

ECON2103 Microeconomics

Chapter 8 Exercises

Solutions

1.

- a. Profits are maximized where price equals marginal cost. Therefore,

$$100 = 4q, \text{ or } q = 25.$$

- b. Profit is equal to total revenue minus total cost: $\pi = Pq - (200 + 2q^2)$. Thus,

$$\pi = (100)(25) - (200 + 2(25)^2) = \$1050.$$

- c. The firm will produce in the short run if its revenues are greater than its total variable costs. The firm's short-run supply curve is its MC curve above minimum AVC . Here, $AVC = \frac{VC}{q} = \frac{2q^2}{q} = 2q$.

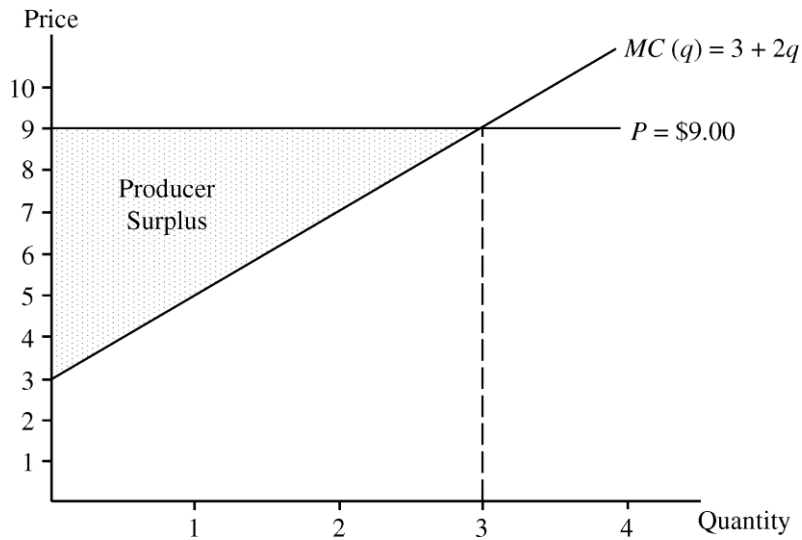
Also, $MC = 4q$. So, MC is greater than AVC for any quantity greater than 0. This means that the firm produces in the short run as long as price is positive.

2.

- a. The firm should set the market price equal to marginal cost to maximize its profits:

$$9 = 3 + 2q, \text{ or } q = 3.$$

- b. Producer surplus is equal to the area below the market price, that is, \$9.00, and above the marginal cost curve, that is, $3 + 2q$. Because MC is linear, producer surplus is a triangle with a base equal to 3 (since $q = 3$) and a height of \$6 ($9 - 3 = 6$). The area of a triangle is $(1/2) \times (\text{base}) \times (\text{height})$. Therefore, producer surplus is $(0.5)(3)(6) = \$9$.



- c. Profit is equal to total revenue minus total cost. Total cost is equal to total variable cost plus fixed cost. Total variable cost is equal to $AVC(q) \times q$. At $q = 3$, $AVC(q) = 3 + 3 = 6$, and therefore

$$TVC = (6)(3) = \$18.$$

Fixed cost is equal to \$3. Therefore, total cost equals TVC plus TFC , or

$$C = \$18 + 3 = \$21.$$

Total revenue is price times quantity:

$$R = (\$9)(3) = \$27.$$

Profit is total revenue minus total cost:

$$\pi = \$27 - 21 = \$6.$$

Therefore, the firm is earning positive economic profits. More easily, you might recall that profit equals producer surplus minus fixed cost. Since we found that producer surplus was \$9 in part b, profit equals $9 - 3$ or \$6.

3.

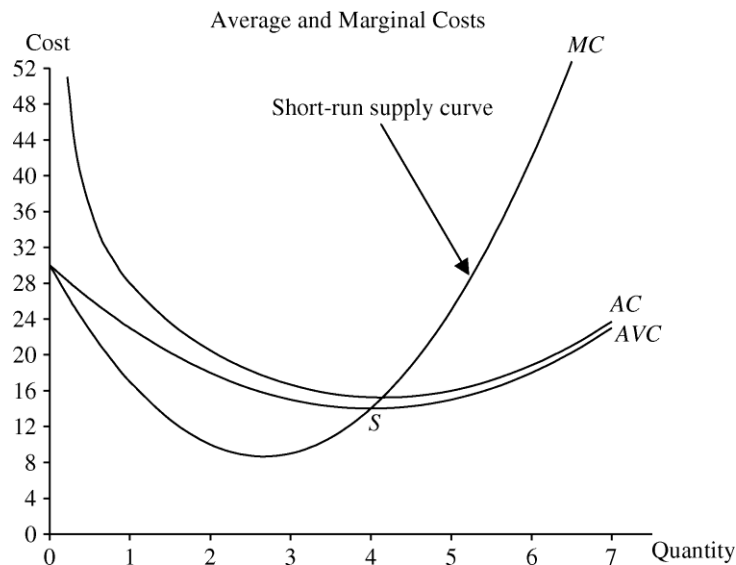
- a. The functions can be calculated as follows:

$$MC = \frac{dC}{dq} = 3q^2 - 16q + 30$$

$$AC = \frac{C}{q} = q^2 - 8q + 30 + \frac{5}{q}$$

$$AVC = \frac{VC}{q} = q^2 - 8q + 30.$$

Graphically, all three cost functions are U-shaped in that cost initially declines as q increases, and then increases as q increases. Average variable cost is below average cost everywhere. Marginal cost is initially below AVC and then increases to intersect AVC at its minimum point, S . MC is also initially below AC and then intersects AC at its minimum point.



