Answers to selected “Problems and Applications” Questions in Mankiw

Chapter 1:

4) If you spend $100 now instead of saving it for a year and earning 5 percent interest, you are giving up the opportunity to spend $105 a year from now. The idea that money has a time value is the basis for the field of finance, the subfield of economics that has to do with prices of financial instruments like stocks and bonds.

5) The fact that you've already sunk $5 million isn't relevant to your decision anymore, since that money is gone. What matters now is the chance to earn profits at the margin. If you spend another $1 million and can generate sales of $3 million, you'll earn $2 million in marginal profit, so you should do so. You are right to think that the project has lost a total of $3 million ($6 million in costs and only $3 million in revenue) and you shouldn't have started it. That's true, but if you don't spend the additional $1 million, you won't have any sales and your losses will be $5 million. So what matters is not the total profit, but the profit you can earn at the margin. In fact, you'd pay up to $3 million to complete development; any more than that, and you won't be increasing profit at the margin.

Chapter 2:

4) a. Figure 1 shows a production possibilities frontier between guns and butter. It is bowed out because when most of the economy’s resources are being used to produce butter, the frontier is steep and when most of the economy’s resources are being used to produce guns, the frontier is very flat. When the economy is producing a lot of guns, workers and machines best suited to making butter are being used to make guns, so each unit of guns given up yields a large increase in the production of butter. Thus, the production possibilities frontier is flat. When the economy is producing a lot of butter, workers and machines best suited to making guns are being used to make butter, so each unit of guns given up yields a small increase in the production of butter. Thus, the production possibilities frontier is steep.
b. Point A is impossible for the economy to achieve; it is outside the production possibilities frontier. Point B is feasible but inefficient because it’s inside the production possibilities frontier.

c. The Hawks might choose a point like H, with many guns and not much butter. The Doves might choose a point like D, with a lot of butter and few guns.

d. If both Hawks and Doves reduced their desired quantity of guns by the same amount, the Hawks would get a bigger peace dividend because the production possibilities frontier is much steeper at point H than at point D. As a result, the reduction of a given number of guns, starting at point H, leads to a much larger increase in the quantity of butter produced than when starting at point D.
Chapter 3:

3)

a. 

<table>
<thead>
<tr>
<th></th>
<th>Workers needed to make:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One Car</td>
</tr>
<tr>
<td>U.S.</td>
<td>1/4</td>
</tr>
<tr>
<td>Japan</td>
<td>1/4</td>
</tr>
</tbody>
</table>

b. (See Figure below). With 100 million workers and four cars per worker, if either economy were devoted completely to cars, it could make 400 million cars. Since a U.S. worker can produce 10 tons of grain, if the United States produced only grain it would produce 1,000 million tons. Since a Japanese worker can produce 5 tons of grain, if Japan produced only grain it would produce 500 million tons. These are the intercepts of the production possibilities frontiers shown in the figure. Note that since the tradeoff between cars and grain is constant, the production possibilities frontier is a straight line.

c. Since a U.S. worker produces either 4 cars or 10 tons of grain, the opportunity cost of 1 car is $2\frac{1}{4}$ tons of grain, which is 10 divided by 4. Since a Japanese worker produces either 4 cars or 5 tons of grain, the opportunity cost of 1 car is $1\frac{1}{4}$ tons of grain.
grain, which is 5 divided by 4. Similarly, the U.S. opportunity cost of 1 ton of grain is 2/5 car (4 divided by 10) and the Japanese opportunity cost of 1 ton of grain is 4/5 car (4 divided by 5). This gives the following table:

<table>
<thead>
<tr>
<th>Opportunity Cost of:</th>
<th>U.S.</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Car (in terms of tons of grain given up)</td>
<td>2 1/2</td>
<td>1 1/4</td>
</tr>
<tr>
<td>1 Ton of Grain (in terms of cars given up)</td>
<td>2/5</td>
<td>4/5</td>
</tr>
</tbody>
</table>

d. Neither country has an absolute advantage in producing cars, since they're equally productive (the same output per worker); the United States has an absolute advantage in producing grain, since it is more productive (greater output per worker).

