This exam has 33 points. There are six questions on the exam; you should work all of them. Half the questions are worth 5 points each and the other half are worth 6 points each.

Put your answers to the exam in a blue book or on blank sheets of paper. The figure for the exam appears after the questions.

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. Therefore, even if you think something is "obvious," do not omit it. If you omit anything, you will not get credit for it. You get credit for nothing which does not explicitly appear in your answer. If you have questions about the adequacy of an explanation of yours during the exam, ask me.

You have **1 hour and 5 minutes** (that is, until 12:55PM) to finish this test.

Answer all of the following questions.

1. [**6 points**]   Often we have assumed society wishes to equate "Marginal External Cost" and "Marginal Net Private Benefit." Why does such an assumption make sense? Include in your answer a discussion of "External Cost" and "Net Private Benefit" (note the last two phrases do not include the word "Marginal").

2. [**5 points**]   In class, we discussed how asymmetric information can cause "adverse selection" (if there are hidden "types") or "moral hazard" (if there are hidden actions).

   We also discussed how, if there is asymmetric information about the Marginal Net Private Benefit curve, Coasian bargaining can result in an outcome which is not socially optimal, due to the ability of one of the parties to make (empty) threats. Explain this analysis. As a small part of your answer, tell me whether this is a case of adverse selection or of moral hazard.

3. [**6 points**]   What important economic result does Figure 1 illustrate?

   Use Figure 1 to prove the result (at least in the special case illustrated by the figure).

4. [**6 points**]   Why do we expect Willingness to Pay to usually not equal Willingness to Accept? It's enough to illustrate your answer with one graph showing either a potential gain of utility or a potential loss of utility; you do not have to illustrate both cases.

5. [**5 points**]   What is the "starting point bias" present in (some) contingent valuation analyses?

6. [**5 points**]   Some critics of Nicholas Stern's economic analysis of global warming say the discount rate he used was too low. If he had used a higher discount rate, what might have changed in his analysis? Why?
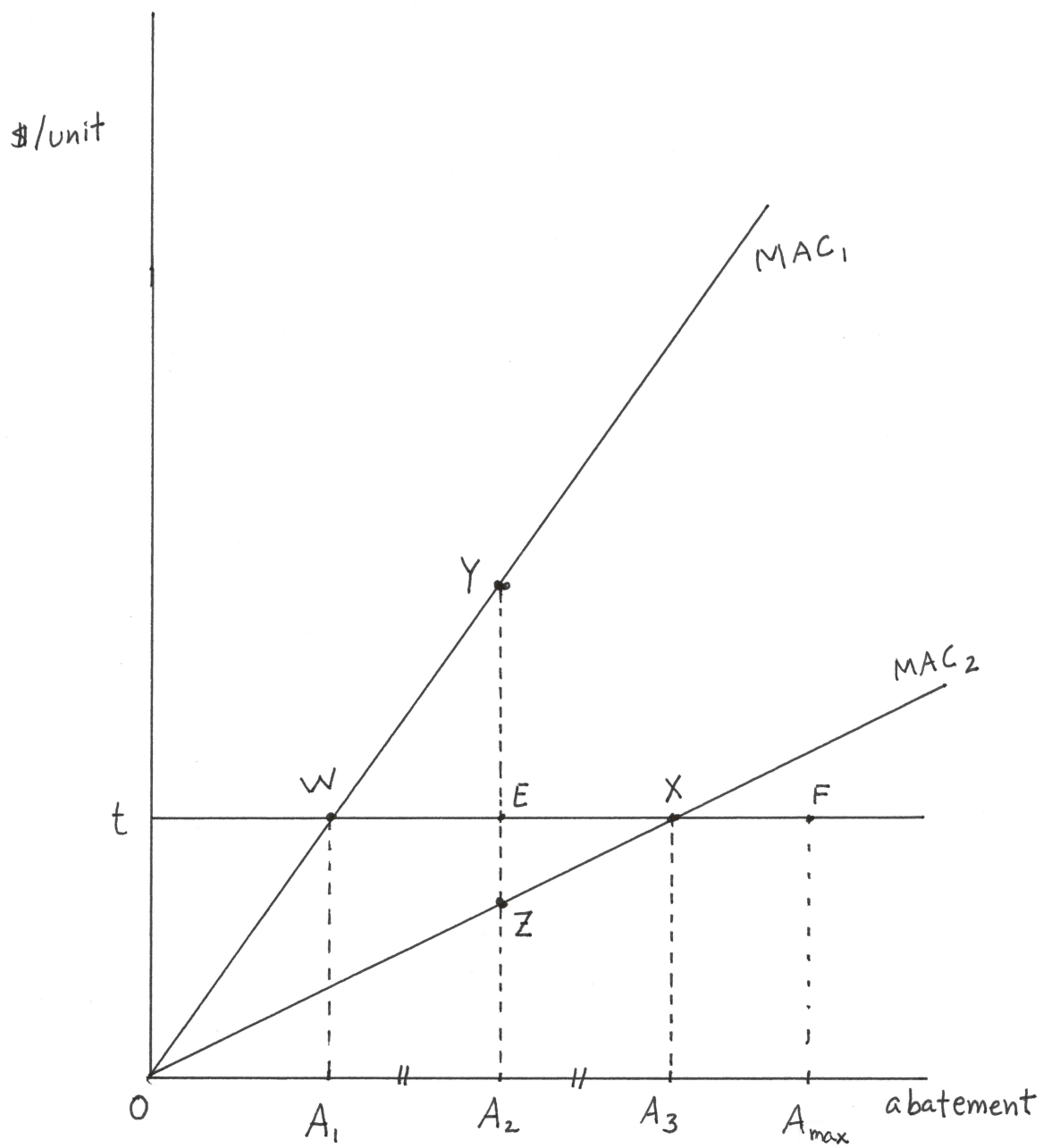
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Figure 1

