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Economics 410

The Maxwell School
Syracuse University

Exam 1

Spring 2006

VERSION G

Instructions

1. Write your SU ID NUMBER and the exam version letter above on your blue book. Please do NOT write your name.

2. Do not open the exam until you are told to do so.

3. Please turn off the ringer on your phone right now – before the exam begins.

4. Write on both sides of the bluebook pages.

5. SHOW ALL YOUR WORK. Numerical answers without supporting work will receive little or no credit.

6. Label all graphs, axes, curves, lines, points, etc., carefully.

7. You have 80 minutes to work on the exam. There are 80 points possible; please budget your time accordingly.

8. Calculators may be used but may NOT be shared.

9. Collaboration of any kind on the exam is not allowed. Use of phones, computers or text messaging will be presumed to be collaboration – so don't do it. Cheating of any kind will result in an F on the exam and referral of the case to the Dean's office.

10. Some handy formulas:

$$PV = \frac{B}{(1+r)^t} \qquad PV = \frac{B}{r}$$

Part 1: Single Source Pollution (20 points)

Suppose that electricity can be produced by nuclear power at a constant marginal cost of $10 per unit (that is, MC=$10). A city's demand for electricity from nuclear power is given by the equation: P = $15 – Q/1,000,000.

(1) Please determine the market equilibrium price and quantity of electricity.

(2) Suppose each unit of electricity generated produces 1 gram of radioactive waste. The waste remains safely inside the reactor for 20 years. After 20 years, the reactor core is moved to a storage site. From year 21 on (forever), there is a 1/100,000,000 chance (each year) that a person will come into contact with the waste. If that happens, the damages are $6 million. Calculate the expected present value of the damages associated with one unit of electricity. Be sure to show all your work. You may assume the interest rate is 5%.

(3) Using your answer to question (2), find the efficient price and quantity of electricity. If we were to achieve this by taxing nuclear power, what should the tax rate be? What will be the total dollar effect of this on consumer surplus? On government revenue? On the externality problem? What is the overall welfare gain?

Part 2: Multiple Source Pollution (30 points)

Suppose a city is concerned about a new air pollutant. The pollutant is currently uncontrolled and 200 tons are emitted each year. The emissions come from two sources, each of which is responsible for 100 units. Source 1's marginal abatement cost is given by $MC1=4*Q1$, where $Q1$ is the amount of abatement it does. Source 2's marginal abatement cost is $MC2=8*Q2$. The marginal benefits of abatement are believed to be given by a function of the form: $MB=A-B*Qa$, where A and B are parameters and Qa is the total amount of abatement.

(4) A study reports that the marginal benefit for an improvement in air quality from the uncontrolled level (i.e., when $Qa = 0$) would be $300. The study also reports that if the pollution level were reduced to 150 tons, the marginal benefit of abatement would fall to $250. Determine the efficient level of abatement. How much should source 1 clean up? Source 2?

(5) Design a tradable permit policy that would achieve the efficient amount of abatement while spreading the overall cost equally between the two firms. How many permits would you distribute to each firm? What would the price of a permit be in equilibrium?

Part 3: Pollution Control Under Uncertainty (30 points)

Suppose that a particular water pollutant causes $50 of damage per ton. Two sources emit the pollutant and each is currently generating 100 tons (total emissions = 200 tons). Source 1 is known to be able to reduce its emissions at a marginal cost given by MC1 = 1*Q1. Source 2's abatement costs are not certain. One possibility is that MC2 = 2*Q2 but it's also possible that MC2 = 5*Q2. It cannot be determined in advance which of the MC2 curves is correct.

(6) If it were certain that source 2 had the first marginal cost curve (MC2 = 2*Q2), calculate each of the following: the efficient total amount of abatement; the amount of abatement that should be done by each source; the emissions tax that would get to efficiency; the quantity of permits that would achieve efficiency; and the market-clearing price of a permit if a permit policy were used.

In the remaining questions, suppose that one of the policies has been imposed and source 2 turns out to have the second marginal cost curve (MC2 = 5*Q2).

(7) Suppose the emissions tax was imposed. How much abatement will be done by each source? Is this efficient? Discuss.

(8) Suppose the permit policy was imposed and each of the sources has been given half of the permits. How much abatement will be done by each source? Is this efficient? Discuss. Will there be any sales of permits from one source to another? If so, calculate the value of the permit sales (assuming that the permit market is perfectly competitive).