e. Japan has a comparative advantage in producing cars, since it has a lower opportunity cost in terms of grain given up. The United States has a comparative advantage in producing grain, since it has a lower opportunity cost in terms of cars given up.

f. With half the workers in each country producing each of the goods, the United States would produce 200 million cars (that is 50 million workers times 4 cars each) and 500 million tons of grain (50 million workers times 10 tons each). Japan would produce 200 million cars (50 million workers times 4 cars each) and 250 million tons of grain (50 million workers times 5 tons each).

g. From any situation with no trade, in which each country is producing some cars and some grain, suppose the United States changed 1 worker from producing cars to producing grain. That worker would produce 4 fewer cars and 10 additional tons of grain. Then suppose the United States offers to trade 7 tons of grain to Japan for 4 cars. The United States will do this because it values 4 cars at 10 tons of grain, so it will be better off if the trade goes through. Suppose Japan changes 1 worker from producing grain to producing cars. That worker would produce 4 more cars and 5 fewer tons of grain. Japan will take the trade because it values 4 cars at 5 tons of grain, so it will be better off. With the trade and the change of 1 worker in both the United States and Japan, each country gets the same amount of cars as before and both
get additional tons of grain (3 for the United States and 2 for Japan). Thus by trading and changing their production, both countries are better off.

5)

a. Since a Canadian worker can make either two cars a year or 30 bushels of wheat, the opportunity cost of a car is 15 bushels of wheat. Similarly, the opportunity cost of a bushel of wheat is 1/15 of a car. The opportunity costs are the reciprocals of each other.

b. See Figure 4. If all 10 million workers produce two cars each, they produce a total of 20 million cars, which is the vertical intercept of the production possibilities frontier. If all 10 million workers produce 30 bushels of wheat each, they produce a total of 300 million bushels, which is the horizontal intercept of the production possibilities frontier. Since the tradeoff between cars and wheat is always the same, the production possibilities frontier is a straight line.

If Canada chooses to consume 10 million cars, it will need 5 million workers devoted to car production. That leaves 5 million workers to produce wheat, who will produce a total of 150 million bushels (5 million workers times 30 bushels per worker). This is shown as point A on Figure 4.

c. If the United States buys 10 million cars from Canada and Canada continues to consume 10 million cars, then Canada will need to produce a total of 20 million cars. So Canada will be producing at the vertical intercept of the production possibilities frontier. But if Canada gets 20 bushels of wheat per car, it will be able to consume 200 million bushels of wheat, along with the 10 million cars. This is shown as point B in the figure. Canada should accept the deal because it gets the same number of cars and 50 million more bushels of wheat.
10) 

a. True: two countries can achieve gains from trade even if one of the countries has an absolute advantage in the production of all goods. All that's necessary is that each country have a comparative advantage in some good.

b. False: it is not true that some people have a comparative advantage in everything they do. In fact, no one can have a comparative advantage in everything. Comparative advantage reflects the opportunity cost of one good or activity in terms of another. If you have a comparative advantage in one thing, you must have a comparative disadvantage in the other thing.

c. False: it is not true that if a trade is good for one person, it can't be good for the other one. Trades can and do benefit both sides—especially trades based on comparative advantage. If both sides didn't benefit, trades would never occur.
Chapter 4:

2) The statement that "an increase in the demand for notebooks raises the quantity of notebooks demanded, but not the quantity supplied," in general, is false. As Figure 1 shows, the increase in demand for notebooks results in an increased quantity supplied. The only way the statement would be true is if the supply curve was a vertical line, as shown in Figure 2.
4) Technological advances that reduce the cost of producing computer chips represent a decline in an input price for producing a computer. The result is a shift to the right in the supply of computers, as shown in Figure 3. The equilibrium price falls and the equilibrium quantity rises, as the figure shows.