① Society's goal is to maximize

$$\text{Net Private Benefit} - \text{External Cost}$$

↑ ↑

Gross Benefits minus Gross Costs for the firm creating the pollution (and its customers) | Costs borne by agents other than the firm and its customers — for example, by pollution victims
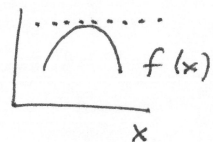
If we think of these as being functions of output Q, then, using abbreviations, society wants to maximize $NPB(Q) - EC(Q)$.

Calculus explanation: to find the maximum, set zero equal to the derivative of the objective function with respect to Q:

$$0 = \frac{d}{dQ}NPB(Q) - \frac{d}{dQ}EC(Q) = MNPB - MEC$$

$$\Rightarrow MEC = MNPB.$$

Non calculus explanation: a maximum of a function such as

is obtained when the tangent line (the dotted line) is horizontal. The tangent line is the marginal of f, which in our case

$$\underbrace{\text{is marginal}}_{\text{slope of the}} (NPB-EC) = MNPB - MEC.$$ So we want this, which is

the tangent line's slope, to be zero. Hence $MNPB = MEC$. Or: $MNPB < MEC \Rightarrow$ Q should fall to increase NPB-EC; $MNPB > MEC \Rightarrow$ Q should rise to increase NPB-EC; so the best Q is where $MNPB = MEC$, maximizing NPB-EC.

(2) $/unit

false MNPB

MEC

true MNPB

Q

Q^*_{true} Q^*_{false} Q^{π}_{true} Q^{π}_{false}
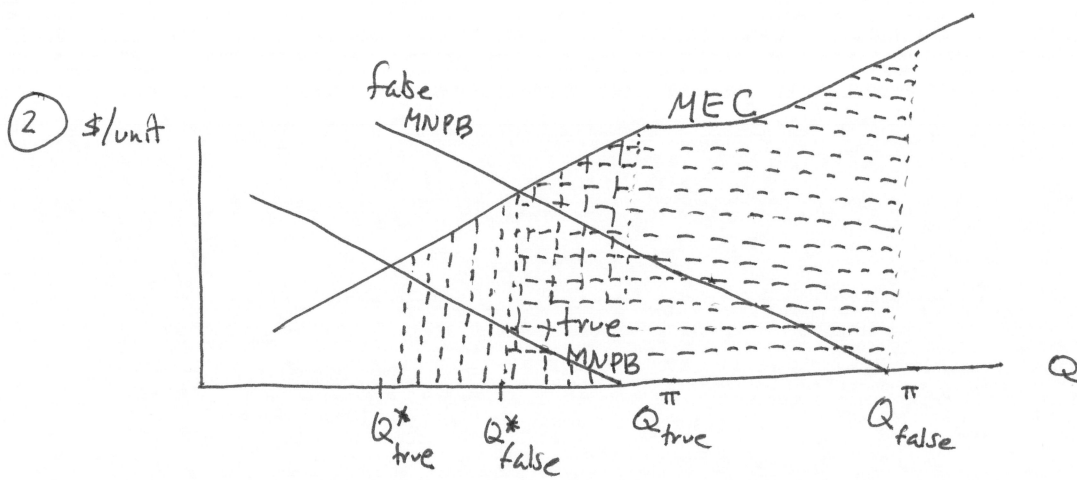
With the "true MNPB," Coasian bargaining between the firm and pollution victims, if the firm has the property right to pollute, could result in a payment by the victims to the firm of as much as the ||| area, and as little as the area under the true MNPB curve between Q^{π}_{true} and Q^*_{true}. This is because the firm will accept any payment above MNPB to decrease Q, and the victims are willing and able to offer any payment below MEC to decrease Q.

