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Office hours: Tuesdays 9:00-10:00am, or by appointment.

Qualitative Part (30 points)
1. Identify the two main characteristics of a public good and briefly explain them. Provide an example.
   1) **Nonrival (indivisible):** When consumption of a good by one person does not reduce the quantity that can be consumed by others
   2) **Nonexcludability:** A good that, once produced, is accessible to all consumers, no one can be excluded from consuming such a good after it is produced.

Examples: public radio; clean air; clean water and biological diversity.

Quantitative Part: Negative Externality Problem (70 Points)
An example of a positive externality that is derived from consumption is Education. Hence, subsidizing the tuition fees of university students will encourage more young people to go to the university, which will generate a positive externality for future generations and benefit the country as a whole. Assume that:

<table>
<thead>
<tr>
<th>Market Demand Function (MB_P):</th>
<th>P = 20 - 2q</th>
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<tbody>
<tr>
<td>Marginal Cost Function (MC):</td>
<td>MC = 2q</td>
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<tr>
<td>Marginal External Benefit (MB_E):</td>
<td>MB_E = 10 - q</td>
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where P denotes price and q represents the quantity of students enrolled in the university.

(a) Obtain the market equilibrium price and quantity, the socially optimal price and quantity and the optimal subsidy. Label the graph completely. (40 Points)

(b) Calculate CS, PS and Government’s cost after the subsidy. (30 points)

(a) Let us first identify the market equilibrium in which \( MB_P = MC \) or \( 20 - 2q = 2q \).
Hence $q^M=5$ and the optimal price is $p=20-2\times5=10$.

In order to calculate the socially optimal output level we, first, need to identify the marginal social benefit function which is $MB_S=MB_P+MB_E=[20-2q]+[10-q]=30-3q$.

In addition, we know that the socially optimal output level can be obtained using $MB_S=MC$ or,

$$30-3q=2q$$

$q^*=\frac{30}{5}=6$ and the optimal price is $p(MB_S)=30-3\times6=12$, hence, $p^S=12$. However, consumers are willing to pay a different price. Let us identify such a price using the demand function (or $MB_P$),

$$p^*=20-2\times6=8$$

Therefore, the difference between $p^S$ and $p^*$ represents the subsidy which is

$$\text{Subsidy}= p^S - p^* =12-8=4$$

(b) The Government Cost after the subsidy is $GC=4\times6=24$

The CS after the subsidy is $CS=(20-8)\times6/2=36$

The PS after the subsidy is $PS=(12-0)\times6/2=36$