



# Elasticity and Its Applications

# Elasticity . . .

- ... allows us to analyze supply and demand with greater precision.
- ... is a measure of how much buyers and sellers **respond to changes** in market conditions

# 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.
- Price elasticity of demand is the percentage change in quantity demanded given a percent change in the price.

# The Price Elasticity of Demand and Its Determinants

- Availability of Close Substitutes
  - Crucial for fiscal intervention (tax policy)
- Necessities versus Luxuries
- Definition of the Market
  - Crucial for the Antitrust interventions/investigations

# The Price Elasticity of Demand and Its Determinants

- Demand tends to be more elastic:
  - the larger the number of close substitutes.
  - if the good is a luxury.

# Computing the Price Elasticity of Demand

- The price elasticity of demand is computed as the percentage change in the quantity demanded divided by the percentage change in price.

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

# Computing the Price Elasticity of Demand

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

- 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:

$$\varepsilon = \frac{p_1}{x_1(.)} \frac{\Delta x_1(p_1, p_2, w)}{\Delta p_1}$$

# Elastic and Inelastic 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.

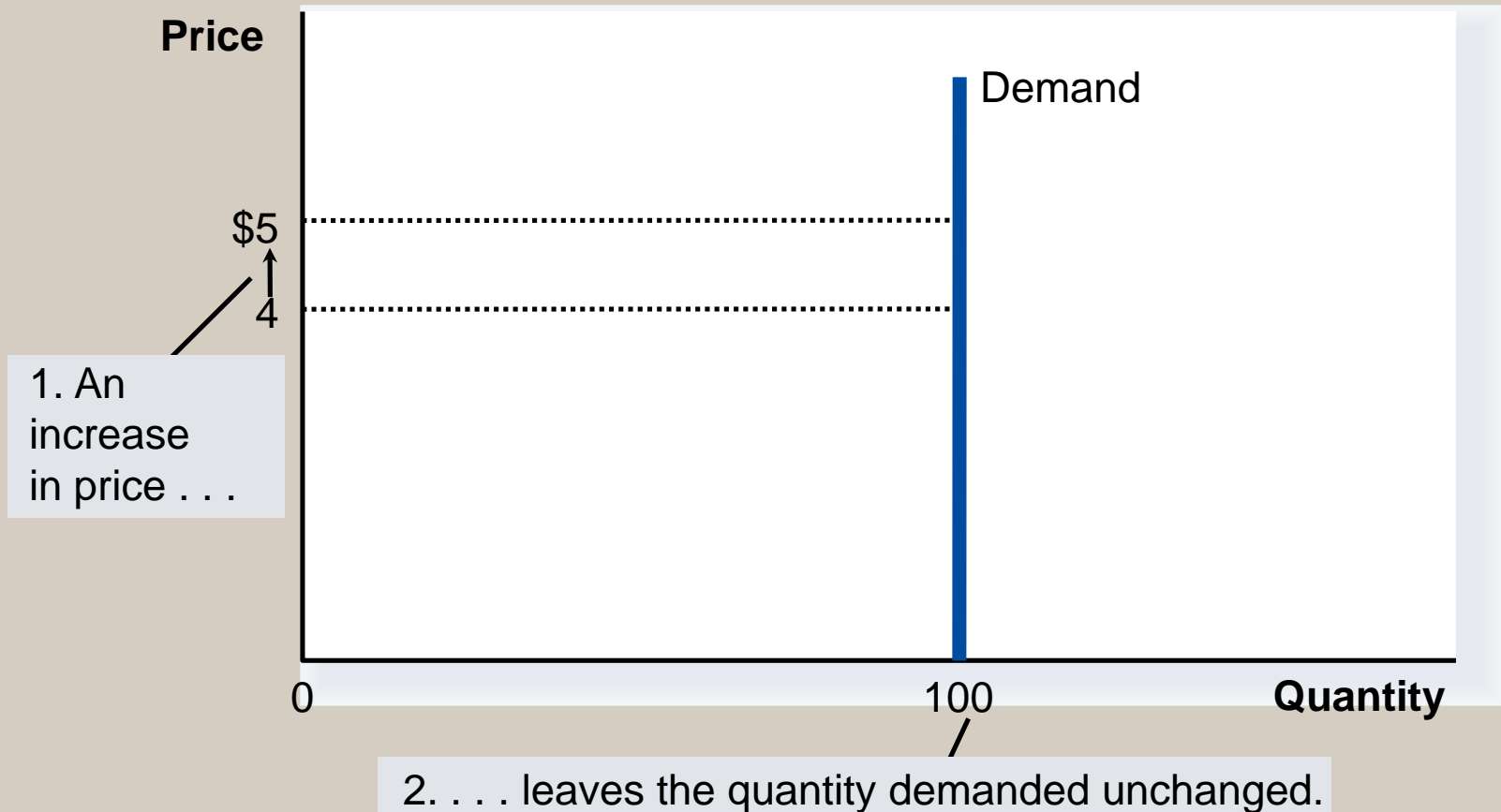


# Elastic and Inelastic of Demand Curves

- 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.

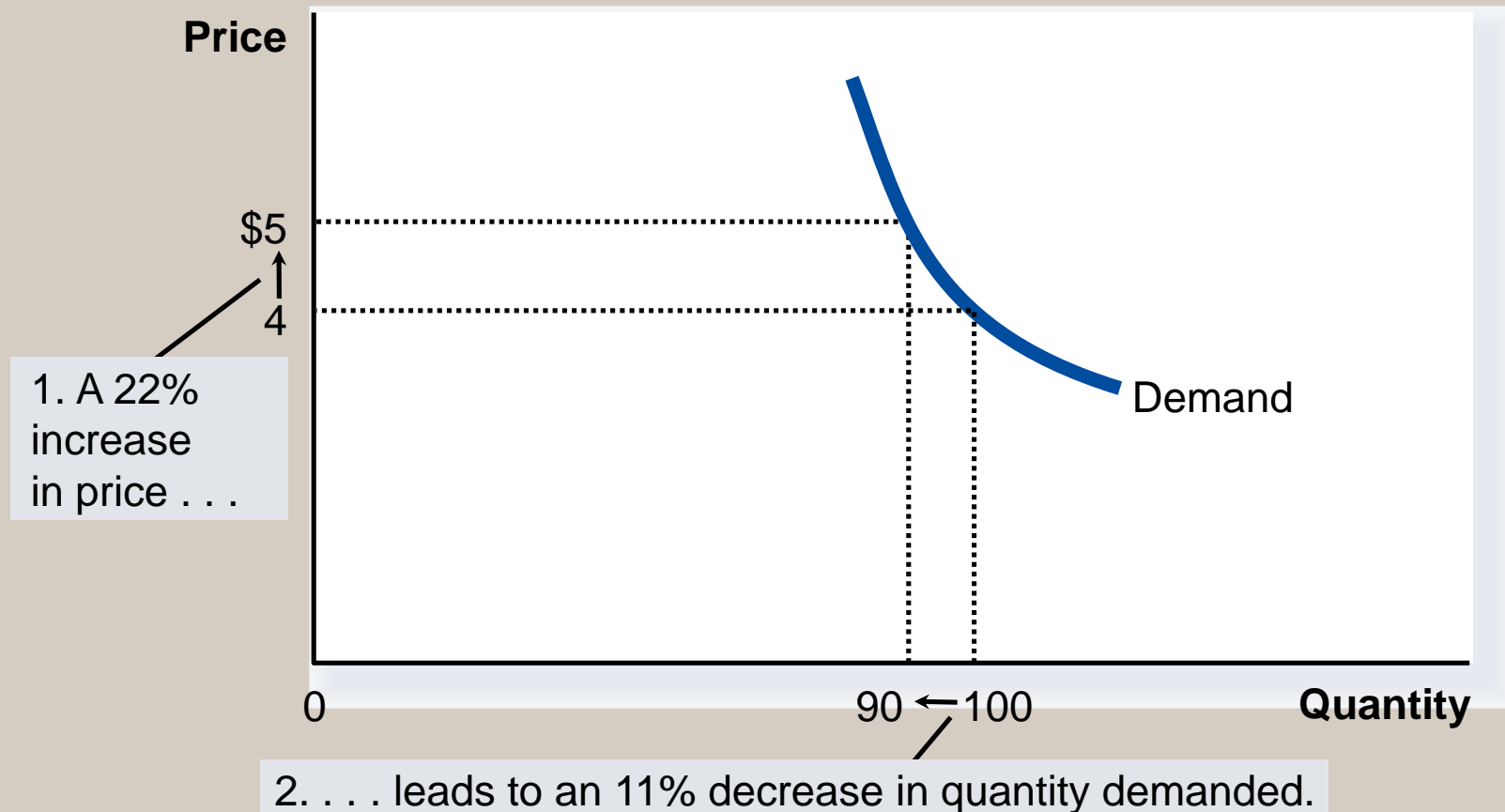
# Figure 1 The Price Elasticity of Demand

