Economics 3250 Dr. Lozada
Spring 2015 Final Exam

This exam has 50 points. There are ten questions on the exam, each worth 5 points.

Put your answers to the exam in a blue book or on blank sheets of paper.

Answer the questions using as much precision and detail as the time allows. Correct answers which are unsupported by explanations will not be awarded points.

**Answer all of the following ten questions.**

1. **[5 points]**
   (a) What is the scientific mechanism by which carbon dioxide and other "greenhouse gases" increase the average temperature of the Earth?
   (b) Suppose global emissions of "greenhouse gases" remained constant at their current levels forever. Would this solve the problem of global climate change? Why or why not?

2. **[5 points]** Describe the general economic consequences that have occurred as a consequence of trying to combat the thinning of the ozone layer. Have those economic consequences been mild or severe? Are they likely to be mild or severe in the future?

3. **[5 points]** One of the economic benefits of biodiversity is "existence value." Name two other economic benefits of biodiversity (and explain your answer).

4. **[5 points]** Suppose you were trying to figure out the socially-optimal sulfur dioxide emissions from China. What specific damages would you take into account? Would the dollar amount of these damages per ton of emissions be the same as for sulfur dioxide emissions from the USA? Explain.

5. **[5 points]** Explain Kenneth Boulding's "Spaceship Earth" analogy, and state its policy implications.

6. **[5 points]** Suppose a graph of "births minus natural deaths" versus population size "$x$" for a fishery looks like this: it is zero at $x = 0$; it is zero at $x = K$ where $K$ stands for the "carrying capacity"; it is positive between $x = 0$ and $x = K$; and it is negative for $x > K$.
   (a) Sketch the graph of steady-state total revenue versus fishing effort.
   (b) Sketch a graph of total cost versus fishing effort.
   (c) Where is the open-access equilibrium? Why?

7. **[5 points]** Define and give an example of:
   (a) emissions charges;
   (b) user charges;
   (c) product charges; and
   (d) deposit-refund systems.

8. **[5 points]**
   (a) Describe a situation in which economists worry that people will overstate "willingness to pay" ("WTP").
   (b) Describe a situation in which economists worry that people will understate WTP.
   (c) Why might such overstating of WTP or understating of WTP occur less frequently than economists expect?

9. **[5 points]** Use Figure 1 (which is on the next page) to prove an important point about the difference between pollution taxes and pollution standards.

10. **[5 points]** How might the distinction between "reserves" and "resources" be viewed differently by Malthusians versus what the textbook calls "Ricardians"?

