CHAPTER 4

Elasticities

Learning Objectives

- Define price elasticity of demand
  - Explain its determinants
- Understand how changes in price affect total revenue
  - Relate total revenue to price elasticity of demand
- Define cross-price elasticity and income elasticity
  - Normal vs. Inferior goods
  - Substitute vs. Complement goods
- Define price elasticity of supply
  - Explain its determinants

THE ELASTICITY OF DEMAND

- *Price elasticity of demand* is a measure of how much the quantity demanded of a good responds to a change in the price of that good.
- It captures how sensitive the quantity demanded (buyers behavior) is to changes in the price of a good.

Determinants of Price Elasticity of Demand

Elasticity of demand depends on:

- Availability of Close Substitutes
- Definition of the Market
- Share in the budget
- Necessities versus Luxuries
- Time Horizon

Determinants of Price Elasticity of Demand

Demand tends to be more elastic:

- the larger the number of close substitutes.
  - Coca cola vs. Drinking water
- the more narrowly defined the market.
  - Masafi vs. Drinking water
- the larger share in the (household) budget.
  - Car vs. Salt
- the good is a luxury.
  - Vacation in Bahamas vs. Business travel
- the longer the time period.
  - Gasoline price change effect in two weeks vs. two years

Computing the Price Elasticity of Demand

- The price elasticity of demand is computed:

$$\text{Price Elasticity of Demand} = \frac{\text{Precentage change in quantity demanded}}{\text{percentage change in price}}$$

$$E_D^p = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta p}{p}} = \frac{\frac{Q_2 - Q_1}{Q_1}}{\frac{p_2 - p_1}{p_1}} = \frac{p}{Q}\frac{\Delta Q}{\Delta p} = \frac{p}{Q} \times (slope)$$

- Note that the slope is the slope of demand curve in this formula. We need to use the inverse of the slope if we use inverse demand curve.

Examples of Elasticities

- More close substitutes

Green peas	2.80
Restaurant meals	1.63
Shoes	0.70
Coffee	0.25

Automobiles	1.35
Foreign air travel	0.77

- Small budget share
- No close substitute

Movies	0.87
Theater, opera	0.18

Computing the Price Elasticity of Demand

- Example: If the price of an ice cream cone increases from $2.00 to $2.20 and the amount you buy falls from 10 to 8 cones, then your elasticity of demand would be calculated as:

$$E_D^p = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta p}{p}} = \frac{\frac{Q_2 - Q_1}{Q_1}}{\frac{p_2 - p_1}{p_1}}$$

$$\text{Price elasticity} = \frac{\frac{8-10}{10} \times 100}{\frac{2.2-2}{2} \times 100} = \frac{-20\%}{10\%} = -2$$

Computing the Price Elasticity of Demand

- Change from ($2.00, 10) to ($2.20, 8)

$$\text{Price elasticity} = \frac{(8-10)/10}{(2.2-2)/2} = -2.00$$

- Change from ($2.20, 8) to ($2.00, 10)

$$\text{Price elasticity} = \frac{(10-8)/8}{(2.0-2.2)/2.2} = -2.75$$

The Midpoint Method: A Better Way to Calculate Elasticities

- The midpoint formula is preferable when calculating the price elasticity of demand because it gives the same answer regardless of the direction of the change.

$$\text{Price elasticity of demand} = \frac{\frac{Q_2 - Q_1}{(Q_2 + Q_1)/2}}{\frac{p_2 - p_1}{(p_2 + p_1)/2}}$$

The Midpoint Method: A Better Way to Calculate Elasticities

- Example: If the price of an ice cream cone increases from $2.00 to $2.20 and the amount you buy falls from 10 to 8 cones, then your elasticity of demand, using the midpoint formula, would be calculated as:

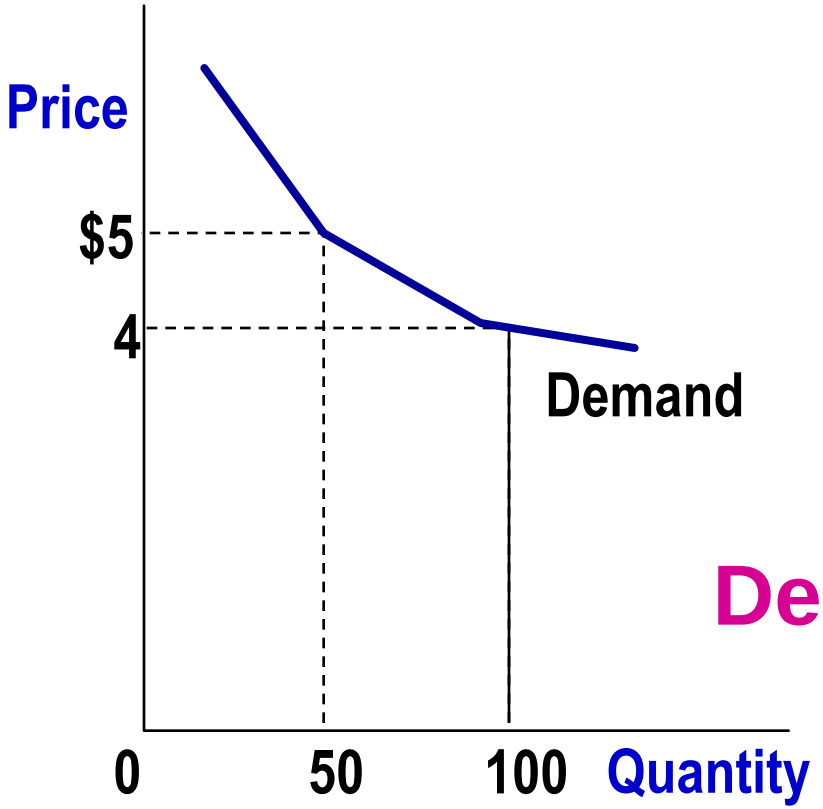
$$\frac{\frac{8-10}{(8+10)/2}}{\frac{2.2-2}{(2.2+2)/2}} = -\frac{22\%}{9.5\%} = -2.32$$

The Variety of Demand Curves

- Inelastic Demand
  - Quantity demanded does not respond strongly to price changes.
  - Price elasticity of demand is less than one.

- Elastic Demand
  - Quantity demanded responds strongly to changes in price.
  - Price elasticity of demand is greater than one.

Computing the Price Elasticity of Demand



$$E_D = \frac{(100-50)/(100+50)/2}{(4.00-5.00)/(4.00+5.00)/2}$$

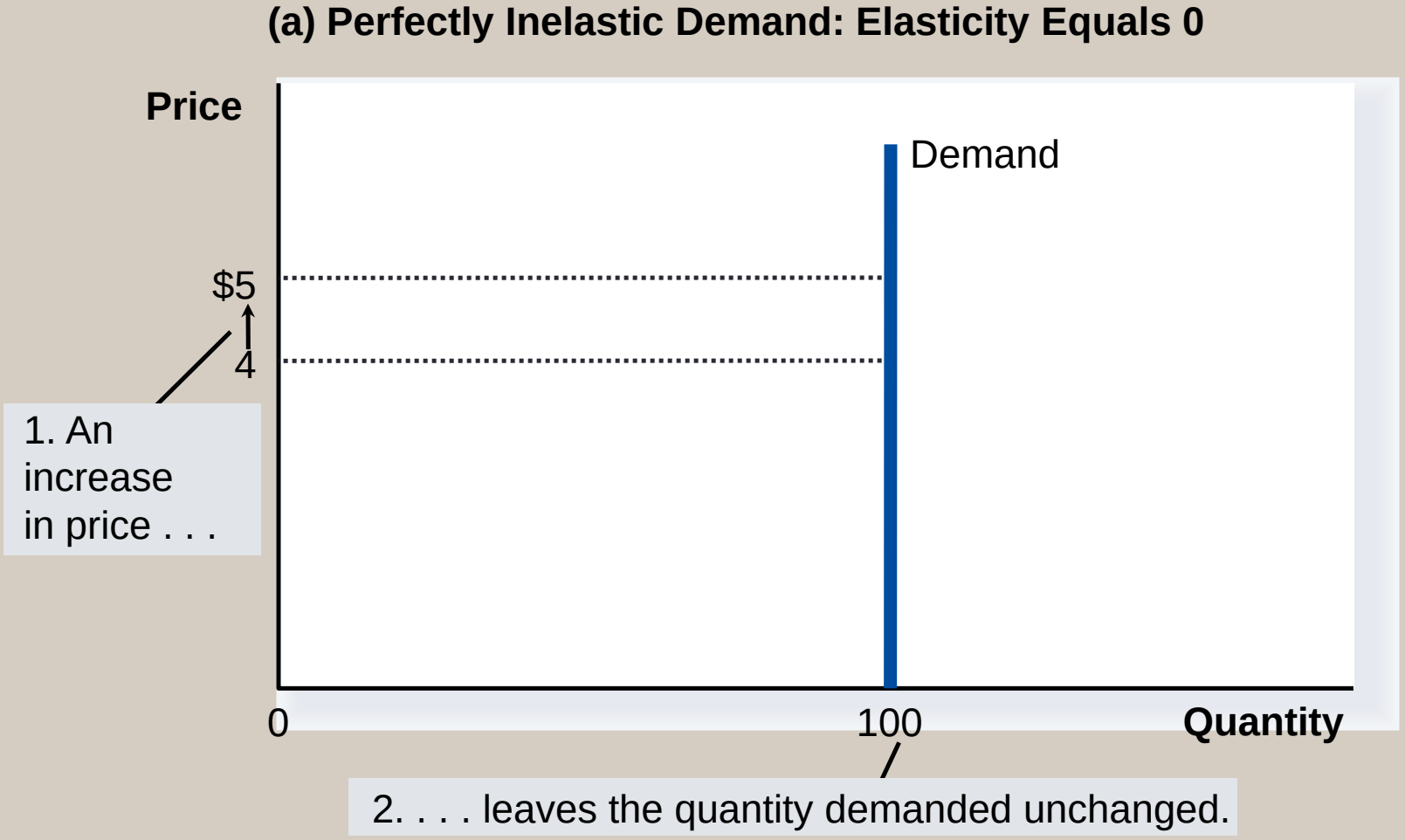
$$= \frac{67 \text{ percent}}{-22 \text{ percent}} = -3$$