(a) Perfectly Inelastic Demand: Elasticity Equals 0



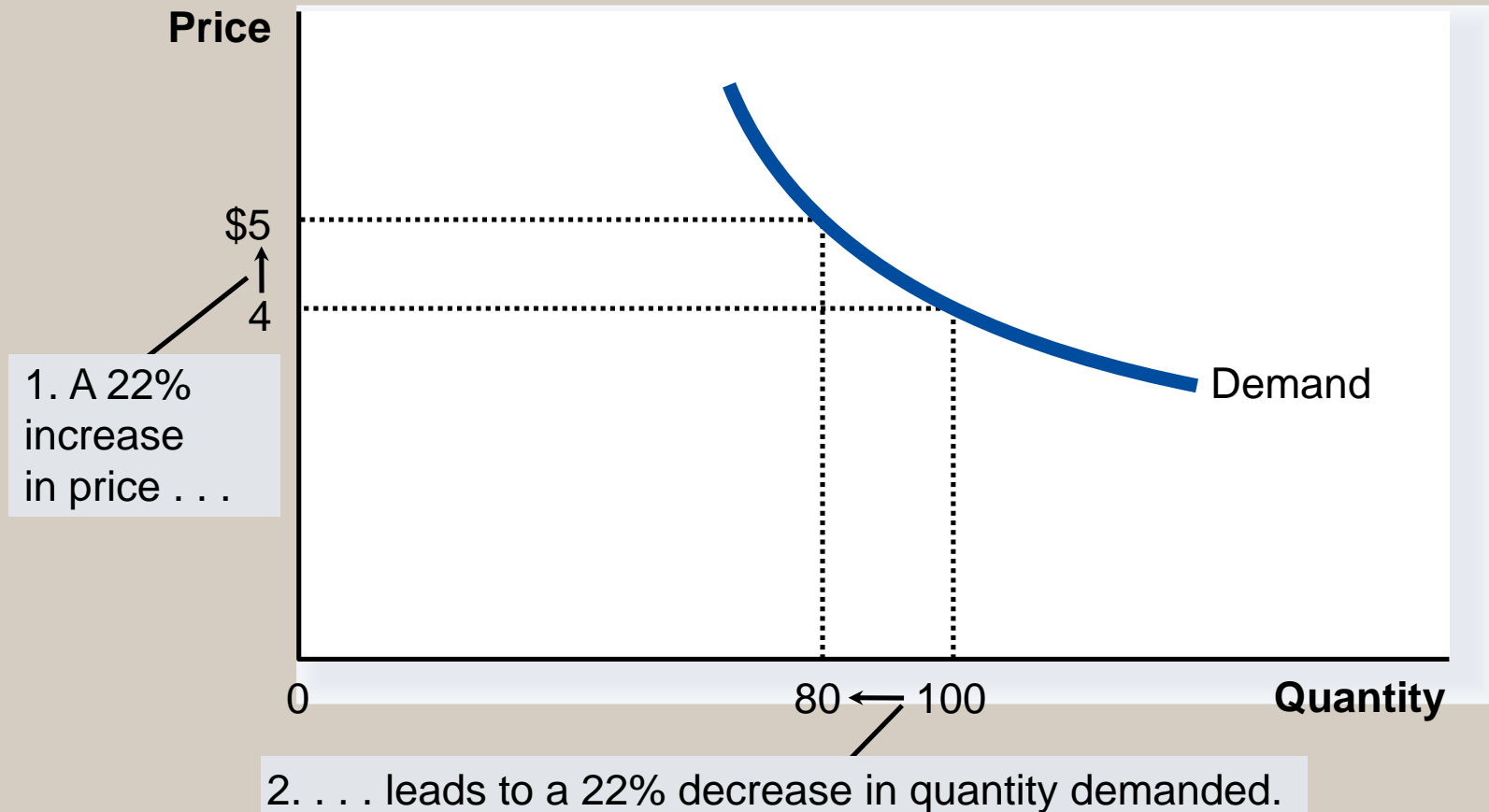
# Figure 1 The Price Elasticity of Demand

## (b) Inelastic Demand: Elasticity Is Less Than 1



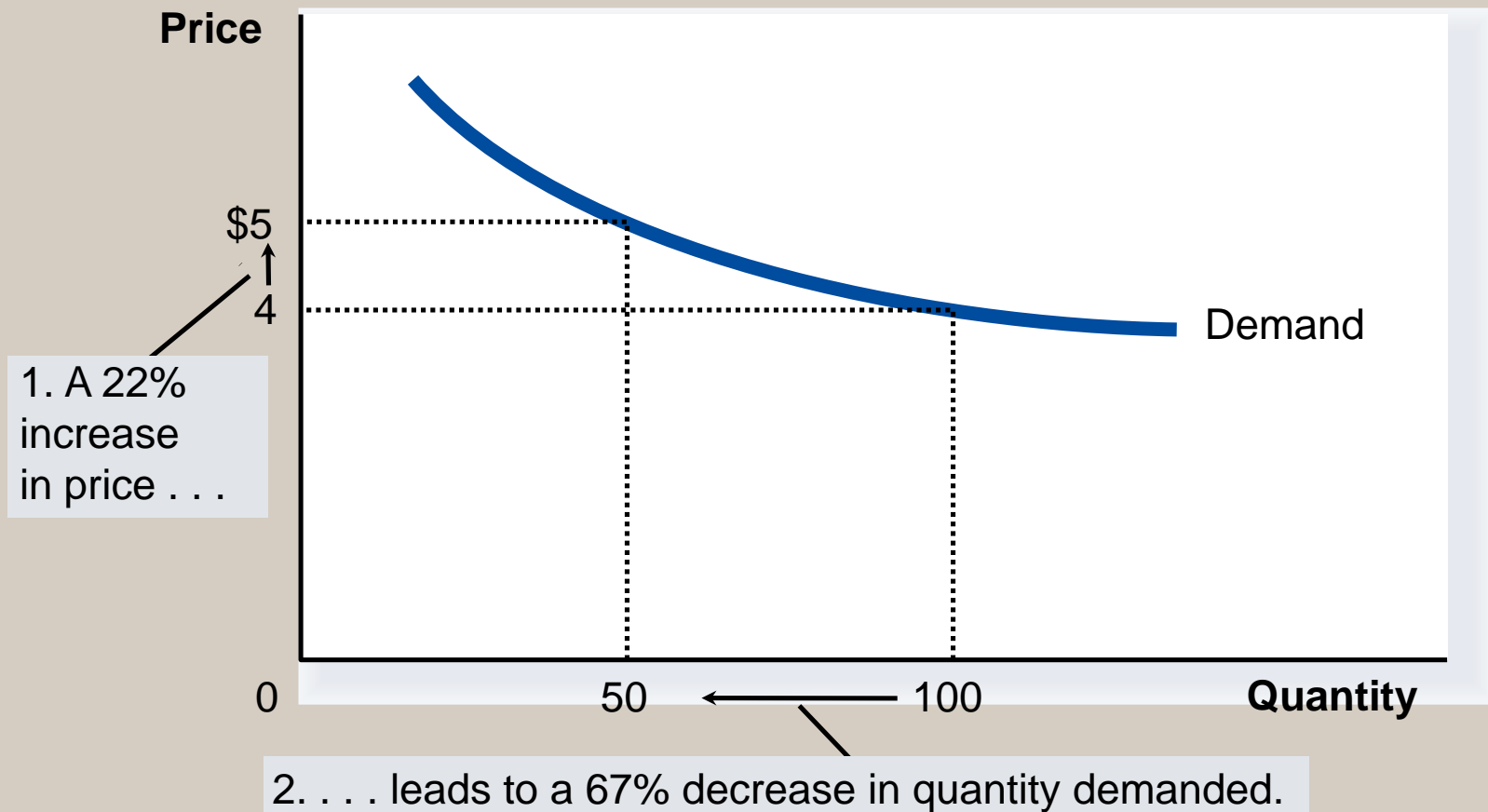
# Figure 1 The Price Elasticity of Demand

