Problem 1:

Suppose that the United States has agreed to abide by a Global Warming Treaty.

1.1. Draw a figure showing the relationship between the quantity of CO2 emissions, \(Q\), and the Marginal Benefit for the U.S. if \(MB=1600-2Q\). Assume the treaty only allows the U.S. to emit \(Q_0=600\). Label \(Q_0\) and \(Q_1\) on your graph, if \(Q_1\) is the emissions level that U.S. would emit if there were no treaty. Calculate the compliance cost for U.S. graphically and numerically.

1.2 Now assume that the U.S. utilizes two alternative reduction mechanisms:
- Purchasing permits from Russia at price \(P=100\) dollar per unit of CO2 emissions;
- Using the Clean Development Mechanism (CDM) to build a clean energy plant in India. This plant will reduce overall CO2 emissions at a marginal cost equal to \(MC=2Q_a\), where \(Q_a\) is the amount of CO2 emissions reductions obtained through the CDM.

(a) Draw a new graph showing the marginal benefit for the U.S. of CO2 emissions beyond \(Q_0\). Let \(Q_p\) denote the amount of CO2 emissions accounted for through the purchase of permits. Derive \(Q_p\) and \(Q_a\) numerically, also show them on your graph.

(b) What are the treaty compliance costs for the U.S.?

(c) What is the total level of CO2 emissions in the U.S.?

1.3 In less than one page, describe and discuss at least five different obstacles to carbon trading between countries.
Problem 2.

2.1. Essays:
(a) If a price support program is already in place, will banning pesticides increase or decrease welfare? (A price support program increases the output price above the market price). Page limit: half a page.
(b) Under what kind of market structure and externality costs can we have under-use of pesticides. Provide a graph to explain your point. Page limit: one page.

2.2. Pesticide damage control framework.

A farmer knows that during a high pest year, the proportion of the total crop lost due to pest damage is $D_H(X)$, where $X$ is the amount of pesticide used. During a low pest year, the damage function is $D_L(X)$. Potential output (in the absence of pests) is $Y$. The probability for a high pest year is $\phi$ and output price is $p$ and fertilizer price is $w$. The farmer can use pesticides preventatively (Prevention) or she can use Integrated Pest Management (IPM).

Prevention:
(a) Write the equation for expected profit under preventative approach. Interpret.

(b) Write the condition for the optimal level of pesticide use under a preventative approach. The condition should be in general terms (using the notation above) and employ the concept of marginal benefit and cost.

IPM:
Under IPM the farmer invests in monitoring to find out whether it is a high or a low pest year and applies pesticides accordingly.

(c) Write out the conditions for optimal level of pesticide use under IPM for high-pest year and for low-pest year.

Assume that under Prevention, farmer profits are 40 in a high-pest year and 60 in a low-pest year; under IPM, profits are 45 (high-pest) and 75 (low-pest) but with an additional fixed cost of 5 for monitoring. Suppose that the probability of a high pest year, $\phi$, is .5.

(d) What is the average profit under Prevention and IPM?

(e) How much are farmers willing to pay to use IPM?
Problem 3:

While sitting in your favorite café studying for your finals, you overhear someone talking on his cellphone for all to hear. He is a government employee, and you learn that he works for the State of Euphoria Department of Environmental Safety.

“…I mean, it’s my job to make sure people are safe from environmental dangers. I’m going to quit because the governor only listens to those evil economists, who don’t care about people’s safety at all. In fact, they want to cut my budget, while people are still getting sick! I told the governor that as long as people are still getting sick from pesticides, I should be getting a bigger budget in order to help stop people from getting sick!…” says the man on the phone.

a) You, as an economist, sit back and think about what he just said and wonder if the economists really are evil. Write a note to this government employee, a paragraph or two in length; explain why a good economist could possibly advise the governor to cut the budget for Environmental Safety, even when not every single person is perfectly safe? How should the government decide how large of a budget to give the Department of Environmental Safety? Hint: Your answer should include the word “Marginal”

The Environmental Safety employee sees you listening to his conversation and comes over to talk to you. After talking to him for a few minutes he tells you a few things: 1) His job is to build and install water filters throughout the state, and 2) He happens to know that there is a direct relationship between how many filters he installs, and the number of days people are sick in the state.

\[
\text{# Sick-Days} = f(\text{# filters})
\]

\[
S = \frac{1,000,000}{1 + F}
\]

b) If all the government employee cares about is preventing people from getting sick, how many filters would he like to install?

c) If the price of a water filter is $1000, and the Department of Environmental Safety has a budget of $3,999,000, how many sick days will occur?

d) If instead of a budget cut, the Department of Environmental Safety actually receives $1,000,000 in additional budget money. How many fewer sick days occur from this additional budget?

e) What is the implicit price of reducing one more sick-day?

Congratulations. You made it!