Problem 1

For each of the following examples, state whether there are externalities (positive, negative, or none), and explain why.

a. Watching football game in the classroom with a low quality earphones, which are not soundproof and noisy.

Answer: Negative. You also distract other students from concentrating on the lecture.

b. Asking good questions in class.

Answer: Positive. Asking good questions not only benefits the asker, but also benefits everyone else in the class who may learn from both the question and the answer.

c. Smoking in your own bedroom (suppose there is no smoke sensor in your room).

Answer: None. Since you only poison yourself. (There might be negative externality from second hand smoke, if you assume that the bedroom is shared with other people.)

d. The laboratory dumps toxic chemicals from its research project into Lake Mendota.

Answer: Negative. The whole community suffers the potential damage brought by the chemical.

e. The fraternity next to your dorm plays loud music, keeping you from studying.

Answer: Negative. The noise disturbs your study while your neighbor is enjoying the life.

Problem 2

Education is an example of a positive externality: acquiring more education benefits the individual student and having a more highly educated work force is good for the economy as a whole. The accompanying table illustrates the marginal benefit to Sian per year of education and the marginal cost per year of education. Each year of education has a marginal external benefit of society equal to $8000. Assume that the marginal social cost is the same as the marginal cost paid by an individual student.
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<th>Sian's total benefit</th>
<th>Sian’s marginal benefit per year</th>
<th>Marginal social benefit per year</th>
<th>Sian’s total cost</th>
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**Problem 3**

A dentist and a writer live next door to each other, and each has her office at home. Screams of pain from the patients in the dentist’s office interfere with the writer’s creativity, causing her to write inferior novels and lose $800 per year in income. The dentist would have to spend $600 to install sound-absorbing material on her office walls, and this material would have to be replaced each year. The writer sues the...
dentist. The court can rule in favor of the author and require the dentist to soundproof her walls, or it can rule in favor of the dentist and dismiss the case. Explain what would happen under each ruling if:

a. The dentist and the writer are on speaking terms (small transaction costs, ignoring court fees).

b. They are not speaking to each other under any circumstances (large transaction costs).

Make sure that your answer contains some comparison between the socially optimal outcome and the outcome actually achieved in each circumstance. Try to use the Coase Theorem to explain your findings.

Answer:

a. By the Coase theorem, if property rights are clearly defined and transaction costs are low, then the efficient resolution of externalities will be reached.

- **Court rules in favor of dentist**

  If the court rules in favor of the dentist, the dentist would have no incentive to soundproof her walls. However, the writer would have the incentive to pay the dentist $600 to soundproof the walls. This is because the writer would be better off by paying the $600 to get quiet environment than by losing $800 from suffering the noise. Given the small transaction costs, the efficient outcome would be reached; the writer would internalize the negative externality.

- **Court rules in favor of the writer**

  If the court rules in favor of the writer, the dentist would have to pay $600 to soundproof the walls. In this case, the dentist would be forced to internalize the costs of the negative externality.

b. **Court rules in favor of dentist**

  If the court rules in favor of the dentist, she has no incentive to soundproof the walls. Since they don’t speak to each other under any circumstances, the costs of negotiation (perhaps through a third party) would be high. Thus, in addition to paying the dentist the $600 to soundproof the walls, the writer would also incur the costs of negotiating the agreement. If these costs exceeded $200 (and assuming the negotiations would have to occur each year), then the writer would not have the incentive to pursue negotiations, since the costs of getting quiet exceed the benefits. With high transaction costs, the efficient outcome would be less likely. This situation illustrates the importance of low transaction costs in the application of the Coase theorem.

- **Court rules in favor of the writer**
If the court rules in favor of the writer, the dentist would have to pay $600 to soundproof the walls. In this case, the dentist would be forced to internalize the costs of the negative externality. Under this situation, the efficient outcome will be reached.

**Problem 4**

Suppose that in the market for paper, demand is $P=100-Q$. The marginal private cost of producing paper is $10+Q$. However, pollution generated by the production process creates a per unit external harm (i.e. negative externality) equal to $0.5Q$ (i.e. the level of the externality increases with the quantity produced).

a. Assume that the optimal output is produced at where $P=MC$. What is the (unregulated) market equilibrium and quantity if the externality is not corrected for in this market?

*Answer: Use $P=MC \rightarrow 100-Q=10+Q \rightarrow Q=45$, plug back to MC or Demand equation, the market equilibrium price is $P=55$*

b. What is the socially optimal quantity of paper that should be produced?

*Answer: The social marginal cost is: $SMC=10+Q+0.5Q=10+1.5Q$. Since there is no consumption externality, the socially optimal determined by $SMC=P$.