## (c) Unit Elastic Demand: Elasticity Equals 1



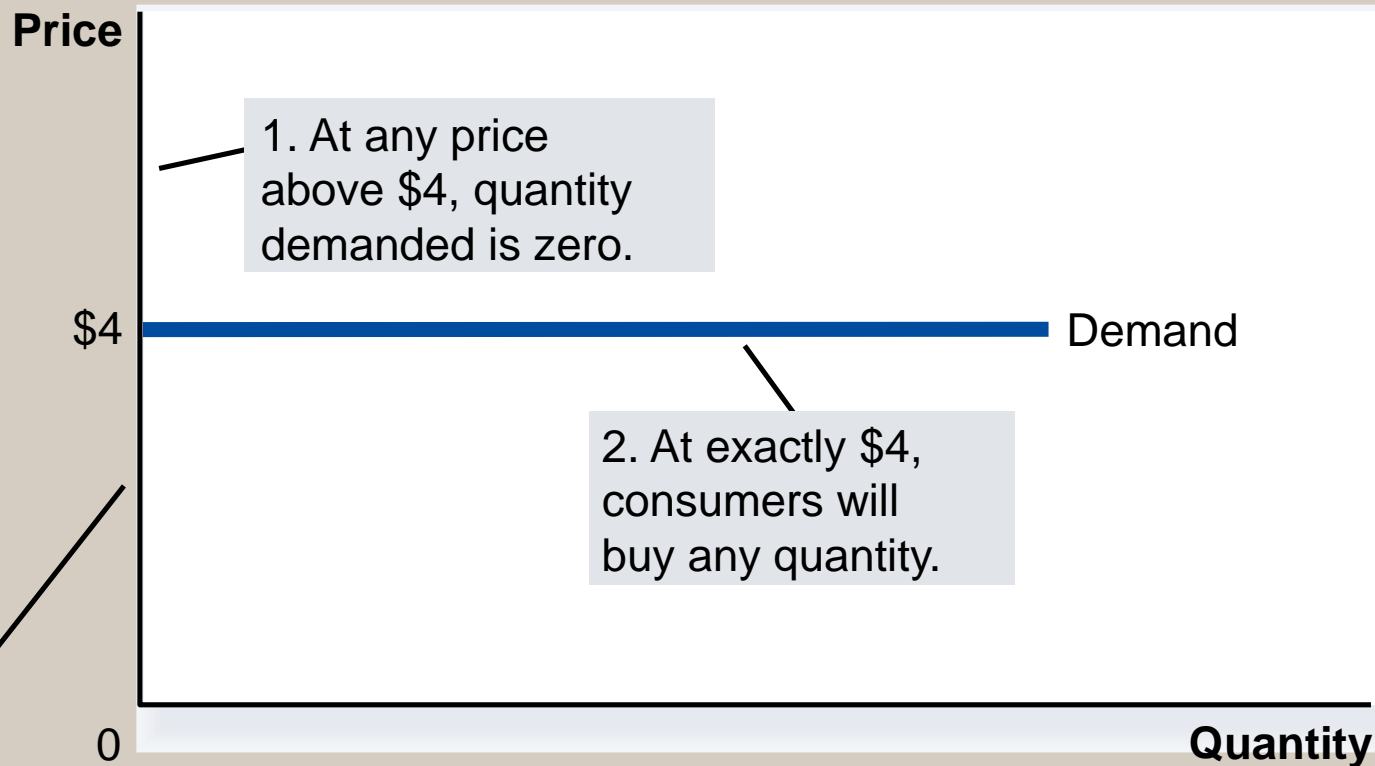
# Figure 1 The Price Elasticity of Demand

(d) Elastic Demand: Elasticity Is Greater Than 1



# Figure 1 The Price Elasticity of Demand

## (e) Perfectly Elastic Demand: Elasticity Equals Infinity



Elasticity has negative value, demand is downward sloping

$$\frac{\partial x_1(.)}{\partial p_1} < 0$$

if  $|\varepsilon| > 1$  **elastic**: a price variation of 1% induces a demand variation higher than 1%

if  $|\varepsilon| < 1$  **inelastic**: a price variation of 1% induces a demand variation lower than 1%

if  $|\varepsilon| = 1$  **unit elasticity**: a price variation of 1% induces a demand variation of 1%

# Linear demand

$$x_1 = a - bp_1$$

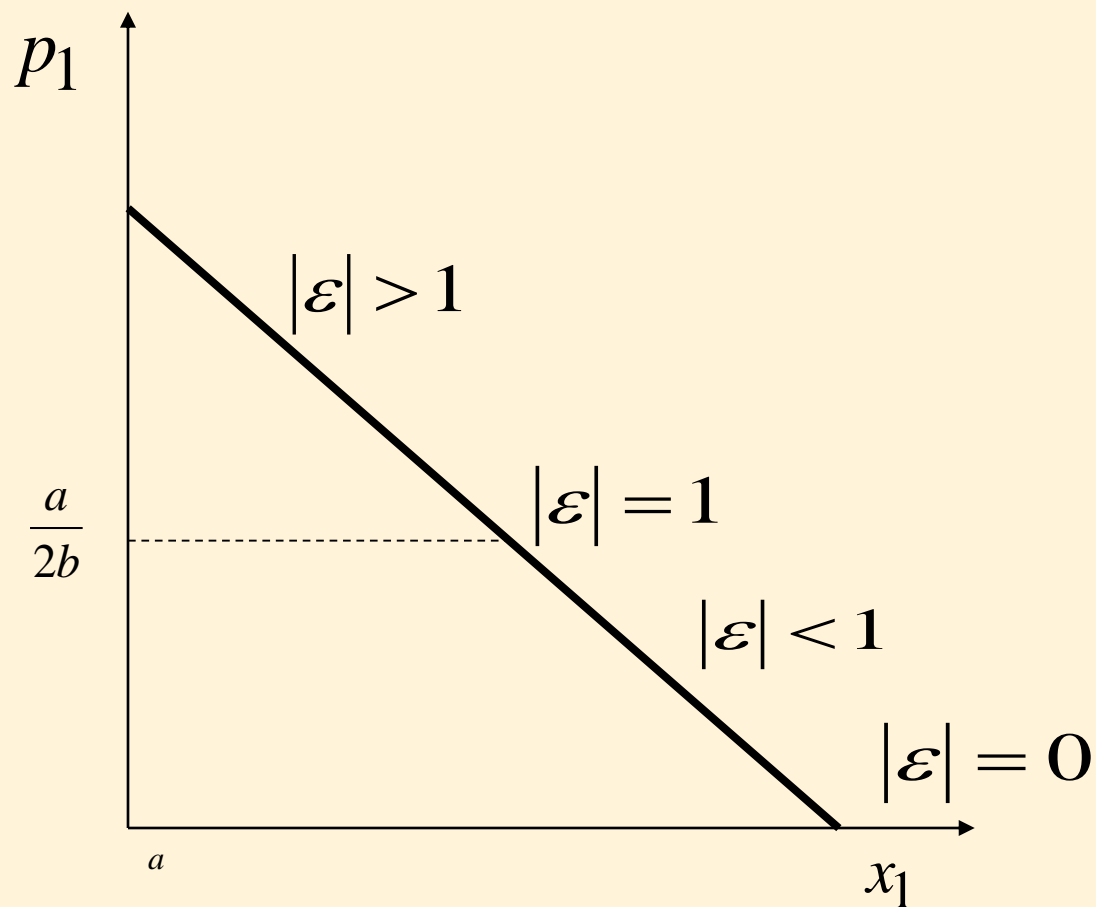
slope:

$$\frac{\partial x_1(.)}{\partial p_1} = -b$$

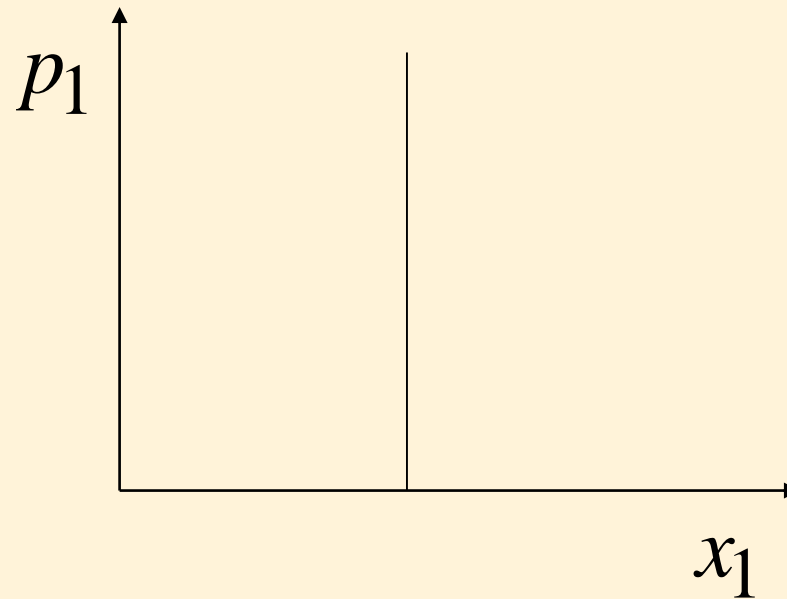
$$\varepsilon = -\frac{p_1 b}{x_1} = -\frac{bp_1}{(a - bp_1)}$$



# Elasticity along the demand curve



# Perfectly inelastic demand



Ex:  $x_1 = 4$

$$\varepsilon = \frac{\partial x_1}{\partial p_1} \frac{p_1}{x_1} = 0 \frac{p_1}{4} = 0$$

# Total Revenue and the Price Elasticity of Demand

- *Total revenue* is the amount paid by buyers and received by sellers of a good.
- Computed as the price of the good times the quantity sold.

$$TR = P \times Q$$

# Total Revenue and the Price Elasticity of Demand

- Experiment

two volunteers, please

Question:

You are a price taker, selling coal in Newcastle:

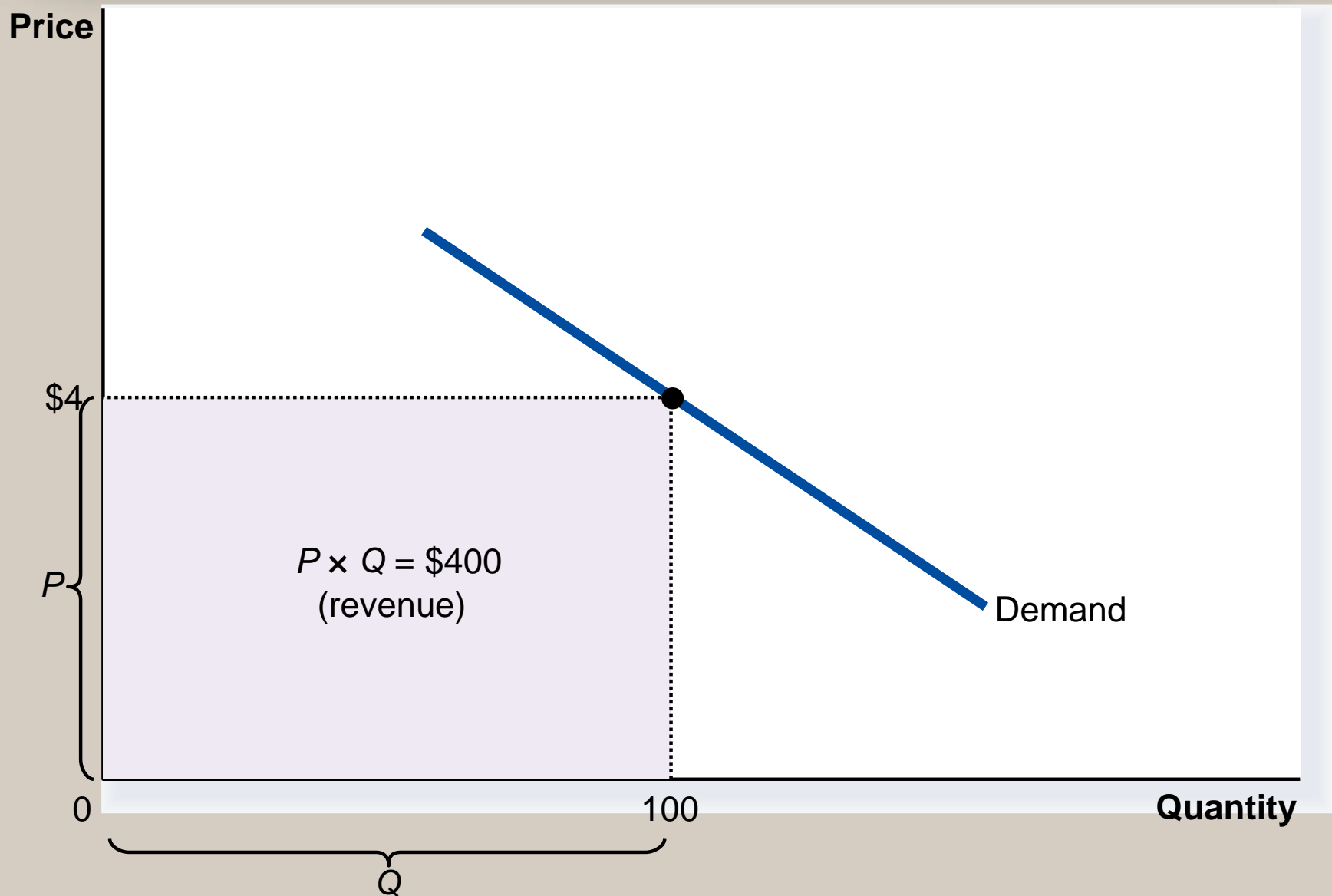
what do you prefer:

a price increase or a price decrease?

Standard economist's answer to almost any question:

It depends

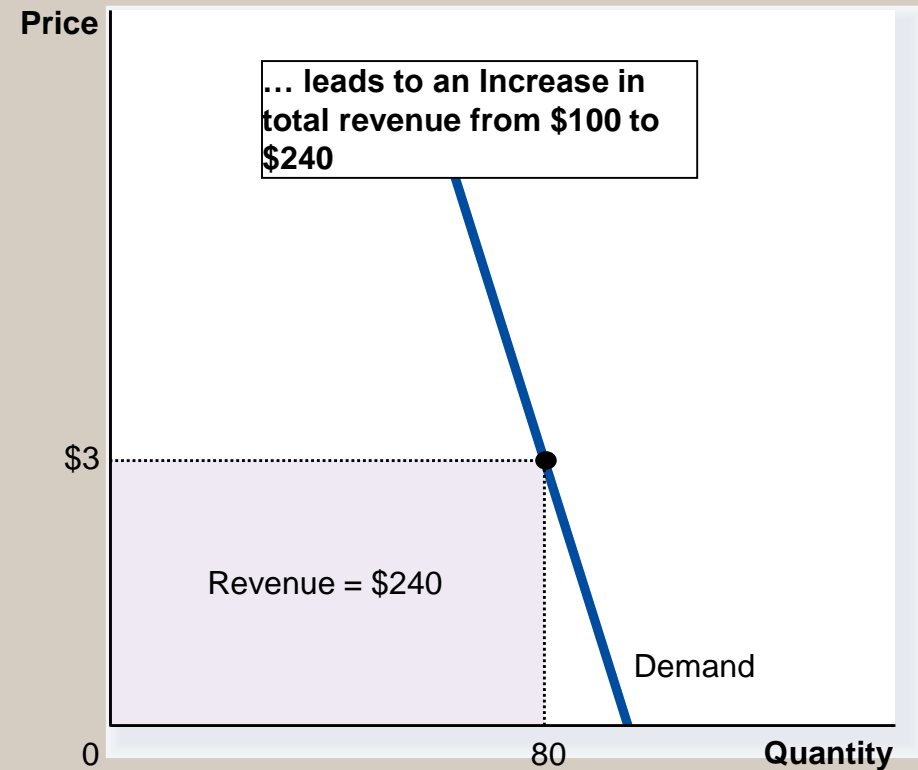
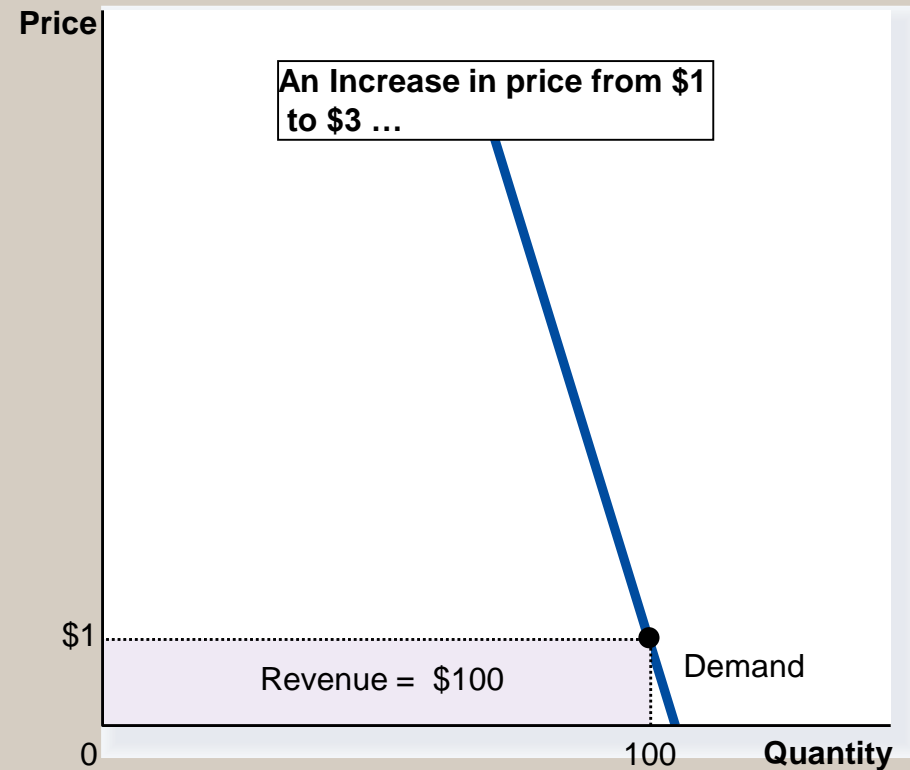
## Figure 2 Total Revenue



# Elasticity and Total Revenue along a Linear Demand Curve

- With an inelastic demand curve, an increase in price leads to a decrease in quantity that is proportionately smaller. Thus, *total revenue increases*.