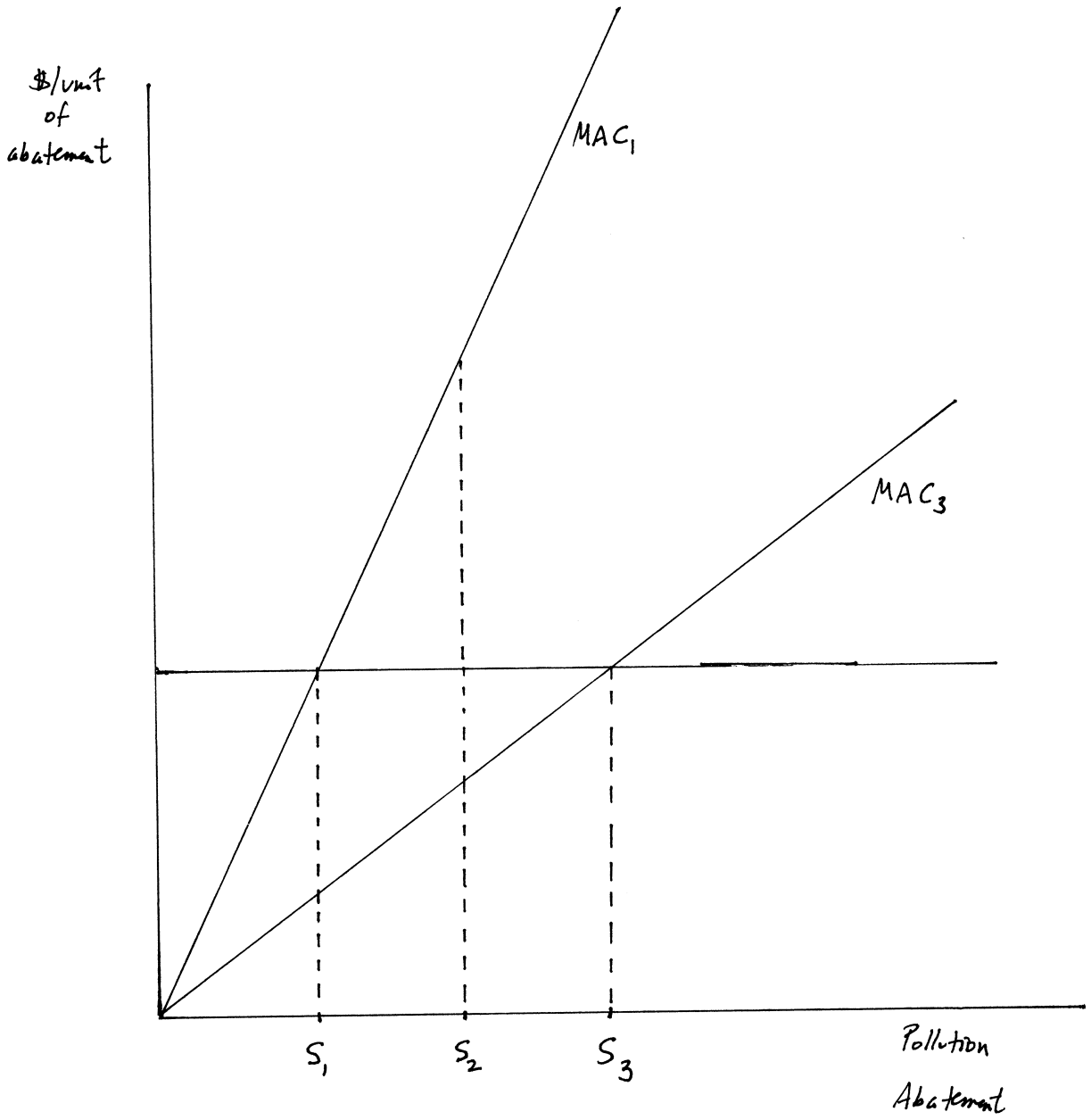



Figure 1

# Answers to Econ. 3250 Final Exam, Spring 2015

(1) a) $CO_2$ and other greenhouse gases are rather transparent to short-wavelength solar radiation, so it passes through the atmosphere and hits the earth. The earth re-radiates it as longer-wavelength radiation, but greenhouse gases are mostly opaque to that, so it can't pass through the atmosphere; it's absorbed instead. Therefore more solar energy than in pre-industrial times enters the earth's atmosphere and never leaves. This causes warming.*

b) No. Keeping emissions constant would still increase the concentration of greenhouse gases in the atmosphere, making global climate change worse and worse, just at a slower rate than if emissions kept rising.

*Optional: The earth naturally has some greenhouse gases, such as water vapor, which is why it's always been warmer than outer space. Manmade emissions of greenhouse gases have been too small to cause much of a change in total greenhouse gases in the lower atmosphere, where the water vapor is, but manmade emissions of greenhouse gases have caused a large change in total greenhouse gases in the upper atmosphere, which has very little water vapor.

The main ozone-depleting chemicals are chlorofluorocarbons (CFC's), which are mainly used as refrigerants. Other uses include foam-blowing and spray can propellants. Industry has developed substitutes for CFC's in these applications, although the substitutes in refrigeration do have chemical similarities to the old CFC's. Nevertheless, the refrigeration substitutes hurt the ozone layer much less than the old CFC's did, and while they cost more than the old CFC's, they don't cost much more. It also has not been costly for refrigeration technicians to take care not to release CFC's into the atmosphere. So the economic cost to combat thinning of the ozone layer has been mild. It may become even milder as ever-better substitutes for CFC's are found.

Optional: Costs of reducing reliance on old CFC's were not very low in the very early years after the Montreal Protocol was signed. There were even some attempts to evade the Protocol's restrictions in the 1990's. By now, the costs have fallen.

