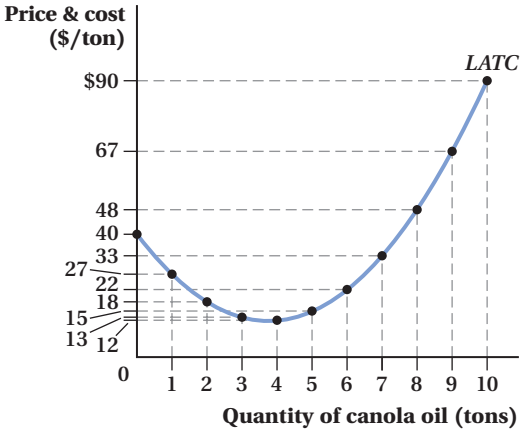
Solution

17. a. The long-run average total cost of producing canola oil is

$$LATC = \frac{LTC}{Q} = Q^2 - 15Q + 40$$



b. The long-run equilibrium price of canola oil is approximately \$12, which is the minimum of the $LATC$ curve.

c. Each firm will produce the quantity of canola oil that corresponds to the minimum point on the $LATC$ curve, that is, 4 tons of canola oil.

d. Using the demand function, we get

$$Q^{\mathrm{D}} = 999 - 0.25P = 999 - 0.25 \times 12 = 996$$

At the long-run equilibrium price, consumers will demand approximately 996 tons of canola oil.

e. Since each representative firm supplies 4 tons of canola oil, the number of suppliers in the long-run equilibrium will be

$$\frac{996}{4} = 249$$

f. Long-run marginal cost is the derivative of the long-run total cost function with respect to quantity:

$$\begin{aligned} LMC &= \frac{dLTC}{dQ} \\ &= 2(3)Q^{3-1} - 15(2)Q^{2-1} + 40 + 0 \\ &= 6Q^2 - 30Q + 40 \end{aligned}$$

g. Using calculus, consumer surplus is

$$\begin{aligned} CS &= \int_0^{996}\big((3{,}996 - 4Q) - 12\big)\,dQ \\ &= \int_0^{966}(3{,}984 - 4Q)\,dQ = \int_0^{996} 3{,}984\,dQ - \int_0^{966} 4Q\,dQ \\ &= [3{,}984Q]_0^{996} - \left[\frac{4Q^2}{2}\right]_0^{996} = [3{,}984Q]_0^{996} - [2Q^2]_0^{996} \\ &= [3{,}984(996) - 3{,}984(0)] - [2(996)^2 - 2(0)^2] \\ &= (3{,}968{,}064 - 0) - (1{,}984{,}032 - 0) = 1{,}984{,}032 \end{aligned}$$