1. **RAT Repeat.** Consider these statements about the first and second equimarginal principles.

   a. (3 pts) Why do we want the first equimarginal principle to be satisfied?
   
   i. Social efficiency is achieved and/or net benefits to society are maximized /3
   
   b. (2 pts) What equality holds if the first equimarginal principle is satisfied?
   
   i. MB = MC /2
   
   c. (3 pts) Why do we want the second equimarginal principle to be satisfied?
   
   i. The total cost to achieve an outcome is minimized /3
   
   d. (2 pts) What equality holds if the second equimarginal principle is satisfied?
   
   i. The MC to achieve a goal is equal across all ways to achieve it. /2

2. **RAT Repeat.** The two graphs on the left below present Al and Betty’s MWTP for the public good Q.

   a. (3 pts) In the figure on the right, draw the MWTP curve for Al and Betty combined.

   | 2.a | Is the vertical intercept at about 4.5? | /1 |
   | 2.b | Is the horizontal intercept at 3? | /1 |
   | 2.c | Is there a kink in the curve at Q=2, $/Q=0.5 | /1 |

   b. (2 pts) If the unit cost for Q is $3, how many units would be provided by the private actions of Al and Betty?

   2.b Zero /2

   c. (2 pts) If the unit cost for Q is $3, what would be the socially efficient number of units?

   2.c About 0.75 thousand or wherever the student’s social MWTP crosses $3. /2
3. The figure below presents eight possible options for a firm in terms of its profit and pollution. The firm can reduce its pollution, but for the most part this will lead to a reduction in profits.

![Graph](image)

a. (2 pts) In the absence of any regulation on the firm’s pollution, how much pollution would the firm emit?

<table>
<thead>
<tr>
<th>3.a</th>
<th>8 thousand units</th>
</tr>
</thead>
</table>

b. (2 pts) If the firm were required to reduce its pollution from the profit-maximizing level to 6,000 units, what would be the marginal cost per unit of pollution. Show any math used in your calculation

<table>
<thead>
<tr>
<th>3.b</th>
<th>Δπ = 1,000, ΔPoll = 2000, MC =1/2</th>
</tr>
</thead>
</table>

c. (3 pts) Suppose that the firm were required to pay a tax of $1 per unit of pollution generated, how much pollution would the firm choose to emit? Briefly explain your answer.

<table>
<thead>
<tr>
<th>3.c</th>
<th>From 3000 to 4000 the MB of increased pollution is $1/unit. For higher levels of pollution the MB is less than $1 and for lower levels of pollution the MB&lt;$1. Hence the firm would stop at either 3 or 4 thousand.</th>
</tr>
</thead>
</table>

d. (3 pts) Suppose that under a cap and trade system the firm’s initial allocation is 4 thousand units of pollution but it can buy or sell rights to pollute for $2 per unit. Would the firm buy rights, sell rights, or neither? Briefly explain why.

<table>
<thead>
<tr>
<th>3.d</th>
<th>As discussed in previous question, the MB of pollution from 3,000 to 4,000 is $1 per unit. Hence, if the price of permits was $2 per unit the firm would sell rights and reduce its pollution.</th>
</tr>
</thead>
</table>
4. (10 pts) Your Uncle Bob believes fervently in the free market. He’s convinced that every environmental regulation is wrong. Write a short e-mail message in language that any uncle would be able to understand, explaining why some regulation of pollution makes sense in terms of social efficiency. (For full credit, your answer should demonstrate understanding of the first equimarginal principle, without using any technical language)

Dear Uncle Bob,

Is it clear that social net benefits are considered? /3
Are marginal concepts used correctly to explain that, for at least some pollutants, the MC at 0% elimination is less than the MB? /5
Is the answer well written in every-day language with correct grammar and word choice? /2

5. Suppose you were asked to estimate how much people in Texas would value a policy that will protect the Great Apes in Africa.
   a. Considering the valuation taxonomy above, what type of benefit would this policy create for the people of Texas? Explain very briefly.
      
