Problem 1: Price Ceiling

Demand for leaf blowers in Madison is given by the equation \( Q_D = 90 - P \); supply is given by \( Q_S = 2P \).

a. What is the equilibrium price and quantity?

At the equilibrium price, quantity demanded equals quantity supplied: \( Q_D = 90 - P = 2P = Q_S \).

Solve for the equilibrium price: \( 90 = 3P \Rightarrow P^e = 30 \).

Plug the eqm. price back into either supply or demand equation to get eqm. quantity: \( Q^e = 2(30) = 60 \).

b. In order to encourage a citywide cleanup, the city of Madison imposes a price ceiling of $10/blower. Does this cause a shortage or surplus? Of what size?

First graph the equilibrium market outcome. Put the demand and supply equations into slope intercept form.

Demand: \( P = 90 - Q_D \), supply: \( P = \frac{1}{2} Q_S \).

The price ceiling prevents the price from rising above $10, which implies there is a shortage.

To determine the size check the value of supply and demand when \( P = 10 \), demand = 80, supply = 20.

So the shortage is: \( 80 - 20 = 60 \).

Problem 2: Price Support

Consider the potato market. The demand for potatoes (in pounds) is given by \( P = 30 - 2Q_D \) and supply of potatoes is given by \( P = 10 + 2Q_S \). Suppose that the government implements a price support program with the price floor set at $24.

a. Is the market price above or below the government’s guarantee price?

Set supply = demand: \( 10 + 2Q = 30 - 2Q \), which means that \( Q^e = 5 \).

So, equilibrium price: \( P^e = $20 \).

So the market price is below the government’s guarantee price. The price floor will be binding.
b. How many pounds of potatoes will be supplied given the price support?
Plug the price of $24 into the supply equation:
\[ 24 = 10 + 2Q_s \]
The quantity supplied: \( Q_s = 7 \) (Shown on graph in part a.)

c. What is consumer demand for potatoes given the price support?
Plug the price of $24 into the demand equation:
\[ 24 = 30 - 2Q_d \]
The quantity supplied: \( Q_d = 3 \) (Shown on graph in part a.)

d. Calculate the excess supply given the price support.
Excess supply = \( Q_s - Q_d = 7 - 3 = 4 \) pounds of excess supply

e. Calculate the direct cost of the support program, assuming that there is no storage cost.
Cost of the program is the cost that the government must spend to purchase the extra pounds of potatoes that are supplied. The government must purchase the excess supply at the guaranteed price.
Cost to government = Excess Supply * Price = \( 4 \times 24 = 96 \)

f. In the graph of the potato market, shade the area that corresponds to the government’s cost.
The cost to the government is shaded in grey.

g. If the total cost of the program is $104, what is the storage cost per pound?
Total cost = total cost of purchasing excess supply + total cost of storage
\$104 = \$96 + \text{total cost of storage}, \text{ so the total cost of storage = \$8}
Therefore, the cost per pound is \( \frac{\$8}{4} = \$2 \)
Storage cost per pound is \$2

**Problem3: Price Subsidy**
Again consider the market for potatoes with demand given by \( P = 30 - 2Q_D \) and supply given by \( P = 10 + 2Q_s \).
Now suppose the government implements a price subsidy program instead of the price support program. Let the government target price be $24.

a. How many pounds of potatoes will be supplied with this program?
With a price subsidy, the producers are guaranteed to receive a price of $24 per pound. So, the result will be the same as in the case of the price floor, \( Q_S = 7 \).

b. At what price are consumers willing to buy all 7 pounds of potatoes?
   To find this, plug the quantity of 7 into the demand curve.
   \[ P = 30 - 2Q_D = 30 - 2(7) = 16 \]

c. What is the cost of the subsidy program?
   The cost of the subsidy is the difference between the price guarantee and the price at which consumers are willing to purchase the total quantity supplied.
   \[ \text{Cost of subsidy} = (24 - 16)\times 7 = (8)\times 7 = 56 \]

d. In the graph of the potato market, shade the area that corresponds to the government’s cost.
   The government’s cost is shaded in grey.

![Graph of potato market]

\[ P = 10 + 2Q_S \]
\[ P = 30 - 2Q_D \]

5 7 15

\( Q_{\text{pounds of potatoes}} \)

10 16 24 30

30

\[ Q_E = 3 \]

Plugging in to either equation, then find that \( P_E = 10 \)

CS = \( \frac{1}{2} \times 3 \times (13-10) = 4.5 \)

PS = \( \frac{1}{2} \times 3 \times (10-1) = 27/2 = 13.50 \)

TS = 4.5 + 13.5 = 18

Problem 4: Tariff and Quota

Domestic demand for 1 lb. of coffee is given by the equation: \( P = -Q_D + 13 \).