(3)

Possible examples include

direct use value:
- medicinal plants, for example in tropical forests
- ecotourism ——— " ———
- nuts and fruits from tropical forests

indirect use value:
- Carbon sequestration by forests (to help with global climate change)
- Storm protection by wetlands (they absorb water that otherwise could cause flooding)
- water purification by wetlands (they trap sediment)

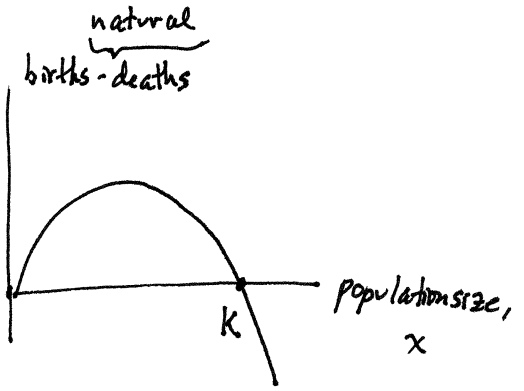
(4)

$SO_2$ emissions from China have bad effects where the $SO_2$ is deposited, primarily as acid rain, which would be in Korea, Japan, and eastern (especially northeastern) China. Damages which should be taken into account include forest damage, damage to fresh-water fisheries, and damage to buildings made of stone. These damages would have to be specific to East Asia, and so would not be the same as damages in North America caused by U.S. emissions.

A spaceship is a small, isolated environment. Other than the International Space Station, and its predecessors, manned flights into space were not resupplied, so they had to carry everything needed for survival with them. Therefore the astronauts wasted as little as possible, and recycled as much as possible, which they still do. Boulding points out that the Earth is like a spaceship, getting nothing except sunlight from elsewhere, so we should start behaving more like astronauts, decreasing natural resource use and increasing recycling, and limiting production of waste (though astronauts could dispose of some waste by putting it into space).

Optional: Boulding contrasts the "spaceman economy" with the "cowboy economy," the latter inspired by the 19th century cowboys of the western US, who thought of resources as being almost limitless in their abundance.

⑥




a) population size change = births $\overbrace{-}^{\text{natural}}$ deaths - harvest

Steady state ⇒ population size change = 0 ⇒

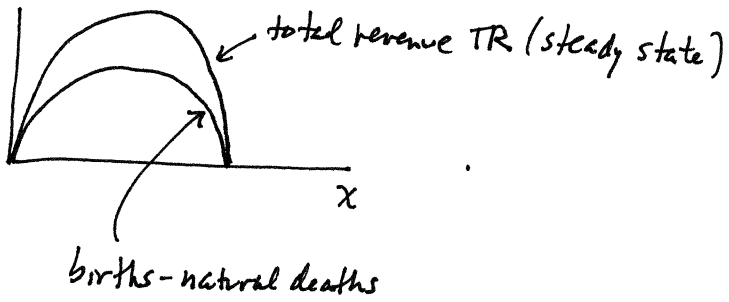
steady state harvest = births - natural deaths

and

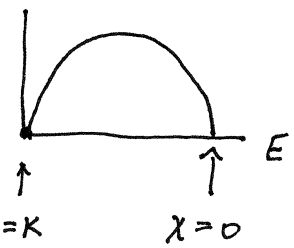
total revenue in the steady state = price (a constant) times steady state harvest

= constant * (births - natural deaths).

So




As effort E ↑, stock size x ↓. E = 0 at x = K (no human activity in the fishery). Thus TR




in the steady state.

(7)