Since computer software is a complement to computers, the lower equilibrium price of computers increases the demand for software. As Figure 4 shows, the result is a rise in both the equilibrium price and quantity of software.
Since typewriters are substitutes for computers, the lower equilibrium price of computers reduces the demand for typewriters. As Figure 5 shows, the result is a decline in both the equilibrium price and quantity of typewriters.
8)

a. Cigars and chewing tobacco are substitutes for cigarettes, since a higher price for cigarettes would increase the demand for cigars and chewing tobacco.

b. An increase in the tax on cigarettes leads to increased demand for cigars and chewing tobacco. The result, as shown in Figure 25 for cigars, is a rise in both the equilibrium price and quantity of cigars and chewing tobacco.

c. The results in part (b) showed that a tax on cigarettes leads people to substitute cigars and chewing tobacco for cigarettes when the tax on cigarettes rises. To reduce total tobacco usage, policymakers might also want to increase the tax on cigars and chewing tobacco, or pursue some type of public education program.

11)

a. As Figure 6 shows, the supply curve is vertical. The constant quantity supplied makes sense because the basketball arena has a fixed number of seats no matter what the price.
b. Quantity supplied equals quantity demanded at a price of $8. The equilibrium quantity is 8,000 tickets.

c.

<table>
<thead>
<tr>
<th>Price</th>
<th>Quantity Demanded</th>
<th>Quantity Supplied</th>
</tr>
</thead>
<tbody>
<tr>
<td>$4</td>
<td>14,000</td>
<td>8,000</td>
</tr>
<tr>
<td>8</td>
<td>11,000</td>
<td>8,000</td>
</tr>
<tr>
<td>12</td>
<td>8,000</td>
<td>8,000</td>
</tr>
<tr>
<td>16</td>
<td>5,000</td>
<td>8,000</td>
</tr>
<tr>
<td>20</td>
<td>2,000</td>
<td>8,000</td>
</tr>
</tbody>
</table>

The new equilibrium price will be $12, which equates quantity demanded to quantity supplied. The equilibrium quantity is 8,000 tickets.

13) Equilibrium occurs where quantity demanded is equal to quantity supplied. Thus:

\[ Q^d = Q^s \]

\[ 1,600 - 300P = 1,400 + 700P \]

\[ 200 = 1,000P \]

\[ P = $0.20 \]

\[ Q^d = 1,600 - 300(0.20) = 1,600 - 60 = 1,540 \]

\[ Q^s = 1,400 + 700(0.20) = 1,400 + 140 = 1,540. \]

The equilibrium price of a chocolate bar is $0.20 and the equilibrium quantity is 1,540 bars.
Chapter 5:

2)  
   a. For business travelers, the price elasticity of demand when the price of tickets rises from $200 to $250 is \[
   \frac{(2,000 - 1,900)/1,950}{(250 - 200)/225} = 0.05/0.22 = 0.23. \]
   For vacationers, the price elasticity of demand when the price of tickets rises from $200 to $250 is \[
   \frac{(800 - 600)/700}{(250 - 200)/225} = 0.29/0.22 = 1.32. \]
   b. The price elasticity of demand for vacationers is higher than the elasticity for business travelers because vacationers can choose more easily a different mode of transportation (like driving or taking the train). Business travelers are less likely to do so since time is more important to them and their schedules are less adaptable.

3)  
   a. If your income is $10,000, your price elasticity of demand as the price of compact discs rises from $8 to $10 is \[
   \frac{(40 - 32)/36}{(10 - 8)/9} = 0.22/0.22 = 1. \]
   If your income is $12,000, the elasticity is \[
   \frac{(50 - 45)/47.5}{(10 - 8)/9} = 0.11/0.22 = 0.5. \]
   b. If the price is $12, your income elasticity of demand as your income increases from $10,000 to $12,000 is \[
   \frac{(30 - 24)/27}{(12,000 - 10,000)/11,000} = 0.22/0.18 = 1.22. \]
   If the price is $16, your income elasticity of demand as your income increases from $10,000 to $12,000 is \[
   \frac{(12 - 8)/10}{(12,000 - 10,000)/11,000} = 0.40/0.18 = 2.2. \]

5)  
   a. With a 4.3 percent decline in quantity following a 20 percent increase in price, the price elasticity of demand is only 4.3/20 = 0.215, which is fairly inelastic.
   
   b. With inelastic demand, the Transit Authority’s revenue rises when the fare rises.
   
   c. The elasticity estimate might be unreliable because it is only the first month after the fare increase. As time goes by, people may switch to other means of transportation in response to the price increase. So the elasticity may be larger in the long run than it is in the short run.
6) Tom's price elasticity of demand is zero, since he wants the same quantity regardless of the price. Jerry's price elasticity of demand is one, since he spends the same amount on gas, no matter what the price, which means his percentage change in quantity is equal to the percentage change in price.