Demand is price elastic.

The Variety of Demand Curves

- Perfectly Inelastic
  - Quantity demanded does not respond to price changes.
- Perfectly Elastic
  - Quantity demanded changes infinitely with any change in price.
- Unit Elastic
  - Quantity demanded changes by the same percentage as the price.

Figure 1 The Price Elasticity of Demand



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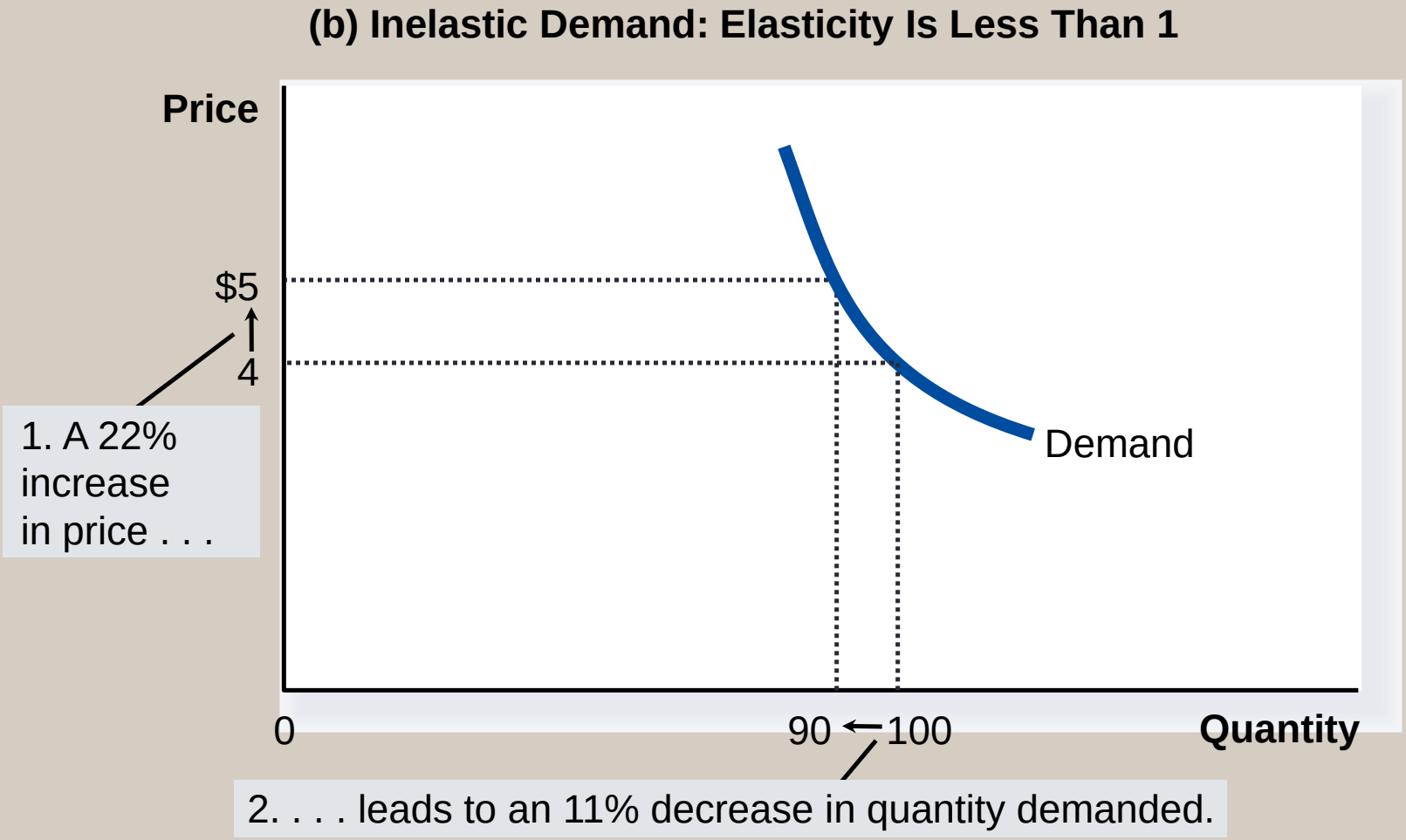
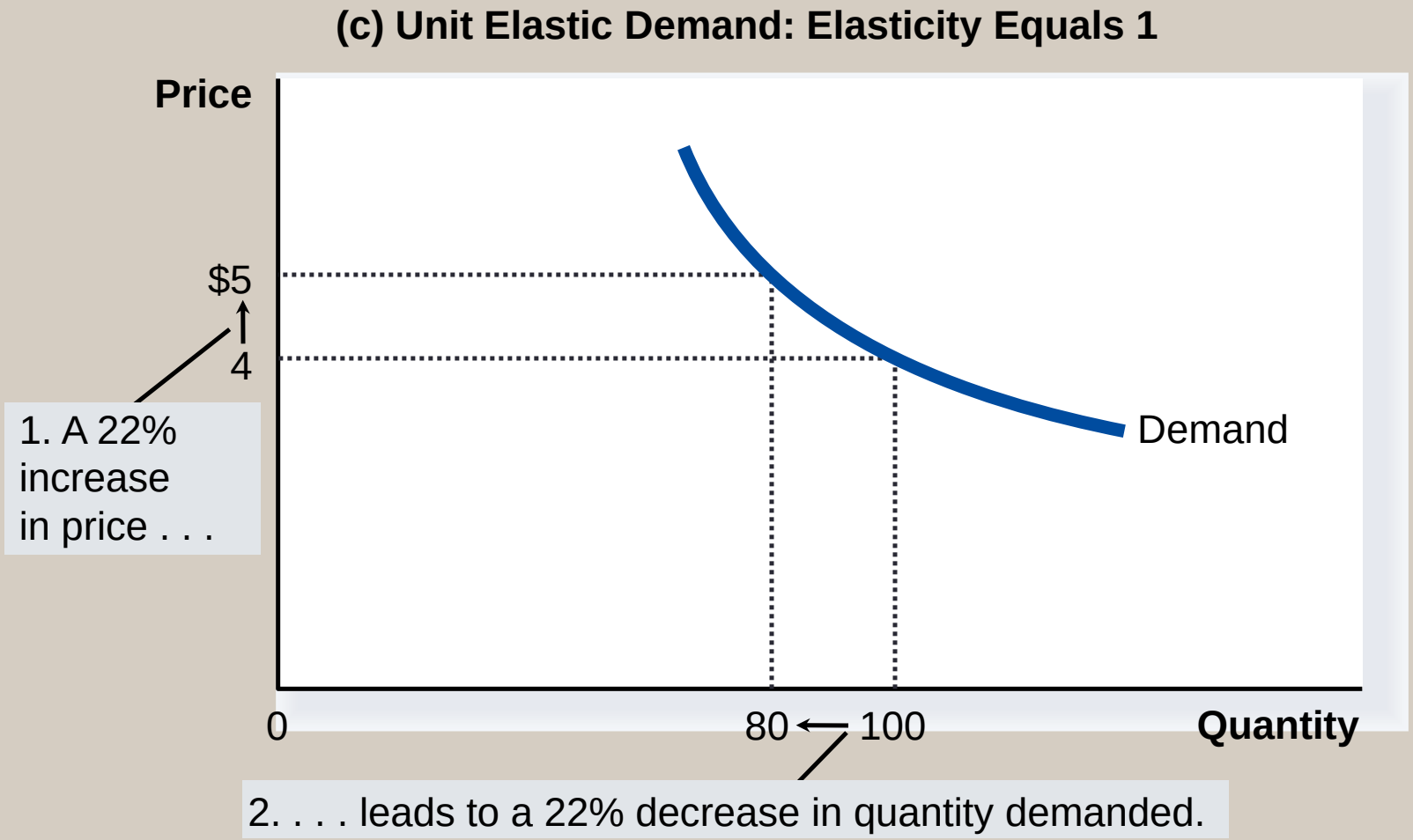


