Solution

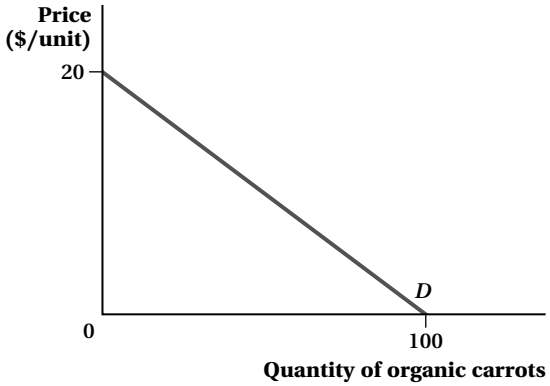
2. a. The demand curve for organic carrots when $P_C = 5$ and $I = 10$ becomes

$$Q_O^D = 75 - 5P_O + 5 + (2 \times 10) = 100 - 5P_O$$

In other words,

$$5P_O = 100 - Q_O^D$$

$$P_O = 20 - \frac{1}{5}Q_O^D$$



b. For $P_O = 10$, the quantity demanded is

$$Q_O^D = 100 - (5 \times 10) = 50$$

c. When $P_O = 5$, the quantity demanded of organic carrots is

$$Q_O^D = 100 - (5 \times 5) = 75$$

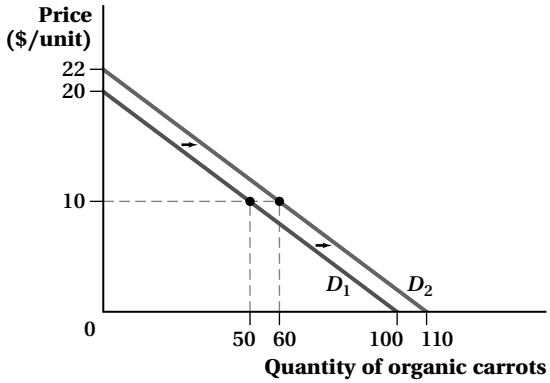
d. Suppose $P_O = 10$ and $P_C = 15$, and $I = 10$; then

$$Q_O^D = 75 - 5P_O + 15 + (2 \times 10) = 75 - (5 \times 10) + 15 + (2 \times 10) = 60$$

Thus, there has been a change in the quantity demanded due to the change in the price of conventional carrots, which leads to an outward shift in the demand curve for organic carrots. The new function represented by D_2 is

$$Q_O^D = 75 - 5P_O + 15 + (2 \times 10) = 110 - 5P_O$$

$$\rightarrow P_O = 22 - \frac{1}{5}Q_O^D$$



e. When the price of conventional carrots increases, the demand for organic carrots shifts, which leads to an increase in the quantity demanded for organic carrots at the original price.

f. An increase in income shifts out the demand curve for organic carrots. Hence, as the average consumer income increases, the quantity demanded of organic carrots increases. Such an observation is consistent with the definition of a normal good.

g. Since $\frac{\partial Q_O^D}{\partial P_O} = -5 < 0$, the law of demand holds.

h. Since $\frac{\partial Q_O^D}{\partial P_C} = 1 > 0$, the two types of carrots are substitutes. This is the same answer that is determined in part (e).

i. Since $\frac{\partial Q_O^D}{\partial I} = 2 > 0$, the organic carrots are a normal good. This is the same answer that is determined in part (f).