

Part I: Short-answer essay. Be sure to include enough discussion to explain your answers.

1. (15) Use a diagram to show a situation in which the “optimal” level of emissions is positive. Explain why enforcing a ban on emissions (i.e., emissions = 0) in this case would result in lower net social benefit. Draw another diagram in which the “optimal” level of emissions is 0, so a ban on emissions would be the optimal policy.

**First diagram should look like those in Figures 3.7A or 3.7B, with an explanation that  $E_1$  is optimal. Because MAC is above MDF for emissions below  $E_1$ , each unit reduction of emissions below  $E_1$  costs more (MAC) than it saves in lower damages (MDF). A reduction to 0 would result in social losses equal to the entire area between the MAC and MDF curves between 0 and  $E_1$ .**

**Second diagram should look like Figure 3.13A, where MAC is never greater than MDF, so reduction of emissions to 0 creates no social loss. (Could also use Figure 3.13B and note social losses are very small.)**

2. (15) Compare and contrast the revealed-preference approach to measuring the value of nonmarket goods to the stated-preference approach. Provide at least one example of each.

**Wanted a clear statement that revealed preference approaches (such as hedonic pricing or travel cost studies) are firmly based upon the actual (observed) behavior, and therefore measure direct use value. By contrast, stated preference studies (such as contingent valuation or conjoint analysis) measure indirect use values by asking people to state what they would be willing to pay or make choices between hypothetical alternatives.**

3. (15) Briefly describe three criteria other than economic efficiency that could be used in making public policy decisions about the environment.

**Other criteria we covered are: equity, sustainability, environmental justice, ecological impact, ethics, public participation, and advancement of knowledge.**

4. (15) Briefly discuss the possible effects (i.e., both positive and negative) of environmental policy on the economy.

**Negative: environmental policy increases production costs (by diverting some inputs into the production of environmental quality), and thus raises prices, reduces both output (GDP) and employment, and could slow rate of growth.**

**Positive: environmental policy increases the productivity of environmental resources (such as air, land, water) as well as that of other inputs (especially labor, via better health, but also forests and fisheries); also can reduce health care costs (especially if average costs in healthcare are increasing) and improve ecosystem services (diversity).**

Part II: Problems. Show your work if you want to get partial credit.

1. (20) There are two firms (labeled 1 and 2) whose production processes pollute the water in a river. Their marginal abatement cost functions are

$$MAC_1 = 500 - 2E_1$$

and

$$MAC_2 = 400 - E_2$$

where  $E_1$  and  $E_2$  are the levels of emissions by firms 1 and 2.

a. The government decides it wants to reduce the total level of emissions to 500. Recommend a policy that will accomplish this at the lowest possible total abatement cost for society, and determine the level of emissions for each firm that results from this policy.

(NOTE: you do not need to compute the total abatement costs).

**$MAC_1 = 500 - 2E_1 = MAC_2 = 400 - E_2$  can be simplified to  $E_2 = 2E_1 - 100$ .**

**Using this and  $E_1 + E_2 = 500$  gives  $E_1 = 200$  and  $E_2 = 300$ .**

**Because  $MAC_1 = 500 - 2(200) = MAC_2 = 400 - 300 = 100$ , a tax of 100 will do the job.**

**Giving 250 permits to each firm and letting them trade will also work (price will be 100).**

b. Now suppose the government decides it wants to reduce the total level of emissions to 350. Recommend a policy that will accomplish this at the lowest possible total abatement cost for society, and determine the level of emissions for each firm that results from this policy.

(NOTE: you do not need to compute the total abatement costs).

**Again,  $MAC_1 = 500 - 2E_1 = MAC_2 = 400 - E_2$  can be simplified to  $E_2 = 2E_1 - 100$ .**

**Using this and  $E_1 + E_2 = 350$  gives  $E_1 = 150$  and  $E_2 = 200$ .**

**Because  $MAC_1 = 500 - 2(150) = MAC_2 = 400 - 200 = 200$ , a tax of 200 will do the job.**

**Giving 175 permits to each firm and letting them trade will also work (price will be 200).**

2. (20) Suppose the travel cost demand curve for recreation on Indiana's shoreline of Lake Michigan is

$$MPB = 400 - 10Q,$$

where MPB is the “revealed travel cost” and Q is the number of trips per year. The Indiana state government is considering a clean-up project that will increase the travel cost demand for recreation on its shoreline of Lake Michigan to

$$MPB_{\text{new}} = 500 - 10Q.$$

Assume the average travel cost paid by someone visiting the lake is \$100.

a. What is the “break-even” cost of this project (the highest cost at which this program is feasible)?

$$MPB = 400 - 10Q = APC = MPC = 100 \text{ implies } Q = 30.$$

NPB = area below MPB and above MPC=100 line,

$$\text{so NPB} = (1/2)(30)(400-100) = 4500.$$

$$MPB_{\text{new}} = 500 - 10Q = APC = MPC = 100 \text{ implies } Q = 40.$$

NPB<sub>new</sub> = area below MPB<sub>new</sub> and above MPC=100 line,

$$\text{so NPB}_{\text{new}} = (1/2)(40)(500-100) = 8000.$$

**Gain in NPB = 3500, which is also the “break-even” cost of this project.**

b. Suppose the cost of this project is less than your answer to part a, so the government would be inclined to undertake it. How would you finance this program, keeping in mind that you must balance the budget? Briefly explain.

**One approach is a user fee – each recreational user must pay a fee each time they come to the lake. The user fee has the advantage that only those who benefit directly from recreation at the lake, wherever they live, pay for the clean-up. This will mean that the number of trips after clean-up will be less than 40, but still above 30, so there is a NPB increase even if the project is funded by a user fee. However, if there are substantial passive-use benefits, such as existence value or benefits from ecosystem services provided by the lake, then this has the disadvantage of not collecting any revenue from many who gain non-recreational value from the lake and who would be willing to pay for the clean-up. Also, a user fee has the same effect as a regressive tax.**

**Another approach is for the county government to levy an additional tax on its residents. This has the disadvantage of forcing some who gain nothing of value from the lake to pay for the clean-up, but does collect revenue from many who gain non-recreational value from the lake and who are willing to pay. What type of tax one chooses is important, since a sales tax would be regressive, though an income tax increase could be structured so it is not regressive.**

**Generally would prefer a combination of these two approaches.**

c. Suppose the cost of this project is greater than your answer to part a. If you were hired as a consultant, what would you advise this government to do?

**I would advise them to conduct a stated-preference study to determine whether citizens placed a high enough indirect (passive) use value on a clean-up to make up the difference. For example, ask each person how much they would be willing to pay for this clean-up.**

**I would also recommend that they make an effort to cooperate with the other states that have shorelines on Lake Michigan, because each of these contributes to the environmental problems in the lake to some extent or the other, and should be willing to help.**