[a] 5. Suppose that two firms are Cournot competitors. Industry demand is given by $P = 200 - q_1 - q_2$, where q_1 is the output of Firm 1 and q_2 is the output of Firm 2. Both Firm 1 and Firm 2 face constant marginal and average total costs of $20.

a. Solve for the Cournot price, quantity, and firm profits.

b. Firm 1 is considering investing in costly technology that will enable it to reduce its costs to $15 per unit. How much should Firm 1 be willing to pay if such an investment can guarantee that Firm 2 will not be able to acquire it?

c. How does your answer to (b) change if Firm 1 knows the technology is available to Firm 2?

d. Supposing that the total cost function for each of the two firms is $TC_i = 20q_i$, where i denotes Firm 1 and then Firm 2, respectively, solve for the Cournot price, quantity, and firm profits using calculus and show the answer is the same as that to part (a).

e. Supposing instead that the total cost function for each of the two firms is $TC = q_i^2 + 20q_i$ where i denotes Firm 1 and then Firm 2, respectively, solve for the Cournot price, quantity, and firm profits using calculus.