



PRICE ELASTICITY OF DEMAND

You learnt that the law of demand which explains the inverse relationship between price and quantity demanded of a commodity. The law of demand explains only direction of change in quantity demanded but does not tell us by how much amount the quantity demanded changes due to change in the price. The response of quantity demanded to change in price of the commodity differs in different cases. This forms the subject matter of the study of price elasticity of demand.



OBJECTIVES

After completing this lesson, you will be able to:

- explain the meaning of elasticity of demand;
- explain the meaning of price elasticity of demand, income elasticity of demand and cross elasticity of demand;
- explain various degrees (types) of price elasticity of demand;
- explain methods of calculating price elasticity of demand;
- solve practical problems based on price elasticity of demand; and
- identify factors affecting price elasticity of demand.

16.1 MEANING OF ELASTICITY OF DEMAND

Demand for a commodity is affected by many factors such as its price, price of related goods, income of its buyer, tastes and preferences etc. Elasticity means degree of response. Elasticity of demand means degree of responsiveness of demand. Demand for a commodity responds to change in price, price of related goods, income etc. So, we have three dimensions of elasticity of demand:

- (i) **Price elasticity of demand:** Price elasticity of demand means degree of responsiveness of demand for a commodity to the change in its price. For example, if demand for a commodity rises by 10% due to 5% fall in its price, Price elasticity of demand (e_p)

$$= \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price of the commodity}}$$

$$= \frac{10}{(-)5} = (-)2$$

Note that e_p will always be negative due to inverse relationship of price and quantity demanded.

- (ii) **Income elasticity of demand:** Income elasticity of demand refers to the degree of responsiveness of demand for a commodity to the change in income of its buyer. Suppose, income of buyer rises by 10% and his demand for a commodity rises by 20%, then,

Income elasticity of demand (e_y)

$$= \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price of the commodity}}$$

$$= \frac{20}{10} = 2$$

- (iii) **Cross Elasticity of demand:** Cross elasticity of demand means the degree of responsiveness of demand for a commodity to the change in price of its related goods (substitute goods or complementary goods). Suppose, demand for a commodity rises by 10% due to 5% rise in price of its substitute good, then

Cross elasticity of demand (e_c)

$$= \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price of related good}}$$

$$= \frac{10}{5} = 2$$

(Tastes and preferences cannot be expressed numerically. So elasticity of demand cannot be numerically expressed.)



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16.2 DEGREES (TYPES) OF PRICE ELASTICITY OF DEMAND

You must have noticed that when price of salt rises, we go on consuming the same quantity of salt. In other words, quantity demanded of salt does not respond to the change in its price. But what happens when price of apples rises? We start purchasing less quantity of apples at higher price i.e. demand for apples responds when their price changes. So, degree of responsiveness of quantity demanded to a change in price may differ i.e. elasticity of demand could also differ. In this context, the price elasticity of demand is generally classified into following five categories:

- (i) **Perfectly inelastic demand ($e_d = 0$)** : The demand for a commodity is called perfectly inelastic when quantity demanded does not change at all in response to change in its prices (See table 16.1). Graphically, the demand curve is parallel to y-axis as shown in Fig. 16.1.

Table 16.1

Price (₹ Per kg.)	Quantity demanded (In kgs.)
10	2
15	2
20	2

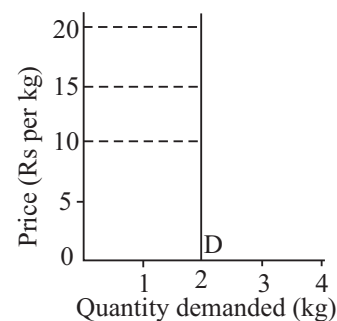


Fig. 16.1

- (ii) **Less than unit elastic demand ($e_d < 1$)** : The demand for a commodity is called less than unit elastic or relatively inelastic when the percentage change in quantity demanded is less than the percentage change in price of the commodity (See table 16.2). Graphically, demand curve is steeper as shown in Fig. 16.2. The demand for necessary goods like medicines and food items etc. is less than unit elastic.