7) To explain the fact that spending on restaurant meals declines more during economic downturns than does spending on food to be eaten at home, economists look at the income elasticity of demand. In economic downturns, people have lower income. To explain the fact, the income elasticity of restaurant meals must be larger than the income elasticity of spending on food to be eaten at home.

8) a. With a price elasticity of demand of 0.4, reducing the quantity demanded of cigarettes by 20 percent requires a 50 percent increase in price, since \( \frac{20}{50} = 0.4 \). With the price of cigarettes currently $2, this would require an increase in the price to $3.33 a pack using the midpoint method (note that \( \frac{3.33 - 2}{2.67} = .50 \)).

b. The policy will have a larger effect five years from now than it does one year from now. The elasticity is larger in the long run, since it may take some time for people to reduce their cigarette usage. The habit of smoking is hard to break in the short run.

c. Since teenagers don't have as much income as adults, they are likely to have a higher price elasticity of demand. Also, adults are more likely to be addicted to cigarettes, making it more difficult to reduce their quantity demanded in response to a higher price.

Chapter 6

4) a. Figure 4 shows the market for beer without the tax. The equilibrium price is \( P_1 \) and the equilibrium quantity is \( Q_1 \). The price paid by consumers is the same as the price received by producers.
b. When the tax is imposed, it drives a wedge of $2 between supply and demand, as shown in Figure 5. The price paid by consumers is $P_2$, while the price received by producers is $P_2 - $2. The quantity of beer sold declines to $Q_2$. 

Figure 4

Figure 5
5) Reducing the payroll tax paid by firms and using part of the extra revenue to reduce the payroll tax paid by workers would not make workers better off, because the division of the burden of a tax depends on the elasticity of supply and demand and not on who must pay the tax. Since the tax wedge would be larger, it is likely that both firms and workers, who share the burden of any tax, would be worse off.

6) If the government imposes a $500 tax on luxury cars, the price paid by consumers will rise less than $500, in general. The burden of any tax is shared by both producers and consumers—the price paid by consumers rises and the price received by producers falls, with the difference between the two equal to the amount of the tax. The only exceptions would be if the supply curve were perfectly elastic or the demand curve were perfectly inelastic, in which case consumers would bear the full burden of the tax and the price paid by consumers would rise by exactly $500.

7) a. It doesn’t matter whether the tax is imposed on producers or consumers—the effect will be the same. With no tax, as shown in Figure 6, the demand curve is D1 and the supply curve is S1. If the tax is imposed on producers, the supply curve shifts up by the amount of the tax (50 cents) to S2. Then the equilibrium quantity is Q2, the price paid by consumers is P2, and the price received (after taxes are paid) by producers is P2 – 50 cents. If the tax is instead imposed on consumers, the demand curve shifts down by the amount of the tax (50 cents) to D2. The downward shift in the demand curve (when the tax is imposed on consumers) is exactly the same magnitude as the upward shift in the supply curve when the tax is imposed on producers. So again, the equilibrium quantity is Q2, the price paid by consumers is P2 (including the tax paid to the government), and the price received by producers is P2 – 50 cents.
b. The more elastic is the demand curve, the more effective this tax will be in reducing the quantity of gasoline consumed. Greater elasticity of demand means that quantity falls more in response to the rise in the price of gasoline. Figure 7 illustrates this result. Demand curve D1 represents an elastic demand curve, while demand curve D2 is more inelastic. To get the same tax wedge between demand and supply requires a greater reduction in quantity with demand curve D1 than for demand curve D2.
c. The consumers of gasoline are hurt by the tax because they get less gasoline at a higher price.

d. Workers in the oil industry are hurt by the tax as well. With a lower quantity of gasoline being produced, some workers may lose their jobs. With a lower price received by producers, wages of workers might decline.

