Problem 1: Information about firms and consumer is provided below. N is number of identical firms on the market, P is price of the good of interest, P' is price of other good consumed by consumers, Q is quantity and I is income.

$$\text{Firm: } TC = 0.15q^2 + 10$$
$$\text{Consumer: } Q_D = 4000 - 500P + 200P' + 0.1I$$
$$N = 100, P' = 10, I = 40000$$

(a) Find individual and market supply function

(b) Find demand function

(c) Find market equilibrium

Solution:

(a) Individual and market supply function: Individual firm chooses profit maximizing level of output which is one where $MC = P$:

$$MC = TC' = 0.3q = P \quad \Rightarrow \quad q = \frac{10P}{3}$$

Since there are 100 identical firms on the market the market supply is given by:

$$Q_S = \frac{1000P}{3}$$

(b) Find demand function

$$Q_D = 4000 - 500P + 200P' + 0.1I = 4000 - 500P + 200 * 10 + 0.1 * 40000$$
$$Q_D = 10000 - 500P$$

(c) Find market equilibrium: In equilibrium quantity supplied equals quantity demanded:

$$Q_S = Q_D$$
$$\frac{1000P}{3} = 10000 - 500P \quad \Rightarrow \quad 1000P = 30000 - 1500P \quad \Rightarrow \quad P = \frac{30000}{2500}$$
$$P^* = 12, \quad Q^* = 4000$$

Problem 2: Causes of shifts of demand and supply. Follow the set up from the previous problem. What happens if P' changes to 22.5?

Solution: The new demand function is as follows:

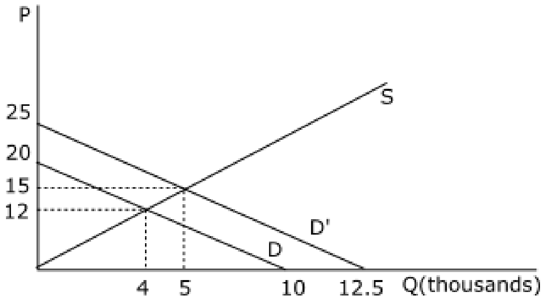
$$Q_D = 4000 - 500P + 200P' + 0.1I = 4000 - 500P + 200 * 22.5 + 0.1 * 40000$$
$$Q_D = 12500 - 500P$$

Supply remains unchanged:

$$Q_S = \frac{1000P}{3}$$

In equilibrium quantity supplied equals quantity demanded:

$$Q_S = Q_D$$
$$\frac{1000P}{3} = 12500 - 500P \quad \Rightarrow \quad 1000P = 37500 - 1500P \quad \Rightarrow \quad P = \frac{37500}{2500}$$
$$P^* = 15, \quad Q^* = 5000$$



Problem 3: Consider the following supply and demand functions.

Supply: $P = 20 + 4Q$

Demand: $P = 200 - Q$

Compute market equilibrium. Then suppose that the government imposed a per unit tax of 20 to be paid by producers. What will be the effect of the tax on market equilibrium?

Solution:

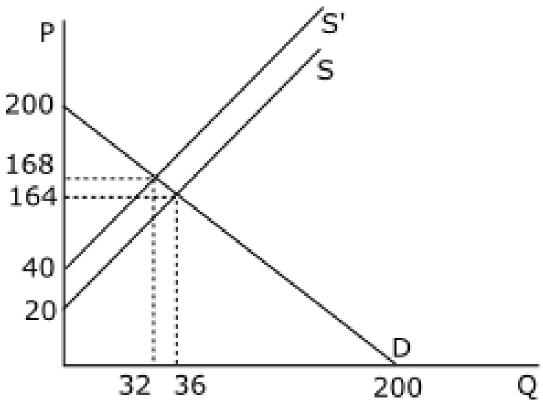
$$Q_S = \frac{P - 20}{4}$$
$$Q_D = 200 - P$$