Figure 1 The Price Elasticity of Demand



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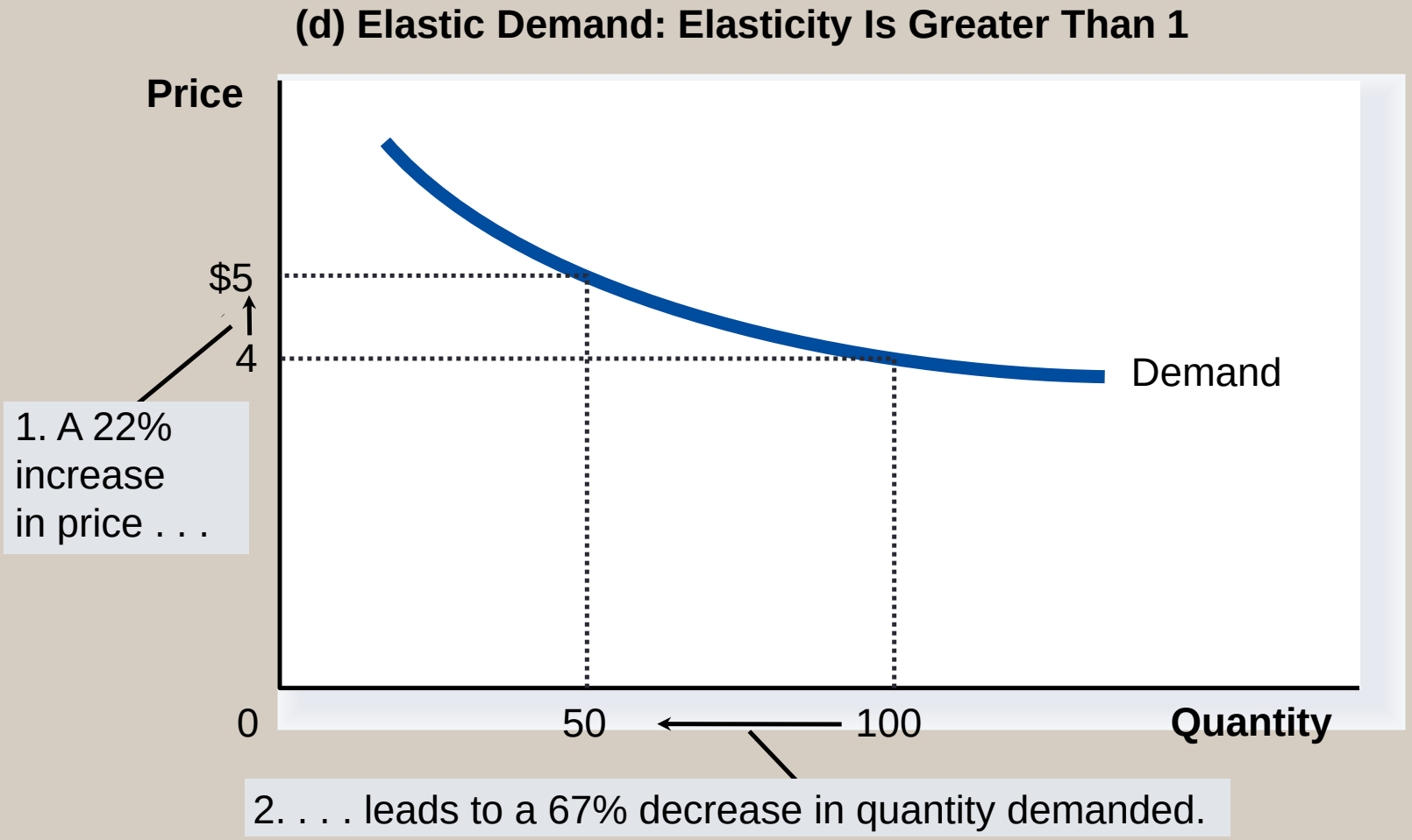
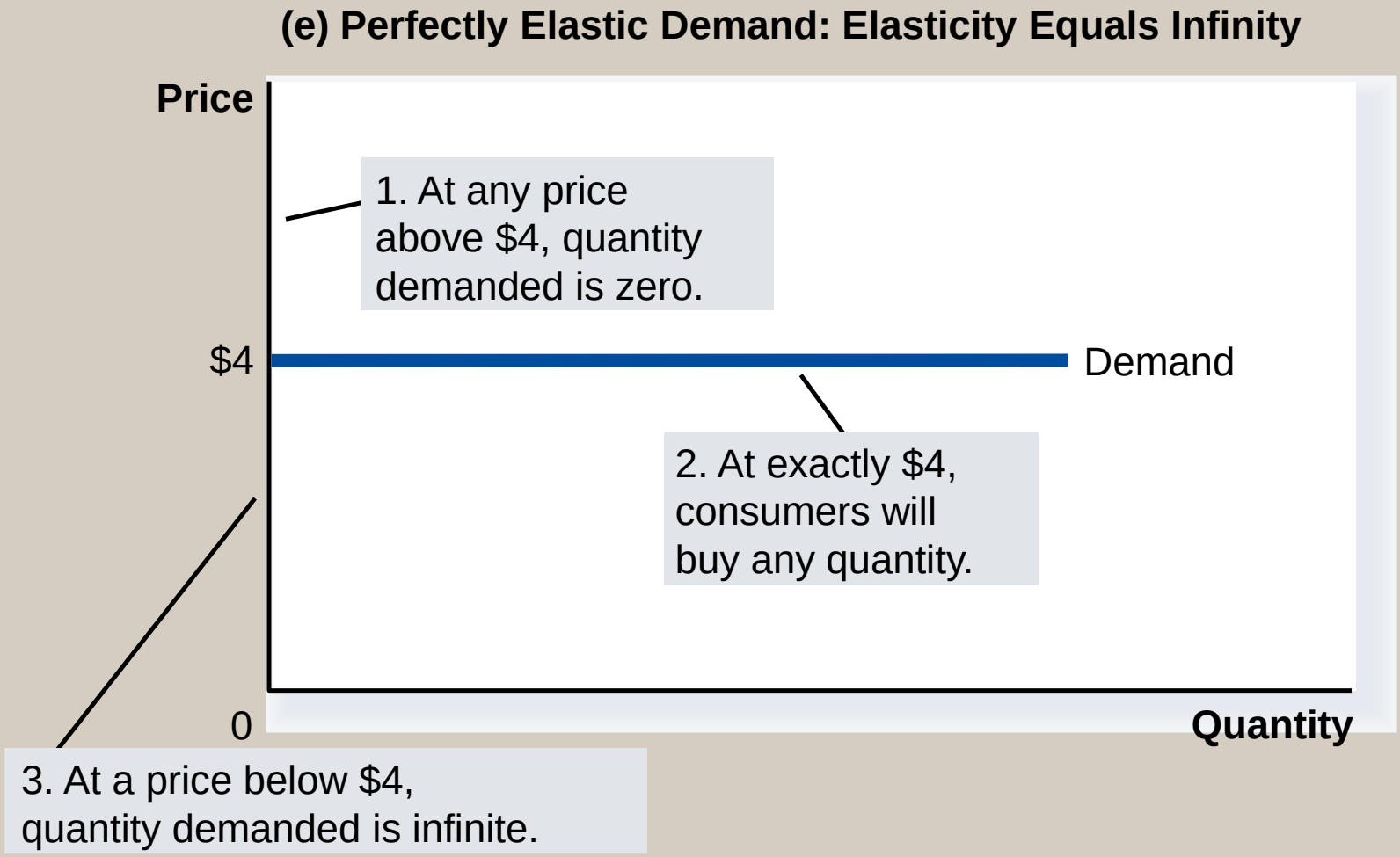
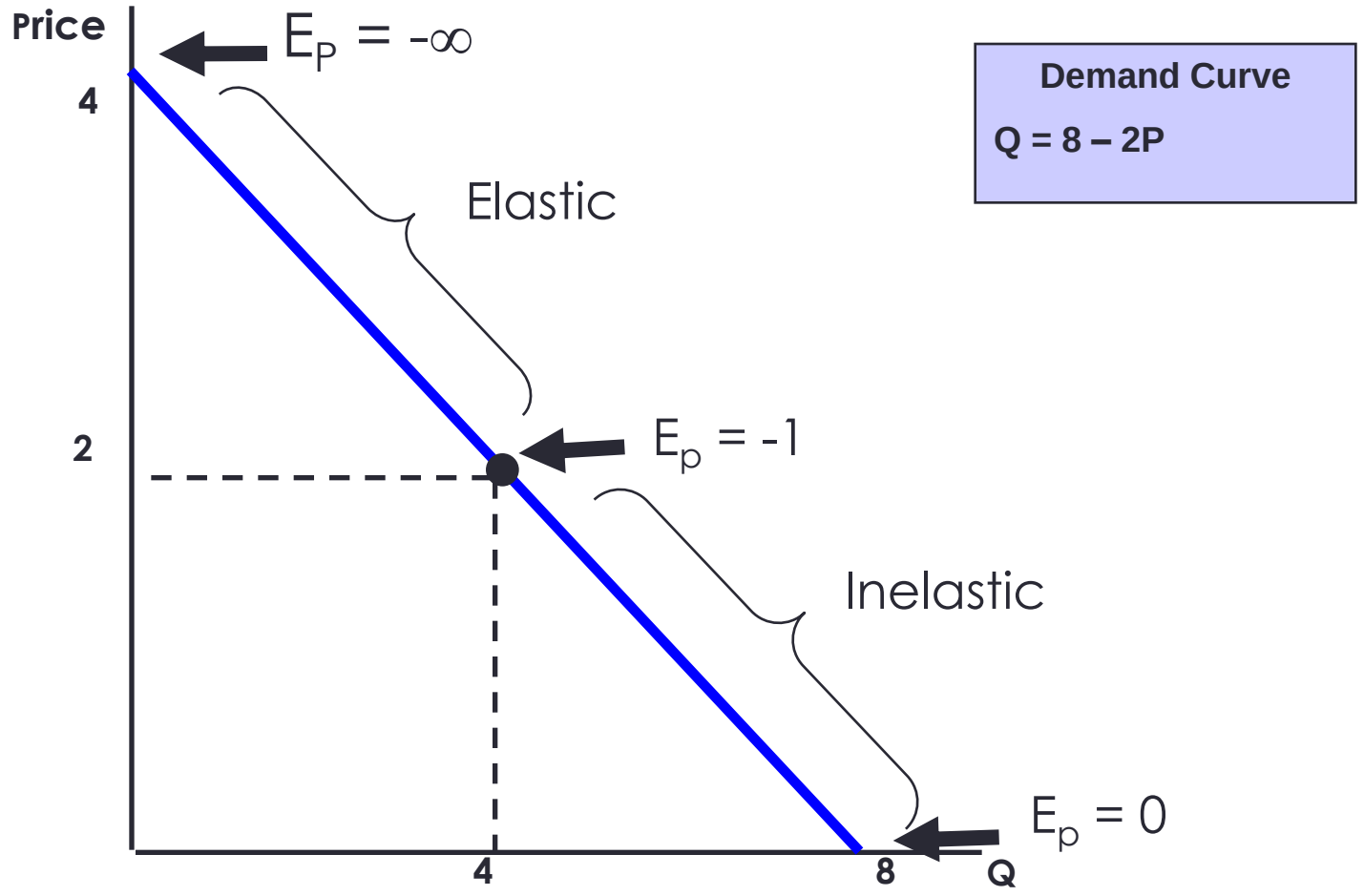