      5.a Non-use value – existence value. If they mention travel or visits, it should be use value, non-extractive. /2

      b. What valuation method would you use to carry out your estimate? Why is this the best approach?
      
      5.b If existence value is mentioned, stated preference or CVM. If travel or visits are mentioned, travel cost /2
      Explanation shows understanding of method proposed /2

6. The table below presents the number of trips taken to a river by a typical individual living around a popular park. The table presents the number of trips that are taken and the number of trips that are expected to be taken after the river has been cleaned up.

<table>
<thead>
<tr>
<th>Miles traveled</th>
<th>Travel cost per trip</th>
<th>Trips taken per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>$2</td>
<td>8</td>
</tr>
<tr>
<td>15</td>
<td>$4</td>
<td>5</td>
</tr>
<tr>
<td>25</td>
<td>$6</td>
<td>3</td>
</tr>
</tbody>
</table>
a. (6 pts) Using the data in the table and applying the travel cost model, on the graph on the right, draw the demand curve for a typical person living within 60 miles of the park. (Be sure to fully label your axes).

<table>
<thead>
<tr>
<th>40</th>
<th>$10</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>$14</td>
<td>0</td>
</tr>
</tbody>
</table>

- **6.a** Demand curve is downward sloping /1
- **Points are correct** /3
- **Axes labeled correctly ($/trip & trips)** /2

b. (2 pts) Using your figure, estimate the marginal willingness to pay for the third trip per year.

- **6.b** $6 /2

c. (3 pts) For someone living 15 miles from the park, indicate on your figure the total net benefits that the individual enjoys.

- **6.c** Is an area, not a height /1
- **Area or line is between demand curve and $4 cost** /1
- **Is completely correct, area below demand curve and above $4** /1

d. (3 pts) Suppose that due to damage to the park’s trails, people now take one fewer trip per year. Indicate on the graph an estimate of the welfare loss to someone who lives 25 miles from the park.

- **6.d** A shift in the demand curve is indicated /1
- **The welfare cost is shown as an area between the demand curves or vertical distances for each trip.** /1
- **Everything is correct – between curves, above $6** /1
7. The figure above presents the private (market) marginal willingness to pay for a good Q and the private (market) marginal cost to produce that good. For each of the questions below give a numerical answer or clearly indicate the answer on the graph.

a. Suppose that consumers of the good faced a price of $4 per unit. How many units would the consumers demand?
   7.a  5,000 /2

b. Suppose that producers of the good faced a price of $4 per unit. How many units would the producers supply?
   7.b  2,000 /2

c. What is the private marginal net benefit of the 1,000th unit?
   7.c  $6 /2

d. What is the market equilibrium price and quantity?
   7.d  price=$6, Q = 3,000 /2

e. Indicate the consumer surplus and producer surplus at the market equilibrium.
   7.e  Correct triangles are indicated – 1 point each /2

f. Suppose that each unit creates an external cost of $3 imposed on people other than the consumers and producers of this good. What would be the socially efficient quantity?
   7.f  2,000 (full credit) partial credit if MC_S is drawn but number is wrong /3

g. Suppose that each unit creates an external cost of $3 imposed on people other than the consumers and producers of this good. What would be the total net benefits to society at the market equilibrium?
   7.g  Correctly shows the positive portion of the net benefits between 0 and 2,000 /2
   Correctly shows the negative portion between 2,000 & 3,000 /2
h. Suppose that each unit creates an external benefit of $1 that is enjoyed by people other than the consumers and producers of this good. What would be the total external benefits at the market equilibrium? (must be a numerical value)

![Image of a table with the following content:

<table>
<thead>
<tr>
<th>7.g</th>
<th>$3,000</th>
</tr>
</thead>
</table>

Clippings Questions  
Based on clipping on last page.
You may remove that page and refer to it when answering these questions

Where appropriate, be sure that your answers uses specific evidence from the article.