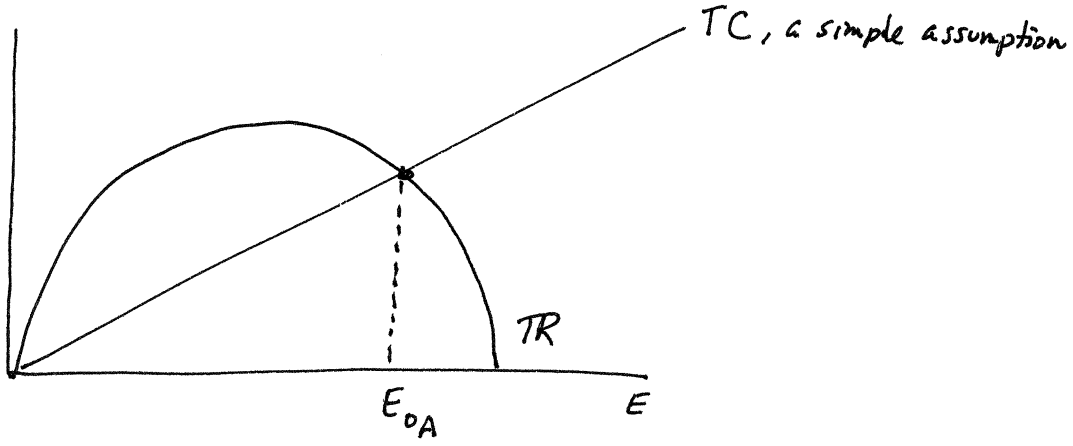
a) Emissions charges are the same as pollution taxes: payments made per ton or liter of pollutant emitted.

b) User charges are fees polluters have to pay, but they are not related to the amount of pollution generated. An example would be fees polluters pay to fund the regulatory agency overseeing that pollutant.

c) Product charges are fees added onto the final price of the commodity whose production caused the pollution. An example would be a fee added to the price of new tires to help eliminate pollution caused by old tires ("pollution" such as being eyesores or serving as breeding grounds for mosquitos).

d) In a deposit-refund system, a fee is imposed when the product is bought, and it is refunded if the product is returned to an approved place once it is no longer useful to the consumer. Glass bottles are sometimes subject to such a system.

b), c)




The open-access equilibrium is at $E_{OA}$, since there $TR = TC$, so profit $\pi = 0$. Any other level of $\pi$ would lead to firm entry (if $\pi > 0$) or exit (if $\pi < 0$), so would not be an equilibrium.

Optional: Private property is different because in it, firm entry is not allowed, so $\pi > 0$ can persist in equilibrium.

(8)

a) Suppose a respondent is told that high reported WTP makes it more likely the government will preserve an environmental amenity which the respondent likes. If the WTP survey is anonymous, the respondent has an incentive to overstate WTP, since that makes it more likely the amenity will be preserved, and comes at no cost to the respondent because of anonymity.

b) If the survey in (a) is not anonymous, and preservation of the amenity will require respondents to actually pay their WTP, they have an incentive to "free-ride" on other supporters of the amenity by understating their WTP. Doing so, they reason, decreases the chance that the amenity is preserved by a tiny amount, while greatly decreasing the payment they have to make if it is preserved.

c) Mis-reporting WTP means telling a lie, which humans often are hesitant to do because honesty is a valued personality characteristic.

(9)

If a standard of $S_2$ is imposed, Firm 3 will produce at A, generating total abatement costs of $0AS_2$ (the area under $MAC_3$); Firm 1 will produce at B, generating abatement costs of $0BS_2$. Abbreviate total abatement costs by "AC." Under a pollution tax of "t" in Fig. 1, Firm 3 produces at D, and has $AC = 0DS_3$; Firm 1 produces at C and has $AC = 0CS_1$.

Pollution under standard: $S_2 + S_2 = 2S_2$

Pollution under tax: $S_1 + S_3 = S_1 + S_3 (+ S_2 - S_2)$

$= S_1 + S_2 + S_3 - S_2$

$= S_1 + S_2 + S_2 - S_1$ since $S_3 - S_2 = S_2 - S_1$

$= 2S_2$.

Since pollution is the same, whichever policy minimizes total AC is more efficient. Starting with a standard, a move to a tax:

Saves Firm 1 $0BS_2 - 0CS_1 = BCS_1S_2$

Costs Firm 2 $0AS_2 - 0DS_3 = -DAS_2S_3$

↳ a negative benefit, actually.

Note that $BCS_1S_2 > ECS_1S_2 = DES_2S_3 > DAS_2S_3$. So with this figure, the tax minimizes total AC and is more efficient than the standard.