Figure 1 The Price Elasticity of Demand



Price Elasticity of Linear Demand



Price Elasticity of Linear Demand

- Using the linear demand curve equation, it is easy to calculate the price elasticity of the demand.
- Demand curve is give by: $Q_D = 8 - 2P$, and the inverse demand curve is then: $P = 4 - Q_D/2$.
- The slope of the demand curve is -2 and the slope of the inverse demand curve is $-1/2$.
- Thus, the price elasticity of demand at $(P = 2, Q = 4)$ is:

$$\varepsilon_D^P = \frac{P}{Q}\frac{\Delta Q}{\Delta P} = \frac{2}{4}(-2) = -1 \quad \text{(unit elastic)}$$

- and at $P = 1$, the quantity is $Q_D = 6$, and elasticity is:

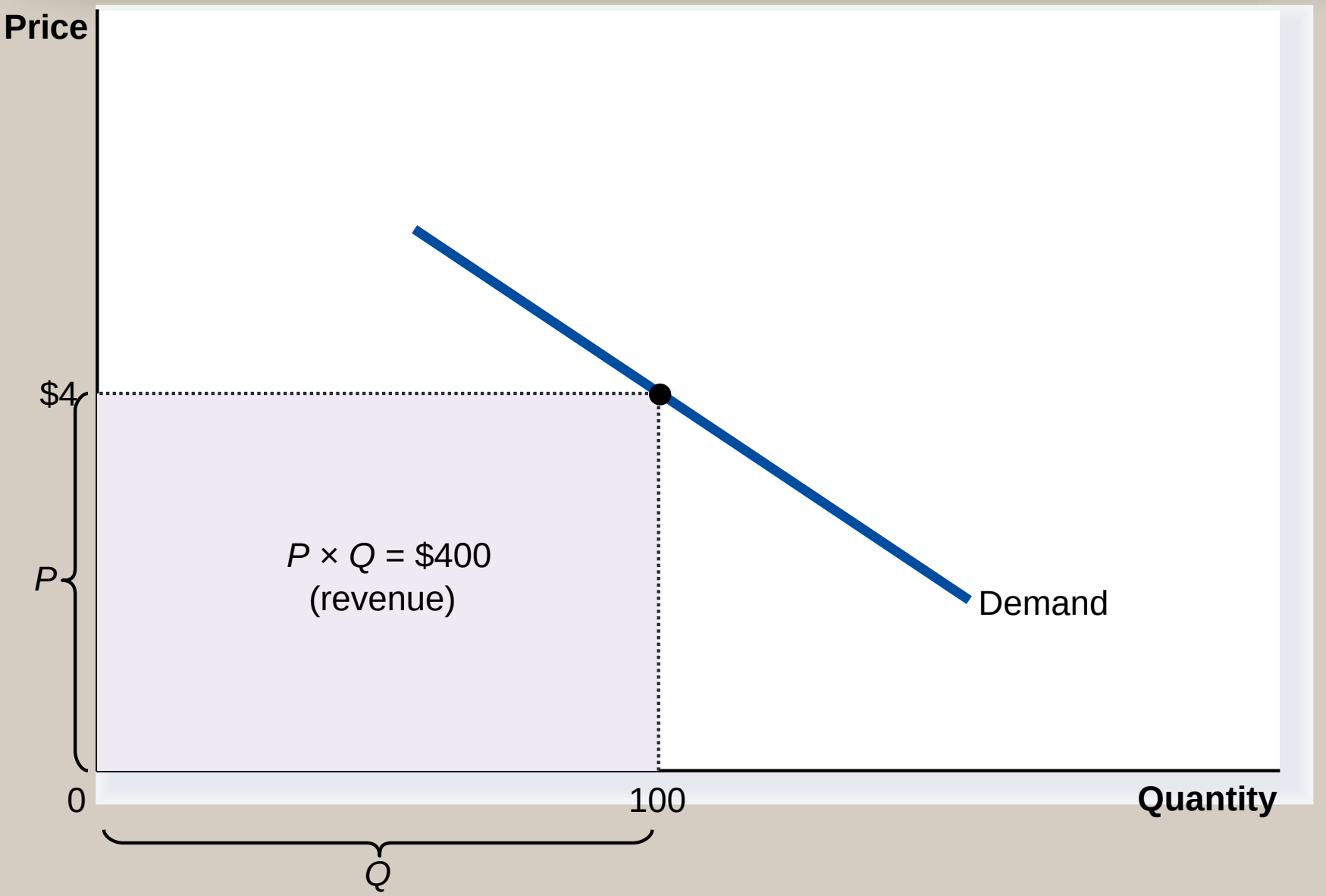
$$\varepsilon_D^P = \frac{P}{Q}\frac{\Delta Q}{\Delta P} = \frac{1}{6}(-2) = -0.33 \quad \text{(inelastic)}$$