If the firm lies and claims its MNPB curve is the false one instead of the true one, and if the pollution victims believe the lie, the firm could get as much as the ≡≡≡ area, and as little as the area under the false MNPB curve between Q^{π}_{false} and Q^*_{false}, as payment by the victims to lower Q to Q^*_{false}. For a sufficiently large false MNPB, the firm is sure to be better off telling the lie.

This is adverse selection because the asymmetric information is about the "type" of the firm, either a "low MNPB" type or a "high MNPB" type.

Note: The best "false MNPB" for the firm will have Q^*_{false} equal to Q^{π}_{true}, since the latter is where the firm really wants to be at the end of the bargaining.

(3)

MAC: marginal abatement cost

MAC$_1$, MAC$_2$: MAC for firm 1 and firm 2

$\uparrow$ $\uparrow$

dirtier firm   cleaner firm

- Compare a fixed <u>standard</u> of A$_2$ for each firm with a tax (of amount " t ") on non-abatement (that is, on pollution).

- A firm that's taxed will choose abatement so that MAC = t.

 Reason: if abatement "A" is smaller than that level, then t > MAC, so should abate more (paying MAC) instead of paying t. If "A" is bigger than the MAC = t level of A, then t < MAC, so the firm should abate less (saving MAC) and pay t instead.

- Under the tax, Firm 1 goes to W and Firm 2 goes to X (due to the previous point). Abatement costs "AC" are the area under the MAC curves. So AC = OWA$_1$ and OXA$_3$ for Firms 1 and 2, respectively.

- Under the standard, A$_2$, pollution is the same as under the tax, A$_1$ + A$_3$.

 Proof : by construction, A$_3$ - A$_2$ = A$_2$ - A$_1$

$$A_1 + A_3 - A_2 = A_2$$

$$A_1 + A_3 = A_2 + A_2 .$$

- Under the standard, AC = OYA$_2$ and OZA$_2$ for Firms 1 and 2.

- Going from a standard to a tax, AC changes by :

Firm 1

$OYA_2 \rightarrow OWA_1$, a

decrease of WYA_2A_1

$\searrow_1$

Firm 2

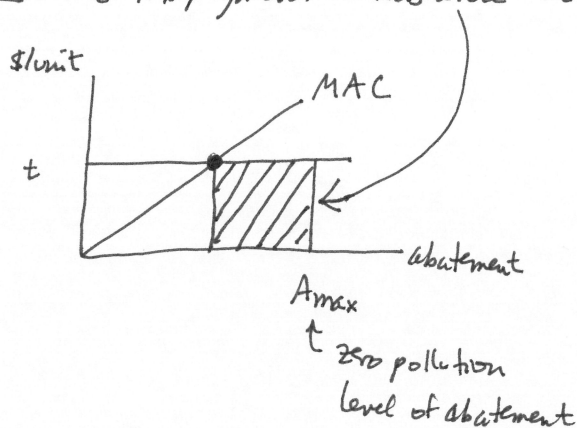$OZA_2 \rightarrow OXA_3$, an

increase of ZXA_3A_2.

$\searrow$

Overall, since $WYA_2A_1 > WEA_2A_1 = EXA_3A_2 > ZXA_3A_2$,

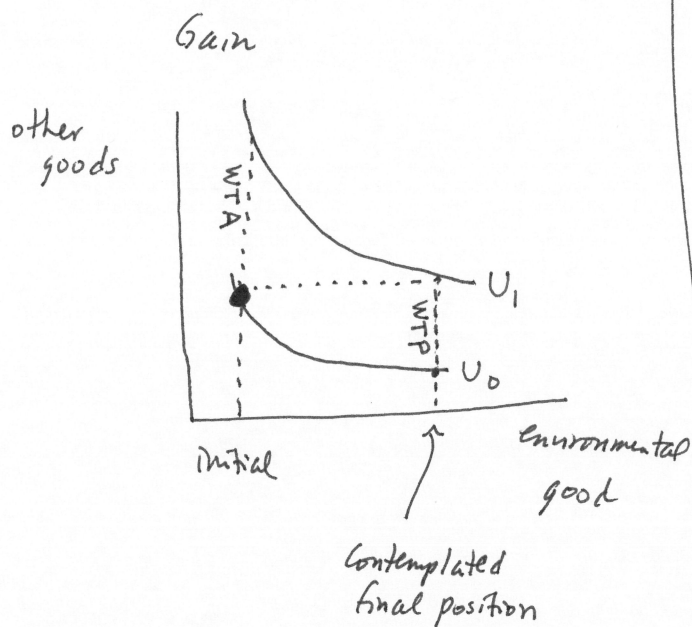abatement costs fall when going from a standard to a tax, while

