PART II: WRITTEN SECTION. **ANSWER ALL QUESTIONS** IN EXAM BOOKLETS

FOR QUESTION 3 YOU MUST ALSO FILL IN THE TABLE ON THE QUESTION SHEET (BELOW)

1) Skippy has $100 in budget. She buys two goods, x and y. Her *Income Elasticity of Demand* for x is zero. The price of y is $1. When the price of x is $2 Skippy buys 20 units of x. When the price of x is $1, she buys 40 units of x. The most she is willing to pay to have the price of x lowered to $1 is $25. Based on this information, answer the following:

   a. If Skippy pays the $25 fee and the price is lowered to $1, how many units of x does she consume?
   b. Instead of lowering the price of x, you were to give Skippy a lump sum amount that would be as good as having the price of x fall to $1. How much would you give her and how many units of x will she consume?
   c. Show everything you know about this question in a CAREFULLY drawn and labelled graph. Include as much detail as possible. Label both CV and EV

2) Suppose there is an industry with two firms. Currently Firm 1 is producing 120 units of Emissions and Firm 2 is producing 60 units of emissions. Each firm's Marginal Savings function (also their Marginal Abatement cost functions) is given by
$$MS_1 = 120 - E_1.$$
$$MS_2 = 120 - 2E_2$$

   Also, there are four people, each with a marginal damage function $MD_i = (1/3)E_T$
   (where $E_T = E_1 + E_2$)

   a. *Find the aggregate MS function*
   b. *Find the aggregate MD function*
   c. *Determine the socially optimal level of emissions E and the MD.*
   d. *Suppose the government decided to use a "Fair" standard that required each firm to produce half of the socially optimal emissions. What would be each firm's MS and total abatement cost?*
   e. *What is the Pigovian tax that would achieve the socially optimal level of emissions? Find each firm's emissions, total abatement costs and tax bill.*
   f. *What are the total social costs of each approach (standard and tax)? Also what is each firm's private costs under each approach?*
   g. *Which option would those damaged by emissions prefer? Explain. What about each firm (1 & 2)? Society as a whole?*

3) Suppose that the *MD = 5E* and with its current technology, the firm's MS is given by
$$MS_1 = 200 - 5E.$$
   a. Determine the socially optimal level of emissions E.
   b. Determine the emissions tax that would achieve the socially optimal level of emissions.

Now suppose the firm can adopt a new technology that changes is MS to

New $MS_2 = 160 – 4E$

Calculate change in all costs for the firm from adopting the new technology when:

- c.   The government uses an emissions standard equal to your answer in (a) above
- d.   The government uses an emissions tax equal to your answer in (b)
     (Assume no change to standard or tax rate after the change in technology)

Now suppose the government adjusts the standard and/or the tax such that MD = New MS. Calculate the change in total costs for the firm from adopting the new technology when:

- e.   The government adjusts the standard, and
- f.   The government adjusts the tax rate

YOU ARE TO SHOW ALL YOUR WORK IN THE BOOKLETS AND FILL IN THE TABLE BELOW

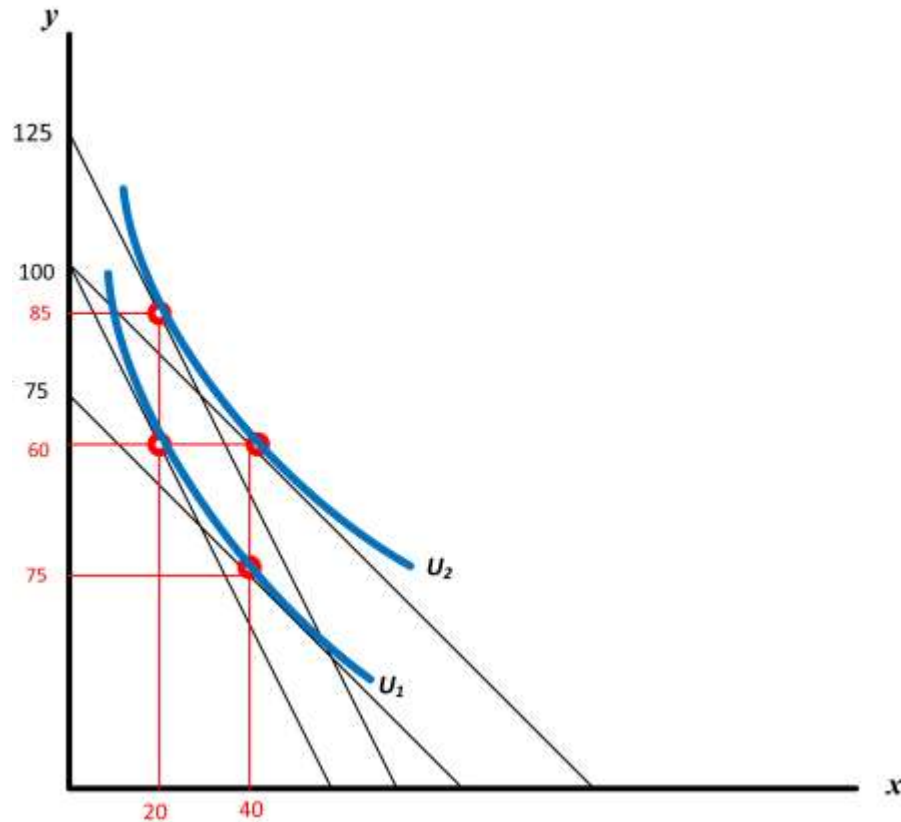| Policy	A Old Technology	B New Tech/old Standard	C New Tech/new Standard
TAC standard	1000	800	986.8