Total Revenue and Total Expenditure

- Total revenue is the amount paid by buyers and received by sellers of a good. This is also shows the total expenditure by consumers.

$$TR = TE = P \times Q$$

Figure 2 Total Revenue

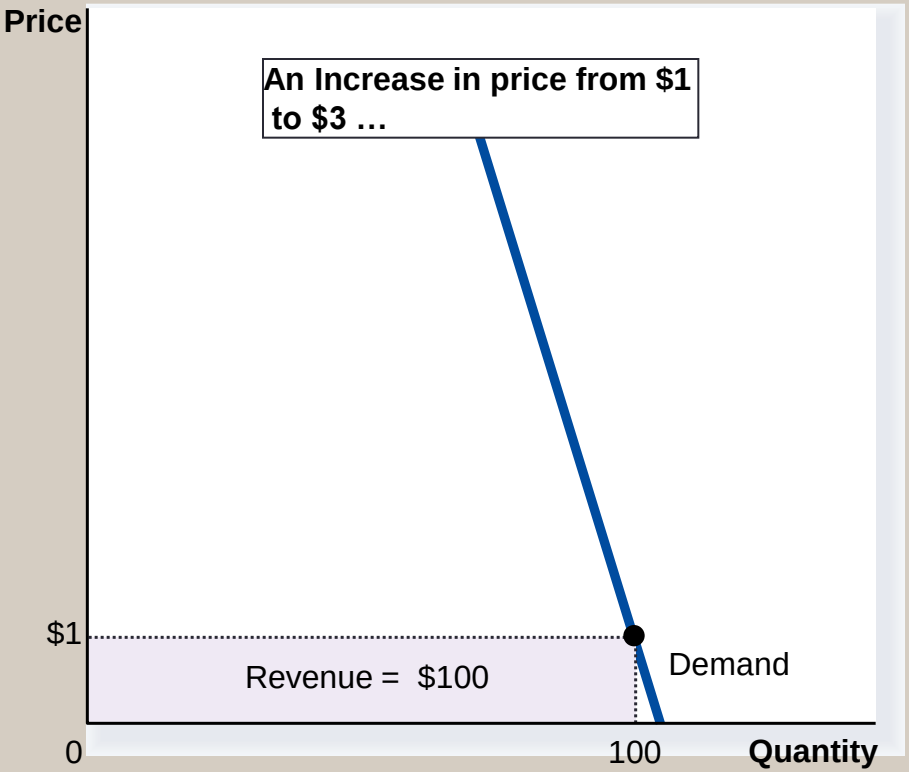


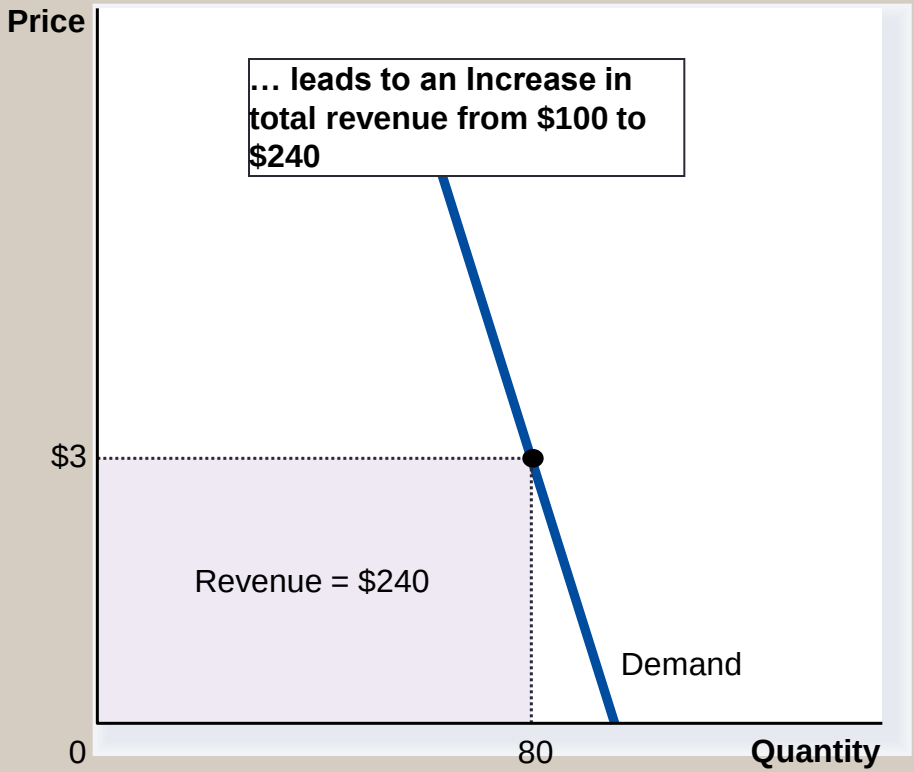
Elasticity and Total Revenue along a Linear Demand Curve

- With an inelastic demand curve, an increase in price leads to

an increase in total revenue.

