1. Demand curve is \( p = 100 - 2Q \), and short-run total cost function \( c(Q) = 640 + 20Q \). Thus, \( MC = 20 \), \( AC(Q) = \frac{640 + 20Q}{Q} = 640Q + 20 \) 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

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

2. Perloff, fourth edition: problem 38 page 304
   a) With a price ceiling, the equilibrium will be \( p = 3 \) and \( q = 30 \).
   b) The consumer surplus increases by

\[
\frac{2 \times 30}{2} - \frac{2 \times (50 - 30)}{2} = 40,
\]

producer surplus decreases by

\[
\frac{2(50 + 30)}{2} = 80.
\]

So the social deadweight loss is 40.

3. Perloff, fourth edition: question 2 page 380
   The effect of a franchise tax or lump sum on a monopoly is to reduce profits by the amount of the tax. Because there is no change in marginal cost, the profit-maximizing/loss-minimizing output
and price remain unchanged, with one exception. If the tax is large enough, losses may exceed fixed costs. If that is the case, the firm will shut down (produce no output) in order to minimize losses.

Set $MR = MC$ and solve

\[
\begin{align*}
MR &= 100 - 2Q \\
MC &= 5 \\
5 &= 100 - 2Q \\
Q^* &= 47.5 \\
p^* &= 52.5 \\
\Pi &= 2493.75 - 247.5 = \$2246.25
\end{align*}
\]

Set $MR = MC$ and solve

\[
\begin{align*}
MR &= 5Q^{0.5} \\
MC &= 5 \\
Q^* &= 1 \\
p &= 10 \\
\Pi &= 10 - 5 = \$5
\end{align*}
\]

a) If the consumer cannot steal music, the total demand function will be

\[
p = 120 - \frac{Q}{2}.
\]

The monopoly will set $MR = 120 - Q = MC = 20$, such that $Q = 100$ and $p = 70$. Consumer surplus will be $\frac{120-70}{2} \times 100 = 2500$, producer surplus will be $(70 - 20)100 = 5000$ and DWL will be $\frac{70-20}{2} \times 100 = 2500$.

b) If the dishonest customer can steal music, the total demand function will be

\[
p = 120 - Q.
\]

The monopoly will set $MR = 120 - 2Q = MC = 20$, such that $Q = 50$ and $p = 70$. Consumer surplus will be $\frac{120-70}{2} \times 50 = 1250$, producer surplus will be $(70 - 20)50 = 2500$ and DWL will be $\frac{70-20}{2} \times 50 = 1250$.

c) When dishonest consumers can pirate the music, consumer surplus decreases by 1250 (2500-1250), producer surplus decreases by 2500 (5000-2500) and DWL decreases by 1250 (2500-1250).