THE UNIVERSITY OF BRITISH COLUMBIA

Economics 371

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Final Examination

Instructions: Time: 2.5 hours. This is a closed book exam. No notes or books may be used.

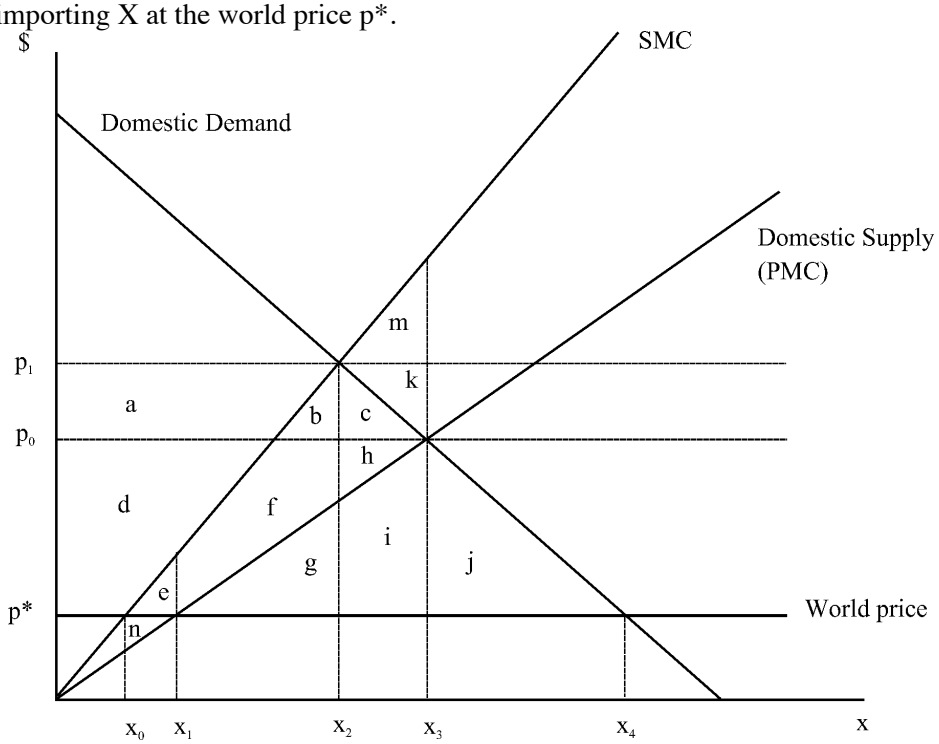
1. **[15 marks]** Suppose a region has two factories that emit smoke. The smoke contains particles that are toxic. The marginal abatement cost from factory 1 is $MAC_1 = 100 - e_1$, where e_1 is grams of particles emitted per day from factory 1. The marginal abatement cost from factory 2 is $MAC_2 = 100 - 2e_2$, where e_2 is grams of particles emitted per day from factory 2. Costs are measured in dollars.
   There is just one monitoring point. Suppose that 1/4 of the particles from factory 1 reach the monitoring point every day, and that 1/2 of the particles from factory 2 reach the monitoring point every day. The regulator has a target of 29 grams of particles per day at the monitoring point.

(a) If the regulator wants to minimize the social cost of meeting the air quality target at the monitoring point, what level of emissions should each factory be allowed to release?

(b) If a pollution tax is used to implement the target, what tax should each factory be charged?

(c) Suppose now that it is estimated that the marginal damage caused by particles at the monitoring point is MD = 60. That is, each additional particle causes damage of $60. If the regulator wants to achieve the socially efficient level of pollution, how much pollution should each factory be allowed to emit? What pollution tax should each be charged?

2. **[20 marks]** A country (Home) produces and consumes good X. X pollutes during production. Pollution from X is directly proportional to output. Social marginal cost (SMC) from domestic production is above private marginal cost (PMC) - the gap between the two curves is the marginal damage from pollution. Home also has the option of importing X at the world price p*.



