ECON 445
Spring 2007
Professor Paul Rothstein

Problem Set 2
Due February 20 at the start of class
Worth 28 points (2 points per question)
Show all of your work!

Problem 1 (6 points)
Suppose that the demand for a product is:

$$P_D = 360 - 4Q_D$$

and the supply is:

$$P_S = 6Q_S$$

Suppose there is also *increasing* marginal damage with output, so:

$$MD = 2Q$$

1. What is the equilibrium price and quantity of this good without government intervention?
2. What price and quantity are efficient?
3. What Pigouvian tax would achieve the efficient allocation? *Note!* The answer is a specific number.

Problem 2 (8 points)
Two firms are ordered by the federal government to reduce their pollution levels. Firm A's marginal costs associated with pollution reduction are:

$$MC = 20 + 4Q$$

Firm B's marginal costs associated with pollution reduction are:

$$MC = 10 + 8Q$$

The marginal benefit of pollution reduction is:

$$MB = 400 - 4Q$$

4. Graph each firm's marginal cost of pollution reduction curve, the "total" marginal cost of pollution reduction curve (recall that the latter gives the least cost way of reducing total pollution by any given amount), and the marginal benefit of pollution reduction curve.

5. What is the socially optimal total level of pollution reduction and the socially optimal level of each firm's pollution reduction?

6. On the existing graph, illustrate the inefficiency of requiring both firms to reduce pollution by the same amount.

7. What Pigouvian tax would achieve the efficient level of pollution reduction?

Problem 3 (4 points)

I wanted to learn a bit more about the Kyoto treaty, so I went to Wikipedia. There I found the following sentence:

> "The cost of complying with Kyoto is prohibitive for many Annex 1 countries (especially those countries, such as Japan or the Netherlands for example, with highly efficient, low GHG polluting industries, and high prevailing environmental standards). Kyoto therefore allows these countries to purchase Carbon Credits instead of reducing GHG emissions domestically."

The conclusion here seems to contradict Gruber's. Recall that in Gruber's analysis, the US buys pollution credits and Russia sells them. Russia earns these credits by reducing pollution by much more than its quota. If Wikipedia's conclusion is correct, then Japan and the Netherlands must be different from Russia. Perhaps Japan is similar to the United States – but it isn't in the amount of pollution it produces for energy, Wikipedia is right that Japan is efficient (relative to Russia and the US). Perhaps Wikipedia's conclusion is right but its argument is wrong!

8. Reread pages 158-161. Note carefully that the quotas for the US and Russia are very different (and why they are different). Now, give quotas for Japan and Russia (actual numbers!) and draw cost curves under which the following is true: Japan has lower marginal costs of pollution reduction than Russia at any level of output but Japan buys credits from Russia.

9. Explain your answer by rewriting the Wikipedia paragraph.

Problem 4 (10 points) The following questions concern, "The Market for Sulfur Dioxide Emissions," by Joskow and others.

Suppose Andy, Bob and Carl submit bids at this auction as follows:
Andy: 20 permits for $50 each.
Bob: 30 permits for $75 each.
Carl: 50 permits for $100 each.

Suppose Alice, Barbara and Cindy submit offers at this auction as follows:
Alice: 20 permits for $100 each.
Barbara: 30 permits for $75 each.
Cindy: 50 permits for $50 each.

10. Draw the buyers' "offer" curves.

11. On the same graph, draw the sellers' curves.

12. State explicitly how the market clears. That is to say, for each of the six players, who gets what?

13. What is the "market price" in this example?

14. Explain in one or two sentences why the flattening of buyers' offer curves over time (see page 680) suggests that this market is working well.