-maximizing firm hires where  $MRP = MFC$ , so at the new higher wage MRP must also be higher; or graphically, there is an upward movement along the firm's downward-sloping MRP curve as the wage/MFC rises from  $W$  to  $W'$  (quantity of labor hired falls from  $q$  to  $q'$ ).

## Question 2

2017 ■ Q2

The table below shows the output a firm produces using different amounts of capital (K) and labor (L). The markets for capital and labor are perfectly competitive. The rental rate of capital is \$75 per unit, and the wage rate is \$200 per unit. In the short run, capital is fixed and labor is variable.

| Labor | Output with K=1 | Output with K=2 |
|-------|-----------------|-----------------|
| 0     | 0               | 0               |
| 1     | 10              | 20              |
| 2     | 25              | 50              |
| 3     | 38              | 75              |

## Question 2

- (a)** If the firm uses one unit of capital and one unit of labor, will it be operating with constant, increasing, or decreasing returns to scale? Explain using numbers from the table.
- (b)** Assume now that the firm currently has two units of capital and is using three units of labor.
- (b)(i)** Calculate the marginal product for the third unit of labor. Show your work.
- (b)(ii)** Did the firm experience diminishing marginal returns with the addition of the third unit of labor? Explain using numbers from the table.
- (b)(iii)** Calculate the firm's average total cost for its current level of production. Show your work.
- (b)(iv)** If the firm's output is sold in a competitive market, what is the lowest output price at which the third unit of labor would be hired?

## Question 2

| Labor | Output with $K=1$ | Output with $K=2$ |
|-------|-------------------|-------------------|
| 0     | 0                 | 0                 |
| 1     | 10                | 20                |
| 2     | 25                | 50                |
| 3     | 38                | 75                |

## Solution 2

(a)

### Mark scheme

- With one unit of capital and one unit of labor, the firm is operating with increasing returns to scale. Doubling both inputs (to two units of capital and two units of labor) more than doubles output – output rises from 10 units to 50 units, a five-fold increase versus only a doubling of inputs. Equivalently, average total cost falls from 27.50 to 11 when labor and capital both double, which also indicates increasing returns to scale.

## Solution 2

(b)

### Mark scheme

- Setup/context sentence only ('the firm currently has two units of capital and is using three units of labor') – establishes the scenario for parts (b)(i)-(iv) and carries no points of its own.

(b)(i)

### Mark scheme

- Marginal product of the third unit of labor =  $(\text{change in output})/(\text{change in labor}) = (75-50)/(3-2) = 25$  units. Show this work.

## Solution 2

**(b)(ii)**

### Mark scheme

- Yes, the firm experienced diminishing marginal returns with the addition of the third unit of labor, because the marginal product of the third worker (25 units) is less than the marginal product of the second worker (30 units).

## Solution 2

(b)(iii)

## Mark scheme

- Average total cost at 2 units of capital and 3 units of labor:  $(75 \times 2)/75 + (200 \times 3)/75 = 2 + 8 = 10$  (*equivalently*,  $((75 \times 2) + (200 \times 3))/75 = 750/75 = 10$ ). Show the capital-cost-per-unit-output plus labor-cost-per-unit-output work.

## Solution 2

### (b)(iv)

#### Mark scheme

- The lowest output price at which the firm would hire the third unit of labor is \$8. This is the price at which the value of the marginal product of the third worker ( $\text{price} \times \text{MP} = \text{price} \times 25$ ) just covers the cost of hiring that worker, consistent with the \$200 labor cost used in the ATC calculation:  $\text{price} \times 25 \geq 200$  implies  $\text{price} \geq \$8$ .

## Question 2

2014 ■ Q2

Ray's Stable hires workers in a perfectly competitive factor market for unskilled labor.

**(a)(i)** Using correctly labeled side-by-side graphs for the labor market and Ray's Stable, show each of the following.

The equilibrium wage and quantity for unskilled labor, labeled  $W_E$  and  $Q_E$ , respectively

**(a)(ii)** Using correctly labeled side-by-side graphs for the labor market and Ray's Stable, show each of the following.

The wage paid by Ray's Stable and the quantity of unskilled labor hired, labeled  $W_R$  and  $Q_R$ , respectively

## Question 2

2014 ■ Q2

Ray's Stable hires workers in a perfectly competitive factor market for unskilled labor.

**(b)** Is the marginal factor cost of unskilled labor for Ray's Stable greater than, less than, or equal to  $W_E$ ? Explain.

## Question 2

2014 ■ Q2

Ray's Stable hires workers in a perfectly competitive factor market for unskilled labor.

**(c)(i)** Now assume that the government imposes an effective minimum wage for unskilled labor.

Show the minimum wage on your graphs in part (a), labeled  $W_{MIN}$ .

**(c)(ii)** Now assume that the government imposes an effective minimum wage for unskilled labor.

On the labor market graph in part (a), show the quantity of unskilled labor supplied in the labor market as a result of the minimum wage, labeled  $Q_S$ .

**(c)(iii)** Now assume that the government imposes an effective minimum wage for unskilled labor.

As a result of the new minimum wage, will the marginal revenue product of the last worker hired by Ray's Stable increase, decrease, or stay the same?

## Solution 2

(a)(i)

### Mark scheme

- Draw the labor market with an upward-sloping labor supply curve (S) and a downward-sloping labor demand curve (D); their intersection identifies the equilibrium wage  $W_E$  and equilibrium quantity of unskilled labor  $Q_E$ .

## Solution 2

(a)(ii)

### Mark scheme

- Draw a separate graph for Ray's Stable with a downward-sloping marginal revenue product curve (MRP, Ray's Stable's demand for labor) and a horizontal labor supply/marginal factor cost curve ( $S = MFC$ ) at the market wage; their intersection gives the wage Ray's Stable pays,  $W_R$  (equal to  $W_E$ , since Ray's Stable is a wage taker), and the quantity of labor it hires,  $Q_R$ .

## Solution 2

(b)

### Mark scheme

- Ray's Stable's marginal factor cost of unskilled labor is equal to  $W_E$  (not greater than). Ray's Stable is a wage taker in the (competitive) unskilled labor market — as one small employer among many, it faces a perfectly elastic (horizontal) labor supply at the wage the market sets, so hiring an extra worker does not bid the wage up.

## Solution 2

(c)(i)

## Mark scheme

- Show the minimum wage  $W_{MIN}$  as a horizontal line on the labor market graph from part (a), drawn above the equilibrium wage  $W_E$  — an effective (binding) minimum wage must be set above equilibrium.

## Solution 2

(c)(ii)

## Mark scheme

- On the labor market graph, at  $W_{MIN}$ , read the quantity of unskilled labor supplied,  $Q_S$ , off the labor supply curve (S); because  $W_{MIN} > W_E$ ,  $Q_S$  exceeds  $Q_E$  (and exceeds quantity demanded at  $W_{MIN}$ ), producing a surplus of unskilled labor.

## Solution 2

(c)(iii)

### Mark scheme

- The marginal revenue product of the last worker hired by Ray's Stable will increase. As a wage taker, Ray's Stable must now pay  $W_{MIN}$  (higher than the old wage  $W_E$ ) for each worker; since it hires where MRP equals the wage and MRP is downward sloping, the higher mandated wage leads it to hire fewer workers — so the last (marginal) worker hired, at this lower quantity, has a higher MRP than before.