		Net change (A-B)	Net Change (A-C)
NET CHANGE		200	13.2

	Old Technology	New Tech/old tax	New Tech/New Tax
TAC tax	1000	1250	986.8
Tax Bill	2000	1500	1582.4
Total Cost	3000	2750	2569.2

		Net change (A-B)	Net Change (A –C)
NET CHANGE		250	431

ANSWER KEY PART 2

[1] CV and EV: Income Elasticity = 0 for x

Skippy has $100 in budget. She buys two goods, x and y. Her *Income Elasticity of Demand* for x is zero. The price of y is $1. When the price of x is $2 Skippy buys 20 units of x. When the price of x is $1, she buys 40 units of x. The most she is willing to pay to have the price of x lowered to $1 is $25. Based on this information, answer the following:

   d. If Skippy pays the $25 fee and the price is lowered to $1, how many units of x does she consume?
   e. Instead of lowering the price of x, you were to give Skippy a lump sum amount that would be as good as having the price of x fall to $1. How much would you give her and how many units of x will she consume?
   f. Show everything you know about this question in a CAREFULLY drawn and labelled graph. Include as much detail as possible. Label both CV and EV

[2] Suppose there is an industry with two firms. Currently Firm 1 is producing 120 units of Emissions and Firm 2 is producing 60 units of emissions. Each firm's Marginal Savings function (also their Marginal Abatement cost functions) is given by

$MS_1 = 120 – E_1$.

$MS_2 = 120 – 2E_2$

Also, the marginal damage function is given by $MD = (4/3)ET$

(where $ET = E_1 + E_2$)

Find the aggregate MS function

$E_1 = 120 – MS$ $E_2 = 60 – (1/2)MS$

$E_1 + E_2 = ET = 180 – (3/2)MS$

$MS = 120 – (2/3)ET$

Determine the socially optimal level of emissions E and the MD.

$120 – (2/3)ET = (4/3)ET$
$2ET = 120$ $ET = 60$ $MD = (4/3)(60) = 80$

Suppose the government decided to use a "Fair" standard that required each firm to produce half of the socially optimal emissions. What would be each firm's MS and total abatement cost?

$ET = 60$ $E_1 = E_2 = 30$ $MS_1 = 90$ $MS_2 = 60$
** $TAC_1 = 4050$ $TAC_2 = 900$**

What is the Pigovian tax that would achieve the socially optimal level of emissions? Find each firm's emissions, total abatement costs and tax bill.

Tax rate is 80 $E_1 = 40$ $E_2 = 20$
$TAC_1 = (120 – 40)(80)(0.5) = 3200$ $TAC_2 = (60 – 20)(80)(0.5) = 1600$

Tax Bill $= 3200$ $Tax Bill = 1600$

What is the total social costs of each approach (standard and tax)? Also what is each firm's private costs under each approach?

Standard:

Total Abatement costs $= 4050 + 900 = 4950$ total Damage $= 2400$

Total social cost is 7350

Tax:

Total Damage is 2400

$TAC_1 = 3200$ $TAC_2 = 1600$ Total Abatement costs = 4800,

Tax Bill $= 3200$ Tax Bill $= 1600$

Total Social Cost is 7200

Private Cost: Firm 1: 6400 Firm 2: 3200

Which option would those damaged by emissions prefer? Explain. What about Each firm (1 & 2)? Society as a whole?

QUESTION 3
Suppose that the **MD = 5E** and with its current technology, the firm's MS is given by
$$MS_1 = 200 – 5E.$$
  g. Determine the socially optimal level of emissions E.
      200 – 5E = 5E, therefore E = 20
  h. Determine the emissions tax that would achieve the socially optimal level of emissions.
      Tax, t = MS = 200-5E = 200 – 5(20) = 100