Table 16.2

Price (₹ Per kg.)	Quantity demanded (In kgs.)
10	4
20	3

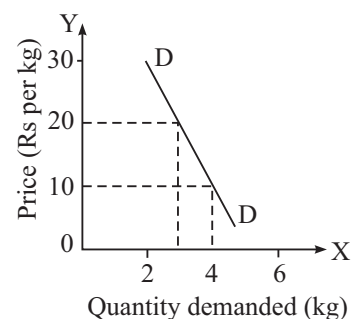


Fig. 16.2

Price Elasticity of Demand

You can see in table 16.2 that fall in quantity demanded is 75% in response to rise in price by 100%.

- (iii) **Unit elastic demand ($e_d = 1$):** When percentage change in quantity demanded of a commodity equals percentage change in its price, the demand for the commodity is called unit elastic (See table 16.3). Graphically, demand curve is rectangular hyperbola as shown in fig. 16.3

(Rectangular hyperbola is a curve on which all the rectangles formed on the curve have same area).

Table 16.3

Price (₹ Per meter)	Quantity demanded (In meters)
20	40
30	20

You can see in table 16.3 that fall in quantity demanded is 50% in response to rise in price by 50%.

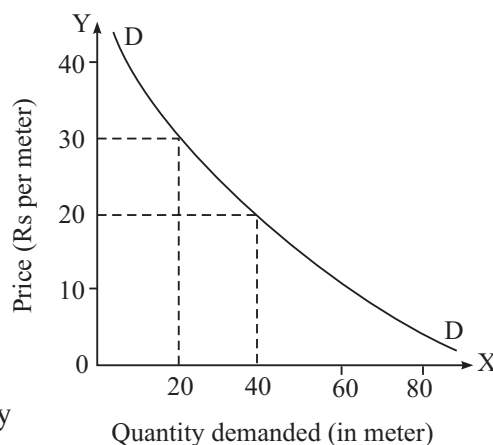


Fig. 16.3

- (iv) **More than unit elastic demand ($e_d > 1$):** When the percentage change in quantity demanded of a commodity is more than the percentage change in its price, the demand for the commodity is called more than unit elastic or highly elastic (see table 16.4). Graphically, the demand curve is flatter as shown in fig. 16.4. The demand for luxury goods is more than unit elastic.

Table 16.4

Price (₹ Per unit)	Quantity demanded (In units)
100	400
150	100

In table 16.4 the quantity demanded has fallen by 75% in response to 50% rise in the price of the commodity.

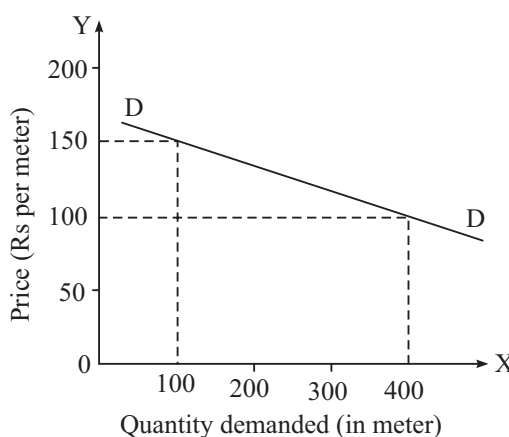


Fig. 16.4

- (v) **Perfectly elastic demand ($e_d = \infty$):** The demand for the commodity is called perfectly elastic when its demand expands or contracts to any extent without

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or very little change in its price (see table 16.5). Graphically, the demand curve is parallel to X-axis as shown in Fig. 16.5.

Table 16.5

Price (₹ Per unit)	Quantity demanded (In units)
20	2
20	4

In table 16.5 the quantity demanded of the commodity rises by 100% without change in its price.