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

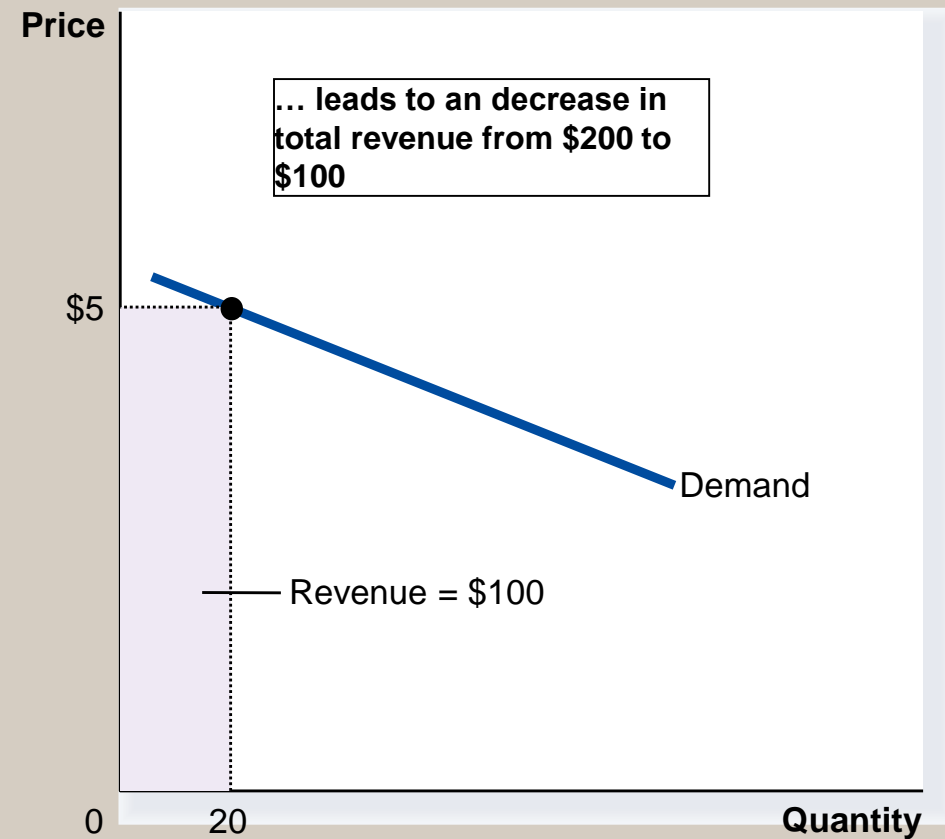
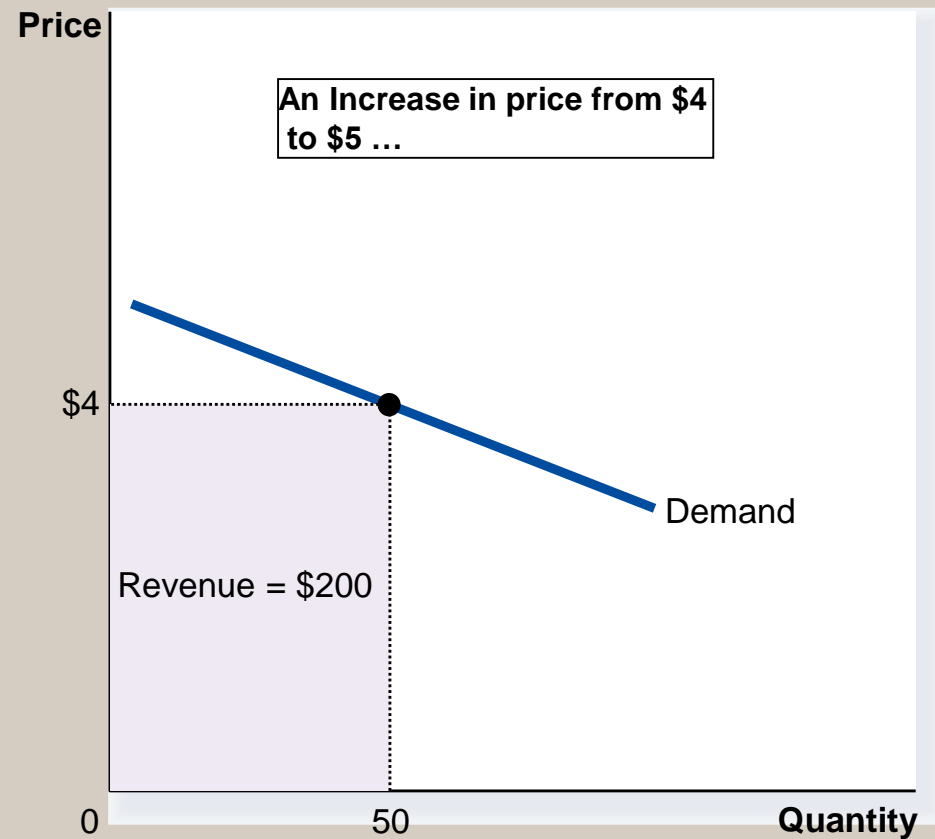


# Elasticity and Total Revenue along a Linear Demand Curve

- With an elastic demand curve, an increase in the price leads to a decrease in quantity demanded that is proportionately larger. Thus, *total revenue decreases*.



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



# Change in Revenue

- $\Delta R = q\Delta p + p\Delta q$
- Marginal Revenue: (marginal) change in revenue due to a (marginal) change in quantity
- $MR = \frac{\Delta R}{\Delta q} = p + q \frac{\Delta p}{\Delta q}$
- Now using marginal changes (first derivative):  
$$\frac{\Delta R}{\Delta q} = \frac{\partial R}{\partial q} = R'$$

# Change in Revenue

$$R'(Q) = P \left[ 1 + P'(Q) \frac{Q}{P} \right] \rightarrow \frac{1}{\varepsilon} = P'(Q) \frac{Q}{P}$$

$$R'(Q) = P(Q) \left[ 1 + \frac{1}{\varepsilon(Q)} \right]$$

Use the absolute value of the elasticity (that is always  $< 0$ )

$$R'(Q) = P(Q) \left[ 1 - \frac{1}{|\varepsilon(Q)|} \right]$$

- If  $|\varepsilon(Q)| = 1$  the marginal revenue is zero

- If demand is inelastic  $|\varepsilon(Q)| < 1$  then  $1 - \frac{1}{|\varepsilon(Q)|} < 0$

# Change in Revenue

- If demand is elastic  $|\varepsilon(Q)| > 1$  then  $1 - \frac{1}{|\varepsilon(Q)|} > 0$

MR is:

**Positive** in the **elastic part** of the demand

**Negative** in the **inelastic part** of the demand

Remark: for  $Q=0$  elasticity is infinite, then

$$R'(Q) = P(Q) \left[ 1 - \frac{1}{\infty} \right] = P$$

For the first unit sold the marginal revenue is equal to the price

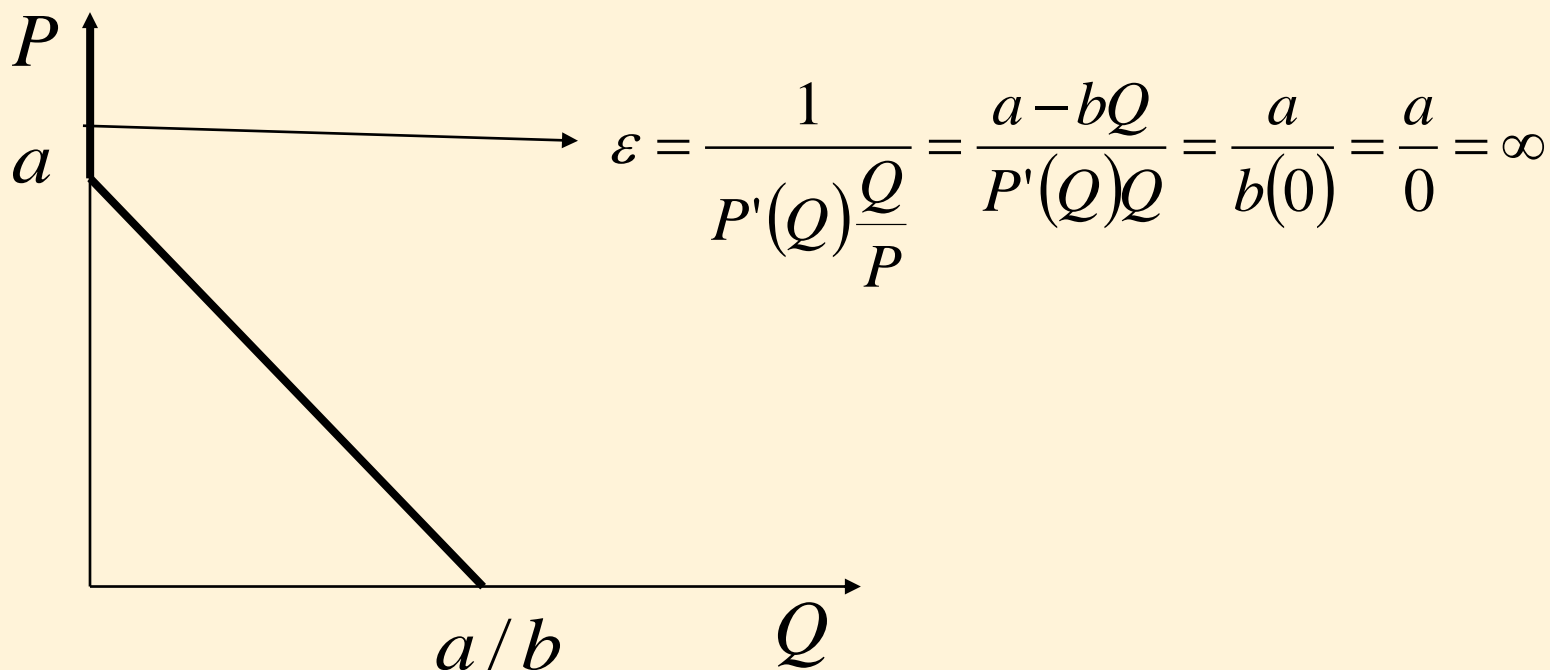
to sell additional units the price must decrease for all units,  
therefore **MR < P**