Now suppose the firm can adopt a new technology that changes is MS to
New **$MS_2 = 160 – 4E$**
Calculate change in costs for the firm from adopting the new technology when:
  i. The government uses an emissions standard equal to your answer in (a) above
      If Standard set at E = 20, Old Technology has a TAC = $1000. New Technology has MS = 80 and a TAC = 800. Savings from switching is $200

  j. The government uses an emissions tax equal to your answer in (b)
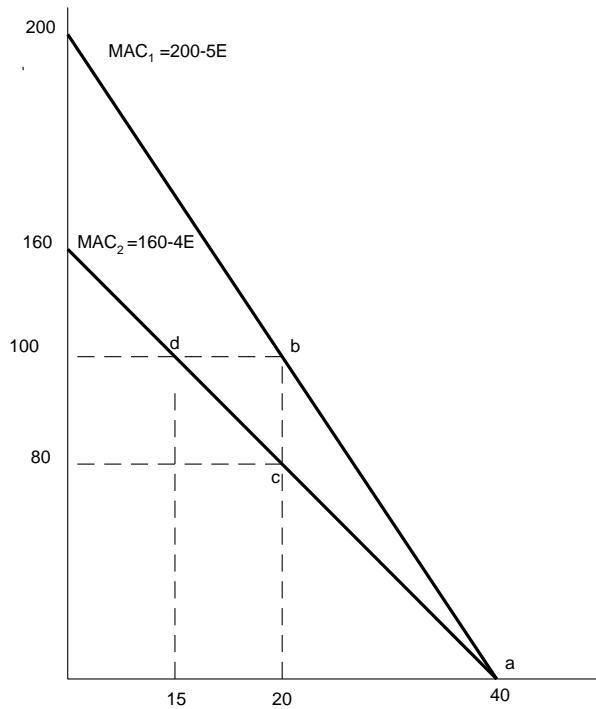(Assume no change to standard or tax rate after the change in technology)
With $100 tax
Old: MS_1 = 200 – 5E = 100 tax   E = 20
New MS_2 = 160 – 4E =100 tax   E = 15

	Tech 1 (old)	Tech 2 (new)
TAC	100x20x(1/2) = 1000	25x100x(1/2) = 1250
TAX Bill	100x20 = 2000	100x15 = 1500
	$3000	$2750

Savings from switching is $250

Now suppose the government adjusts the standard and/or the tax such that MD = New MS. Calculate the change in total costs for the firm from adopting the new technology when:

    k.   The government adjusts the standard, and
    l.   The government adjusts the tax rate

Under NEW technology:
MS_2 = MD
160 − 4E = 5E
E = 17.8 and MS = 88.9

With a standard equal to 17.8
TAC = (40 − 17.8)(88.9)*(1/2) = 986.8
Savings = 1000 − 986.8 = 13.2

Under Tax rate of t = 88.9, E = 17.8
Tax bill = (88.9)(17.8) =1582.4
And TAC = 986.8
TAC + Taxbill = 2569.2

Savings = 3000 − 2569.2 = 430.8
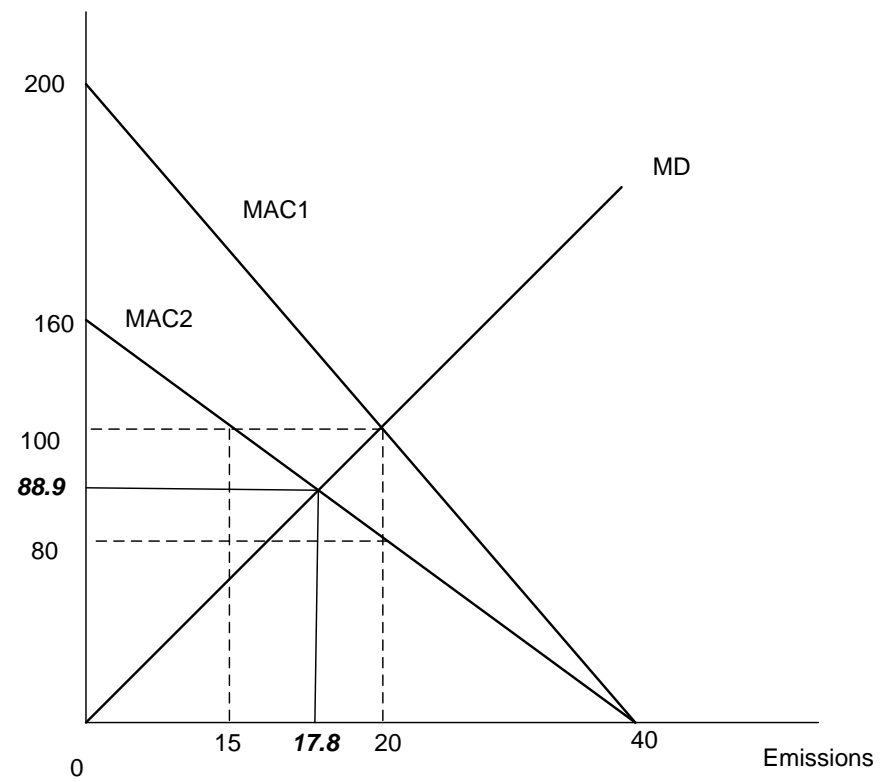
Note in Graph: MAC_1 is MS_1 and MAC_2 is MS_2