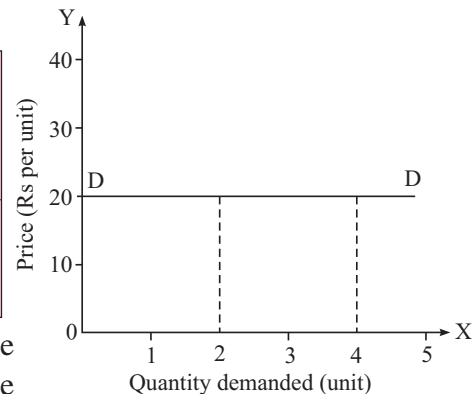


Fig. 16.5



INTEXT QUESTIONS 16.1

- Define the following:
 - Price elasticity of demand
 - Income elasticity of demand
 - Cross elasticity of demand
- When the demand for a commodity is called elastic?
- What is the likely shape of the demand curve when the demand for a commodity is unitary elastic?

16.3 METHODS OF MEASUREMENT OF PRICE ELASTICITY OF DEMAND

There are following two methods of measurement of price elasticity of demand:

- Percentage change method
- Geometric method

In addition to the above mentioned two methods, we will also explain the measurement of price elasticity of demand on the basis of change in total expenditure incurred on the commodity.

16.3.1 Percentage Change Method

This method is also called '**proportionate method**' or flux method. According to this method price elasticity of demand is measured as a ratio of percentage change

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in quantity demanded to the percentage change in price of the commodity.

Price elasticity of demand (e_d)

$$= \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price of the commodity}}$$

Percentage change in quantity demanded

$$= \frac{\text{Change in quantity } (\Delta Q)}{\text{Initial quantity } (Q)} \times 100$$

$$\text{Percentage change in price} = \frac{\text{Change in price } (\Delta P)}{\text{Initial price } (P)} \times 100$$

$$\text{Therefore, } e_d = \frac{\frac{\Delta Q}{Q} \times 100}{\frac{\Delta P}{P} \times 100}$$

Where ΔQ = Change in quantity demanded

Q = Initial quantity demanded

ΔP = Change in price

P = Initial price

Illustration 1

Calculate price elasticity of demand if quantity demanded of a commodity rises by 20% due to 8% fall in its price.

Solution:

$$\begin{aligned} \text{Price elasticity of demand} &= \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price of the commodity}} \\ &= \frac{20}{(-)8} = (-) 2.5 \end{aligned}$$

[This is to be noted that price elasticity of demand is always a negative number because of inverse relationship between price and quantity demanded. However, minus sign is often ignored while writing the value of elasticity.]

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Illustration 2

When price of a commodity is ₹ 10 per unit, its demand is 100 units. When the price falls to ₹ 8 per unit, demand expands to 150 units. Calculate price elasticity of demand.

Solution:

$$e_d = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price of the commodity}}$$

$$\text{Percentage change in quantity demanded} = \frac{(150-100)}{100} \times 100 = 50\%$$

$$\text{Percentage change in price} = \frac{(-)2}{10} \times 100 = (-)20\%$$

So,

$$e_d = \frac{50}{(-)20} = (-)2.5$$

We can also use the simplified formula for percentage change method.

$$\begin{aligned} e_d &= \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} \\ &= \frac{150-100}{(8-10)} \times \frac{10}{100} \\ &= \frac{50}{(-)2} \times \frac{10}{100} \\ &= (-) 2.5 \end{aligned}$$

Illustration 3

Price elasticity of demand of a commodity is (-) 2. A consumer demands 50 units of this commodity when its price is ₹ 10 per unit. At what price he will demand 40 units of this commodity?

Solution:

$$e_d = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

$$\Rightarrow (-)2 = \frac{40-50}{\Delta P} \times \frac{10}{50}$$

$$\Rightarrow -2 = \frac{(-)10}{\Delta P} \times \frac{10}{50}$$

$$\Rightarrow \Delta P = \text{Re } 1 \text{ per unit}$$

$$\text{New price} = 10 + 1$$

$$= ₹ 11 \text{ per unit}$$



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16.3.2 Geometric Method

This method is also known as 'point method'. Geometric method is used to measure the elasticity at a point on the straight line demand curve. Elasticity of demand is different at different points on the same straight line demand curve.

