DUE DATE: 10AM, Dec 30, 2020/Wednesday. You can send your assignment by email.

1. Suppose there are two firms. Both of them emit 30 units of pollution, and the Environmental Authority wants to reduce this level to a total of 20 units between both firms. They decide to allocate 10 permits (allowances) to each firm, where each permit will allow 1 unit of emissions per permit. Assume the following information, where TAC is total abatement cost and MAC is marginal abatement cost:

$$TAC_1 = 10 + .75A_1^2$$
$$MAC_1 = 1.5A_1$$
$$TAC_2 = 5 + .5A_2^2$$
$$MAC_2 = A_2.$$

   a- If each firm keeps its 10 permits, how much will they each spend in total to reduce emissions?

   b- Is there a more cost efficient solution than the one you found in part a? Please explain and find this solution.

   c- How much will the two firms each spend in total to reduce emissions at the cost efficient solution?

   d- How many permits will be sold? Who will sell them? How much will they sell for?

2. Suppose that the marginal damages to society from air pollution are $MD = e - 25$, where e is the level of air pollution. Suppose also that the marginal cost of reducing the air pollution on the part of firms is $MC = 200 - 2e$.

   a- Find the optimal level of pollution. Illustrate graphically.

   b- Find the net gain to society, assuming firms were initially not controlling emissions at all.

   c- What level of tax would achieve the optimal level of pollution?

   d- Suppose instead of a tax a standard is set so that the level of pollution is 10% below the efficient level. Calculate the cost to society.

   e- Suppose that the tax is set so that it is 10% too low. Calculate the cost to society.

3. Pollution control: Absent any environmental policy, suppose that there are N polluters that emit u_i $(i = 1, ..., N)$ units of polluting emissions. Therefore, without any policy, the total amount of emissions is $\Sigma_{i=1}^{N} u_i$. Following the inaction of a policy, let $\bar{e}$ be the legal concentration level with $\Sigma_{i=1}^{N} u_i > \bar{e}$. Each firm incurs costs when reducing their emission levels: $C_i(q_i)$, where q_i is the level of abatement/mitigation done by firm i. Let $u_i = 3i$, $N = 4$, $\bar{e} = 5$, and $C_i(q_i) = i + \frac{i}{2}q_i^2$.

   a- Calculate the efficient abatement level, q_i, and with it, the level of net emissions (i.e.; $u_i - q_i$). To simplify the problem, assume that $u_i > q_i > 0$, that is, the solution is interior.

b- Suppose that there is an emissions trading scheme in this economy. Calculate the permit/allowance price.

c- Calculate the emissions tax rate that would lead to the efficient (first-best) solution.