1. Demand curve is \( p = 100 - 2Q \), and short-run total cost function \( c(Q) = 640 + 20Q \). Thus, \( MC = 20 \), \( AC(Q) = \frac{640 + 20Q}{Q} = \frac{640}{Q} + 20 \) and \( MR = 100 - 4Q \). The monopolist chooses \( Q \) such that \( MR = MC \), i.e., \( 100 - 4Q = 20 \), and thus the profit-maximizing level of output is \( Q^m = 20 \). The monopoly price is \( p^m = 60 \). The profit is

\[
\pi = p^m Q^m - c(Q^m) = 60 \times 20 - 640 - 20 \times 20 = 160
\]

2. To get the profit maximizing output and price levels, set marginal cost equal to marginal revenue in each market and solve.

\[
MR_1 = 50 - 2Q_1 = MC = 10 \\
Q_1^m = 20 \text{ and } p_1^m = 30
\]

\[
MR_2 = 60 - 1.33Q_2 = MC = 10 \\
Q_2^m = \frac{75}{2} = 37.5 \text{ and } p_2^m = 35
\]

3. Consider a monopolist that serves 2 groups of consumers. The marginal cost of production is 1.

a. Group 1 has an inverse demand function \( p_1 = 10 - q_1 \) thus

\[
MR_1 = MC \\
10 - 2q_1 = 1 \\
q_1^m = 4.5 \\
p_1^m = 5.5
\]
Group 2 has a demand $p_2 = 5 - \frac{1}{2}q_2$

\[
MR_2 = MC \\
5 - q_2 = 1 \\
q_2^m = 4 \\
p_2^m = 3
\]

b. Consumers’ surplus, producer’ surplus, total welfare.

\[
CS_1 = \frac{10 - 5.5}{2} \times 4.5 = 10.125 \\
PS_1 = (5.5 - 1) \times 4.5 = 20.25 \\
W_1 = 10.125 + 20.25 = 30.375 \\
CS_1 = \frac{5 - 3}{2} \times 4 = 4 \\
PS_2 = (3 - 1) \times 4 = 8 \\
W_2 = 4 + 8 = 12
\]

c. No price discrimination, aggregate demand is

\[
Q = \begin{cases} 
20 - 3p & \text{if } 0 < p < 5 \\
10 - p & \text{if } 5 \leq p < 10
\end{cases}
\]

and

\[
MR = \frac{20}{3} - \frac{2}{3}Q = 1 \\
Q^m = \frac{17}{2} = 8.5 \\
p^m = \frac{20}{3} - \frac{117}{3} = 3.833
\]

And

\[
CS = \frac{10 - 5}{2} \times 5 + (5 - 3.8) \times 5 + \frac{5 - 3.8}{2} \times (8.5 - 5) = 20.6 \\
PS = (3.8 - 1) \times 8.5 = 23.8 \\
W = 20.6 + 23.8 = 44.4 > W_1 + W_2 = 30.375 + 12 = 42.375
\]

4. Perloff, Third edition, question 5 page 385

See Figure 1. The values of price and quantity depend on the demand curve drawn by the student. Profits are area abcd and the deadweight loss is area bef.

5. Perloff, Third edition, problem 18 page 386

Set $MC = MR$ and solve.
Figure 1: Figure 1

\[ MR = 100 - 2Q \]
\[ MC = 5 \]
\[ 5 = 100 - 2Q \]
\[ Q^* = 47.5 \]
\[ p^* = 52.5 \]
\[ \pi = 2493.75 - 247.50 = $2,246.25 \]

Because the only change is an increase in fixed costs, there is no change in the profit-maximizing output level or price. The only change is a reduction in profit by $90 to $2,156.25.

7. Perloff, Third edition, problem 20 page 420
Set marginal revenue in each market equal to marginal cost to determine the quantities. Plug the quantities into the demand functions to determine prices.

\[ MR_1 = 100 - 2Q_1 = 30 = MC \]
\[ MR_2 = 120 - 4Q_2 = 30 = MC \]
\[ Q_1 = 35; \; p_1 = 65 \]
\[ Q_2 = 22.5; \; p_2 = 75 \]