(a) Suppose that initially there is no international trade allowed. (Domestic consumers have to buy from Home producers). Also suppose there is no pollution regulation.
   (i) What will be the domestic price of X? How much will be produced?
   (ii) What is the socially efficient level of production (assuming that international trade is impossible)?

(b) Continue to assume that pollution is unregulated. Suppose now that the government negotiates a free trade agreement so that consumers are now free to import at the price p*.
   (i) How much X is consumed? How much X is produced? Does pollution rise or fall?

(ii) What is the increase in consumer surplus caused by trade? [Use areas in the diagram]
(iii) What is the loss in producer surplus?
(iv) What areas in the diagram measure the benefits (or costs) of the change in pollution?
(v) What is the overall net social benefit of allowing free trade?

(c) Suppose that we are in the free trade equilibrium (that is, output and consumption are as in b(i) above). The government is considering imposing a pollution tax.
(i) What is the socially efficient level of output (in free trade)? What is the socially efficient level of consumption (in free trade)?
(ii) Use a diagram to indicate the socially efficient pollution tax. What is the net social gain from imposing such a tax?
(iii) Representatives from Home's X industry are unhappy about the tax. They argue that the tax will reduce competitiveness and cause their output to fall. Moreover, the foreign government has no pollution policy. So Home's industry says that it is unfair to have a pollution tax on home production. They argue that the Home government should either exempt them from the pollution tax or that an equivalent pollution tax should also be charged on imports from the foreign country. What do you think should be done? Explain carefully.

3. **[15 marks]** Carbon emissions are a uniformly mixed pollutant – the location from which the emissions are generated does not affect the damage caused. Suppose that the global community finally comes to a consensus and agrees that a binding restriction on global carbon emissions must be implemented. However, if agreement cannot be reached on how to implement the target, then the consensus will collapse. Three alternative policies are suggested: (1) Each country would have a restriction on carbon emissions per unit of GDP. (2) Each country would have a restriction on carbon emissions per person living in that country. (3) There would be a global uniform carbon tax. What are the strengths and weaknesses of each policy? What would you recommend? Justify your answer.

4. **[10 marks]**. "Since international trade increases a country's real income, and since the willingness to pay for environmental quality increases with income, then one would expect trade liberalization to reduce pollution in developing countries." Discuss.

5. **[15 marks]** Consider a fish population that lives in waters off the coast of British Columbia. Assume that the fishery can only be accessed by boat. Suppose that anyone who wants to catch fish is free to do so if they have a suitable boat. The fish are quite tasty and so there is strong consumer demand.
(a) Explain why one would expect that the level of harvesting in this fishery would be socially excessive.
(b) Suppose that the government decides it must act to protect the fishery. It determines that the fishery will be viable only if the annual harvest is reduced substantially. For concreteness suppose that there are initially 300 boats active in the fishery. The government proposes that (i) all boats engaged in the fishery must have a license and (ii) the number of licensed boats will be strictly limited to 150. That is, it plans to significantly reduce the size of the fishing fleet. It also proposes to compensate those who are not granted a license – it will pay them to refit their boats to be used for some other purpose. Would you expect this proposal to yield a cost-effective outcome? Would you expect it to be effective in preserving the fish stock? Explain carefully, using concepts from economic theory (and any evidence you are aware of).

6. **[10 marks]** Antibiotics kill bacteria and can cure and prevent infections. However, as antibiotics are used more, some strains of bacteria can develop a resistance to the antibiotics they have been exposed to (through a natural selection process). These resistant bacteria cannot be killed by the antibiotics that had been in use and new forms of antibiotics are needed to deal with them. Do you think a free market would lead to the socially efficient usage of antibiotics? Explain carefully. Would you recommend any policies to regulate the use of antibiotics?

7. **[15 marks]** Canada has just announced that it will formally withdraw from the Kyoto Protocol. That is, the current Canadian government has announced that it does not intend to meet targets for reduced carbon emissions that an earlier government had agreed to. Do you agree or disagree with this decision? Explain carefully why or why not. [Note that there is not necessarily a right or wrong answer here – I am looking for a creative and carefully reasoned response].