8)

a. Figure 8 shows the effects of the minimum wage. In the absence of the minimum wage, the market wage would be $w_1$ and $Q_1$ workers would be employed. With the minimum wage ($w_m$) imposed above $w_1$, the market wage is $w_m$, the number of employed workers is $Q_2$, and the number of workers who are unemployed is $Q_3 - Q_2$. Total wage payments to workers are shown as the area of rectangle ABCD, which equals $w_m$ times $Q_2$.

b. An increase in the minimum wage would decrease employment. The size of the effect on employment depends only on the elasticity of demand. The elasticity of supply doesn’t matter, because there’s a surplus of labor.
c. The increase in the minimum wage would increase unemployment. The size of the rise in unemployment depends on both the elasticities of supply and demand. The elasticity of demand determines the quantity of labor demanded, the elasticity of supply determines the quantity of labor supplied, and the difference between the quantity supplied and demanded of labor is the amount of unemployment.

d. If the demand for unskilled labor were inelastic, the rise in the minimum wage would increase total wage payments to unskilled labor. With inelastic demand, the percentage decline in employment would be less than the percentage increase in the wage, so total wage payments increase. However, if the demand for unskilled labor were elastic, total wage payments would decline, since then the percentage decline in employment would exceed the percentage increase in the wage.

11) a. The effect of a $0.50 per cone subsidy is to shift the demand curve up by $0.50 at each quantity, since at each quantity a consumer’s willingness to pay is $0.50 higher. The effects of such a subsidy are shown in Figure 14. Before the subsidy, the price is P1. After the subsidy, the price received by sellers is PS and the effective price paid by consumers is PD, which equals PS minus 50 cents. Before the subsidy, the quantity of cones sold is Q1; after the subsidy the quantity increases to Q2.
b. Because of the subsidy, consumers are better off, since they consume more at a lower price. Producers are also better off, since they sell more at a higher price. The government loses, since it has to pay for the subsidy.

Chapter 7:

1) If an early freeze in California sours the lemon crop, the supply curve for lemons shifts to the left, as shown in Figure 5. The result is a rise in the price of lemons and a decline in consumer surplus from A + B + C to just A. So consumer surplus declines by the amount B + C.

![Figure 5](image)

In the market for lemonade, the higher cost of lemons reduces the supply of lemonade, as shown in Figure 6. The result is a rise in the price of lemonade and a decline in consumer surplus from D + E + F to just D, a loss of E + F. Note that an event that affects consumer surplus in one market often has effects on consumer surplus in other markets.
2) A rise in the demand for French bread leads to an increase in producer surplus in the market for French bread, as shown in Figure 7. The shift of the demand curve leads to an increased price, which increases producer surplus from area $A$ to area $A + B + C$. 
The increased quantity of French bread being sold increases the demand for flour, as shown in Figure 8. As a result, the price of flour rises, increasing producer surplus from area D to D + E + F. Note that an event that affects producer surplus in one market leads to effects on producer surplus in related markets.

4) a. Ernie’s supply schedule for water is:

<table>
<thead>
<tr>
<th>Price</th>
<th>Quantity Supplied</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than $7</td>
<td>4</td>
</tr>
<tr>
<td>$5 to $7</td>
<td>3</td>
</tr>
<tr>
<td>$3 to $5</td>
<td>2</td>
</tr>
<tr>
<td>$1 to $3</td>
<td>1</td>
</tr>
<tr>
<td>Less than $1</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 8
Ernie’s supply curve is shown in Figure 10.

![Supply Curve Diagram]

**Figure 10**

b. When the price of a bottle of water is $4, Ernie sells two bottles of water. His producer surplus is shown as area A in the figure. He receives $4 for his first bottle of water, but it costs only $1 to produce, so Ernie has producer surplus of $3. He also receives $4 for his second bottle of water, which costs $3 to produce, so he has producer surplus of $1. Thus Ernie’s total producer surplus is $3 + $1 = $4, which is the area of A in the figure.

c. When the price of a bottle of water rises from $4 to $6, Ernie sells three bottles of water, an increase of one. His producer surplus consists of both areas A and B in the figure, an increase by the amount of area B. He gets producer surplus of $5 from the first bottle ($6 price minus $1 cost), $3 from the second bottle ($6 price minus $3 cost), and $1 from the third bottle ($6 price minus $5 price), for a total producer surplus of $9. Thus producer surplus rises by $5 (which is the size of area B) when the price of a bottle of water rises from $4 to $6.