$100-Q=10+1.5Q \rightarrow Q=36; P=64$  

c. Suppose that the government wants to achieve the socially optimal quantity by imposing a tax on producers. What would be the size of the tax per unit of paper?

*Answer: The government can impose a tax to internalize the negative externality into the firm's marginal cost. Hence, a tax=$0.5Q$ should be added to the firm’s marginal cost. The new marginal cost is: $MC=10+1.5Q$*

**Problem 5**

Watertown is a small town surrounded by many small lakes. Winters in Watertown are very cold but (for some unknown reason) people love to ice-fish on the lakes around Watertown. People travel from nearby cities to ice-fish in the winter. The county council decides to start requiring licenses to fish in the Watertown area. Demand for these licenses is: $P=250-Q$ and the marginal cost of issuing licenses is $MC=Q$.

a. Assume that the optimal output is produced at where $P=MC$. Find the market equilibrium price and quantity for ice-fishing rights.

*Answer: To find the equilibrium, set $P=250-Q$ equals to $MC=Q$*  

$250-Q \rightarrow Q=125; P=$125
b. One of the members of the council, Mr. Smith, thinks that there are external costs involved with selling fishing licenses. He claims that before licenses were required there were more people coming to Watertown for ice fishing and this was very helpful for the local merchants. He estimates that the licenses discourage people from coming to town and the net loss of merchants to 10+Q. Considering the market for ice-fishing rights, is it a positive or a negative externality?

Answer: Since we are talking about the market for ice fishing permit, it creates a negative externality. The county’s cost of issuing licenses doesn’t include the cost of hurting the local tourist economy.

c. Assuming Mr. Smith’s estimate is correct, find the socially efficient quantity and price of ice fishing rights.

Answer: To find the socially efficient outcome, we need to find the quantity where SMC=SMB

\[ SMC = PMC + \text{Externality} = Q + (10+Q) = 10+2Q; \text{SMB = Demand} \]

\[ 10+2Q = 250-Q \rightarrow Q=80; \text{P} = $170 \]

Problem 6

According to economists Becker and Grossman, each pack of cigarettes smoked creates about 68 cents of externalities borne by other members of society. The externalities include the costs of cigarette smokers’ excess use of health services, costs of fatal death, secondhand smoke, etc.

a. Explain how a tax could be used to correct the externality. Show it graphically.

Answer: In the case of a negative externality, the SMB is less than the PMB and the quantity consumed Q1 exceed socially optimal quantity Q2. A tax on cigarettes could
be imposed. A tax equal to the difference between the PMB and the SMB (in this case a tax of 68 cents/pack) would shift the demand curve down such that the marginal private benefit with the tax would be equal to the marginal social benefit. This would reduce the equilibrium quantity produced to the efficient level. Thus, the quantity of cigarettes produced would decrease from Q1 to Q2.

b. Mention another way that the government may try to use to correct the overproduction of cigarettes due to the negative externality.

Answer: Other possible means that the government could use to correct the overconsumption of cigarettes include:

- Government Quota: Assuming the government could know the efficient level, it could impose a quota, limiting consumption of cigarettes to Q2. The challenge for the government is estimating the Q2 perfectly.

- Government regulation of cigarette quality: The government could impose “quality standards” and allow consumption only of cigarettes that meet minimum health standards. This would decrease the negative externality and also reduce demand, both of which would bring the MPB closer to the MSB.

Now assume the demand (PMB) for cigarettes is \( P = 19 - 1.5Q \), and the private marginal cost (PMC) for cigarettes is \( PMC = 2 + 0.5Q \). Also suppose the marginal damage of smoking is one dollar.

c. What is the equilibrium quantity and price of cigarettes?

Answer: \( PMC = 2 + 0.5Q \), set equal to \( PMB = P = 19 - 1.5Q \)

\[ 2 + 0.5Q = 19 - 1.5Q \rightarrow Q = 8.5; \ P = 6.25 \]

d. What is the socially optimal quantity and price of cigarettes?

Answer: \( SMB = PMC = 2 + 0.5Q \), set \( SMB = PMB - MD = 19 - 1.5Q = 18 - 1.5Q \)

\[ 2 + 0.5Q = 18 - 1.5Q \rightarrow Q = 8; \ P = \text{price received by the producer plus the tax} = 6 + 1 = 7 \]

e. The present of negative externality creates deadweight loss, show it graphically, and calculate the amount of DWL.

Answer: the red triangle in the figure is \( \text{DWL} = (6.25 - 5.25) \times (8.5 - 8)/2 = 0.25 \). The points of the DWL triangle are the SMB curve evaluated at \( Q = 8 \) and \( Q = 8.5 \) and the PMB curve evaluated at \( Q = 8.5 \).