According to the geometric method, elasticity of demand at any point of a straight line demand curve is measured as a ratio of lower segment of the demand curve and upper segment of the demand curve

$$e_d = \frac{\text{Lower segment of the demand curve}}{\text{Upper segment of the demand curve}}$$

Let us consider a straight line demand curve AB at which elasticity of demand is to be measured at point C, D, M, N, and P (Fig. 16.5).

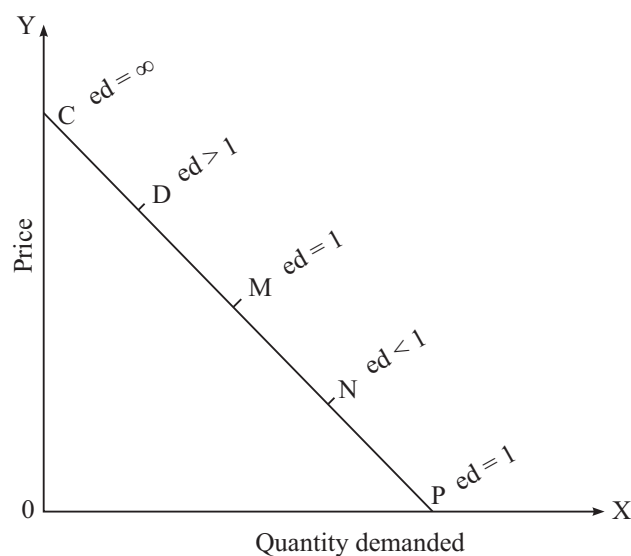


Fig. 16.6

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M is the mid- point of the demand curve AB.

$$\begin{aligned}\text{So, } e_d \text{ at point M} &= \frac{\text{Lower segment of the demand curve}}{\text{Upper segment of the demand curve}} \\ &= \frac{MP}{MC} = 1\end{aligned}$$

(Because MP= MC)

$$e_d \text{ at point N} = \frac{NP}{NC}$$

Point N is below point M so NP is less than NC and elasticity will be less than one.

$$e_d \text{ at point P} = \frac{0}{PC} = 0$$

(Here lower segment is 0)

$$e_d \text{ at point D} = \frac{DP}{DC}$$

Point D is above point M. So, DP is more than DC. Elasticity at this point will be more than one.

$$e_d \text{ at point C} = \frac{CP}{0} = \infty$$

(Upper segment is 0)

So, we can conclude that elasticity at mid- point of a straight line demand curve will be 1, elasticity at every point below the mid- point will be less than one and elasticity at every point above the mid- point will be greater than one.

16.4 RELATIONSHIP BETWEEN TOTAL EXPENDITURE AND PRICE ELASTICITY OF DEMAND

We have studied that price of a good and its quantity demanded are inversely related. So, responsiveness of demand in relation to change in price i.e. price elasticity of demand determines the change in expenditure. We can consider the following cases:

- (i) **Elasticity is less than one ($e_d < 1$):** When the demand for a commodity is less than unit elastic, a fall in price leads to fall in total expenditure and a rise in price leads to rise in total expenditure on the commodity. (Price of the commodity and total expenditure move in same direction). See table 16.6.

Table 16.6

Price (₹ Per unit)	Quantity Demanded (In Units)	Total Expenditure (In ₹)
12	10	120
10	11	110
8	12	96

- (ii) **Elasticity is more than unit elastic ($e_d > 1$):** When the demand for a commodity is more than unit elastic, a fall in price leads to rise in total expenditure and a rise in price leads to a fall in total expenditure on the commodity. (Price of the commodity and total expenditure move in opposite direction). See table 16.7.

Table 16.7

Price (₹ Per unit)	Quantity Demanded (In Units)	Total Expenditure (In ₹)
12	10	120
10	14	140
8	20	160

- (iii) **Elasticity is equal to one ($e_d = 1$):** When the demand for a commodity is unit elastic, total expenditure incurred on the commodity does not change with the change in its price. See table 16.8.