6) a. The effect of falling production costs in the market for stereos results in a shift to the right in the supply curve, as shown in Figure 11. As a result, the equilibrium price of stereos declines and the equilibrium quantity increases.
b. The decline in the price of stereos increases consumer surplus from area A to \( A + B + C + D \), an increase in the amount \( B + C + D \). Prior to the shift in supply, producer surplus was areas \( B + E \) (the area above the supply curve and below the price). After the shift in supply, producer surplus is areas \( E + F + G \). So producer surplus changes by the amount \( F + G - B \), which may be positive or negative. The increase in quantity increases producer surplus, while the decline in the price reduces producer surplus. Since consumer surplus rises by \( B + C + D \) and producer surplus rises by \( F + G - B \), total surplus rises by \( C + D + F + G \).

c. If the supply of stereos is very elastic, then the shift of the supply curve benefits consumers most. To take the most dramatic case, suppose the supply curve were horizontal, as shown in Figure 12. Then there is no producer surplus at all. Consumers capture all the benefits of falling production costs, with consumer surplus rising from area A to area \( A + B \).

![Figure 11](image_url)
7) Figure 13 shows supply and demand curves for haircuts. Supply equals demand at a quantity of three haircuts and a price between $4 and $5. Firms A, C, and D should cut the hair of Riki, Jerry, and Montel. Oprah’s willingness to pay is too low and firm B’s costs are too high, so they do not participate. The maximum total surplus is the area between the demand and supply curves, which totals $11 ($8 value minus $2 cost for the first haircut, plus $7 value minus $3 cost for the second, plus $5 value minus $4 cost for the third).
Figure 13

8) The effect of falling production costs in the market for computers results in a shift to the right in the supply curve, as shown in Figure 14. As a result, the equilibrium price of computers declines and the equilibrium quantity increases. The decline in the price of computers increases consumer surplus from area A to A + B + C + D, an increase in the amount B + C + D.
Prior to the shift in supply, producer surplus was areas B + E (the area above the supply curve and below the price). After the shift in supply, producer surplus is areas E + F + G. So producer surplus changes by the amount F + G – B, which may be positive or negative. The increase in quantity increases producer surplus, while the decline in the price reduces producer surplus. Since consumer surplus rises by B + C + D and producer surplus rises by F + G – B, total surplus rises by C + D + F + G.
b. Since adding machines are substitutes for computers, the decline in the price of computers means that people substitute computers for adding machines, shifting the demand for adding machines to the left, as shown in Figure 15. The result is a decline in both the equilibrium price and equilibrium quantity of adding machines. Consumer surplus in the adding-machine market changes from area $A + B$ to $A + C$, a net change of $C - B$. Producer surplus changes from area $C + D + E$ to area $E$, a net loss of $C + D$. Adding machine producers are sad about technological advance in computers because their producer surplus declines.

c. Since software and computers are complements, the decline in the price and increase in the quantity of computers means that the demand for software increases, shifting the demand for software to the right, as shown in Figure 16. The result is an increase in both the price and quantity of software. Consumer surplus in the software market changes from $B + C$ to $A + B$, a net change of $A - C$. Producer surplus changes from $E$ to $C + D + E$, an increase of $C + D$, so software producers should be happy about the technological progress in computers.

d. Yes, this analysis helps explain why Bill Gates is one the world’s richest men, since his company produces a lot of software that is a complement with computers and there has been tremendous technological advance in computers.

![Figure 16](image_url)
Chapter 9

2)  
a. The statement, "If the government taxes land, wealthy landowners will pass the tax on to their poorer renters," is incorrect. With a tax on land, landowners can not pass the tax on. Since the supply curve of land is perfectly inelastic, landowners bear the entire burden of the tax. Renters will not be affected at all.

b. The statement, "If the government taxes apartment buildings, wealthy landowners will pass the tax on to their poorer renters," is partially correct. With a tax on apartment buildings, landowners can pass the tax on more easily, though the extent to which they do this depends on the elasticities of supply and demand. In this case, the tax is a direct addition to the cost of rental units, so the supply curve will shift up by the amount of the tax. The tax will be shared by renters and landowners, depending on the elasticities of demand and supply.

