

Solution

10. a. The inverse supply is

$$P = \frac{Q^S}{10}$$

whereas the inverse demand is

$$P = 20 - \frac{1}{5}Q^D$$

The graph is shown at right.

b. Define Q_E and P_E as equilibrium quantity and price, respectively. In equilibrium, price is such that demand is equal to supply. Therefore in equilibrium,

$$\frac{Q^S}{10} = 20 - \frac{Q^D}{5}$$

$$\frac{Q_E}{10} = 20 - \frac{Q_E}{5}$$

$$Q_E = 200 - 2Q_E$$

$$3Q_E = 200$$

$$Q_E = \frac{200}{3} = 66\frac{2}{3}$$

The equilibrium price is then

$$P_E = \frac{Q_E}{10} = \frac{\frac{200}{3}}{10} = \frac{20}{3} = 6\frac{2}{3}$$

c. The new supply function is

$$Q^S = 10P - 20$$

Hence, the new inverse supply function is

$$P = \frac{1}{10}Q^S + 2$$

d. Solving for the new equilibrium price and quantity, we get

$$\frac{Q^S}{10} + 2 = 20 - \frac{Q^D}{5}$$

$$\frac{Q_E}{10} + 2 = 20 - \frac{Q_E}{5}$$

$$Q_E + 20 = 200 - 2Q_E$$

$$3Q_E = 180$$

$$Q_E = 60$$

The equilibrium price is now

$$P_E = \frac{Q_E}{10} + 2 = \frac{60}{10} + 2 = 8$$

e. Since $\frac{\partial Q^D}{\partial P} = -5 < 0$, the law of demand holds. Since $\frac{\partial Q^S}{\partial P} = 10 > 0$, the law of supply holds.

f. Substituting $P_R = 50$ into the expanded demand curve, we can see that

$$\begin{aligned} Q^D &= 150 - 5P - 50 \\ &= 100 - 5P \end{aligned}$$

This is the demand curve as given in the problem's setup.

g. At the new price of towel racks, $Q^D = 150 - 5P - 60 = 90 - 5P$. This is a shift downward and to the left (inward) of the original demand curve.

