Chapter 4: Equilibrium

Question 1

We have \( Q^D = 4000 - 10p \) and \( Q^S = 20p - 2000 \). To solve for the market equilibrium:

\[
Q^D = Q^S \\
4000 - 10p = 20p - 2000 \\
30p = 6000 \\
p^* = \$200 \\
Q^* = 4000 - 10(200) = 20(200) - 2000 = 2000 \text{ security systems.}
\]

Now, at the equilibrium point, we have the following price elasticities of demand and supply:

\[
\varepsilon = \left( \frac{\partial Q^D}{\partial p} \right) \left( \frac{p}{Q} \right) = -10 \left( \frac{200}{2000} \right) = -1 \quad \text{and} \quad \eta = \left( \frac{\partial Q^S}{\partial p} \right) \left( \frac{p}{Q} \right) = 20 \left( \frac{200}{2000} \right) = 2.
\]

Question 2

We have \( p = 10000 - 20Q^D \) and \( p = 2000 + 5Q^S \). To solve for the market equilibrium:

\[
10000 - 20Q = 2000 + 5Q \\
25Q = 8000 \\
Q^* = 320 \\
p^* = 10000 - 20(320) = 2000 + 5(320) = \$3600.
\]

Solving for the demand and supply function yields \( Q^D = 500 - 0.05p \) and \( Q^S = 0.2p - 400 \). Therefore, at the equilibrium point, we have the following price elasticities of demand and supply:

\[
\varepsilon = \left( \frac{\partial Q^D}{\partial p} \right) \left( \frac{p}{Q} \right) = -0.05 \left( \frac{3600}{320} \right) = -0.5625 \quad \text{and} \quad \eta = \left( \frac{\partial Q^S}{\partial p} \right) \left( \frac{p}{Q} \right) = 0.2 \left( \frac{3600}{320} \right) = 2.25.
\]
Question 3

(a) Solve for the inverse demand curve:

\[ Q^D = 2,500 - 50p \]
\[ 50p = 2,500 - Q^D \]
\[ p = 50 - \frac{Q^D}{50} \]

Solve for the inverse supply curve:

\[ Q^S = 150p - 300 \]
\[ 150p = 300 + Q^S \]
\[ p = 2 + \frac{Q^S}{150} \]

(b) Solve for the equilibrium:

\[ Q^D = Q^S \]
\[ 2,500 - 50p = 150p - 300 \]
\[ 200p = 2,800 \]
\[ p^* = \$14 \]
\[ Q^* = 2,500 - 50(14) = 150(14) - 300 = 1,800 \text{ CDs.} \]

(c) i. A $16 price floor is binding as $16 > p^* = $14. Therefore 2,500 – 50(16) = 1,700 CDs are demanded while 150(16) – 300 = 2,100 CDs are supplied under a $16 price floor.

ii. A $16 price ceiling is not binding as $16 > p^* = $14. Therefore 1,800 CDs are supplied and demanded at the non-binding $16 price ceiling as price remains $14.

iii. A $10 price floor is not binding as $10 < p^* = $14. Therefore 1,800 CDs are supplied at demanded at the non-binding $10 price floor as price remains $14.

iv. A $10 price ceiling is binding as $10 < p^* = $14. Therefore 2,500 – 50(10) = 2,000 CDs are demanded while 150(10) – 300 = 1,200 CDs are supplied under a $10 price ceiling.

(d) CDs are a normal good, because when income increased, the demand curve shifted out as the intercept increased from 2,500 to 2,900 and the slope coefficient (-50) didn’t change. The new equilibrium is

\[ 2,900 - 50p = 150p - 300 \]
\[ 200p = 3,200 \]
\[ p^* = \$16 \]
\[ Q^* = 2,900 - 50(16) = 150(16) - 300 = 2,100 \text{ CDs.} \]
Question 4

We know that the change in price following the tax will be

$$\Delta p = \left(\frac{\eta}{\eta - \epsilon}\right) \times tax = \left(\frac{1.8}{1.8 + 0.6}\right)(4) = 0.75 \times 4 = $3.00.$$ 

Therefore consumers bear $3 of the $4 tax (or 75% of the tax), and the new price for each bag of dog food will be $14 + $3 = $17.