3)  
a. The statement, "A tax that has no deadweight loss cannot raise any revenue for the government," is incorrect. An example is the case of a tax when either supply or demand is perfectly inelastic. The tax has neither an effect on quantity nor any deadweight loss, but it does raise revenue.

b. The statement, "A tax that raises no revenue for the government cannot have any deadweight loss," is incorrect. An example is the case of a 100 percent tax imposed on sellers. With a 100 percent tax on their sales of the good, sellers won't supply any of the good, so the tax will raise no revenue. Yet the tax has a large deadweight loss, since it reduces the quantity sold to zero.

5)  
a. The deadweight loss from a tax on heating oil is likely to be greater in the fifth year after it is imposed rather than the first year. In the first year, the elasticity of demand is fairly low, as people who own oil heaters are not likely to get rid of them right away. But over time they may switch to other energy sources and people buying new heaters for their homes will more likely choose gas or electric, so the tax will have a greater impact on quantity.
b. The tax revenue is likely to be higher in the first year after it is imposed than in the fifth year. In the first year, demand is more inelastic, so the quantity does not decline as much and tax revenue is relatively high. As time passes and more people substitute away from oil, the equilibrium quantity declines, as does tax revenue.

8)

a. Figure 6 illustrates the market for socks and the effects of the tax. Without a tax, the equilibrium quantity would be $Q_1$, the equilibrium price would be $P_1$, total spending by consumers equals total revenue for producers, which is $P_1 \times Q_1$, which equals area $B+C+D+E+F$, and government revenue is zero. The imposition of a tax places a wedge between the price buyers pay, $P_B$, and the price sellers receive, $P_S$, where $P_B = P_S + \text{tax}$. The quantity sold declines to $Q_2$. Now total spending by consumers is $P_B \times Q_2$, which equals area $A+B+C+D$, total revenue for producers is $P_S \times Q_2$, which is area $C+D$, and government tax revenue is $Q_2 \times \text{tax}$, which is area $A+B$.

b. Unless supply is perfectly elastic, the price received by producers falls because of the tax. Total receipts for producers fall, since producers lose revenue equal to area $B+E+F$.

![Figure 6](image-url)
c. The price paid by consumers rises, unless demand is perfectly elastic. Whether total spending by consumers rises or falls depends on the price elasticity of demand. If demand is elastic, the percentage decline in quantity exceeds the percentage increase in price, so total spending declines. If demand is inelastic, the percentage decline in quantity is less than the percentage increase in price, so total spending rises. Whether total consumer spending falls or rises, consumer surplus declines because of the increase in price and reduction in quantity.

11)  

a. Setting quantity supplied equal to quantity demanded gives \( 2P = 300 - P \). Adding \( P \) to both sides of the equation gives \( 3P = 300 \). Dividing both sides by 3 gives \( P = 100 \). Plugging \( P = 100 \) back into either equation for quantity demanded or supplied gives \( Q = 200 \).

b. Now \( P \) is the price received by sellers and \( P + T \) is the price paid by buyers. Equating quantity demanded to quantity supplied gives \( 2P = 300 - (P + T) \). Adding \( P \) to both sides of the equation gives \( 3P = 300 - T \). Dividing both sides by 3 gives \( P = 100 - T/3 \). This is the price received by sellers. The buyers pay a price equal to the price received by sellers plus the tax \( (P + T = 100 + 2T/3) \). The quantity sold is now \( Q = 2P = 200 - 2T/3 \).

c. Since tax revenue is equal to \( T \times Q \) and \( Q = 200 - 2T/3 \), tax revenue equals \( 200T - 2T^2/3 \). Figure 9 shows a graph of this relationship. Tax revenue is zero at \( T = 0 \) and at \( T = 300 \).
d. As Figure 10 shows, the area of the triangle (laid on its side) that represents the deadweight loss is \( \frac{1}{2} \times \text{base} \times \text{height} \), where the base is the change in the price, which is the size of the tax \((T)\) and the height is the amount of the decline in quantity \((2T/3)\). So the deadweight loss equals \( \frac{1}{2} \times T \times \frac{2T}{3} = \frac{T^2}{3} \). This rises exponentially from 0 (when \(T = 0\)) to 45,000 when \(T = 300\), as shown in Figure 11.
e. A tax of $200 per unit is a bad idea, because it's in a region in which tax revenue is declining. The government could reduce the tax to $150 per unit, get more tax revenue ($15,000 when the tax is $150 versus $13,333 when the tax is $200), and reduce the deadweight loss (7,500 when the tax is $150 compared to 13,333 when the tax is $200).

