ME Tutorial 14

Q1. The market-determined price in a perfectly competitive industry is P = \$10. Suppose that the total cost equation of an individual firm in the industry is given by the expression:

$$TC = 100 + 5Q + 0.02Q^2$$

a) What is the firm's profit-maximizing output level?
b) Given your answer to part a, what is the firm's total profit?
c) Diagram your answers to parts A and B.

Q2. R.K Enterprises is a small firm in the steel office chairs industry, which is perfectly competitive. The market price of each chair is Rs 640. The cost function of the firm is

$$TC=240Q - 20Q^2 + Q^3$$

a) What is the profit maximizing output?
b) What is the average cost when output level is 20 units?
c) What is the profit earned by firm if the output sold in the market is 20 units?
d) Suppose the local govt. imposes a specific tax of Rs 325 per chair on the R.K.Enterprises. What is the profit maximizing output?
e) After imposition of Rs 325 per chair as tax on R.K.Enterprises if firm is producing 15 units, what are the profits earned by R.K.Enterprises?

Q3. Hale and Hearty Limited (HH) is a small distributor of B&Q Food stores, Inc., in the highly competitive health care products industry. The market-determined price of a 100-tablet vial of HH's most successful product, papaya extract, is \$10. HH's total cost (TC) function is given as

$$TC = 100 + 2Q + 0.01Q^2$$

a) What is the firm's profit-maximizing level of output? What is the firm's profit at the profit-maximizing output level? Is HH in short-run or long-run competitive equilibrium? Explain.
b) At P = \$10, what is HH's break-even output level?
c) What is HH's long-run break-even price and output level?
d) What is HH's shutdown price and output level?

ME Tutorial 14

Q1. The market-determined price in a perfectly competitive industry is P = \$10. Suppose that the total cost equation of an individual firm in the industry is given by the expression:

$$TC = 100 + 5Q + 0.02Q^2$$

a) What is the firm's profit-maximizing output level?
b) Given your answer to part a, what is the firm's total profit?
c) Diagram your answers to parts A and B.

Q2. R.K Enterprises is a small firm in the steel office chairs industry, which is perfectly competitive. The market price of each chair is Rs 640. The cost function of the firm is

$$TC=240Q - 20Q^2 + Q^3$$

a) What is the profit maximizing output?
b) What is the average cost when output level is 20 units?
c) What is the profit earned by firm if the output sold in the market is 20 units?
d) Suppose the local govt. imposes a specific tax of Rs 325 per chair on the R.K.Enterprises. What is the profit maximizing output?
e) After imposition of Rs 325 per chair as tax on R.K.Enterprises if firm is producing 15 units, what are the profits earned by R.K.Enterprises?

Q3. Hale and Hearty Limited (HH) is a small distributor of B&Q Food stores, Inc., in the highly competitive health care products industry. The market-determined price of a 100-tablet vial of HH's most successful product, papaya extract, is \$10. HH's total cost (TC) function is given as

$$TC = 100 + 2Q + 0.01Q^2$$

a) What is the firm's profit-maximizing level of output? What is the firm's profit at the profit-maximizing output level? Is HH in short-run or long-run competitive equilibrium? Explain.
b) At P = \$10, what is HH's break-even output level?
c) What is HH's long-run break-even price and output level?
d) What is HH's shutdown price and output level?

Solutions:

Q1.

a. The profit-maximizing condition for a firm in a perfectly competitive industry is

$$P_0 = MC$$

The firm's marginal cost equation is

$$MC = \frac{dTC}{dQ} = 5 + 0.04Q$$

Substituting these results into the profit-maximizing condition yields

$$10 = 5 + 0.04Q$$

$$0.04Q = 5$$

$$Q^* = 125$$

b. The perfectly competitive firm's profit at P^* = \$10 and Q^* = 125 is

$$\begin{aligned}\pi^* &= TR - TC \\ &= P^*Q^* - (100 + 5Q^* + 0.02Q^{*2}) \\ &= 10(125) - \left[100 + 5(125) + 0.02(125)^2\right] \\ &= 1{,}250 - 1{,}037.50 = \$212.50\end{aligned}$$

c. Figure 8.3 diagrams the answers to parts a and b.