# Change in Revenue

**Linear Demand**  $P(Q) = a - bQ$

The slope of the inverse demand curve is constant:  $P'(Q) = -b$

**We now set up the marginal revenue curve:**



# Change in Revenue

From: 
$$\frac{\partial R(Q)}{\partial Q} = P(Q) \left[ 1 - \frac{1}{|\varepsilon(Q)|} \right]$$

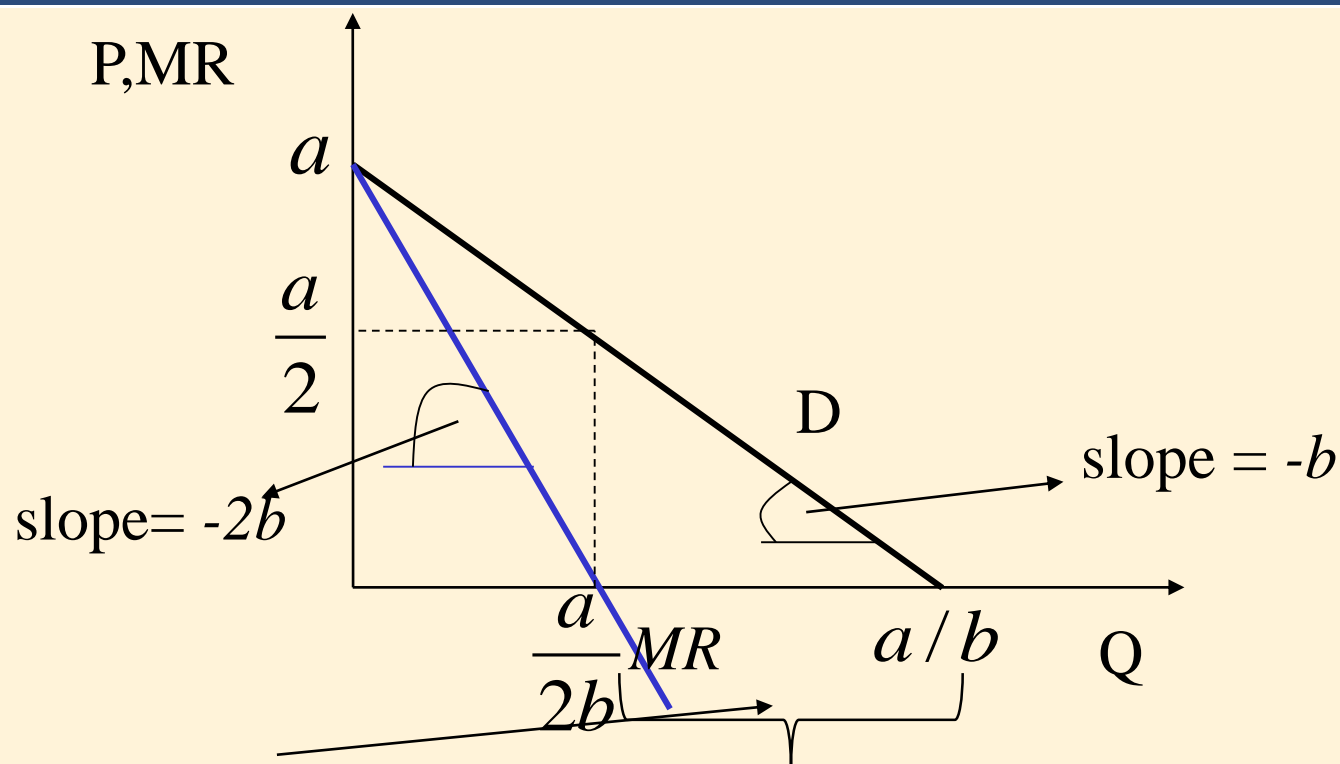
Then:

$$\frac{\partial R(Q)}{\partial Q} = P(Q) + \frac{\partial P(Q)}{\partial Q} Q = P(Q) - bQ = (a - bQ) - bQ = a - 2bQ$$

**Marginal Revenue  
Curve**



# Change in Revenue



for  $Q > \frac{a}{2b}$  the demand is inelastic,  $|\epsilon| < 1$ , then  $MR < 0$

# Income Elasticity of Demand

- *Income elasticity of demand* measures how much the quantity demanded of a good responds to a change in consumers' income.
- It is computed as the percentage change in the quantity demanded divided by the percentage change in income.



# Computing Income Elasticity

$$\text{Income elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in income}}$$

# Income Elasticity

- Types of Goods
  - Normal Goods
  - Inferior Goods
- Higher income raises the quantity demanded for normal goods but lowers the quantity demanded for inferior goods.

# Income Elasticity

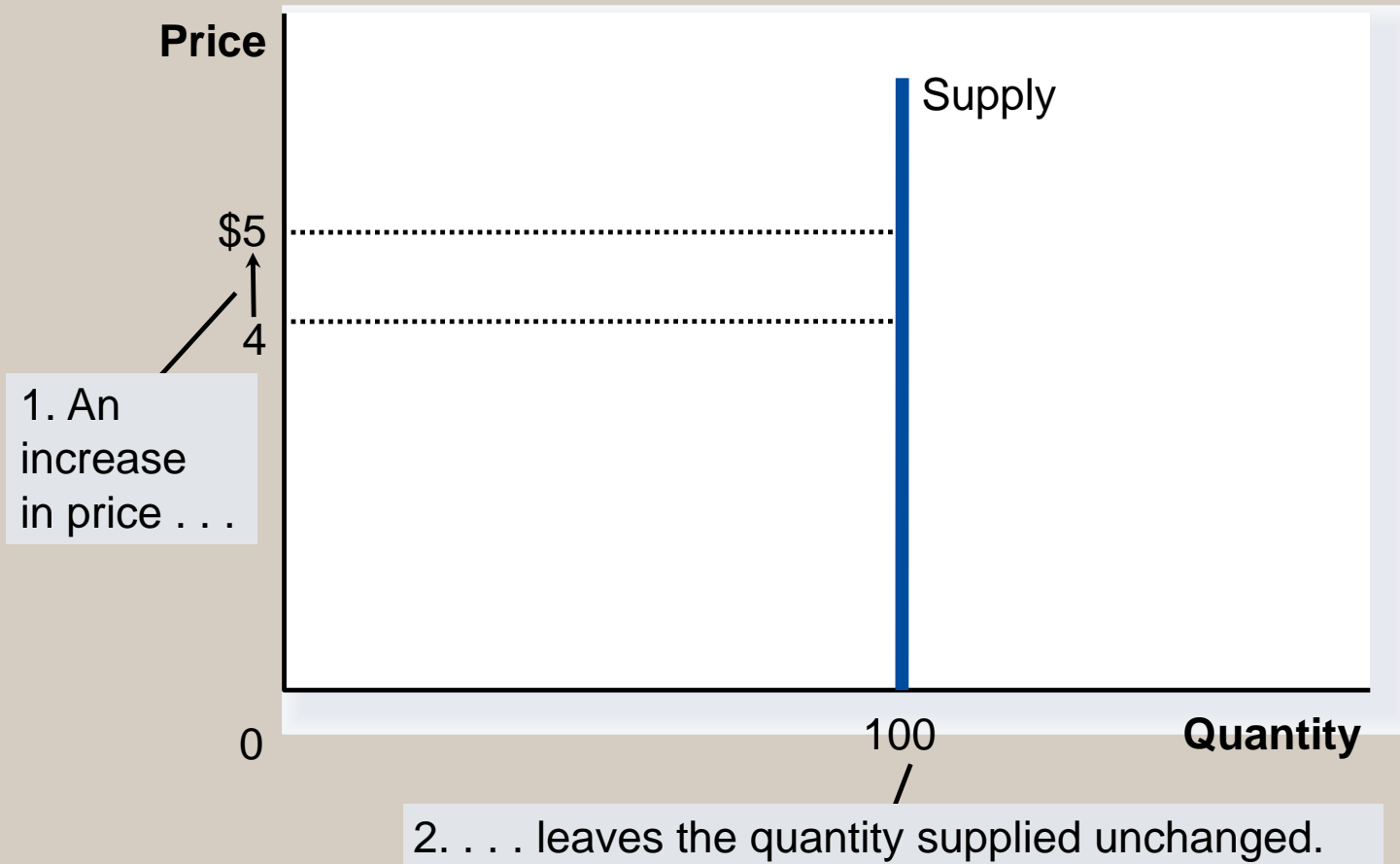
- Goods consumers regard as **necessities** tend to be **income inelastic**
  - Examples include food, fuel, clothing, utilities, and medical services.
- Goods consumers regard as **luxuries** tend to be **income elastic**.
  - Examples include sports cars and expensive foods.

