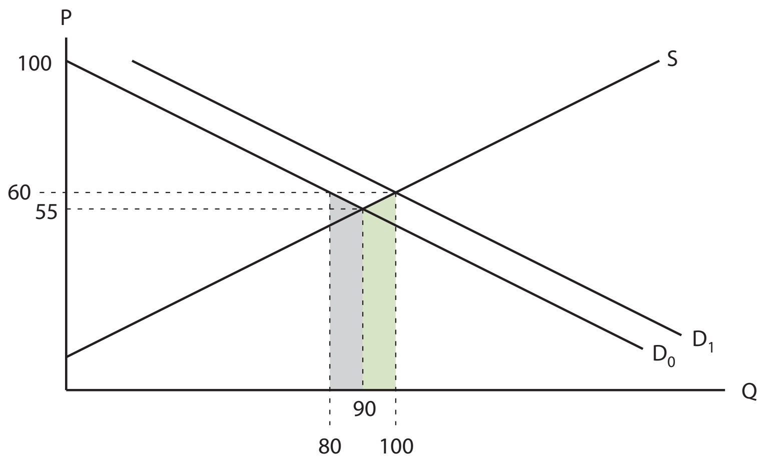
6. (a) Solve for the without-project equilibrium:

$$Q_d = Q_s \quad \Rightarrow \quad 200 - 2P = 2P - 20 \quad \Rightarrow \quad P^* = \$55 \quad \Rightarrow \quad Q^* = 90$$

Then solve for the with-project equilibrium, where $Q_d = 220 - 2P$ because of project's effect on demand:

$$Q_d = Q_s \quad \Rightarrow \quad 220 - 2P = 2P - 20 \quad \Rightarrow \quad P^* = \$60 \quad \Rightarrow \quad Q^* = 100$$

The situation is depicted below:



The grey shaded area represents the value of the foregone consumption, which is

$$\frac{(60 + 55)}{2} \times (90 - 80) = \$575$$

and the green shaded area represents the value of the additional resources used to increase total production from 90 unit to 100 units, which is

$$\frac{(60 + 55)}{2} \times (100 - 90) = \$575$$

. The social opportunity cost of the 20 units of input used by the project is the sum of these two areas

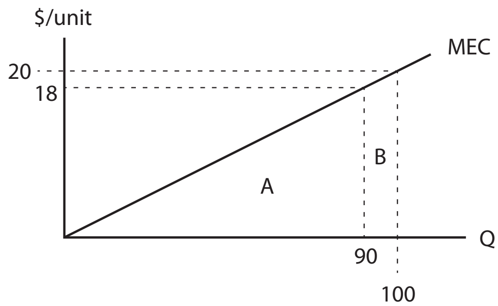
$$\$575 + \$575 = \$1150$$

In comparison, expenditures on the input are

$$20 \times \$60 = \$1200$$

(b) The project causes total production of the input to increase from 90 units to 100 units. Referring to the figure below, when production is 90, the total external cost is A and when production is 100, the total external cost is B. So the project increases the total external cost by B, which is

$$\frac{(20 + 18)}{2} \times (100 - 90) = \$190$$



This increase in the total external cost is direct result of using the input and must therefore be added to the social opportunity cost calculated in part a. Doing so the social opportunity cost of the 20 units of input used by the project is

$$\$1150 + \$190 = \$1340$$