Econ 350
Answers to Problem Set 4

1. Under MC pricing, you would set P = MC and solve for Q and P:

Q = 24.04
P = 24.04

CS = (0.96)(24.04)(0.5) = 11.54
PS = (24.04)(24.04)(0.5) = 288.96
Social Welfare = CS + PS = 300.50

Under AC pricing, you would set P = AC and solve for Q and P:

Q = 46.30
P = 23.15

CS = (1.85)(46.3)(0.5) = 42.83
PS = 0 (since P = AC, the water supplier will make zero profits)
Social Welfare = CS + PS = 42.83

Thus, AC pricing will reduce social welfare by 257.67.

2. A zero discharge goal ignores the costs of attaining pollution reduction. It is likely that the optimal amount of water pollution discharge is some non-zero amount--an amount that balances the marginal abatement costs with marginal damages.

3. For a given marginal damage curve, the MAC curve for bleached paper lies above the MAC curve for unbleached paper. This suggests that the optimal emissions of bleached paper should exceed the optimal emissions of unbleached paper. Thus, a standards-based approach where a uniform standard applies to both bleach and unbleached paper would unlikely lead to cost efficient emissions reduction. An optimal emissions tax system would entail two taxes with each tax set equal to the value of MAC at their optimal emissions level.

4.

5.

6. SO2 emissions at three electric power plants.

NOTE: THE CURRENT EMISSIONS FOR FIRM 2 SHOULD BE 200 AND FIRM 3'S CURRENT EMISSIONS SHOULD BE 50.

a) Efficient abatement is solved by setting MD = \$50,000 equal to each firms MAC curve.

Plant 1: $50{,}000 = 100{,}000 - 1000E_1 \rightarrow E_1 = 50$
(thus plant 1 should cut 50 units for a total cost of \$1.25m)

Plant 2: $50{,}000 = 300{,}000 - 1500E_2 \rightarrow E_2 = 167$
(thus plant 2 should cut 33 (=200-167) units for a total cost of \$0.825m)

Plant 3: $50{,}000 = 400{,}000 - 8000E_3 \rightarrow E_3 = 43.75$
(thus plant 3 should cut 6.25 units for a total cost of \$0.156m)

Thus, the total cost of abatement under this scenario is \$2.23m and emissions are reduced by 89.25.

b) The total cost of each plant cutting emissions by 20% is:

Plant 1: reduces emissions by 20 units at a cost of \$0.2m

Plant 2: reduces emissions by 40 units at a cost of $1.2m
Plant 3: reduces emissions by 10 units at a cost of $0.4m

Thus the total cost would be $1.8m. Notice, however, that the total emissions reduced in part (b) is less than in part (a). To achieve the same pollution reduction as in part (a), emissions would have to be cut by 25.5% (=89.25/350) across the board and yield a TAC = $2.93m.

c) The emissions tax necessary to achieve the result from part (a) would be t = $50,000 per ton of SO2. Clearly each firm would prefer the standards since they would avoid the high tax bill. Even though Plants 2 and 3 would end up paying more in abatement costs under the standards compared to the abatement costs under the efficient tax, their total tax payments would simply be too much to pay. From the economist's point of view, the tax leads to the socially efficient outcome. Under the standards approach, the plants will still generate pollution that imposes uncompensated damages on the greater society. The tax, though quite costly from the plants' point of view, generates tax revenue that could, in principle, be used to compensate the victims of pollution. A tradable discharge permit system might provide more flexibility for the firms. Or, the tax could be modified to exempt a specified amount of emissions before the tax would kick in.

7. Cleaner autos and gas taxes.

a) The policies do not seem to be working toward the same objectives. If the objective is to reduce auto emissions, an increase in the gasoline tax would cause drivers to cut back on how much they drive. Combined with the clean auto mandate, overall auto emissions would be further reduced.

b) There are likely to be a variety of policies. Here are some samples from your answers:

- Introduce inspection and maintenance programs that will force consumers to buy cars that produce less emissions (this will encourage manufacturers to stop producing dirty cars)
- Provide government subsidies to auto manufacturers to develop cleaner technology
- Give tax breaks to auto manufacturers for the development of cleaner technology
- Put a tax on the dirty cars so as to encourage the purchase of cleaner cars.