Market equilibrium:

$$Q_S = Q_D \quad \Rightarrow \quad \frac{P-20}{4} = 200 - P \quad \Rightarrow \quad 5P = 820 \quad \Rightarrow \quad P^* = 164$$
$$Q^* = 200 - 164 = 36$$

Tax is now imposed and paid by firms. So the new supply function is: $P - 20 = 20 + 4Q$. The demand function remains the same. The new equilibrium is as follows:

$$Q_S = \frac{P-40}{4}$$
$$Q_D = 200 - P$$
$$Q_S = Q_D \quad \Rightarrow \quad \frac{P-40}{4} = 200 - P \quad \Rightarrow \quad 5P = 840 \quad \Rightarrow \quad P^* = 168$$
$$Q^* = 200 - P = 32$$



Problem 4: Consider the following supply and demand function.

Supply: $P = 4Q$

Demand: $P = 150 - Q$

(a) Find market equilibrium.

(b) Calculate producer surplus, consumer surplus and total surplus.

(c) Suppose now that the government impose taxes \$5 per unit sold. Calculate consumer surplus, producer surplus, government revenue, total surplus and deadweight loss.

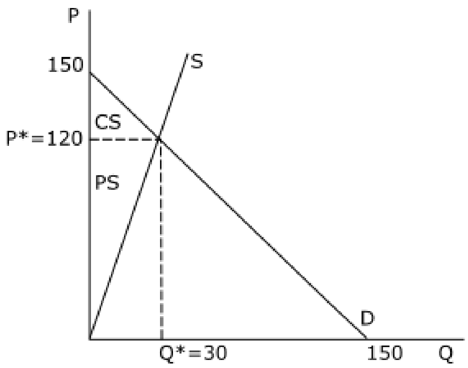
(d) Illustrate the situation in (c) graphically. Does it matter whether the tax is imposed on the producers or the consumers? Explain.

Solution:

(a) To solve for market equilibrium we need to find solution to the following system:

$$P = 4Q$$
$$P = 150 - Q$$
$$4Q = 150 - Q \quad \Rightarrow \quad Q^* = 30, P^* = 120$$

(b) Consumer surplus and producer surplus is the area of triangles depicted on the picture below:



$$\text{CS} = \frac{1}{2} 30 \times 30 = 450$$
$$\text{PS} = \frac{1}{2} 30 \times 120 = 1800$$
$$\text{Welfare} = \text{Total surplus} = \text{CS} + \text{PS} = 2250$$

(c) First we need to find market equilibrium with taxes, because it is needed for surplus computation. We need to find price paid by buyers P_d, price received by sellers P_s, and quantity Q. Irrespective of who pays the tax (producer or consumer) the difference between P_d and P_s is \$5. So $P_s = P_d - 5$. Now the system of two equations is as follows:

$$P_d - 5 = 4Q$$
$$P_d = 150 - Q$$
$$4Q + 5 = 150 - Q \quad \Rightarrow \quad Q^* = 29, \quad P_d^* = 121, \quad P_s^* = 116$$

Now we can compute surpluses:

$$\text{CS} = \frac{1}{2} 29 \times 29 = 420.5$$
$$\text{PS} = \frac{1}{2} 116 \times 29 = 1682$$
$$\text{Government Revenue} = 5 \times 29 = 145$$
$$\text{Welfare} = 420.5 + 1682 + 145 = 2247.5 < 2250$$
$$\text{DWL} = 2.5$$

(d) No, it does not matter. Look at the graph of the market, and put the tax on the graph. The tax puts a wedge between the price paid by buyers and the price received by sellers. No matter who formally pays the tax, the costs of the tax are borne by both sides of the transaction, and who pays what share depends on the relative elasticities (slopes of demand and supply curve). If the demand is relative inelastic in comparison to supply (the reaction of consumers on change in price is subtle) most of the tax will be paid by consumers. If on the other hand consumers are very sensitive to changes in price and producers are not, most of the tax will be paid by producers.