# 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.
- Price elasticity of supply is the percentage change in quantity supplied resulting from a percent change in price.

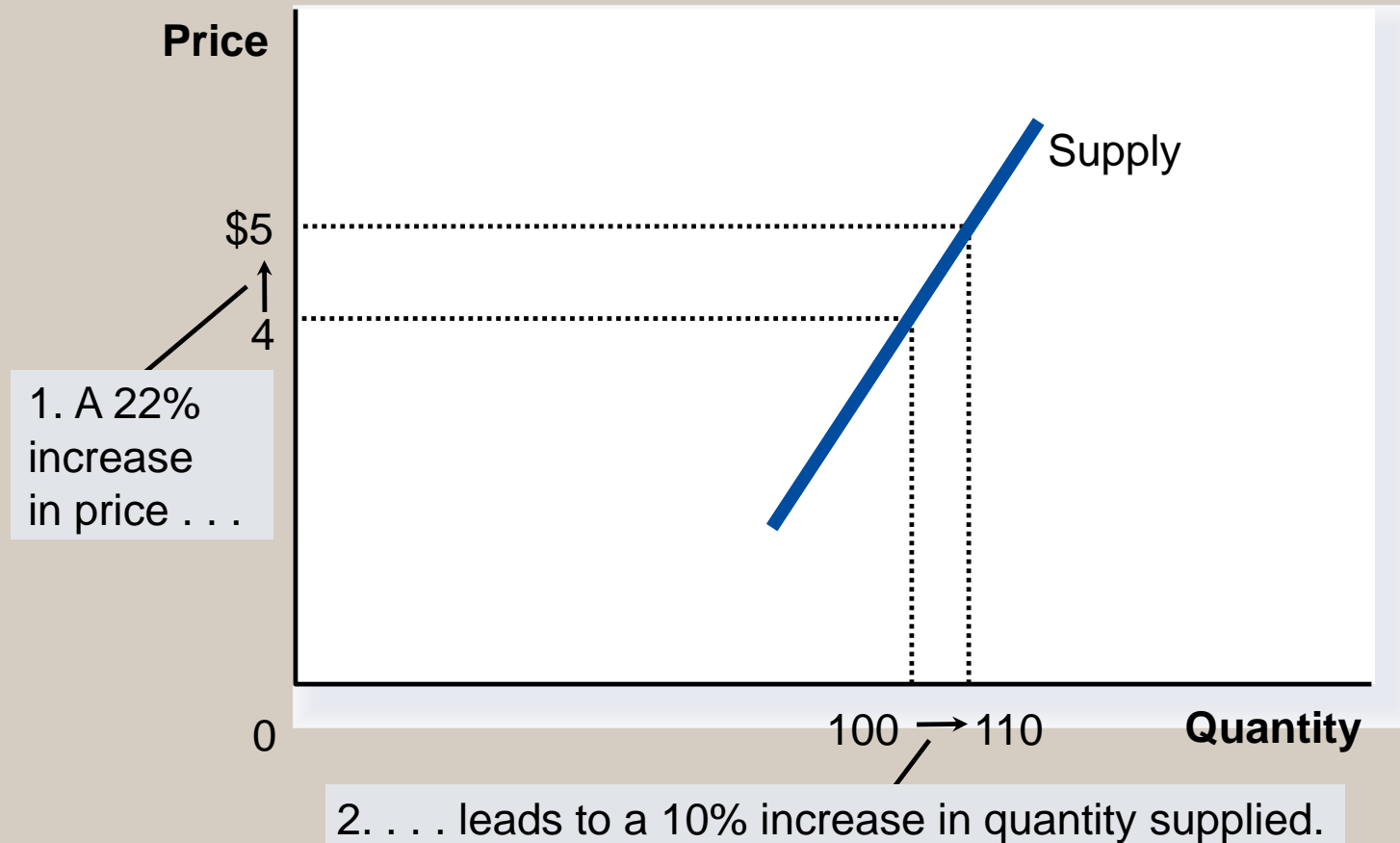
# Figure 6 The Price Elasticity of Supply

(a) Perfectly Inelastic Supply: Elasticity Equals 0



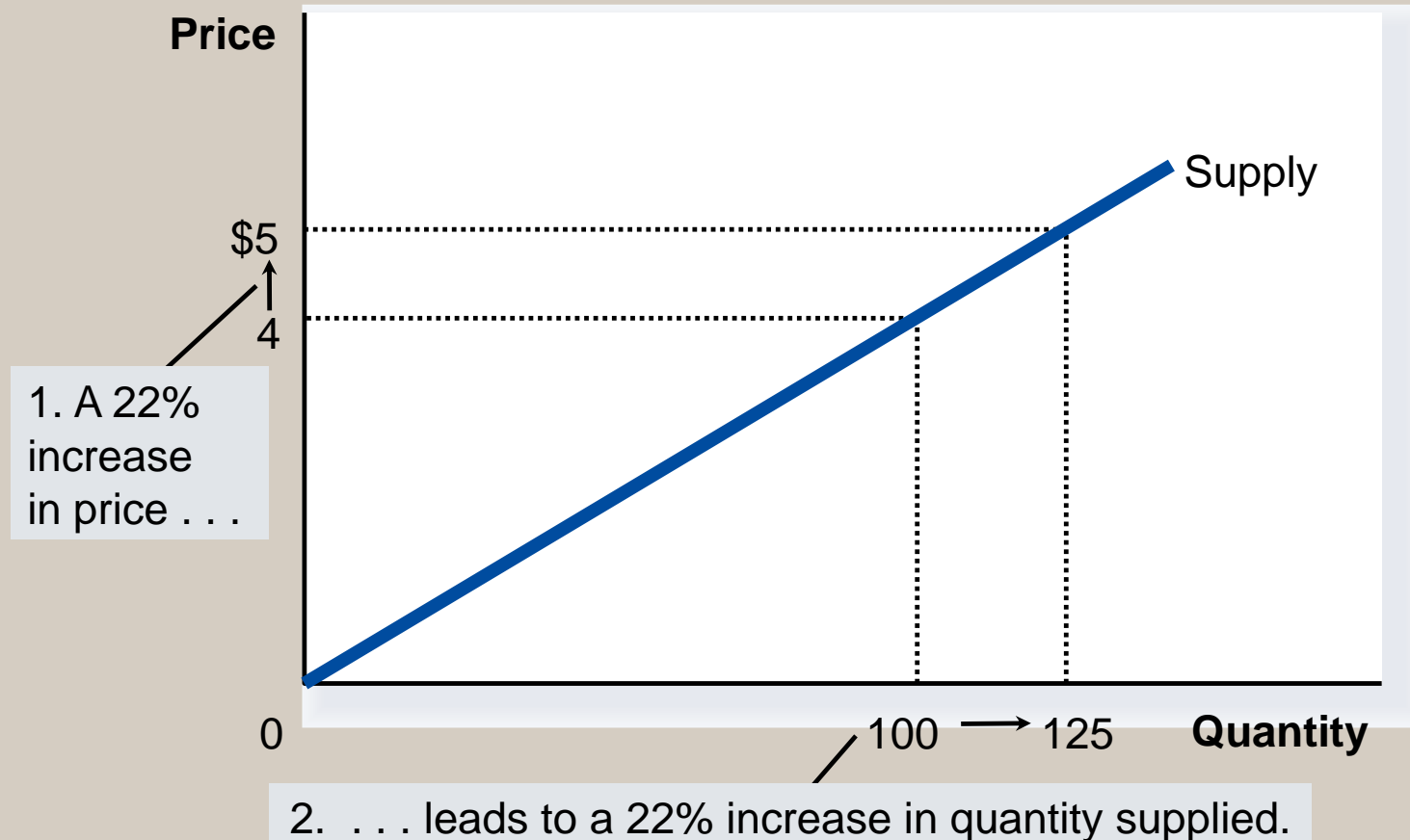
## Figure 6 The Price Elasticity of Supply