8.

9. Mandatory beverage container laws.

a) It is difficult to say whether the mandatory-deposit law is "cost effective" without knowing more about other compliance costs and overall benefits. Would Michiganders be willing to pay $300 million per year to achieve this much litter reduction? It could be that an 82% decrease in beverage-container litter is too much or too little.

b) Even if Michigan residents valued the litter reduction at more than $300 million per year it is still not clear that the law is cost effective. We still do not have information on other compliance aspects. Is there a less-costly way to achieve the same result?

c) 30,000 full time workers. Your guess is as good as mine as to whether this "army" can do a better job at cleaning up bottles compared to the mandatory-deposit law. Even if they could do a "better" job, that doesn't necessarily settle the issue. Some might prefer the mandatory-deposit law because it places the cost on the "guilty" parties.

10.

11. We did most of this one in class.

12. Billboards provide a social benefit in the sense that they provide consumers information about products and services. Such information could, for example, reduce the costs consumers face when searching for products--consider the value to a family on a road trip trying to locate a place to eat or sleep. On the other hand, billboards may be viewed as a blight on the rural landscape (a negative externality).

13. Check your notes and the text.

14. We considered this one in class.

15. CFC tax

a) The equilibrium before the tax is found by setting demand = supply:

18.4 – 0.5P = 10 +2.5P ➔ P = 2.8 and Q = 17

The equilibrium with the tax is found by setting demand = new supply:

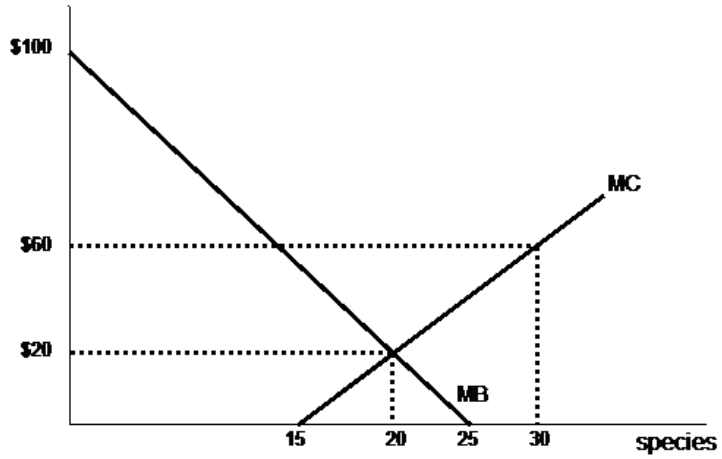
18.4 – 0.5P = 8.5 + 2.5P ➔ P = 3.3 and Q = 16.75

b) The burden of the tax is primarily borne by the buyers in the market. Notice that the price rises from 2.8 to 3.3, an increase of 0.50. Since the tax = 0.60, buyers pay roughly 83% (=.5/.6) of the tax. Buyers end up paying more of the tax because the demand for CFCs is relatively more inelastic than the supply.

16. The economic forces leading to extinction include (i) overharvesting due to common resources problems, and (ii) habitat destruction due to the spread of development such as logging, farming, or urban sprawl. Some of the benefits of preserving biodiversity include the exploitation of genetic lifestock for medical research and farming, and the maintenance of species and ecosystems for ecological balance and adaptability purposes.

17. The efficient number of species to preserve is found by setting the marginal benefit equal to the marginal cost of species. The marginal benefit is derived from the total benefit equation by taking the first derivative with respect to Q: thus, MB = 100 - 4Q. The marginal cost is given as MC = 4(Q-15) = 4Q - 60. Setting MB = MC we get:

100 - 4Q = 4Q - 60
160 = 8Q
Q = 20



For part (b), to preserve all 30 species the MC would be $60 per species. Thus, the external benefit would have to match this cost in order to justify saving all 30 species.

18.