8. (8 pts) List the three characteristics of efficient property rights and identify which of the three characteristics is most clearly not satisfied. Drawing on evidence from the article, explain how this characteristic is not satisfied.

| 8 | Lists exclusivity, enforceability & transferability (1 pt each) | /3 |
|   | Identifies exclusivity as the characteristic most clearly violated | /2 |
|   | Appropriate evidence is provided from the article. | /2 |
|   | Clearly written | /1 |

9. Suppose that you are asked to place a value on the benefits to the cotton farmers and the costs to the wine producers of 2-4-D.

a. (3 pts) For the benefit to the cotton farmers, briefly explain how you would come up with a dollar value for your estimate.

| 9.a | Should talk about production increases or reduction in costs | /2 |
|     | Should mention profits | /1 |

b. (4 pts) For the cost to the wine producers, briefly explain how you would come up with a dollar value for your estimate.

| 9.b | Should talk about production decreases or increased costs | /2 |
|     | Should mention profits | /1 |
|     | Appropriate evidence is used. | /1 |

10. (8 pts) Bending Branch Winery was able to find a way to achieve a better outcome. This is an example of what type of classic economic approach used to achieve economic efficiency? Explain how this led to a more efficient outcome. (Be sure to use apply the definition of efficiency in your answer).

| 10 | Should mention Coaseian bargaining (1 point if idea is clear but name missing) | /2 |
|    | Mentions side payment | /2 |
|    | Mentions efficiency or net benefits | /2 |
|    | Uses evidence from the article to support argument | /1 |
|    | Is clearly written | /1 |
Based on “Farmers' war on weeds threatens neighboring vineyards” By Bill Lambrecht
Houston Chronicle, November 23, 2014

COMFORT, TX- When the grape leaves started to shrivel at Bending Branch Winery, John Rivenburgh recognized the problem: Herbicides had drifted into the vineyards from a neighboring farm.

Texas is the nation's leading cotton producer, but in recent years the industry has been fighting a losing battle against the cotton-strangling weed Palmer amaranth, better known as pigweed. The good news is that the cotton industry today is optimistic; new seeds and chemicals are coming to the rescue. Peter Dotray, a Texas Tech weed scientist, said Monsanto's dicamba seeds along with Dow Chemical's 2-4-D is "game-changer" in the fight against "superweeds."

However, the dry conditions and fast-draining red soils in the High Plains where cotton is grown have also proved suitable for grapes. And because these crops are often planted side by side, the prospect of heavy-duty chemicals drifting from cotton fields has spawned fears in the state's burgeoning wine industry.

Monty Dixon, once had 14,000 vines of Riesling grapes in West Texas but said he was forced to quit growing grapes when drift from 2-4-D sprayed on wheat fields damaged his plants season after season. “It’s not just the grapes you see hanging that are harmed. It's next year's cluster and the cluster the year after that. You get a dose, it mutates the vines.”

Grape-growers are mobilizing for a fight. At least 20 Texas counties imposed restrictions in the past on the use of dicamba and 2-4-D. And industry has responded. Dow agreed that the 2-4-D label would address spray drift and the company said it would include terms in its sales agreements requiring growers to keep records of where the herbicide is applied.

Bending Branch Winery didn’t have to wait for regulations or voluntary action; the winery was able to find a solution before it suffered a complete loss. The nearby cotton farmer agreed to switch to a safer, more expensive weed-killer if the winery paid the difference. Bending Branch paid the $300 cost and so far has avoided the worst consequences.

“That a solution for this year,” explained Rivenburgh. “But I don’t know about next year, or the year after that.”
11. *RAT Repeat.* John would be willing to pay up to $8 for one fishing trip, $14 for a total two trips and $17 for a total of three trips. His marginal cost, what he has to pay for each trip, is $5.

a. (2 pts) What is the marginal net benefit to John of his 2\textsuperscript{nd} trip?

\[ \text{a. $1 /2} \]

b. (3 pts) Economic theory suggests that John would choose to take 2 trips. Why do we believe that John would not take a 3\textsuperscript{rd} trip?

\[ \text{b. Either mention Total NB goes down of MB<MC} \]