Figure 3 How Total Revenue Changes When Price Changes: Inelastic Demand



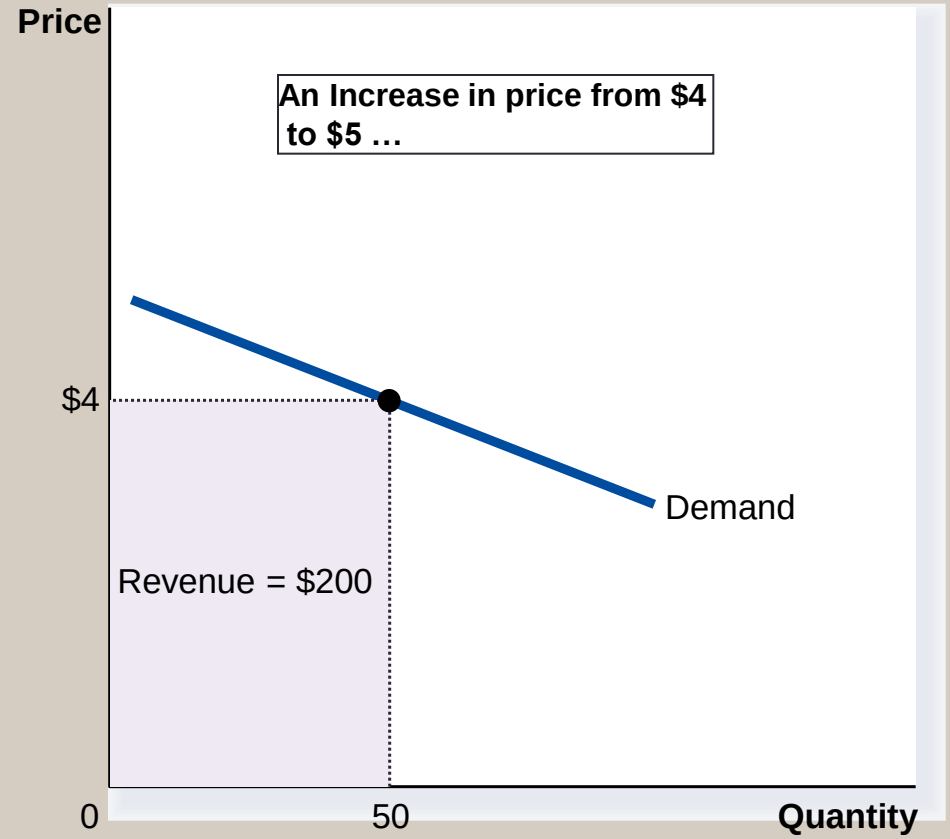


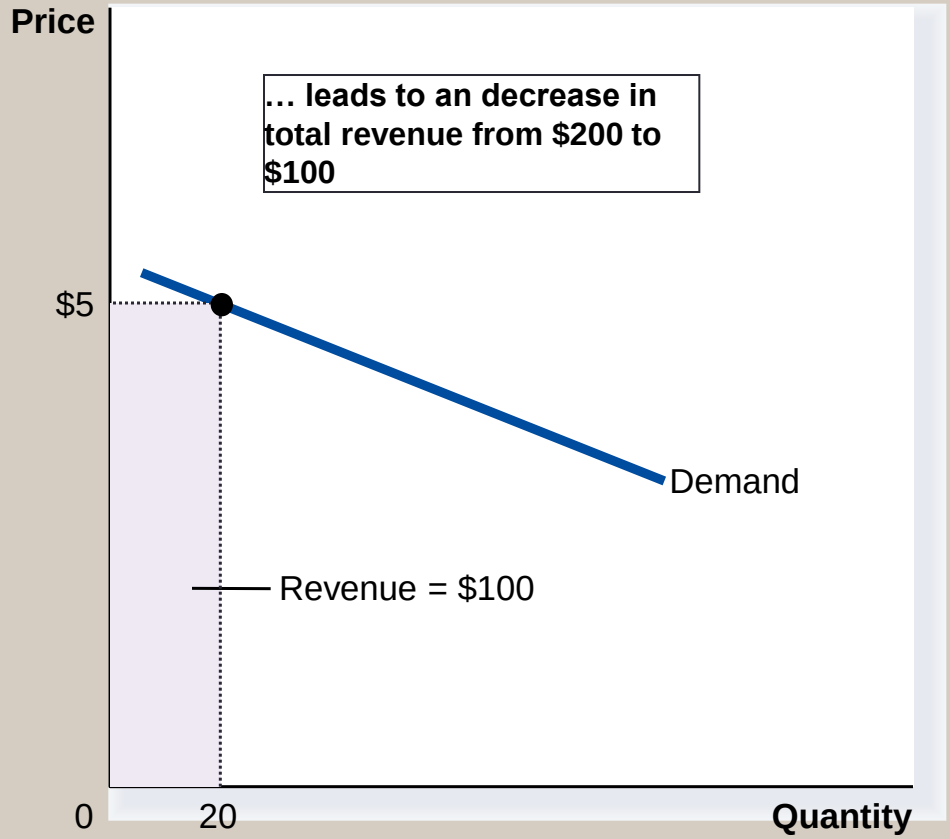
Elasticity and Total Revenue along a Linear Demand Curve

- With an elastic demand curve, an increase in the price leads to

a decrease in total revenue.

Figure 4 How Total Revenue Changes When Price Changes: Elastic Demand





Elasticity of a Linear Demand Curve

Price	Quantity
$7	0
6	2
5	4
4	6
3	8
2	10
1	12
0	14

Elasticity of a Linear Demand Curve

Price	Quantity	Total Revenue (Price × Quantity)
$7	0	$ 0
6	2	12
5	4	20
4	6	24
3	8	24
2	10	20
1	12	12
0	14	0

Elasticity of a Linear Demand Curve

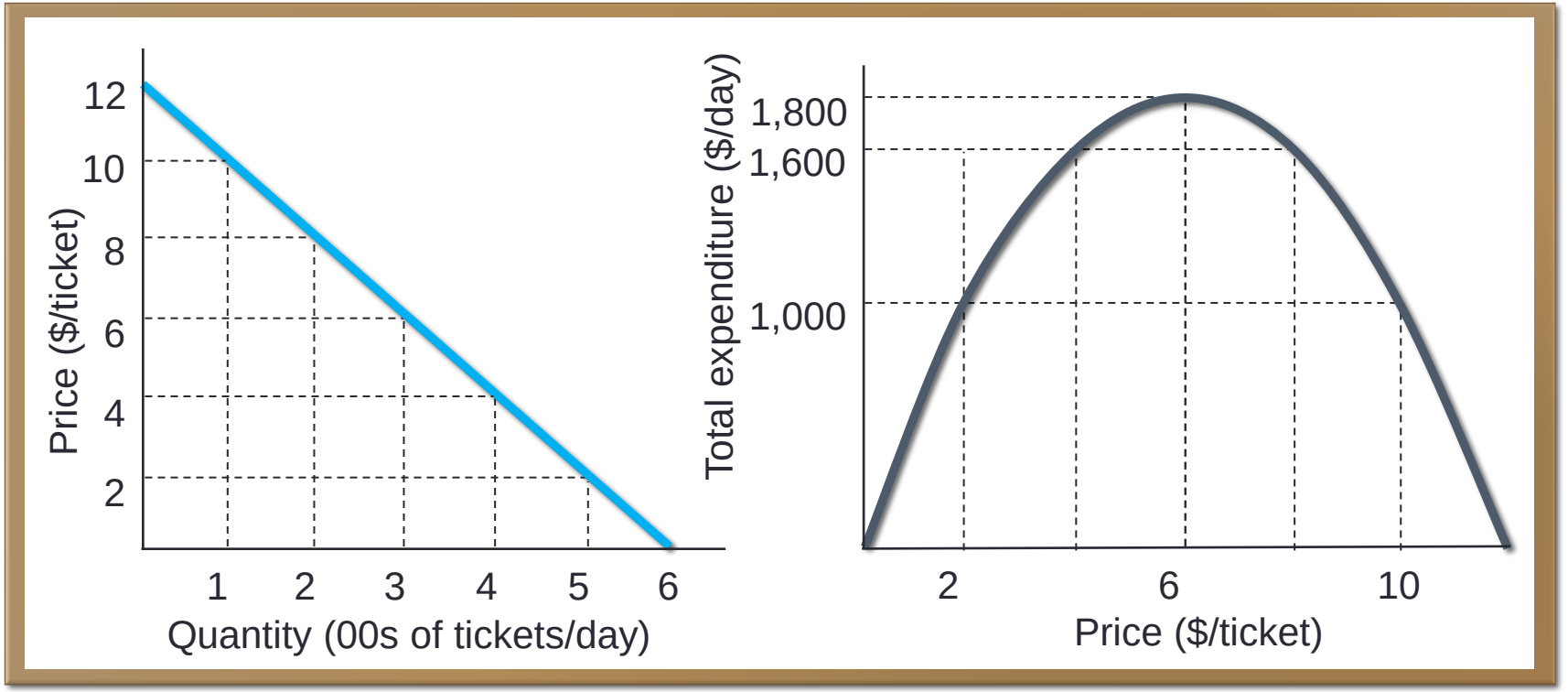
Price	Quantity	Total Revenue (Price × Quantity)	Percent Change in Price	Percent Change in Quantity
$7	0	$ 0		
			15	200
6	2	12		
			18	67
5	4	20		
			22	40
4	6	24		
			29	29
3	8	24		
			40	22
2	10	20		
			67	18
1	12	12		
			200	15
0	14	0		

Elasticity of a Linear Demand Curve

Price	Quantity	Total Revenue (Price × Quantity)	Percent Change in Price	Percent Change in Quantity	Elasticity	Description
$7	0	$ 0				
			15	200	13.0	Elastic
6	2	12				
			18	67	3.7	Elastic
5	4	20				
			22	40	1.8	Elastic
4	6	24				
			29	29	1.0	Unit elastic
3	8	24				
			40	22	0.6	Inelastic
2	10	20				
			67	18	0.3	Inelastic
1	12	12				
			200	15	0.1	Inelastic
0	14	0				

Price Changes and Total Expenditure Changes

Price	$12	$10	$8	$6	$4	$2	$0
Quantity	0	100	200	300	400	500	600
Expenditure	$0	$1,000	$1,600	$1,800	$1,600	$1,000	$0



Income Elasticity of Demand

- *Income elasticity of demand* measures how much the quantity demanded of a good responds to a change in consumers' income.

$$\text{Income Elasticity of Demand} = \frac{\text{Precentage change in quantity demanded}}{\text{Percentage change in Income}}$$

$$E_D^I = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta I}{I}} = \frac{I}{Q}\frac{\Delta Q}{\Delta I}$$

Income Elasticity

- Types of goods based on their income effects:
  - Normal Goods

$$I \uparrow \longrightarrow Q \uparrow \quad \text{or} \quad E_D^I > 0$$

  - Inferior Goods

$$I \uparrow \longrightarrow Q \downarrow \quad \text{or} \quad E_D^I < 0$$

Income Elasticity

- Evan among the normal good:
  - Goods consumers regard as necessities tend to be income inelastic.

$$0 < E_D^I < 1$$

    - Examples include food, fuel, clothing, utilities, and medical services.

  - Goods consumers regard as luxuries tend to be income elastic.

$$1 < E_D^I$$

    - Examples include sports cars, furs, and expensive foods.