Table 16.8

Price (₹ Per unit)	Quantity Demanded (In Units)	Total Expenditure (In ₹)
12	10	120
10	12	120
8	15	120

All the three cases discussed above are shown diagrammatically in Fig. 16.7



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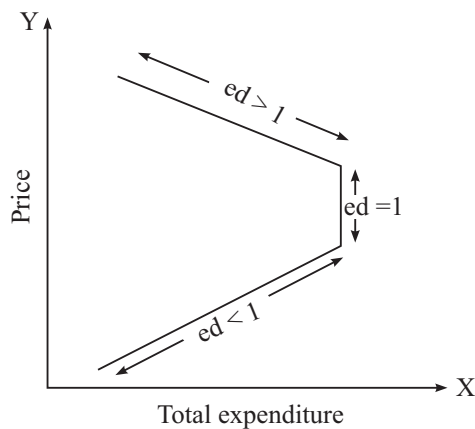


Fig. 16.7

Illustration 1:

Due to 2% fall in price of good X total expenditure on good X rises by 3%. A 10 % rise in price of good Y leads to 20 % rise in total expenditure on good Y. Using total expenditure method, compare price elasticity of demand of good X and good Y.

Solution:

Demand for good X is more than unit elastic because price of the commodity and total expenditure on the commodity move in opposite direction.

Demand for good Y is less than unit elastic because price of the commodity and total expenditure on the commodity move in same direction.

Illustration 2:

When the price of a good changes to ₹ 11 per unit, the consumer's demand falls from 11 units to 7 units. The price elasticity of demand is $(-)$ 1. What was the price before change? Use expenditure approach of price elasticity of demand to answer this question.

Solution:

Price (₹ Per unit)	Quantity Demanded (In Units)	Total Expenditure (In ₹)
?	11	?
11	7	77

As the price elasticity of demand is $(-)$ 1 i.e. unit elastic, so, total expenditure will remain unchanged at ₹ 77. Therefore, price before change was $77/11 = ₹ 7$ per unit

Illustration 3:

When price of a good falls from ₹ 10 per unit to ₹ 9 per unit, its demand rises from 9 units to 10 units. Compare expenditures on the good to find price elasticity of demand.

Price (₹ Per unit)	Quantity Demanded (In Units)	Total Expenditure (In ₹)
10	9	90
9	10	90

The demand for the good is unit elastic as the total expenditure remains unchanged at ₹ 90 when its price falls.



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16.5 FACTORS AFFECTING PRICE ELASTICITY OF DEMAND

As discussed earlier, in case of some goods responsiveness of quantity demanded to the change in price is more than some other goods. For example, a very small change in price of luxury goods may affect their demand to a considerable extent but a large change in price of salt may not affect its demand. This means, price elasticity of demand is different for different goods. Following factors may affect the price elasticity of demand for a good:

- (i) **Availability of close substitutes:** Demand for a commodity which has large number of substitutes, is usually more elastic than those commodities which have no substitutes. For example, coke, Pepsi, limca etc. are good substitutes. Even a small rise in price of coke will induce the buyers to go for its substitutes. On the other hand demand for electricity will be less elastic because it has no close substitutes.
- (ii) **Nature of the Commodity:** Demand for necessities like medicines, food grains is less elastic because we have to consume them in minimum required quantity, whatever their price may be. But demand for comforts and luxuries like refrigerators, air conditioners etc. is more elastic because their consumption may be postponed for future if their price rises.
- (iii) **Share in Total Expenditure:** Greater the proportion of income spent on the commodity, more is the elasticity of demand for it. Demand for a commodity is inelastic if proportion of income spent on that commodity is very small.
- (iv) **Level of Price:** Demand for a commodity at higher level of price (like air conditioners, cars etc.) is generally more elastic than for a commodity at lower level of price (like match box, pencils etc.)
- (v) **Level of Income:** Demand for a commodity is generally less elastic for higher income level groups in comparison to people with low incomes. For example,

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if price of a good rises, a rich consumer is not likely to reduce his demand but a poor consumer can reduce his demand for that commodity.

- (vi) **Habits:** Habits of consumers also determine price elasticity of demand of commodities. For example, a chain smoker will not restrict his smoking even when the price of cigarettes rise.



