1. Consider the following diagram, which shows the marginal costs of pollution abatement for two firms, where MD means marginal damage to society from pollution, SMB means social marginal benefit of pollution abatement and PMB means private marginal benefit of pollution abatement, which is zero for each firm.

![Diagram showing marginal costs and benefits of pollution abatement](image)

a. What will be the level of pollution emitted by each firm in competitive equilibrium (without government intervention)? What is the socially efficient level of pollution emitted by each firm?

b. Suppose that the government mandates each firm to reduce its level of emissions to 40 units of emissions (equivalent to 110 units of pollution abatement each). Show why this is not the cheapest way to reduce pollution.

c. What are two government policies that would lead to the efficient level of pollution abatement in the cheapest way (assuming that the government knows the firms’ marginal cost curves and the social marginal benefit curve)? How do these policies work?
2. State a reason for government intervention in the education market. Be specific about which problems with the private education market lead to an inefficient outcome. How could government intervention in the education market improve social welfare?

3. Consider the diagram below representing provision of a radio broadcast. The radio broadcast is a public good in the sense that every unit available to one person is available to everyone. MC means marginal cost of an additional unit of provision, $MB_i$ means the marginal benefit to person $i$ of an additional unit of provision. There are two people, 1 and 2, who listen to the radio station. Its only source of funding comes from their donations.

\[
\begin{array}{|c|c|c|}
\hline
\text{Quantity} & \text{Cost, benefit} & \text{Radio broadcast provision} \\
\hline
\end{array}
\]

\[
\begin{align*}
\text{MC} &= \text{SMC} \\
\text{MB}_1 &> \text{MB}_2 \\
\end{align*}
\]

a. Draw the socially efficient level of provision. Indicate how you got your answer.

b. What level of provision will there be in Nash equilibrium? Explain. Is there a free-rider problem in this market?

4. a. Consider a society in which there are two types of people, type A and type B. Type A people have a 10% risk per year of catching disease X, a disease which requires $40,000 in medical treatment. Type B people have only a 1% risk per
year of catching the disease. Type A and type B people are otherwise indistin-
guishable, and there is an equal number of both types of people. All members
of society have the same utility function over income, $U(I) = I^{1/2}$. There are a
large number of insurance companies which insure against the disease.

i. What would be the premium for actuarially fair full insurance for the pooled
risk? What would happen if a company offered actuarially fair full insurance
aimed at someone whose risk of contracting the disease per year was the average
of the two groups’ risks?

ii. Describe how an insurance company could offer two policies that separate
the two groups (so one group chooses one policy and the other group chooses
another). Describe the properties that a separating equilibrium must have if it
exists (you don’t have to calculate it, just describe it in words).

b. How does Social Security avoid the adverse selection problem that private
annuities face?