Cross-Price Elasticity of Demand

- *Cross-Price Elasticity of Demand* measures how much the quantity demanded of a good responds to a change in the price of another (related) good.

$$\text{Cross Price Elasticity of Demand} = \frac{\text{Precentage change in quantity demanded}}{\text{Percentage change in price of related good}}$$

$$E_D^{p_r} = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta p_r}{p_r}} = \frac{p_r}{Q}\frac{\Delta Q}{\Delta p_r}$$

Cross-Price Elasticity of Demand

- Two Types of Goods
  - Substitute Goods

$$P_r \uparrow \longrightarrow Q \uparrow \quad \text{or} \quad E_D^{Pr} > 0$$

  - Complement Goods

$$P_r \uparrow \longrightarrow Q \downarrow \quad \text{or} \quad E_D^{Pr} < 0$$

THE ELASTICITY OF SUPPLY

- *Price elasticity of supply* is a measure of how much the quantity supplied of a good responds to a change in the price of that good.
- It captures how sensitive the quantity supplied (sellers behavior) is to changes in the price of a good.

Determinants of Price Elasticity of Supply

- The main factor in determining elasticity of supply is the ability of sellers to change the amount of the good they produce.
  - Land is inelastic.
  - Books, cars, or manufactured goods are elastic.
  - Flexibility of Inputs
    - Lemonade (low skilled workers) vs. Econ Professors
  - Mobility of Inputs
    - Wheat (farm workers are mobile) vs. houses (land is immobile)
  - Substitutability of Inputs
    - Diamond or cultivated land vs. cars
  - Time horizon: Supply is more elastic in the long run.
    - Apartment units in the next 6 months vs. in the next 5 years

Computing the Price Elasticity of Supply

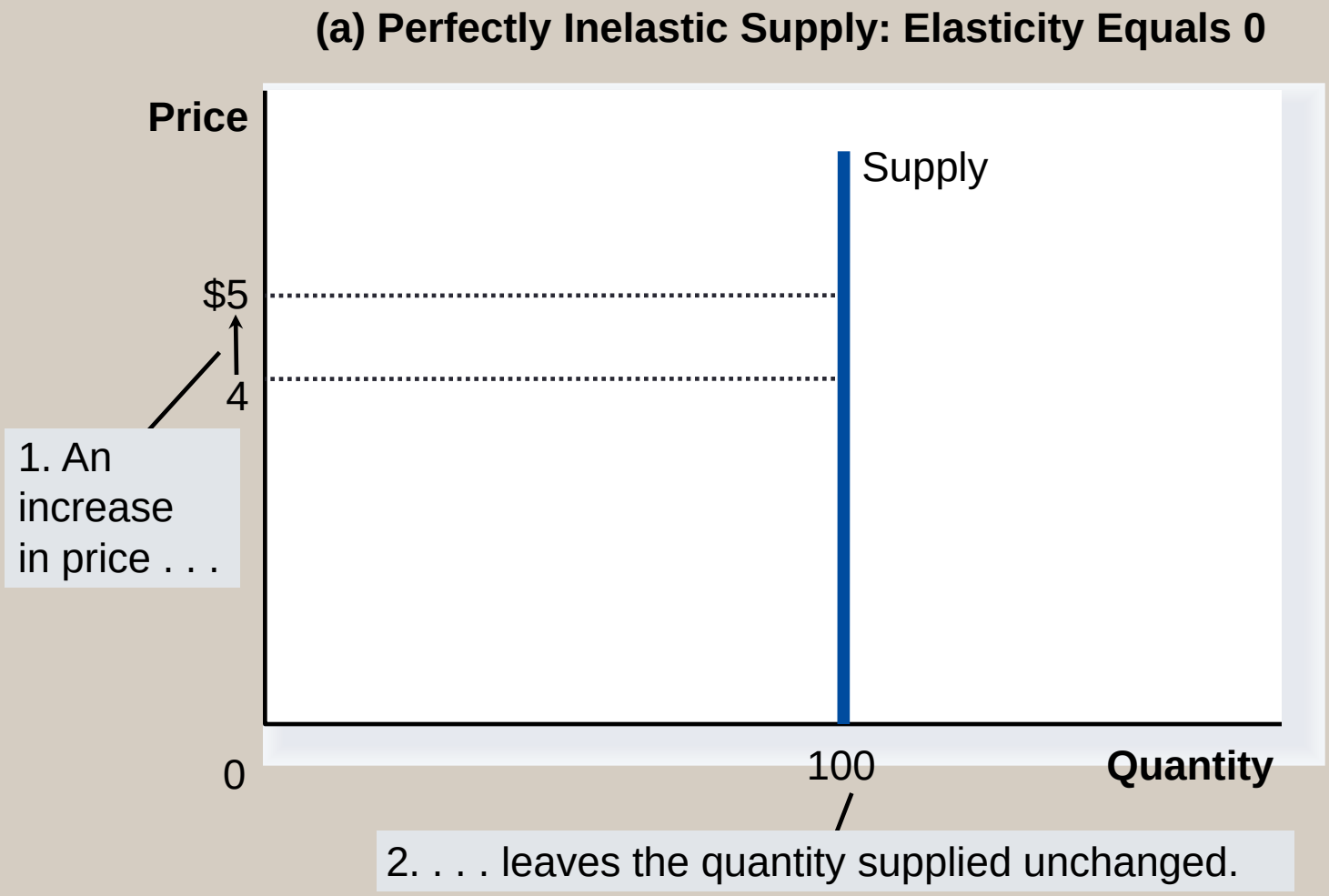
- The price elasticity of supply is computed:

$$\text{Price elasticity of supply} = \frac{\text{Precentage change in quantity supplied}}{\text{percentage change in price}}$$

$$E_S^p = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta p}{p}} = \frac{p}{Q}\frac{\Delta Q}{\Delta p} = \frac{p}{Q} \times (slope)$$

- Note that the slope is the slope of supply curve in this formula. We need to use the inverse of the slope if we use inverse supply curve.

Figure 6 The Price Elasticity of Supply



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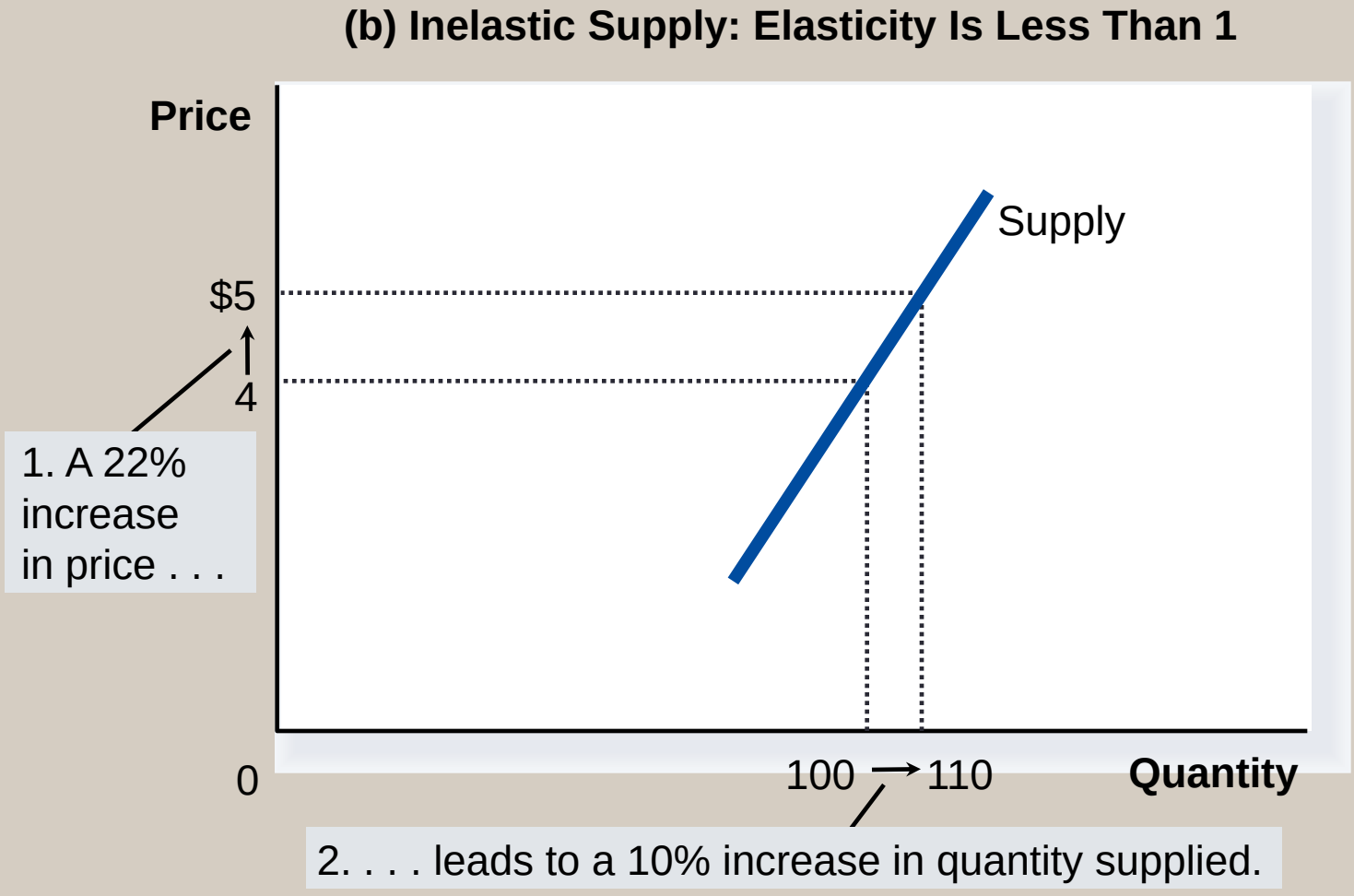