Question 5

(a) Following an excise tax, the quantity will always fall (as consumers respond with lower quantity demand) as the price increases unless demand is perfectly inelastic. If demand is perfectly inelastic, then consumers will not decrease their quantity demanded even when the price increases. The only other possibility is that quantity will not change if supply is perfectly inelastic.

(b) If demand is perfectly inelastic, the new price will equal the old price plus the full amount of the tax. Thus, the new price of a taxi ride will equal the old price plus $2. If supply is perfectly inelastic, the new price paid by consumers is the same price as they originally paid. Of course, taxi drivers receive net $2 less per ride after they pay the tax.

Question 6

The problem tells us that demand for beef does not change because consumers remain confident in the food supply when the test is in place. The test, however, does cost $500 per cow, which increases the (marginal) cost of producing beef. Therefore, marginal costs increase, which means that the supply curve shifts in. As a result, the equilibrium price of beef increases and the equilibrium quantity of beef decreases. See the graph below.

**Market for Beef**
Question 7

(a) When the price of tacos, a substitute for hamburgers, falls, the demand for hamburgers decreases. The price of tacos has no effect on the supply of hamburgers. As a result, the equilibrium price of hamburgers decreases and the equilibrium quantity of hamburgers decreases. See the graph below.

(b) When the price of cattle feed, an input into the production of hamburger, increases, the demand for hamburger is left unchanged, but the supply of hamburger decreases as the production costs have increased. As a result, the equilibrium price of hamburgers increases and the equilibrium quantity of hamburgers decreases. See the graph below.
(c) Assuming hamburgers are a normal good, when non-labor income increases, the demand for hamburgers increases. Income has no effect on the supply of hamburgers. As a result, the equilibrium price of hamburgers increases and the equilibrium quantity of hamburgers increases. See the graph below.

![Market for Hamburgers](image)

**Question 8**

The problem focuses on the fact that Hurricane Katrina damaged 25% of U.S. refineries. This makes refining oil into gas more expensive, and therefore the marginal cost of making gasoline increases, which means that the supply of gasoline will shift in. As a result, the equilibrium price of gasoline increases and the equilibrium quantity of gas decreases. See the graph below.

![Market for Gasoline](image)
Question 9

A. Chapter 11 Bankruptcy, as the problem stipulates, allows existing firms to lower their costs while remaining in business. In essence, Chapter 11 bankruptcy allows the supply curve to shift out. As a result, the equilibrium price of air travel will fall while the equilibrium quantity of air travel will increase following increased use of Chapter 11.

![Market for Air Travel](image1)

B. In contrast to Chapter 11, Chapter 7 Bankruptcy dissolves the firm. If bankrupt airlines had to file for Chapter 7 bankruptcy, the supply curve would actually shift in as there would be fewer firms to supply air travel. This would cause the equilibrium price of air travel to increase and for the equilibrium quantity of air travel to fall.

![Market for Air Travel](image2)

C. If the problem with the airline industry is that there is too much capacity and prices are too low, then only allowing Chapter 7 bankruptcies would be better for the industry as Chapter 7, not Chapter 11, facilitates higher prices and lower capacity.
**Question 10**

Malpractice premiums are a cost of providing medical services. Therefore, when premiums increase due to frivolous lawsuits, the price of medical services must increase (and the quantity of medical services demanded will fall).

![Market for Air Medical Services](image)

**Question 11**

The problem tells us two important things: (1) almost everyone buys cable service before the tax, and (2) almost everyone buys cable service after the tax. This implies that demand for cable services is very inelastic. As demand is relatively inelastic to supply, the $5 tax will be born largely by consumers, leaving very little to be paid by Comcast itself. Therefore, even though tax revenue is $4 million, this revenue is generated largely from consumers, not Comcast, so we would not expect Comcast’s profits to have fallen by very much, and certainly not by $4 million.
Question 12

We have that inverse demand is \( p = 40 - 0.5Q^D \) and inverse supply is \( p = 10 + 2Q^S \).

