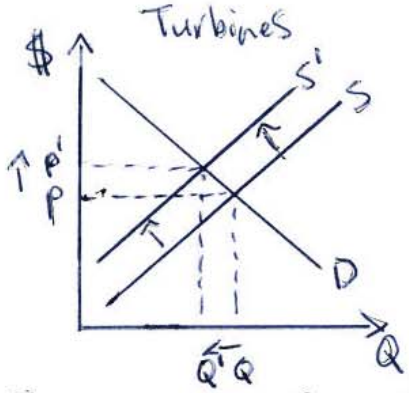
DUE: February 2nd at the beginning of class.

PRELIMINARIES: Complete each of the following problems. You can use any spreadsheet program if you wish. Please accompany your answers with explanations. Work together. Seek help if required.

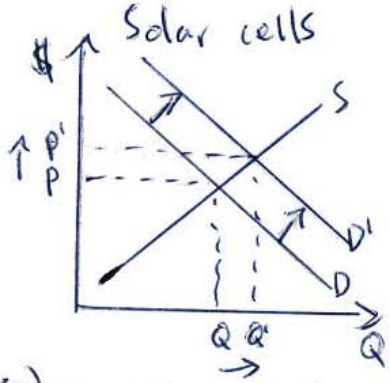
TOTAL: 100 POINTS

1. Suppose the federal government has decided to impose a noise pollution tax on Canadian wind turbines, and that this tax is imposed on wind turbine producers. What economic changes do you expect to observe in the wind turbine market? Show your answer graphically. What will happen to the equilibrium in the solar cell market? Consider cases where i) wind turbines and solar cells are substitutes; ii) wind turbines and solar cells are complements; and iii) wind turbines are an input to solar cell production (as in solar cell makers power their factories with electricity generated by wind-turbines). Show your answers graphically and make sure to explain your answers as well. **(30 points)**

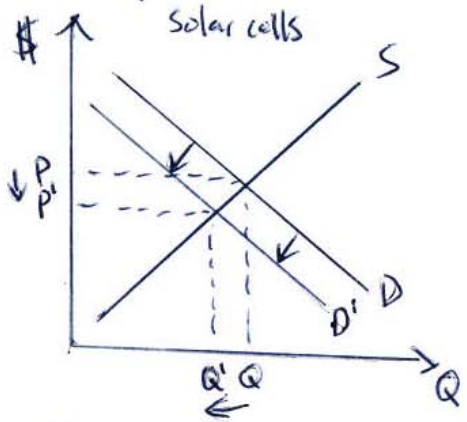
Q1 price of steel ↑ → cost of wind turbines ↑ → less turbines supplied at any given price
→ P increases to P'
→ Q decreases to Q'



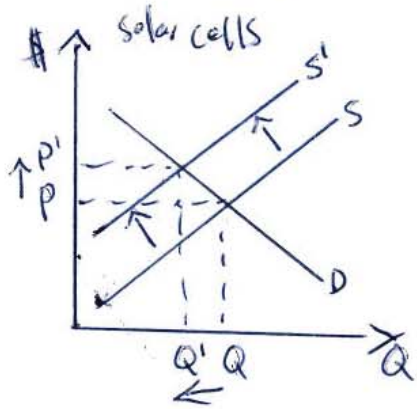
i) substitutes: $P^{turbine}$ ↑ → more solar cells demanded at any price
→ P increases to P'
→ Q increases to Q'



ii) complements: $Q^{turbine}$ ↓ → less solar cells demanded at any price
→ P decreases to P'
→ Q decreases to Q'



iii) turbines inputs for cells: $P^{turbine}$ ↑ → cost of cells ↑ → less cells supplied at any price
→ P increases to P'
→ Q decreases to Q'



2. John, a greenhouse vegetable farmer, has an opportunity to apply a new technology at a cost of $4,000. This technology will create savings in heat and energy consumption of $700 per year for the next 6 years. Assume that the rate of discount is 8%.

a. Would it be rational to invest in this new technology? Explain. **(10 points)**

ANSWER

Benefit from implementing technology = revenue from reduced costs = $700/year
Cost of technology = $4000

To determine if John should invest, calculate the present value of the revenue stream over the next 6 years. This calculation below assumes that you receive your first savings at the end of the first year. If you assume that your first savings is realized at the beginning of the first year, you should clarify so.

$(700/(1+0.08) + (700/(1+0.08)^2 + (700/(1+0.08)^3 + (700/(1+0.08)^4 + (700/(1+0.08)^5 + (700/(1+0.08)^6$

= $3236

Net profits = PV of revenues – PV of cost = $3236 - $4000 < 0

Therefore, John should not invest.

b. As this technology reduces greenhouse gas emissions, the government offers a new program. If he installs the new technology, John can get an interest free loan for the installation of $4000 to be returned to the government at the end of the 6th year. Now should John invest in the new technology? **(15 points)**

ANSWER

Same decision rule as in a), but now PV costs = $4000 / $(1+0.08)^6$ = $2521
Net profits = PV revenues – PV of cost = $3236 - $2521 > 0

Therefore, John should invest.