### (b) Inelastic Supply: Elasticity Is Less Than 1



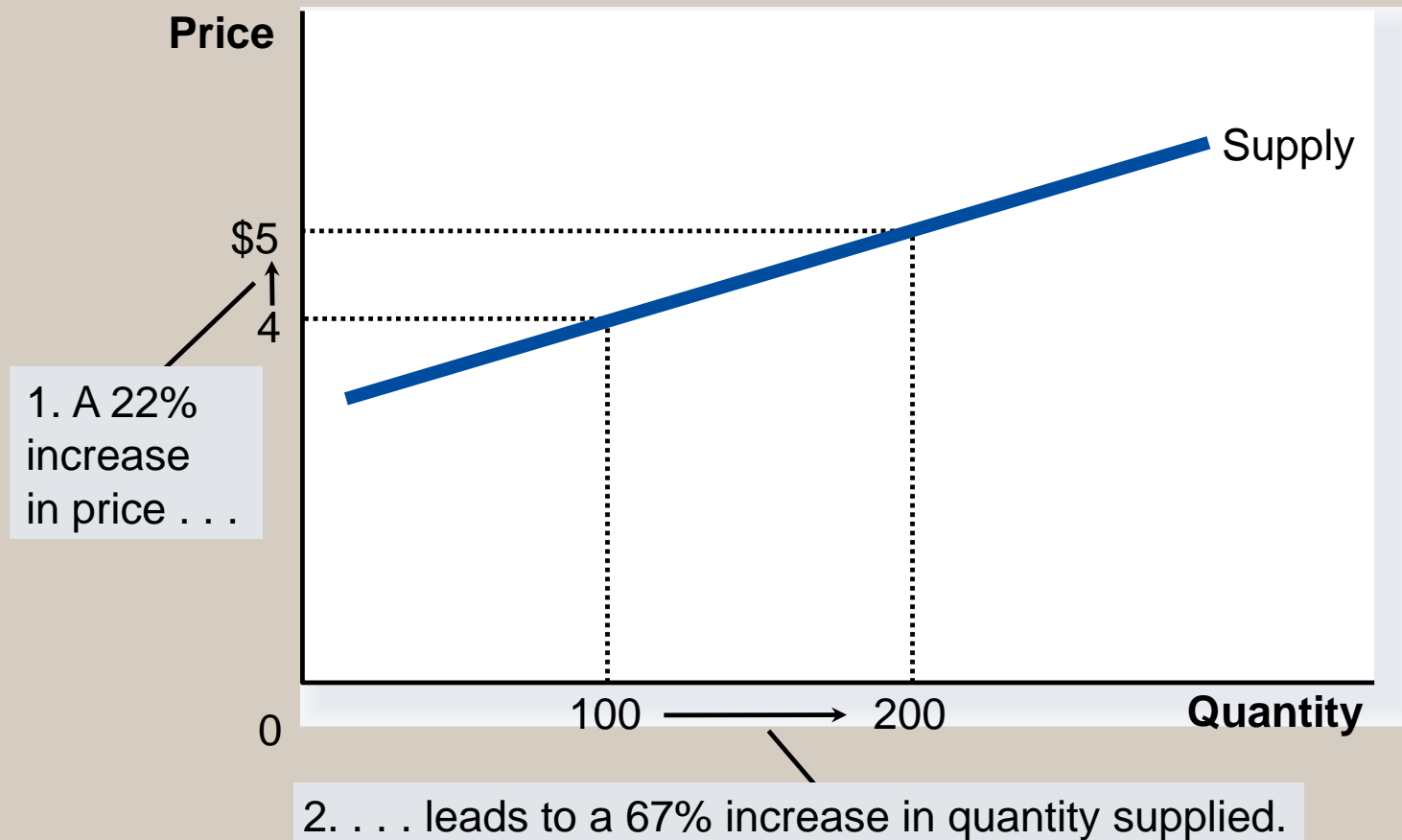
## Figure 6 The Price Elasticity of Supply

(c) Unit Elastic Supply: Elasticity Equals 1



## Figure 6 The Price Elasticity of Supply

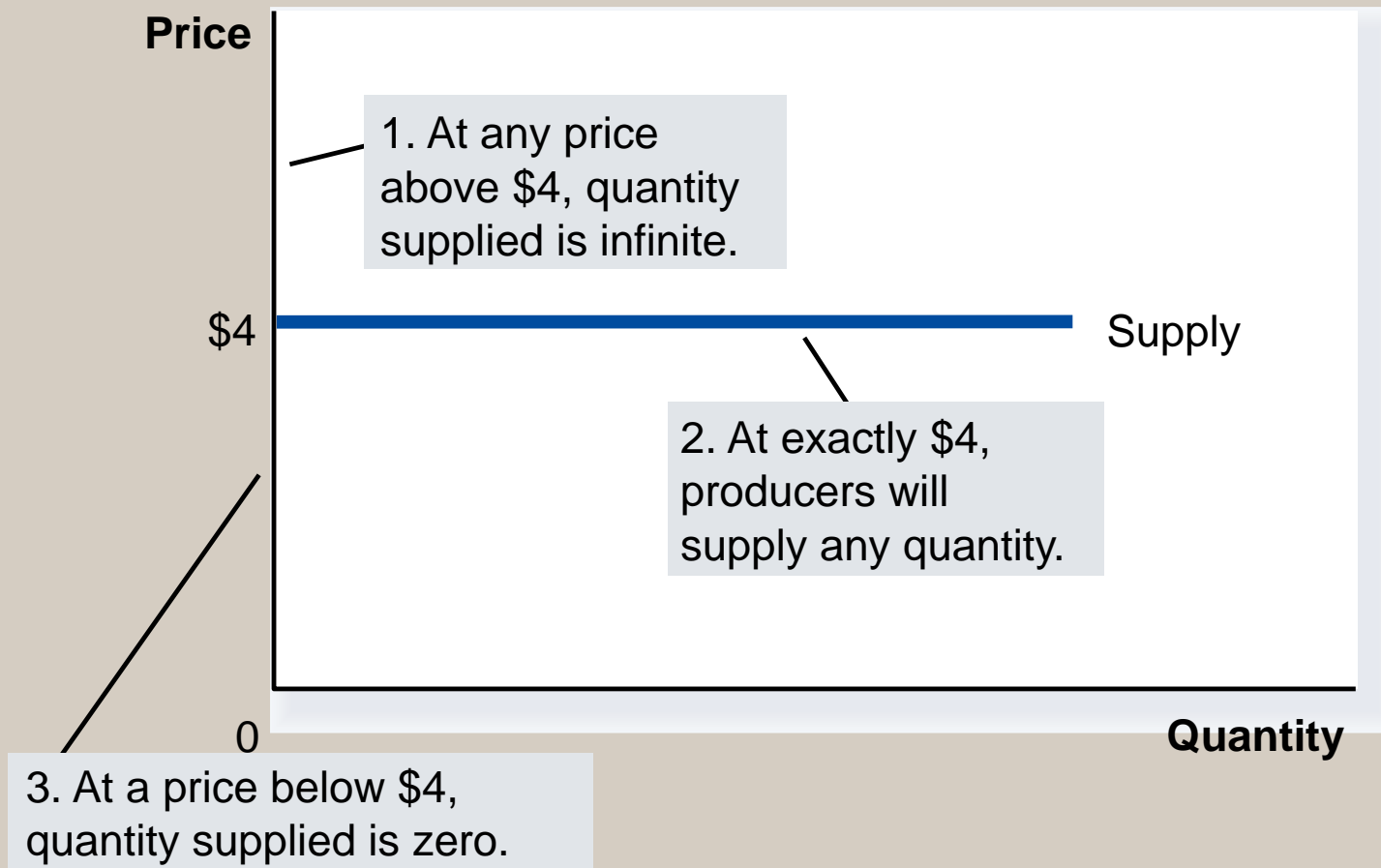
(d) Elastic Supply: Elasticity Is Greater Than 1





## Figure 6 The Price Elasticity of Supply

### (e) Perfectly Elastic Supply: Elasticity Equals Infinity



# Determinants of Elasticity of Supply

- Ability of sellers to change the amount of the good they produce.
  - Beach-front land is inelastic.
  - Books, cars, or manufactured goods are elastic.
- Time period.
  - Supply is more elastic in the long run (input can be easily adjusted)

# Computing the Price Elasticity of Supply

- The price elasticity of supply is computed as the percentage change in the quantity supplied divided by the percentage change in price.

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

# Summary

---

- Price elasticity of demand measures how much the quantity demanded responds to changes in the price.
- Price elasticity of demand is calculated as the percentage change in quantity demanded divided by the percentage change in price.
- If a demand curve is elastic, total revenue falls when the price rises.
- If it is inelastic, total revenue rises as the price rises.

# Summary

---

- The income elasticity of demand measures how much the quantity demanded responds to changes in consumers' income.
- The cross-price elasticity of demand measures how much the quantity demanded of one good responds to the price of another good.
- The price elasticity of supply measures how much the quantity supplied responds to changes in the price. .

# Summary

---

- In most markets, supply is more elastic in the long run than in the short run.
- The price elasticity of supply is calculated as the percentage change in quantity supplied divided by the percentage change in price.
- The tools of supply and demand can be applied in many different types of markets.