Domestic supply of coffee (in pounds) is given by the equation: \( P = 3Q_S + 1 \).

The world price of 1 pound of coffee is $4.

a. Assume that this economy is closed to world trade. What is the new equilibrium price and quantity?
   Calculate the CS, PS, and TS.
   Find the intersection of the supply and demand curves:
   \(-Q_D + 13 = 3Q_S + 1\), which means that \( Q_E = 3 \)
   Plugging in to either equation, then find that \( P_E = 10 \)
   CS = \( \frac{1}{2} \times 3 \times (13-10) = 4.5 \)
   PS = \( \frac{1}{2} \times 3 \times (10-1) = 27/2 = 13.50 \)
   TS = 4.5 + 13.5 = 18
b. Now assume that this economy is open to world trade. How many units will they import or export? Calculate the CS, PS, and TS.

The graph of the economy with the world price is:

\[ S: P = 3Q + 1 \]

\[ D: P = -Q + 13 \]

The new supply from domestic producers at the world price: \( 4 = 3Q_S + 1 \), which means that \( Q_S = 1 \)

The new demand at the world price: \( 4 = -Q_D + 13 \), which means that \( Q_D = 9 \)

So, the total imports will be: \( Q_D - Q_S = 9 - 1 = 8 \) pounds of coffee

\[ CS = \text{Area}(A+B+C) = \frac{1}{2} \times 9 \times (13-4) = \frac{81}{2} = $40.50 \]

\[ PS = \text{Area}(D) = \frac{1}{2} \times 1 \times (4-1) = \frac{3}{2} = $1.50 \]

\[ TS = $40.50 + $1.50 = $42 \]

c. Continue to assume that this economy is open to world trade. Suppose the government enacts a tariff of \$3 per pound of coffee. Calculate the new quantities supply, demand, and import quantities, find CS, PS, and TS with the tariff. What is the total government revenue of the tariff? (Note: total surplus includes government revenue.) What is the DWL of the tariff?

The supply curve with the tax is given by adding the amount of the tax to the original world price. Supply from domestic producers: \( 7 = 3Q_S + 1 \), which means that \( Q_S = 2 \)

Demand: \( 7 = -Q_D + 13 \), which means that \( Q_D = 6 \)

Total imports: \( Q_D - Q_S = 6 - 2 = 4 \) pounds

\[ CS = \frac{1}{2} \times 6 \times (13-7) = \frac{36}{2} = $18 \]

\[ PS = \frac{1}{2} \times 2 \times (7-1) = $6 \]

Tariff Revenue = \( (Q_{\text{Imports}}) \times \text{Tariff} = 4 \times 3 = $12 \)

\[ TS = $18 + $6 + $12 = $36 \]

\[ DWL = TS_{\text{FREE TRADE}} - TS_{\text{TARIFF}} = $42 - $36 = $6 \]
d. Instead of the tariff, suppose that the government implements an import quota of 4 pounds of coffee. Calculate the new equilibrium price and quantity, CS, PS, and TS with the tariff? What is the quota rent earned by the quota license holder? (Note: total surplus includes quota rent.)

The supply curve with the quota is given by creating a new curve. This curve is the bold line in the graph to the left. The supply curve will shift right, where there will be a flat portion equal to the quantity imported at the world price.

The portion of the supply curve above $P=4$: $P = 3(Q-4) + 1$, $P = 3Q - 11$

The new intersection between $S_{QUOTA}$ and $D$ is:

$3Q - 11 = -Q + 13$, so $Q = 6$, which means that the price with the quota will be: $P = -(6) + 13 = $7

This means that the quota rent is: Rent = $(4) \times (7-4) = $12$

Demand: $7 = -Q_D + 13$, which means that $Q_D = 6$

Total imports: $Q_D - Q_S = 6 - 2 = 4$ pounds

$CS = \frac{1}{2} \times 6 \times (13-7) = $36/2 = $18$

$PS = \frac{1}{2} \times 2 \times (7-1) = $6$

$TS = $18 + $6 + $12 = $36$

$DWL = TS_{FREE TRADE} - TS_{QUOTA} = $42 - $36 = $6$

(The above graphs are two ways to show the same thing – the effect of the quota)