Chapter 9

3) Figure 5 shows the market for cotton in countries A and B. Note that the world price of cotton is the same in both countries. Country A imports cotton from country B. The table below shows that total surplus is higher in both countries. However, in country A, consumers are better off and producers are worse off, while in country B, consumers are worse off and producers are better off.

![Figure 5](image)

<table>
<thead>
<tr>
<th>COUNTRY A</th>
<th>Before Trade</th>
<th>After Trade</th>
<th>CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer Surplus</td>
<td>C</td>
<td>C+D+F</td>
<td>+(D+F)</td>
</tr>
<tr>
<td>Producer Surplus</td>
<td>D+E</td>
<td>E</td>
<td>-D</td>
</tr>
<tr>
<td>Total Surplus</td>
<td>C+D+E</td>
<td>C+D+E+F</td>
<td>+F</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>COUNTRY B</th>
<th>Before Trade</th>
<th>After Trade</th>
<th>CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer Surplus</td>
<td>G+H</td>
<td>G</td>
<td>–H</td>
</tr>
<tr>
<td>Producer Surplus</td>
<td>I</td>
<td>H+I+J</td>
<td>+ (H+J)</td>
</tr>
<tr>
<td>Total Surplus</td>
<td>G+H+I</td>
<td>G+H+I+J</td>
<td>+J</td>
</tr>
</tbody>
</table>

6) The tax on wine from California is just like a tariff imposed by one country on imports from another. As a result, Washington producers would be better off and Washington consumers would be worse off. The higher price of wine in Washington means producers would produce more wine, so they would hire more workers. Tax revenue would go to the government of Washington. So both claims are true, but it is a bad policy because the losses to Washington consumers exceed the gains to producers.

12) An export subsidy increases the price of steel exports received by producers by the amount of the subsidy, s, as shown in Figure 10. The figure shows the world price, PW, before the subsidy is put in place. At that price, domestic consumers buy quantity Q1D of steel, producers supply Q1S units, and the country exports the quantity Q1S – Q1D. With the subsidy put in place, suppliers get a total price per unit of PW + s, since they receive the world price for their exports PW, and the government pays them the subsidy of s. However, note that domestic consumers can still buy steel at the world price PW, by importing it. Domestic firms don’t want to sell steel to domestic customers, since they don’t get the subsidy for doing so. So domestic companies will sell all the steel they produce abroad, in total quantity Q2S. Domestic consumers continue to buy quantity Q1D. The country imports steel in quantity Q1D and exports the quantity Q2S, so net exports of steel are the quantity Q2S – Q1D. The end result is that the domestic price of steel is unchanged, the quantity of steel produced increases, the quantity of steel consumed is unchanged, and the quantity of steel exported increases. As the following table shows, consumer surplus is unaffected, producer surplus rises, government revenue declines, and total surplus declines.
Figure 10

<table>
<thead>
<tr>
<th></th>
<th>Without Subsidy</th>
<th>With Subsidy</th>
<th>CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consumer Surplus</strong></td>
<td>$A + B$</td>
<td>$A + B$</td>
<td>0</td>
</tr>
<tr>
<td><strong>Producer Surplus</strong></td>
<td>$E + F + G$</td>
<td>$B + C + E + F + G$</td>
<td>$(B + C)$</td>
</tr>
<tr>
<td><strong>Government Revenue</strong></td>
<td>0</td>
<td>$-(B + C + D)$</td>
<td>$-(B + C + D)$</td>
</tr>
<tr>
<td><strong>Total Surplus</strong></td>
<td>$A + B + E + F + G$</td>
<td>$A + B - D + E + F + G$</td>
<td>$-D$</td>
</tr>
</tbody>
</table>