Question 1

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.
200 – 5E = 5E, therefore E = 20

b) 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:

c) 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

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)

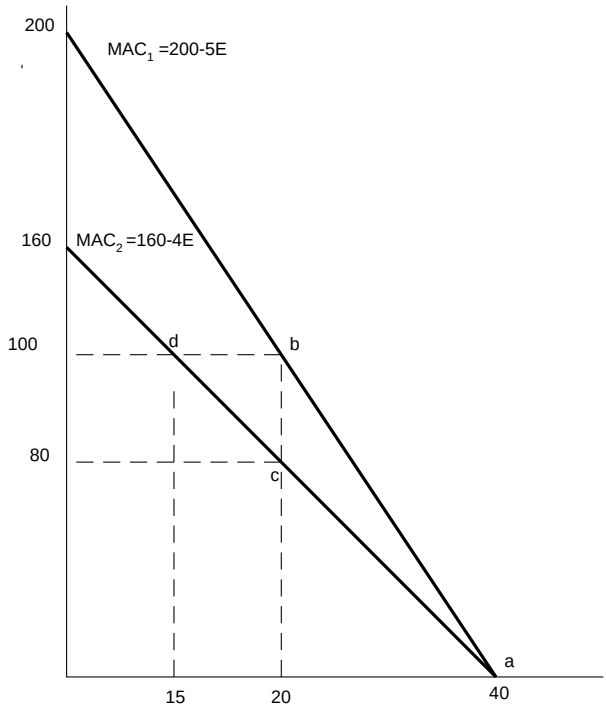
With $100 tax

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:

e) The government adjusts the standard, and
f) 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

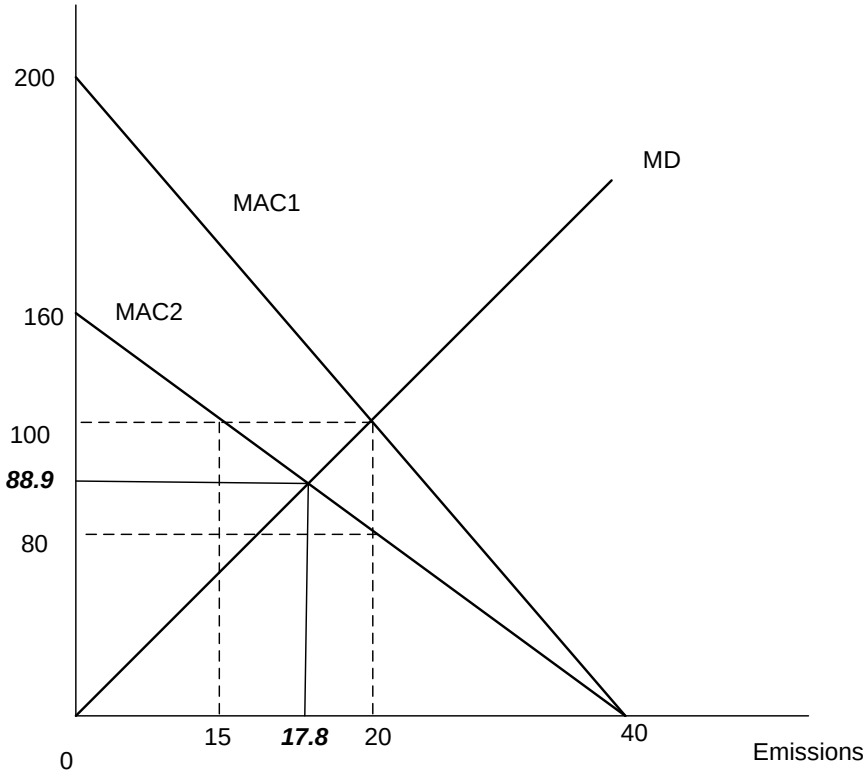
Under Tax rate of t = 88.9, E = 17.8

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

Question 2

a) Aggregating the MS's

$MS_1 = 120 - E_1$ $MS_2 = 96 - .8E_2$ $MS_3 = 160 - 1.33E_3$

Re-write as

$E_1 = 120 - MS$ $E_2 = 120 - 1.25MS$ $E_3 = 120 - 0.75MS$

$E^T = E_1 + E_2 + E_3 = 360 - 3MS$ or $MS = 120 - 1/3E$

b) Social Optimum is MD = MS or E* = 120

c) Uniform standard: $E_1 = E_2 = E_3 = 40$ MS1 = 80, MS2 = 64 MS3 = 106.8

$TAC_1 = 3200$ $TAC_2 = 2560$ $TAC_3 = 4272$

d) Tax is found where MD(120) = (2/3)(120) = 80

$E_1 = 40$, $E_2 = 20$, $E_3 = 60$

TAC for each is:

TAC 1 $3,200
TAC 2 $4,000
TAC 3: $2,400

e) For Marketable Permits the Equilibrium price will be $80 (Same as the tax). The emissions and total abatement costs will be the same as the tax case. However, their NET total cost will differ, depending if they are net buyers or sellers:

		Allocated Permits	Buy or Sell
Firm 1	E = 40	***40***	0
Firm 2	E = 20	***40***	-20
Firm 3	E = 60	***40***	+20

		Permit Costs (negative if net seller)		Net Total costs (TAC & Permits bought/Sold)	
TAC1	**$3,200**	Permits1	$0	**TC 1**	**$3,200**
TAC2	**$4,000**	Permits2	-$1,600	**TC 2**	**$2,400**
TAC3	**$2,400**	Permits3	$1,600	**TC 3**	**$4,000**

		Uniform	Optimal		Permits	Allocated
Emissions		Standard	Tax = 80		Price = 80	Permits
	E1	40	40		40	***40***
	E2	40	20		20	***40***
	E3	40	60		60	***40***
MAC's						
	MAC1	$80	$80		$80	
	MAC2	$64	$80		$80	
	MAC3	$107	$80		$80	
TAC's						
	TAC1	$3,200	$3,200		$3,200	
	TAC2	$2,560	$4,000		$4,000	
	TAC3	$4,267	$2,400		$2,400	

Permit Costs (neg if net seller)

Permits1	$0
Permits2	-$1,600
Permits3	$1,600

Net Total costs (TAC & Permits bought/Sold)

TC 1	$3,200
TC 2	$2,400
TC 3	$4,000