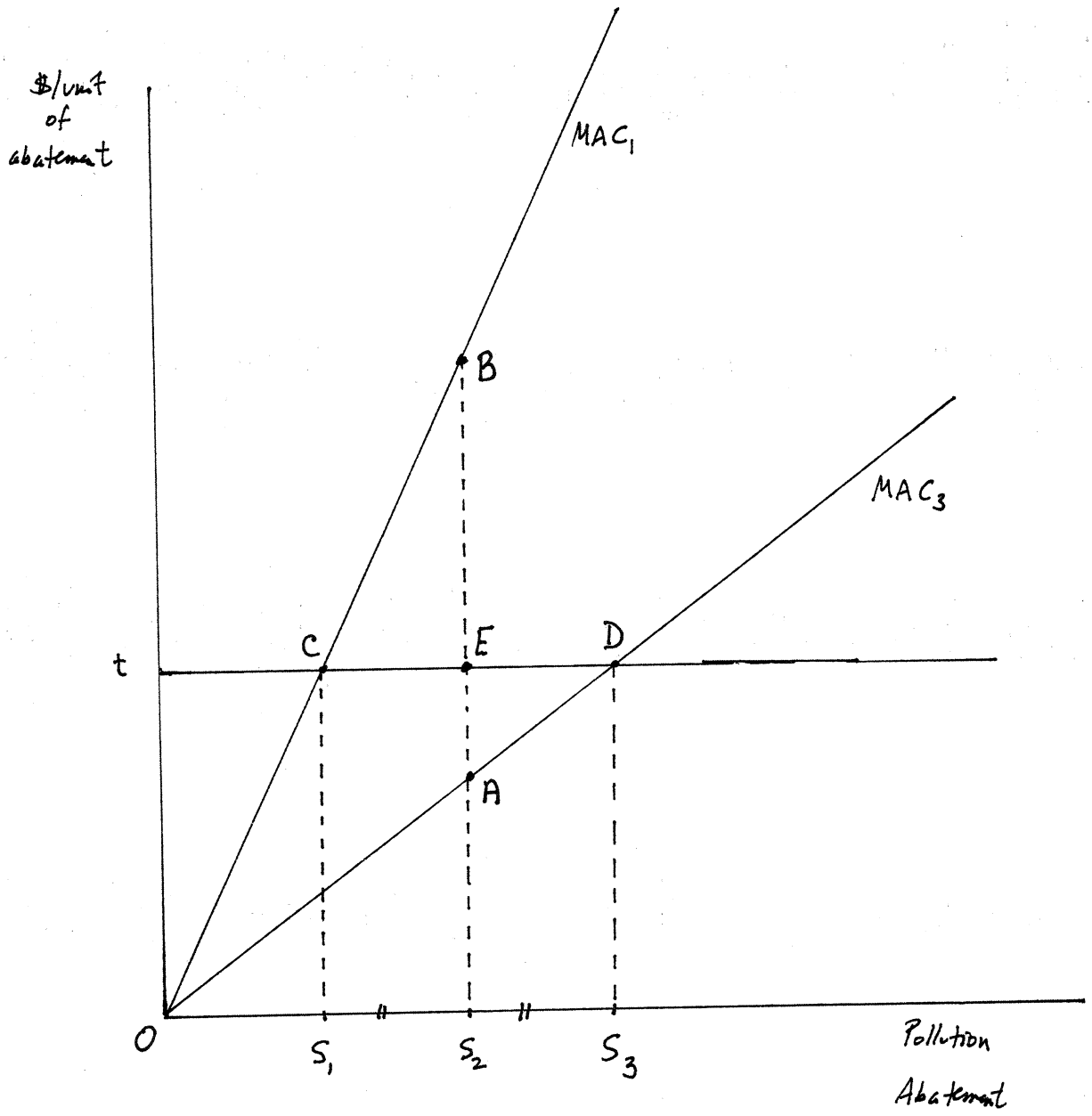

$/unit of abatement
MAC1
MAC3
B
C
E
D
t
A
O
S1
S2
S3
Pollution Abatement

Figure 1

Ricardians (so-called) emphasize the availability of many different qualities of resources; as good ones are used up, extraction from poorer ones begins. So in their view, reserves are a small subset of resources, and the stock will not be exhausted when today's "reserves" have run out.

Malthusians emphasize resource scarcity and, often, imminent exhaustion, so for them the distinction between reserves and resources is minor or unimportant. In their view, when today's "reserves" have run out, the entire stock will be very close to exhaustion.