abatement (and pollution) levels remain unchanged. So a standard is

inefficient (non - Pareto Optimal).

Optional: The tax payment is this area because it is a tax on <u>non</u>-abatement.

$/unit

MAC

t

abatement

A_{max}

t zero pollution

level of abatement

Gain

other goods

WTA

WTP

U_1

U_0

initial

environmental good

↑ Contemplated final position

Loss

other goods

WTA

WTP

U_0

U_1

Contemplated final position

initial

environmental good

WTP: how much of "other goods" you'd be willing to pay in order to enjoy the environmental good being ↑ from the initial to the final position

WTA: how much of "other goods" you'd be willing to accept as compensation for not ↑ the environmental good from the initial to the contemplated final position

U_0: initial indifference curve

U_1: indifference curve if the environmental good ↑ to the final position & "other goods" are unchanged

By inspection, WTA > WTP.
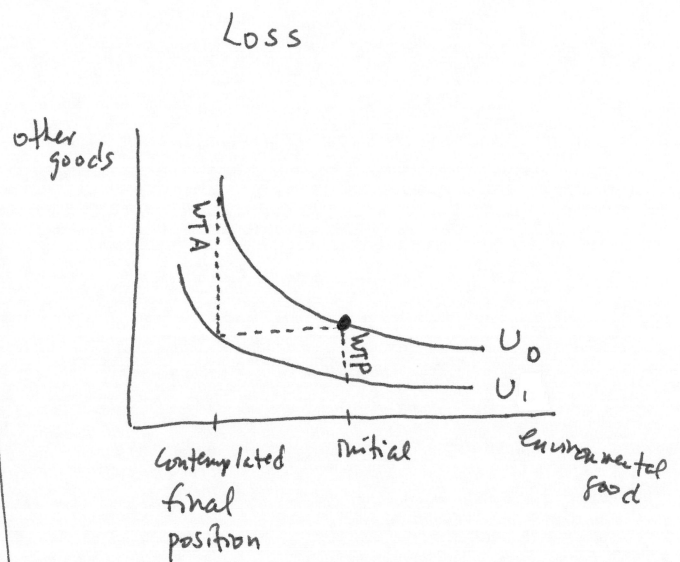
WTP: how much of "other goods" you'd be willing to pay to avoid the environmental good being ↓ from the initial to the contemplated final position

WTA: how much of "other goods" you'd be willing to accept as compensation if the environmental good was ↓ from the initial to the contemplated final position

U_0: initial indifference curve

U_1: indifference curve if the environmental good ↓ to the final position & "other goods" are unchanged

WTA > WTP in the graph.

⑤

    If a contingent valuation survey asks a multiple-choice question about valuation, the responses have to be expressed as particular numerical ranges by the economist. For example, "< $5, $5-$10, $10-$20, or more than $20". Comparing this set of responses to, for example, "< $10 $10-$15, $15-$25, or more than $25,"

respondents randomly chosen from the same population might both pick the second choice most often, even though they don't overlap. The wording of the question is affecting the answers obtained. The "starting point" is $5 in the first version and $10 in the second (although the bias is a function of all the numbers, not just the first).

    A simpler example is : "< $5" or "$5 or more" versus "< $10" or "$10 or more."

You'd expect fewer people to choose "$10 or more" than to choose "$5 or more," but often roughly the same proportion pick "$10 or more" and "$5 or more."

    The explanation is that people's preferences are not well-formed, so phrasing in the question influences them.

⑥ In general, fighting global warming has costs now and bestows benefits later.

Its present value is

$$PV = (\text{present costs}) + \left(\frac{\text{future benefits}}{1 + \text{discount rate for the future}} \right)$$

positive PV contribution ↙

↑ negative PV contribution.

As the discount rate ↑, the second term ↓, so the positive PV term becomes less important, while the negative PV term (the first term) does not change. This makes PV as a whole become more negative, so makes fighting climate change look less desirable.

So, if he had used a higher discount rate, he would not have supported as many actions to stop climate change.