A railroad carries carloads of coal (C) on a spur line that runs from an isolated coal mine to the railroad's main line. Previously, the coal cars merely returned empty, but recently an enterprising young MBA began shipping helium balloons (B) for the miner's children in the cars on the way back. At the moment he has a monopoly. For a one way trip, it costs 10 to haul a car full of coal and 1 to haul an empty car or one filled with helium balloons. (For simplicity, assume that there are no fixed costs of operating the spur line.) The MBA obtains the balloons at a cost of 2 per carload. The coal mine's demand curve for transport is given by \( r_C = 17 - .1C \), and the final demand for helium balloons is \( P_B = 10 - .1B \).

1. What is the equation of the MBA monopolist's derived demand for transport services?

2. If, for some reason, the railroad is interested only in charging the socially optimal (first best) prices, what rates per carload (\( r_C \) and \( r_B \)) will it charge for coal and balloons? What will be the price of balloons (\( P_B \)) set by the MBA?

3. Suppose the balloon market becomes perfectly competitive. What, then, is the equation of the derived demand for balloon transport services? What are the new socially optimal rates? How many cars will the railroad haul?

4. What will be the competitive price of balloons at the mining town?

5. Determine whether or not the rates you calculated in (2) and (3) are subsidy-free.

6. A coal slurry pipeline can be built at a cost of \( F \) that can carry the quantity of coal contained in a carload at a marginal operating cost of 2. (The pipeline cannot carry balloons!) Explain how you would determine whether or not the coal slurry pipeline would be a good investment from the social point of view. Be sure to discuss how the competitiveness of the balloon market and whether or not the pipeline was required to break-even would affect your analysis. Calculate the largest value of \( F \) for which the pipeline would remain a good social investment if the balloon market were a monopoly and the pipeline did not have to cover its overhead.