INTEXT QUESTIONS 16.2

1. Due to 5% fall in price of a commodity its demand rises by 7.5%. Calculate and state coefficient of price elasticity of demand. Whether the demand is elastic or inelastic? Give reason.
2. Write formula for measuring price elasticity of demand at a point on a straight line demand curve.
3. The total expenditure on a commodity falls when its price rises. Comment on the price elasticity of demand of the commodity.
4. State any two factors which may affect price elasticity of demand of a commodity.
5. Why is the demand for water inelastic?



WHAT YOU HAVE LEARNT

- Price elasticity of demand is the degree of responsiveness of demand for a commodity to the change in its price.
- When quantity demanded of a commodity does not change at all in response to change in its price, the demand for the commodity is called perfectly inelastic.
- The demand for a commodity is called less than unit elastic when the percentage change in quantity demanded is less than the percentage change in its price.
- The demand for a commodity is called unit elastic when the percentage change in quantity demanded equals the percentage change in its price.
- The demand for a commodity will be more than unit elastic if the percentage change in quantity demanded is more than the percentage change in its price.
- When the demand for a commodity expands or contracts to any extent without or very little change in its price, its demand is called perfectly elastic.

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- By percentage method, price elasticity of demand can be ascertained by the formula:

$$e_d = \frac{\text{percentage change in quantity demanded}}{\text{percentage change in price of the commodity}}$$
$$= \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

- Price elasticity of demand at mid- point of a straight line demand curve will be 1, elasticity at every point below the mid- point will be less than 1 and elasticity at every point above mid- point will be greater than 1.
- When the demand for a commodity is less than unit elastic, price of the commodity and total expenditure on the commodity move in same direction.
- When the demand for a commodity is more than unit elastic, price of the commodity and total expenditure on the commodity move in opposite direction.
- When the demand for a commodity is unit elastic, total expenditure incurred on the commodity does not change with the change in its price.
- Price elasticity of demand of a commodity is influenced by (i) availability of close substitutes, (ii) nature of the commodity, (iii) share in total expenditure, (iv) level of price, (v) level of income and, (vi) habits etc.



TERMINAL EXERCISE

- Draw diagrams for:
 - Perfectly elastic demand
 - Perfectly inelastic demand
 - Unit elastic demand
- Prepare a schedule for:
 - More than unit elastic demand
 - Less than unit elastic demand
- Explain 'percentage change' method of measuring price elasticity of demand.
- Explain the relationship between total expenditure incurred on a commodity and its price elasticity of demand.
- How is price elasticity of demand of a commodity affected by availability of its close substitutes? Explain.

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6. A household purchases 40 units of a good when its price is Re. 1 per unit. At what price he would purchase 36 units of it if coefficient of price elasticity of demand is unitary.
7. What quantity of a commodity would a household purchase at a price of ₹ 12 per unit, if he purchases 40 units of it at ₹ 10 per unit? Price elasticity of demand is (-) 1.5.
8. A household spends ₹ 120 on purchase of a commodity when its price is ₹ 6 per unit. When price rises to ₹ 10 per unit, his total expenditure on this commodity becomes ₹ 180. Calculate price elasticity of demand by percentage change method.
9. When price of a commodity falls from ₹ 20 per unit to ₹ 16 per unit, its quantity demanded increases by 20%. Calculate coefficient of price elasticity of demand.
10. A consumer buys 15 units of a good at a price of ₹ 10 per unit. At price ₹ 15 per unit he buys 10 units. What is price elasticity of demand? Use expenditure approach. Comment on the likely shape of demand curve on the basis of this measure of elasticity.



ANSWER TO INTEXT QUESTIONS

16.1

1. Read section 16.1
2. Read section 16.2(iv)
3. Rectangular hyperbola

16.2

1. $e_d = 1.5$, Demand is more than unit elastic because percentage change in quantity demanded is more than the percentage change in price of the commodity.
2.
$$e_d = \frac{\text{lower segment of demand curve}}{\text{Upper segment of demand curve}}$$
3. Demand for the commodity is more than unit elastic because price and total expenditure move in opposite direction.
4. (i) Nature of the commodity (ii) Availability of close substitutes
5. Demand for water is inelastic because water is a necessity.