ECON 460: Environmental Economics

1 ANSWER KEY

Externalities and Public Goods

1. Suppose an industry has 12 firms, each with the following marginal (private) cost function

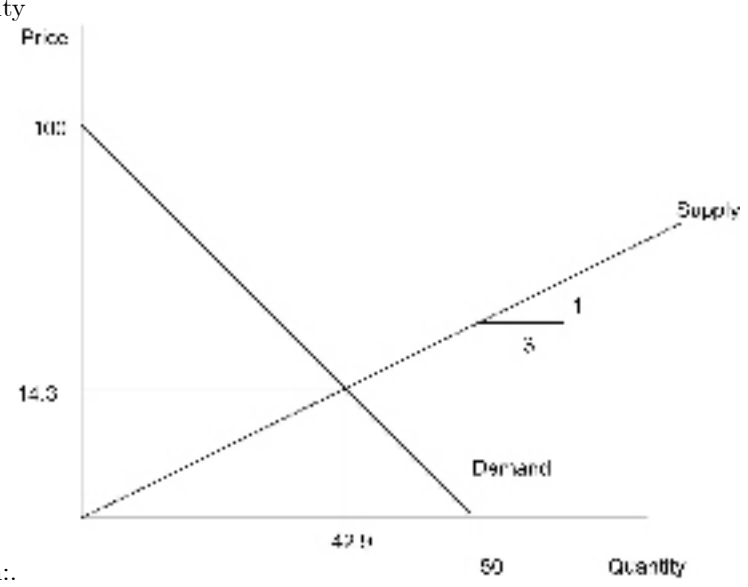
$$MC_i = 4Q_i \qquad (i = 1, ..., 12)$$

and the market demand function is $Q^T = 50 - 0.5P$

(a) Find the equation for the industry supply curve. ANSWER:

$$\begin{aligned} P &= MC = 4Q_i \\ Q_i &= \frac{1}{4}P \\ Q^S &= 12Q_i = 3P \\ &\quad or \\ P &= \frac{1}{3}Q^S \end{aligned}$$

(b) Graph both supply and demand and find the equilibrium price and quantity



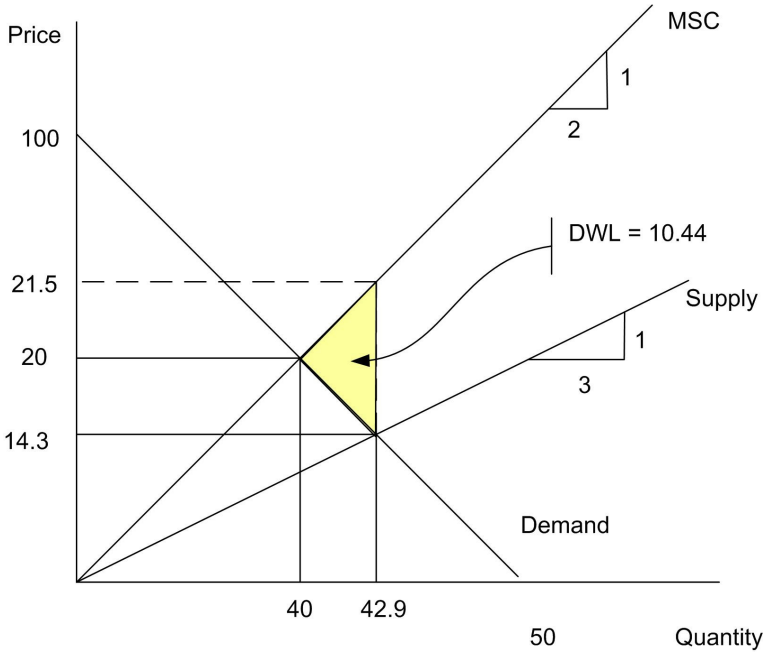
Graph:.

2. Using the information in problem 1, but now suppose that each firm's production causes external damage (pollution). The marginal external cost per firm is $MEC_i = 2Q$

   (a) What is the marginal social cost per firm ($MEC + MC$)? If the marginal external cost was taken into account by all the firms, what would be the supply curve?

   (b) Solve for the equilibrium price and quantities. Graph your results.

   (c) Using your results from problem 1, calculate the net welfare cost when firms DO NOT take the MEC into account (*hint: graph the demand curve and the supply curves from 1 and 2 in a single graph; the answer comes from calculating the "appropriate" area)*



ANS: b and c

3. Suppose we have three people who have different willingness to pay schedules, which are

$$\begin{array}{ll} A & MWTP = 100 - Q \\ B & MWTP = 110 - 1.1Q \\ C & MWTP = 120 - 1.2Q \end{array}$$

Further, the marginal cost of the good is $MC = 10 + .5Q$

(a) If this good is a"public" good, aggregate the MWTP schedules and calculate the socially optimal quantity. What is each person's MWTP for this quantity?

$$\begin{aligned} MWTP &= 330 - 3.3Q \\ MWTP &= MC \\ 330 - 3.3Q &= 10 + .5Q \\ 320 &= 3.8Q \\ Q &= 84.2 \\ A &= 15.8, B = 17.38, C = 18.96 \end{aligned}$$

(b) If this good is a private good (i.e. pizza), aggregate the MWTP in the appropriate manner and solve for the socially optimal (equilibrium) quantity and price. How much of the good does each person consume?
ANSWER: first replace all the MWTP's with P and re-write to isolate the $Q's$ and then sum:

$$\begin{aligned} Q^T &= Q_A + Q_B + Q_C = 300 - 2.74P \\ & \quad or \\ P &= 109.5 - 0.365Q \end{aligned}$$

Then solve for equilibrium:

$$\begin{aligned} 109.5 - 0.365Q &= 10 + .5Q \\ 99.5 &= 0.865Q \\ Q &= 115 \\ P &= 67.5 \\ A &= 32.5, B = 38.6, C = 43.96 \end{aligned}$$