3. Commodity A in a competitive market has an aggregate inverse demand of p = 90 -3Q, where p represents the price in dollars and Q represents the quantity in units. The supply of this commodity is estimated at p = 5+ 2Q

a. Find the equilibrium price and quantity. Show it graphically and compute the total net benefit (also called social welfare or net social benefit). **(15 points)**

ANSWER

At equilibrium, demand = supply.

To determine the equilibrium price and quantity, equate the aggregate demand function and the supply function and solve for p and Q.

$$90 - 3Q = 5 + 2Q$$

$$85 = 5Q$$

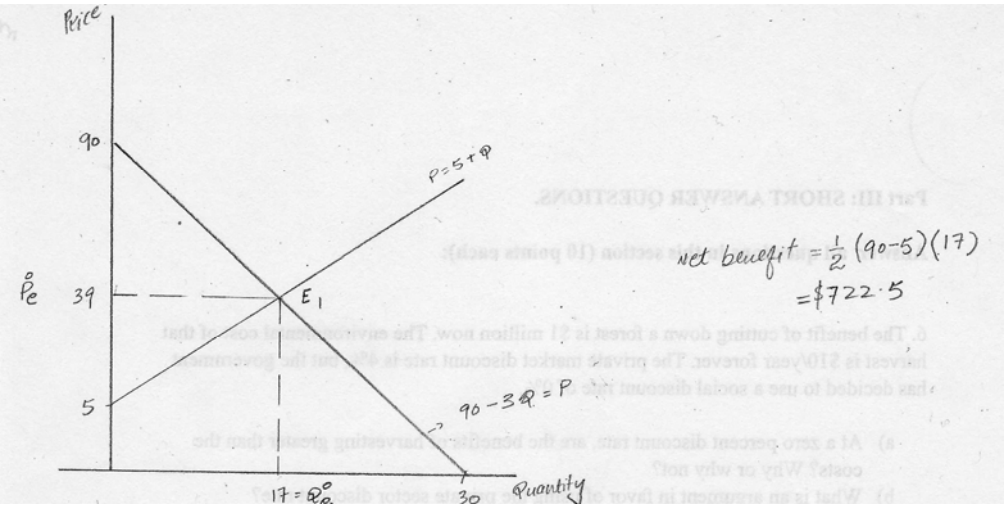
$$Q = 805/5 = 17$$

Sub Q = 17 into the demand or supply function to determine equilibrium price.

$$p = 90 - 3Q = 90 - 3(17) = 39$$

$$p = \$39$$

To determine the total net benefit, find the area of the net benefits triangle (basically it will be the sum of producer + consumer surplus, but I haven't introduced this concept to students so they likely won't refer to them).



Suppose producing commodity A generates pollution, a negative externality. The government taxes at a rate of $3 for every unit of commodity A produced, in order to force producers to face the marginal social costs (MSC) of their production.

b. Find the new equilibrium price and quantity. Show it graphically. **(15 points)**

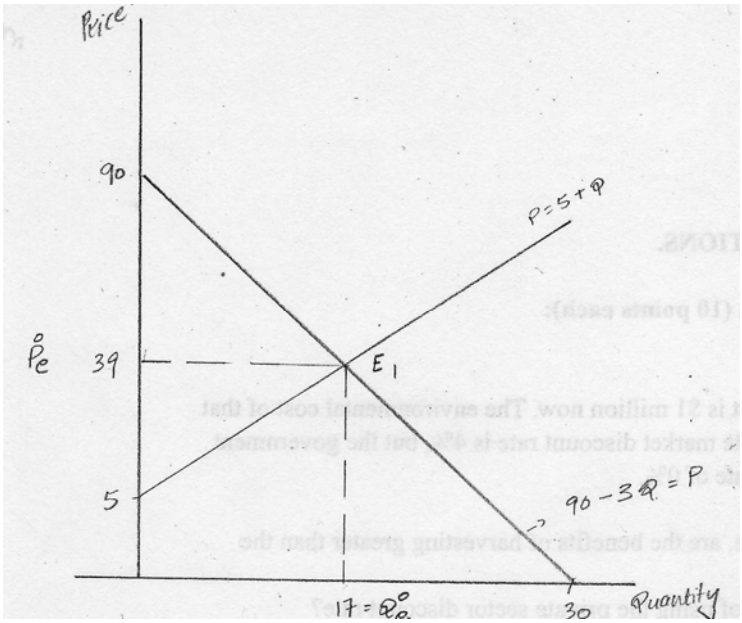
ANSWER

A $3 per unit tax will increase the base price in the supply function by 3.
New supply function: p = (5+3) + 2Q
Consumers will still demand based on p = 90 -3Q

New equilibrium:

$$8 + 2Q = 90 - 3Q$$
$$5Q = 82$$
$$Q = 16.4$$

Subbing Q = 14.4 into p = 8 +2Q we get p = $40.80.



Suppose the industry adopts a new technology that eliminates pollution while maintaining the same cost of production. Government cancels the tax.

c. Comparing the equilibrium with tax to the equilibrium with the new technology, which one creates greater net social benefits? Explain why. **(15 points)**

ANSWER

Under the new technology, there is no tax but the negative externalities are eliminated. Comparing the total surplus without the tax to the total surplus with the tax we have 722.5 – 672.4 which is > 0, therefore the new technology with no tax is preferable.