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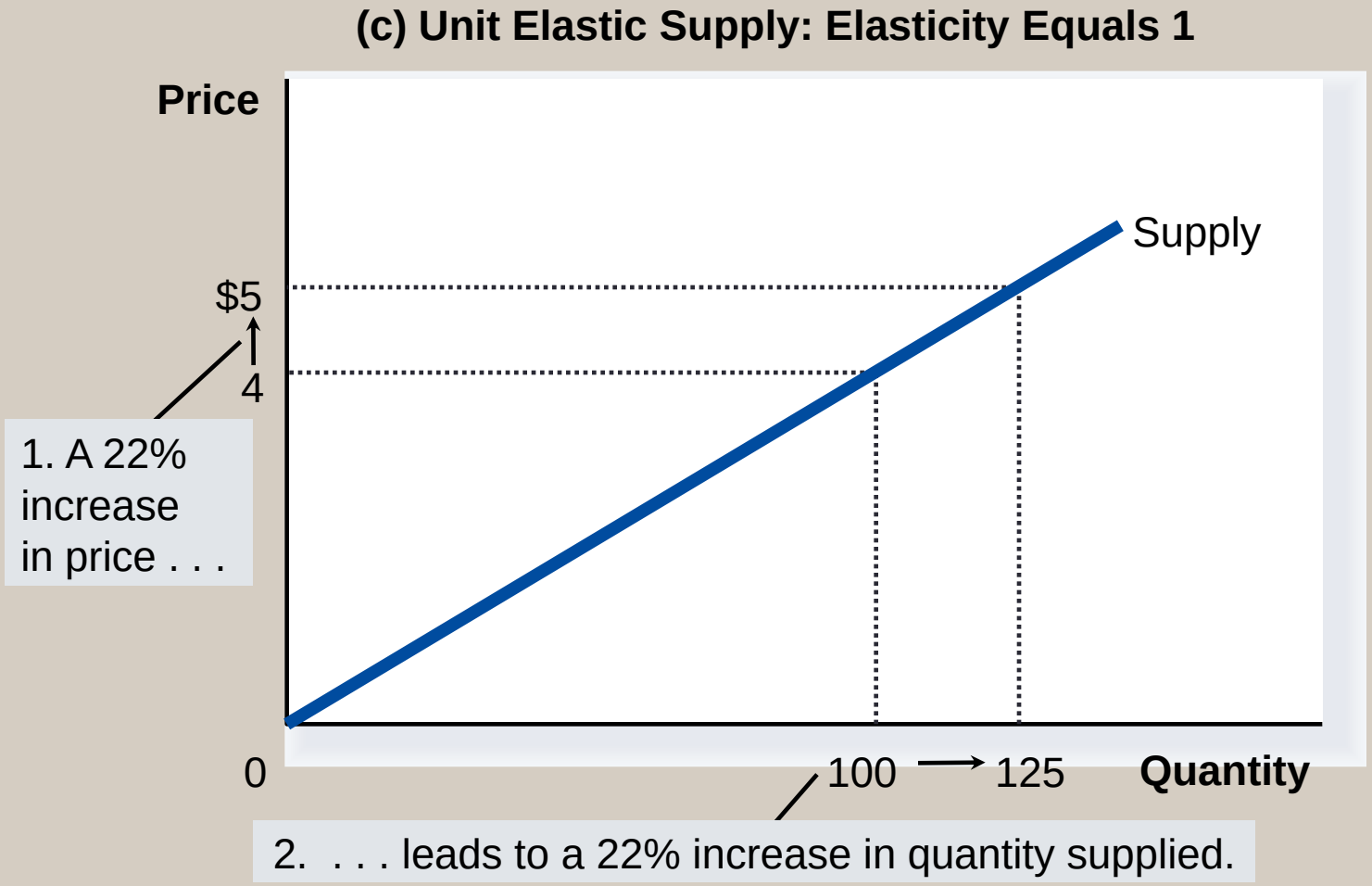

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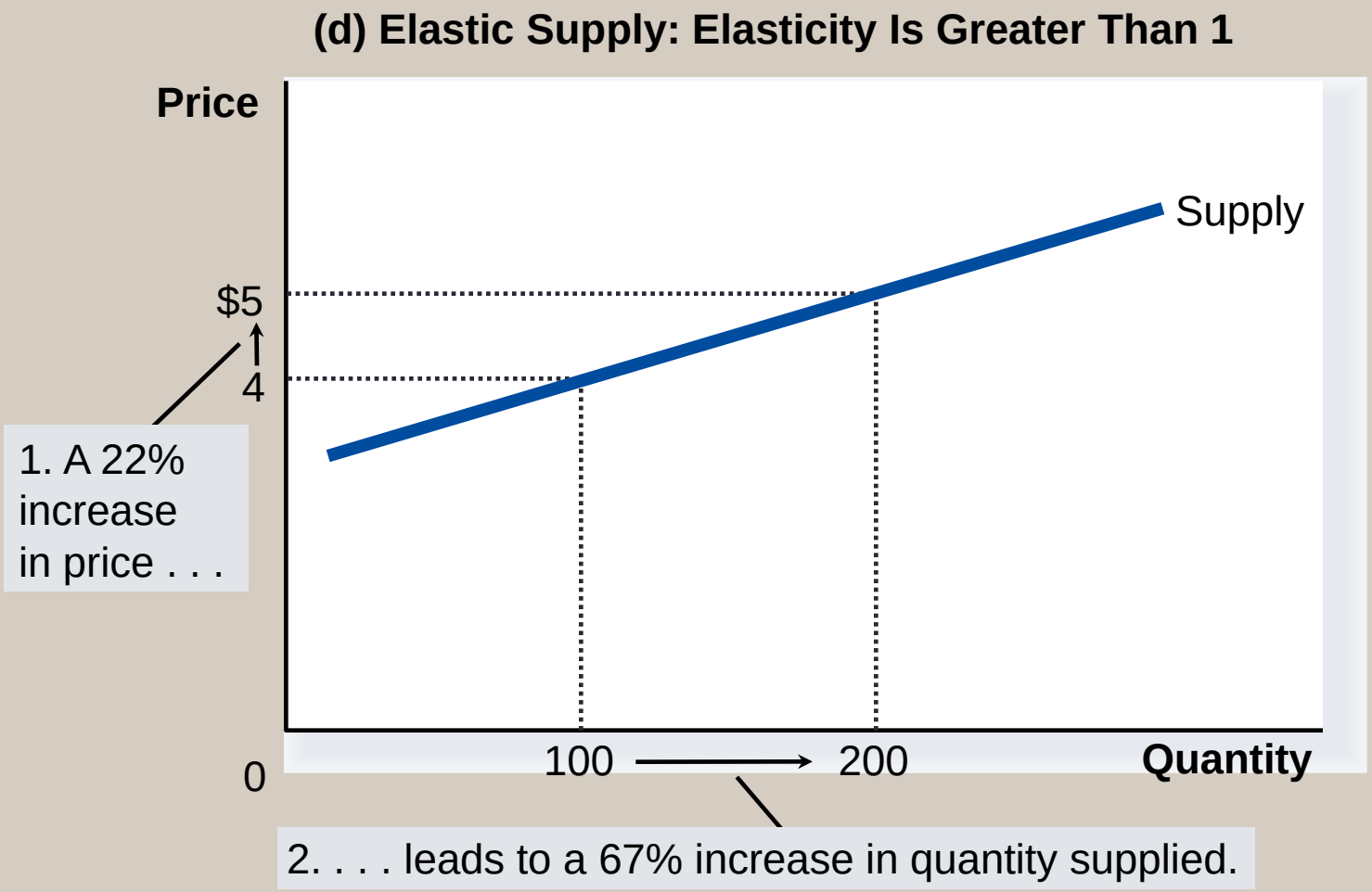

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