*(10)5-1 Consider two parks A and B that are partial substitutes for each other. The yearly demand for visits to park A, when park B is open is given by: \( Q_{A|B\, open} = 60 - 3P_A \). If B were not available, the yearly demand for visits to park A is given by: \( Q_{A|B\, closed} = 100 - 2P_A \). The situation is analogous with respect to park B. When A is open, the yearly demand for visits is given by: \( Q_{B|A\, open} = 140 - 1.75P_B \). If A were not available, the yearly demand for visits to park B is given by: \( Q_{B|A\, closed} = 150 - 1.5P_B \).

a. Graphically show in two diagram the demand for visits, one with the substitute park open and one with the substitute park closed.
b. What is the yearly loss in consumer surplus associated with the closure of park A? With the closure of park B?
c. What is the yearly loss in consumer surplus associated with the simultaneous closure of both parks?

*(10)5-2. Consider a government project that significant increases the amount of oil available to the U.S. The project lowers the price of a barrel from $25 to $20 by lowering marginal cost from $25 to $20. The government project has an effect on both complements to and substitutes for oil. For example, more oil leads to an increase in demand for oil drilling equipment and a reduction in demand for natural gas. Assume the demand for oil is given by \( Q_{D,\, Oil} = 350 - 10P_{Oil} \) and the price is $25. With the project, the price of oil falls to $20. The supply of oil drilling equipment is infinitely elastic at a price of $10 per unit of equipment. Also assume the supply of natural gas is infinitely elastic at a price of $15 per unit. The demand for oil drilling equipment is given by \( Q_{D,\, ODE} = 1250 - 20P_{ODE} - 10P_{Oil} \) and the demand for natural gas is given by \( Q_{D,\, NG} = 325 - 5P_{NG} + 2P_{Oil} \). Last, assume all three markets are efficient, that is all prices reflect social marginal costs and benefits. Graphically show the three markets and calculate the benefits to society from increasing the supply of oil.

*(10)5-3 Reconsider the increased supply of oil problem 5-2, but ignore the complementary relationship between oil and oil drilling equipment. In problem 5-2 we allowed for a change in the price of oil to effect the demand for a substitute under conditions of constant cost. To account for feedback effects, we modify the demand for oil to account for its dependency on the price of a substitute namely, natural gas. The demand for oil is now given by \( Q_{D,\, Oil} = 320 - 10P_{Oil} + 2P_{NG} \). Assume the demand for natural gas is, as before, \( Q_{NG} = 325 - 5P_{NG} + 2P_{Oil} \). Also, assume the supply of natural gas is upward sloping. Specifically assume the supply of natural gas is given by \( Q_{SNG} = 20P_{NG} \). Graphically show the two markets and the effect of increasing the supply of oil taking into account the fact that the project, by lowering the price of oil, decreases the demand for natural gas and with an upward sloping supply lowers the price of natural gas, which in turn decreases the demand for oil. Calculate the benefits of the project and explain how and why the following groups gain or lose as a consequence of the project: oil consumers, oil producers; natural gas consumers; and natural gas producers.
Reconsider the increase supply of oil project of 5-2, but ignore the substitute relationship between oil and natural gas. Assume as before, the supply of oil drilling equipment is infinitely elastic at a private marginal cost of $10 per unit with the demand for oil drilling equipment given by $Q_{DODE} = 1250 - 20P_{ODE} - 10P_o$. Assume, as before the project lowers the price of a unit of oil from $25 to $20. Now assume the private marginal cost of drilling equipment ignores a negative externality associated with the use of the equipment. Specifically assume the negative externality is $2 per unit of oil drilling equipment sold. Graphically show the two markets and calculate the benefits to society from increasing the supply of oil.