A. Solve for the equilibrium:

\[
\begin{align*}
p &= p \\
40 - 0.5Q &= 10 + 2Q \\
2.5Q &= 30 \\
Q^* &= 12 \\
p^* &= 40 - 0.5(12) = 10 + 2(12) = 34.
\end{align*}
\]

B. In order to calculate elasticities, notice that \( Q^D = 80 - 2p \) and \( Q^S = 0.5p - 5 \). From here we see that \( \partial Q^D / \partial p = -2 \) and \( \partial Q^S / \partial p = 0.5 \), and we can calculate both elasticities directly:

\[
e = \left( \frac{\partial Q^D}{\partial p} \right) \left( \frac{p}{Q^D} \right) = -2 \left( \frac{34}{12} \right) = \frac{-68}{12}
\]

and

\[
\eta = \left( \frac{\partial Q^S}{\partial p} \right) \left( \frac{p}{Q^S} \right) = 0.5 \left( \frac{34}{12} \right) = \frac{17}{12}.
\]

C. If the government levies a $5 excise tax, then

\[
\frac{\Delta p}{\Delta t} = \frac{\eta}{\eta - e} = \frac{17}{12} - \frac{68}{12} = \frac{17}{85} = 0.20.
\]

Therefore, the new price paid by consumers is $34 + $5(17/85) = $35, and the new price received by firms is $35 - $5 = $30. Finally notice that when the consumers’ price is $35, 80 - 2($35) = 10 units are demanded. Likewise, when the firms’ price is $30, 0.5($30) - 5 = 10 units are supplied. Therefore, tax revenue is $5 \times 10 = $50.

D. For any excise tax, consumers pay \( 17/85 = 20\% \) of the tax, while firms pay \( 68/85 = 80\% \) of the tax.
Question 13

We have $Q^D = 900 - 50p$ and $Q^S = 100p - 300$.

A. To solve for the inverse demand equation:

$$Q^D = 900 - 50p$$
$$50p = 900 - Q^D$$
$$p = 18 - 0.02Q^D.$$

To solve for the inverse supply equation:

$$Q^S = 100p - 300$$
$$100p = Q^S + 300$$
$$p = 0.01Q^S + 3.$$

B. To solve for the market equilibrium:

$$Q^D = Q^S$$
$$900 - 50p = 100p - 300$$
$$150p = 1,200$$
$$p^* = 8$$

$Q^* = 900 - 50(8) = 100(8) - 300 = 500$ pizzas.

C. At the equilibrium point, we have the following price elasticities of demand and supply:

$$\varepsilon = \left( \frac{\partial Q^D}{\partial p} \right) \left( \frac{p}{Q} \right) = (-50) \left( \frac{8}{500} \right) = -0.8$$

and

$$\eta = \left( \frac{\partial Q^S}{\partial p} \right) \left( \frac{p}{Q} \right) = (100) \left( \frac{8}{500} \right) = 1.6.$$

D. If the government levies a $3 excise tax, then

$$\frac{\Delta p}{\Delta t} = \frac{\eta}{\eta - \varepsilon} = \frac{1.6}{1.6 - (-0.8)} = \frac{1.6}{2.4} = \frac{2}{3}.$$

Thus, consumers pay $(2/3) \times 3 = 2$ of the tax, and price increases from $8 to $10. At $10 per pizza, $900 - 50(10) = 400$ pizzas are sold in equilibrium. Therefore, tax revenue equals $3 \times 400 = 1,200$.

E. From the work above, we know that consumers pay two-thirds of any tax, leaving firms to pay one-third (or 33%) of any tax.

F. As mentioned above, consumers pay $10 for a pizza after the $3 tax is imposed.