Question 1 (Cournot Duopoly and Collusion)
Suppose that two firms (Firm 1 and Firm 2) face an industry demand
\[ P = 600 - Q \]
where
\[ Q = q_1 + q_2 \]
is the total industry output. Both firms have the same unit production cost \( c = 90 \). Therefore, the profits of each firm is given by
\[ \pi_1 (q_1, q_2) = (600 - q_1 - q_2)q_1 - 90q_1 \]
\[ \pi_2 (q_1, q_2) = (600 - q_1 - q_2)q_2 - 90q_2 \]
Suppose the two firms engage in Cournot competition by simultaneously choosing their quantities to maximize own profits.

a) Find the Cournot NE pair \((q_1^c, q_2^c)\).

b) What is the Nash equilibrium profit of each firm in the Cournot Eqb?

c) What is the quantity level \( q^M \) that maximizes the joint profits of the two firms? You can find \( q^M \) by maximizing
\[ \pi \left( q^M \right) = (600 - q^M)q^M - 90q^M \]
What is the profit achieved if the total output in the market is \( q^M \)?

d) Is collusion outcome in which each firm produces
\[ q_1 = q_2 = \frac{q^M}{2} \]
a Nash Equilibrium?