Problem 1 page 43

a) Setting inverse demand function equal to the inverse supply function, we obtain the equilibrium quantity. The inverse demand function is

\[ P = 1000 - 0.025Q, \]

and the inverse supply is

\[ P = 150 + 0.033Q. \]

Thus

\[ 1000 - 0.025Q = 150 + 0.033Q \]
\[ Q = 14655.172 \]

The price is found by substituting \( Q \) into the inverse demand or supply equation

\[ P = 1000 - 0.025 \times 14655.172 \]
\[ P = 633.6207 \]

b)

\[ CS = \frac{1}{2}(1000 - 633.6207)(14655.172) = \frac{536935.16}{2} = 2684675.83 \]
\[ PS = \frac{1}{2}(633.6207 - 150)(14655.172) = \frac{7087544.5}{2} = 3543772.27 \]

Problem 2 pages 43

Before forming the supply association, the industry price is given by \( P^c = MC \). The quantity supplied is \( Q^c \) where price equal to MC. here are no profits and consumer surplus is equal to the area \( adP^c \). After forming the association and restricting supply, the price rises to \( P^M \). The quantity is \( Q^M \). Producers now have profits equal to the area \( P^c cbP^M \) while CS falls to \( abP^M \). The deadweight loss is equal to the area \( bcd \).

Problem 3 pages 43

a) We set price equal to MC for any of the firms to obtain

\[ MC = 4q + 2 = P \]
\[ 4q = P - 2 \]
\[ q = \frac{P - 2}{4} \]
Figure 1:
b) Because they are 100 identical firms, we can simply multiply the supply curve in part a by 100 as follows to obtain the supply equation

\[ Q = 100q \]
\[ Q = 100(\frac{P - 2}{4}) \]
\[ 25P - 50 \]

We then solve this equation for \( P \) as a function of \( Q \) to get inverse supply

\[ Q = 25P - 50 \]
\[ Q + 50 = 25P \]
\[ P = \frac{Q}{25} + 2 \]

Problem 4 pages 43

a) First find the inverse demand function by solving the demand equation for \( P \) as a function of \( Q \)

\[ Q = 1000 - 50Q \]
\[ P = 20 - \frac{Q}{50} \]

Then set this equal to MC to find the competitive solution. This will give

\[ P = MC \]
\[ 20 - \frac{Q}{50} = 10 \]
\[ \frac{Q}{50} = 10 \]
\[ Q = 500 \]

\[ P = 20 - \frac{500}{50} \]
\[ P = 10 \]

Under monopoly we set MR equal to MC. We find MR by finding TR first and taking the derivative with respect to \( Q \).

\[ P = 20 - \frac{Q}{50} \]
\[ TR = PQ = (20 - \frac{Q}{50})Q \]
\[ MR = 20 - \frac{2}{50}Q \]

Setting this equal to MC we obtain

\[ MR = MC \]
\[ 20 - \frac{2}{50}Q = 10 \]
\[ Q = 250 \]
\[ P = 20 - \frac{250}{50} \]
\[ P = 15 \]
b) First compute the elasticity for the competitive case where \( Q = 500 \) and \( P = 10 \).

\[
\varepsilon = -\frac{P}{Q}Q'(P)
\]
\[
= -\frac{10}{500}(-50)
\]
\[
= 1
\]

Then compute the elasticity for the monopoly case when \( Q = 250 \) and \( P = 15 \)

\[
\varepsilon = -\frac{P}{Q}Q'(P)
\]
\[
= -\frac{15}{250}(-50)
\]
\[
= 3
\]

c) The monopoly price is \( P = 15 \). MC for the firm is \( MC = 10 \). So we obtain

\[
\frac{P - MC}{P} = \frac{15 - 10}{15} = \frac{1}{3}
\]

and

\[
\frac{1}{\varepsilon} = \frac{1}{3}
\]

Problem 5 page 44

a) To find the competitive quantity we set price equal to MC and solve for \( Q \) as follows.

\[
P = MC
\]
\[
3 - \frac{Q}{16000} = 1
\]
\[
Q = 32000
\]

We obtain price by substituting the competitive quantity in the inverse demand function.

\[
P = 3 - \frac{Q}{16000}
\]
\[
P = 3 - \frac{32000}{16000} = 1
\]

Or we could simply note that with \( P = MC \), price must be equal to 1, and then substitute this in the inverse demand equation and solve for \( Q \).

b) With an inverse demand of \( P = 3 - Q/16000 \), MR is given by \( MR = 3 - Q/8000 \). Setting this equal to MC will yield the monopoly value of \( Q \).

\[
MR = MC
\]
\[
3 - \frac{Q}{8000} = 1
\]
\[
Q = 16000
\]

Solving for price we obtain

\[
P = 3 - \frac{Q}{16000} = 2
\]
c) See the following graph.

The competitive industry has no profits and so producer surplus is 0. CS is given by the triangle that starts at 1, proceeds over to c, and then angles up to 3.

\[ CS = \frac{1}{2}(32000)(2) = 32000 \]

With a monopoly a CS is given by the triangle that starts at 2, proceeds over to a and then angles up to 3.

\[ CS = \frac{1}{2}(16000)(1) = 8000 \]

Profit or producer surplus for the monopolist are given by the rectangle beginning at 1, proceeding over to b, up to a and then back over to 2.

\[ PS = 16000 \]

So total surplus with monopoly is 24000. The loss from monopoly is then 32000-24000=8000.

One can also compute the area of the DWL triangle abc.