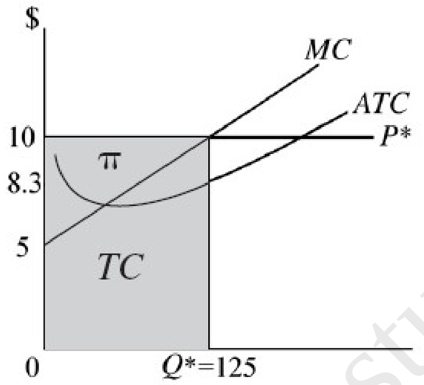


FIGURE 8.3 Diagrammatic solution to problem 8.4.

Q2.

(a) Profit Maximising output when MR=MC
In perfect Competition MR=P
Therefore $640 = 240 - 40Q + 3Q^2$
Q= 20 or -6.67

(b) $AC = 240 - 20Q + Q^2$
Rs 240

(c) Profit $=(640*20)-[(240*20)-(20*(20)^2+(20))]$
= Rs 8000

(d) $TC = 240Q - 20Q^2 + Q^3 + 325Q$
$MC = 565 - 40Q + 3Q^2$
Profit Maximising output P=MC
$640 = 565 - 40Q + 3Q^2$
Q= 15 or -1.67

(e) TR = 640 * 15= Rs 9600
TC = 7350
Profit= Rs 2250

Q3. (a)

$$\pi = TR - TC = PQ - TC = 10Q - (100 + 2Q + 0.01Q^2)$$
$$= -100 + 8Q - 0.01Q^2$$

$$\frac{d\pi}{dQ} = 8 - 0.02Q = 0$$

$$Q^* = 400$$

$$\pi^* = -100 + 8(400) - 0.01(400)^2 = -100 + 3,200 - 1,600 = \$1,500$$

HH is in short-run equilbrium.

b. The break-even condition is defined as

$$TR = TC$$

Substituting into this definition gives

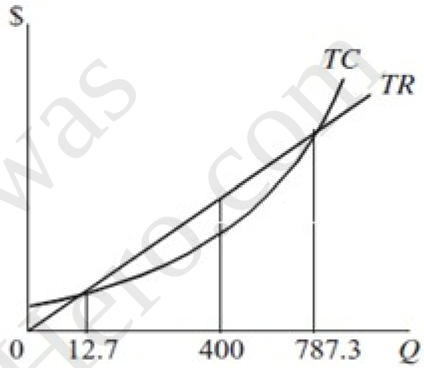
$$10Q = 100 + 2Q + 0.01Q^2$$
$$100 - 8Q + 0.01Q^2 = 0$$

This equation, which has two solution values, is of the general form

$$aQ^2 + bQ + c = 0$$

The solution values may be determined by factoring this equation, or by applying the quadratic formula, which is given as

$$Q_{1,2} = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$
$$= \frac{-(-8) \pm \sqrt{\left[(-8)^2 - 4(0.01)(100)\right]}}{2(0.01)}$$
$$= \frac{8 \pm \sqrt{(64-4)}}{0.02} = \frac{8 \pm 7.746}{0.02}$$
$$Q_1 = \frac{8 + 7.746}{0.02} = 787.3$$
$$Q_2 = \frac{8 - 7.746}{0.02} = 12.7$$



c. In long –run equilibrum, P = ATC min

ATC is given by the expression

$$ATC = \frac{TC}{Q} = \frac{100 + 2Q + 0.01Q^2}{Q} = 100Q^{-1} + 2 + 0.01Q$$

Minimizing this expression yields

$$\frac{dATC}{dQ} = -100Q^{-2} + 0.01 = 0$$

which is a first-order condition for a local minimum.

$$0.01Q^2 = 100$$
$$Q^2 = 10,000$$
$$Q_{be} = 100$$

$$P_{be} = ATC_{min} = 100Q^{-1} + 2 + 0.01Q = \frac{100}{100} + 2 + 0.01(100) = 4$$

d. Firm Shutdown price, P = AVC min

$$AVC = \frac{TVC}{Q} = \frac{2Q + 0.01Q^2}{Q} = 2 + 0.01Q$$

Since this expression is linear, AVC is minimized where $Q_{sd} = 0$. Substituting this result into the preceding condition we get

$$P_{sd} = AVC_{min} = 2 + 0.01Q = 2 + 0.01(0) = \$2$$