

**Econ 325: Environmental and Natural Resource Economics**  
**Fall 2007**  
**Problem Set 5**

Due in class: Thursday November 29, 2007

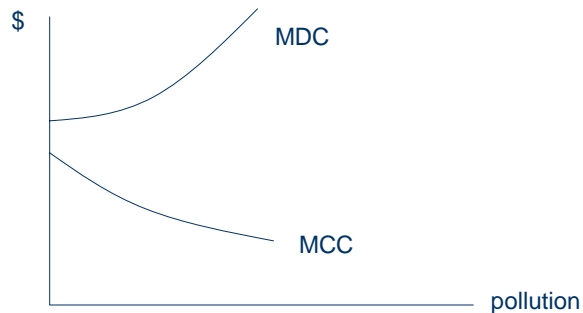
Instructions: Answer all 4 questions. Please show your work.

1. Evaluate the following statement using what you've learned from economics: *The only amount of acceptable pollution is no pollution at all.*

Zero pollution implies ALL production and consumption activities must cease. This is neither desirable nor attainable.

## optimal pollution not zero

- cases where could be very close to zero
- MDC of first unit > first unit MCC (plutonium?)



2. Assume that a society is composed of two polluters, with the marginal abatement (control) costs of polluters 1 and 2, respectively, equal to:

$$MAC_1 = 18 - E_1$$
$$MAC_2 = 12 - 2E_2$$

where  $MAC_1$  refers to the marginal abatement costs of polluter 1, and  $E_1$  refers to the level of emissions of polluter 1.

- a. What is the unregulated level of pollution for each polluter?

The unregulated level of pollution for firm 1 is 18 and for firm 2 is 6.

- b. Find the MAC of each firm if both were to reduce its pollution levels by 50% from the unregulated level of emissions. What is the total abatement cost associated with this system?

$$MAC_1 = 18 - 9 = 9$$
$$MAC_2 = 12 - 2(3) = 6$$
$$TAC = 15$$

- c. Find the total level of emissions that would be generated if a per-unit pollution tax of \$4 were imposed.

If the tax is \$4, firm 1 emits 14 and firm 2 emits 4; total of 18.

- d. Find the total level of emissions that would be generated if a per-unit pollution tax of \$6 were imposed.

If the tax is \$6, firm 1 emits 12 and firm 2 emits 3; total of 15.

- e. Find the total level of emissions that would be generated if a per-unit pollution tax of \$8 were imposed.

If the tax is \$8, firm 1 emits 10 and firm 2 emits 2; total of 12.

- f. How should regulators choose between these taxes? Hint: what further information would you need to choose the optimal tax?

To choose the proper tax, you would need to know the marginal benefits of abatement (or marginal damages of pollution). Then you could set the tax so that the marginal damages equaled the sum of the individual firm's marginal costs.

- g. Find the market price of a marketable pollution permit if pollution is limited to 18 units through the issuance of marketable pollution permits. What is the

total abatement cost associated with this system? How does this compare to your answer in part b? Why?

$$\text{MAC1} = 18 - E1$$

$$\text{MAC2} = 12 - 2E2$$

$$E1 + E2 = 18 \Rightarrow E1 = 18 - E2$$

$$18 - (18 - E2) = 12 - E2$$

$$E2 = 12 - 2E2$$

$$3E2 = 12$$

$$E2 = 4, E1 = 14$$

$$\text{MAC1} = 18 - 14 = 4$$

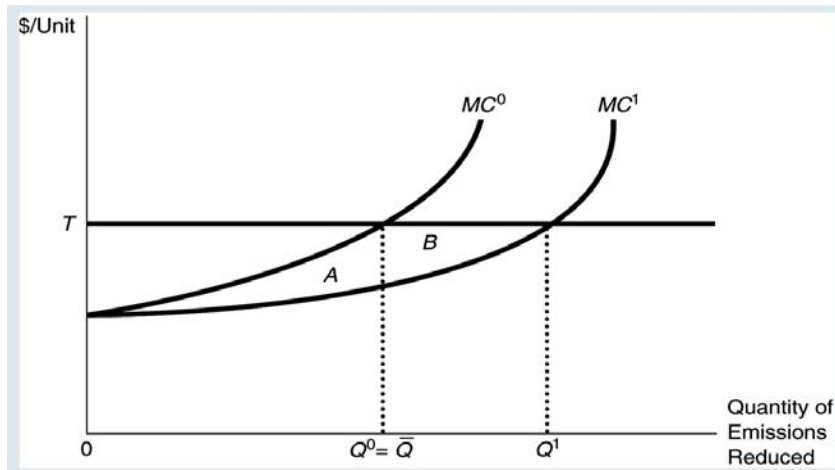
1 point

$$\text{MAC2} = 12 - 2(4) = 4$$

$$\text{TAC} = 8 \text{ (lower than in part b since MAC equal across firms)}$$

2 points

3. What is the advantage of emission charges vs. standards?



Taxes provide an incentive to look for technological innovation and reduce the level of emission levels. The pollution tax could be used to reduce taxes on income, corporate income or support education. For developing countries, the tax revenue could be used for general development purposes. Over time, the emission taxes that the various countries faced could be adjusted to try to equalize emission per capita. Tax also reduces uncertainty about cost of attaining emission reductions.

4. There are three industrial firms in Smiley Town, with the following profiles:

Firm	Initial Pollution Level	Marginal Abatement Cost
A	70 units	\$20
B	80 units	\$25
C	50 units	\$10

The government wants to reduce pollution in Smiley Town to 120 units. It gives each firm 40 tradable pollution permits.

- a. Who sells permits and how many do they sell? Who buys permits and how many do they buy? What is the equilibrium permit price?

Each firm has 40 permits. Therefore, if no trading:

A abates  $70 - 40 = 30 \times \$20 = \$600$   
 B abates  $80 - 40 = 40 \times \$25 = \$1,000$   
 C abates  $50 - 40 = 10 \times \$10 = \$100$

Marketable pollution permits equate MAC across polluters because each firm compares their MAC with the price of the permit.

If  $MAC > \text{price of permit}$ : buy more permits, pollute more (cheaper to pollute)  
 If  $MAC < \text{price of permit}$ : sell more permits, pollute less (cheaper to clean up)

Pick a price, say above \$20. Then, both A and C want to sell permits to B since it is cheaper for them to clean-up rather than pollute – excess supply of pollution permits (not equilibrium).

What about under \$20, above \$10. Then, C will sell, but B needs more (e.g., if C sells all 40 permits to B for \$15 = \$600, but B willing to buy more since abatement cost without trade is \$1000) – excess demand for permits (not equilibrium)

Only possibility is that the equilibrium permit price is \$20. At \$20/permit:

A is indifferent since price = MAC, abates  $70 - 40 = 30 \times \$20 = \$600$  (A has 40 permits)  
 B buys all permits from C, so 0 abatement costs (B has 80 permits)  
 C sells all permits, so has to abate all original emissions  $50 \times \$10 = \$500$  (C has 0 permits)

Total abatement cost: \$1100

- b. Briefly explain why the sellers and buyers are each willing to participate. What is the total cost of pollution abatement in this situation? See above

c. How much higher would the costs of pollution abatement be if the permits could not be traded?

A abates 30 @ \$20 = \$600

B abates 40 @ \$25 = \$1000

C abates 10 @ \$10 = \$100

$MAC1 + MAC2 + MAC3 = \$1700$

Pollution would be \$600 more expensive.