

$$1.(A) 60 - 2q = 30 \Rightarrow q = 15 \Rightarrow P = 45 \Rightarrow \pi = 45 \times 15 - 30 \times 15 = 225 = PS$$

$$CS = 15 \times 15 / 2 = 112.5, \quad TS = 225 + 112.5 = 337.5, \quad DWL = 112.5$$

$$(B) 60 - q = 30 \Rightarrow q = 30 \Rightarrow \pi = 30 \times 30 / 2 = 450, \quad CS = 0$$

$$TS = 0 + 450 = 450, \quad DWL = 0$$

$$(C) \pi = P(q_1)q_1 + P(q_2)(q_2 - q_1) - TS(q_2) = (60 - q_1)q_1 + (60 - q_2)(q_2 - q_1) - 30q_2$$

$$= -q_1^2 - q_2^2 + 30q_2 + q_1q_2$$

$$\text{一階條件為：} -2q_1 + q_2 = 0, \quad -2q_2 + 30 + q_1 = 0$$

$$\Rightarrow \text{聯立解得：} q_1 = 10, \quad q_2 = 20$$

$$\text{對應之價格為：} P_1 = 50, \quad P_2 = 40 \Rightarrow \pi = 50 \times 10 + 40 \times (20 - 10) - 30 \times 20 = 300$$

$$CS = (10 \times 10 / 2) + (10 \times 10 / 2) = 100, \quad TS = 100 + 300 = 400$$

$$DWL = 450 - 400 = 50$$

$$(D) \pi = P(q_1)q_1 + P(q_2)(q_2 - q_1) + P(q_3)(q_3 - q_2) - TS(q_3)$$

$$= (60 - q_1)q_1 + (60 - q_2)(q_2 - q_1) + (60 - q_3)(q_3 - q_2) - 30q_3$$

$$= -q_1^2 - q_2^2 - q_3^2 + 30q_3 + q_1q_2 + q_2q_3$$

$$\text{一階條件為：} -2q_1 + q_2 = 0, \quad -2q_2 + q_1 + q_3 = 0, \quad -2q_3 + 30 + q_2 = 0$$

$$\Rightarrow \text{聯立解得：} q_1 = 7.5, \quad q_2 = 15, \quad q_3 = 22.5$$

$$\text{對應之價格為：} P_1 = 52.5, \quad P_2 = 45, \quad P_3 = 52.5$$

$$\Rightarrow \pi = 52.5 \times 7.5 + 45 \times (15 - 7.5) + 37.5(22.5 - 15) - 30 \times 22.5$$

$$= 337.5$$