- b. The firm will find it profitable to produce in the short run as long as price is greater than or equal to average variable cost. If price is less than average variable cost then the firm will be better off shutting down in the short run, as it will only lose its fixed cost and not fixed plus some variable cost. Here we need to find the minimum average variable cost, which can be done in two different ways. You can either set marginal cost equal to average variable cost, or you can differentiate average variable cost with respect to q and set this equal to zero. In both cases, you can solve for q and then plug into AVC to find the minimum AVC . Here we will set AVC equal to MC :

$$\begin{aligned}
AVC &= q^2 - 8q + 30 = 3q^2 - 16q + 30 = MC \\
2q^2 &= 8q \\
q &= 4 \\
AVC(q=4) &= 4^2 - 8 \cdot 4 + 30 = 14.
\end{aligned}$$

This is point S on the graph. Hence the firm supplies zero output if $P < \$14$.

- c. The firm's supply curve is the MC curve above the point where $MC = AVC$. The firm will produce at the point where price equals MC as long as MC is greater than or equal to AVC . This point is labeled S on the graph, so the short-run supply curve is the portion of MC that lies above point S .
- d. The firm maximizes profit by choosing the level of output such that $P = MC$. To find the price where the firm would supply 6 units of output, set q equal to 6 and solve for MC :

$$P = MC = 3q^2 - 16q + 30 = 3(6^2) - 16(6) + 30 = 42.$$

4.

- a. Equilibrium price and quantity are found by setting market demand equal to market supply:
 $6500 - 100P = 1200P$. Solve to find $P = \$5$ and substitute into either equation to find $Q = 6000$.
 To find the output for the firm set price equal to marginal cost: $5 = \frac{2q}{200}$ so $q = 500$. Profit is total revenue minus total cost or $\pi = Pq - \left(722 + \frac{q^2}{200}\right) = 5(500) - \left(722 + \frac{500^2}{200}\right) = \528 . Notice that since the total output in the market is 6000, and each firm's output is 500, there must be $6000/500 = 12$ firms in the industry.
- b. We would expect entry because firms in the industry are making positive economic profits. As new firms enter, market supply will increase (that is, the market supply curve will shift down and to the right), which will cause the market equilibrium price to fall, all else the same. This, in turn, will reduce each firm's optimal output and profit. When profit falls to zero, no further entry will occur.
- c. In the long run profit falls to zero, which means price falls to the minimum value of AC . To find the minimum average cost, set marginal cost equal to average cost and solve for q :

$$\begin{aligned}\frac{2q}{200} &= \frac{722}{q} + \frac{q}{200} \\ \frac{q}{200} &= \frac{722}{q} \\ q^2 &= 722(200) \\ q &= 380 \\ AC(q = 380) &= 3.8.\end{aligned}$$

Therefore, the firm will not sell for any price less than \$3.80 in the long run. The long-run equilibrium price is therefore \$3.80, and at a price of \$3.80, each firm sells 380 units and earns an economic profit of zero because $P = AC$.

- d. The firm will sell its output at any price above zero in the short run, because marginal cost is above average variable cost ($MC = q/100 > AVC = q/200$) for all positive prices. Profit is negative if price is just above zero.

5.

- a. Since marginal cost is equal to \$1.50 and the price is \$2, each hot dog vendor will want to sell as many hot dogs as possible, which is 100 per day.
- b. Each hot dog vendor is making a profit of \$0.50 per hot dog at the current \$2 price: a total profit of \$50. Therefore, the price will not remain at \$2, because these positive economic profits will encourage new vendors to enter the market. As new firms start selling hot dogs, market supply will increase and price will drop until economic profits are driven to zero. That will happen when price falls to \$1.50, where price equals average cost. (Note that $AC = MC = \$1.50$ for firms in this industry because fixed cost is zero and MC is constant at \$1.50).
- c. At the current price of \$2, the total number of hot dogs demanded is $Q = 4400 - 1200(2) = 2000$, so there are $2000/100 = 20$ vendors. In the long run, price will fall to \$1.50, and the number of hot dogs demanded will increase to $Q = 2600$. If each vendor sells 100 hot dogs, there will be 26 vendors in the long run.
- d. If there are 20 vendors selling 100 hot dogs each, then the total number sold is 2000. If $Q = 2000$ then $P = \$2$, from the demand curve.
- e. At the price of \$2, each vendor is making a profit of \$50 per day as noted in part b. This is the most a vendor would pay per day for a permit.