This chapter is another extension of supply and demand analysis that you learned about in Chapter 3. In that chapter, the assumption was made that competitive markets were highly efficient and allocated scarce resources to their most valued use from society's perspective. Sometimes, however, competitive markets are inefficient with the allocation of society's scarce resources, and therefore competitive markets can end up overproducing, underproducing, or not producing some products. These market inefficiencies are referred to as market failures, which are presented as two types in the first major section of the chapter. Demand-side market failures arise when demand curves do not take into account the full willingness of consumers to pay for a product. Supply-side market failures occur when supply curves do not incorporate the full cost of producing a product.

To better understand these failures, this first major section of the chapter also presents some new concepts that should enhance your understanding of economic efficiency because of the focus on the efficient allocation of resources. This extension requires an explanation of consumer surplus and producer surplus. Consumer surplus is the difference between the maximum price consumers are willing to pay for a product and the actual price. Producer surplus is the difference between the minimum price producers are willing to accept for a product and the actual price. The chapter also revisits the concept of allocative efficiency and explains that it is achieved when the combination of consumer and producer surpluses is at a maximum.

Government often intervenes in the private economy to correct the market inefficiencies and provide public goods, as you will learn in the second major section of the chapter. A private good is characterized by rivalry and excludability, but a public good is characterized by nonrivalry and nonexcludability. These differences mean that the demand curve and supply curve for a public good will differ from those of a private good. You are shown how the demand curve for a public good is constructed and how the optimal allocation of a public good is determined. The demand and supply curves for a public good are related to the collective marginal benefit and cost of providing the good. Governments sometimes use cost-benefit analysis to determine if they should undertake some specific action or project. This analysis requires the government to estimate the marginal costs and the marginal benefits of the project, and it can be used to decide when such projects should be expanded, contracted, or eliminated.

The third major topic of the chapter is externalities, situations in market transactions that create negative or positive spillovers to third parties that are not involved in the buying or selling transactions. Government may intervene in the market economy to reduce inefficiencies associated with negative externalities or engage in activities that capture more of the benefits from positive externalities. Government often uses direct controls (legislation) and taxes to limit or correct negative externalities. It uses subsidies for consumers or producers to realize more of the benefits from positive externalities. In some cases, where the positive externalities are large, the government may provide the product to people without charge or at a minimal fee. This discussion of government intervention, however, needs to be modified by the Coase theorem, which shows that individual bargaining can be used to settle some externality problems.

To correct for the negative externalities associated with pollution, government can create a market for externality rights that results in an optimal reduction of an externality, and this cost-benefit approach will be more effective and efficient than simply banning pollution emissions through legislation. All of this analysis has direct application to the problem of CO₂ emissions and government policies as discussed in the Last Word.

The final brief section of the chapter places government's role in the economy in context. While in theory there may be justification for government intervention in some cases to correct for externalities, in practice finding policies or solutions is subject to a political process that can result in inefficient outcomes.

■ CHECKLIST

When you have studied this chapter you should be able to

☐ Describe the concept of market failure in competitive markets.
☐ Distinguish between a demand-side market failure and a supply-side market failure.
☐ Define consumer surplus and give a graphical example.
☐ Define producer surplus and give a graphical example.
☐ Use consumer surplus and producer surplus to explain how efficiency is achieved in a competitive market.
☐ List the three conditions for achieving allocative efficiency at a quantity level in a competitive market.
☐ Use a supply and demand graph to illustrate efficiency losses (or deadweight losses).
Use the two concepts of rivalry and excludability to describe a private good.
Use the two concepts of nonrivalry and nonexcludability to describe a public good.
Calculate the demand for a public good when given tabular data.
Explain how marginal benefit is reflected in the demand for a public good.
Describe the relationship between marginal cost and the supply of a public good.
Identify on a graph where there is an overallocation, an underallocation, and an optimal quantity of a public good.
Use cost-benefit analysis to determine how many resources a government should allocate to a project.
Discuss the concept of quasi-public goods and why government often provides them.
Describe negative externalities and give an example.
Describe positive externalities and give an example.
Use supply and demand graphs to illustrate how negative externalities and positive externalities affect the allocation of resources.
Discuss two means government uses to achieve economic efficiency when there are negative externalities.
Describe how some externality problems can be solved through individual bargaining based on the Coase theorem.
Describe three government options to correct for the underallocation of resources when positive externalities are large and diffuse.
Discuss the concept of quasi-public goods and why government often provides them.
Explain and illustrate with a graph a rule for determining society's optimal reduction of a negative externality.
Discuss the concept of quasi-public goods and why government often provides them.
Explain and illustrate with a graph a rule for determining society's optimal reduction of a negative externality.
Discuss the concept of quasi-public goods and why government often provides them.

CHAPTER OUTLINE

1. Market failures can occur when competitive markets do not allocate the scarce resources to their most valued or best use. These market failures can be of two types.

a. Demand-side market failures arise when the consumers' full willingness to pay for a good or service is not fully captured in the demand for the good or service. For example, people will not have much incentive to pay to view outdoor fireworks because they can usually still view the fireworks without paying.

b. Supply-side market failures often result from a situation where a business firm does not have to pay the full cost of producing a product. For example, a power plant that uses coal may not have to pay completely for the emissions it discharges into the atmosphere as part of the cost of producing electricity.

c. When markets are economically efficient, the demand curve in the market must include the full willingness of consumers to pay for the product and the supply curve must capture the full cost of producing the product.

d. Consumer surplus is the difference between the maximum price consumers are willing to pay for a product and the actual (equilibrium) price paid. Graphically, it is the triangular area bounded by the portion of the vertical axis above the equilibrium price and the demand curve, the portion of the demand curve below the equilibrium price, and the horizontal line at the equilibrium price from the vertical axis to the demand curve. Price and consumer surplus are inversely (negatively) related: Higher prices reduce it and lower prices increase it.

e. Producer surplus is the difference between the minimum price producers are willing to accept for a product and the actual (equilibrium) price received. Graphically, it is the triangular area bounded by the portion of the vertical axis between the equilibrium price and the supply curve, the portion of the supply curve below the equilibrium price, and the horizontal line at the equilibrium price from the vertical axis to the supply curve. Price and producer surplus are directly (positively) related: Higher prices increase it and lower prices decrease it.

f. The equilibrium quantity shown by the intersection of demand and supply curves reflects economic efficiency.

1. Productive efficiency is achieved because production costs are minimized at each quantity level of output.

2. Allocative efficiency is achieved at the equilibrium quantity of output because three conditions are satisfied: (a) marginal benefit equals marginal cost; (b) maximum willingness to pay equals minimum acceptable price; and, (c) the combination of the consumer and producer surplus is at a maximum.

g. If quantity is less than or greater than the equilibrium quantity or most efficient level, there are efficiency losses (or deadweight losses) to buyers and sellers. The efficiency losses reduce the maximum possible size of the combined consumer and producer surplus.

2. When market failures arise because a demand curve for a product fails to reflect consumers' willingness to pay, then a public good that has net benefits for society fails to be produced.

a. A private good, such as a soft drink, is characterized by rivalry and excludability. Rivalry means that consumption of the product by a buyer eliminates the possibility of consumption of that product by another person. If, for example, one person buys and drinks a soft drink, it is not possible for another person to drink or consume it. Excludability refers to the ability of the seller to exclude a person from consuming the product if the person does not pay for it. In our example, if a person does not pay for the soft drink, the seller can prevent or exclude the person from obtaining or consuming the soft drink.

b. A public good, such as national defense or street lighting, is characterized by nonrivalry and nonexclud-
ability. **Nonrivalry** means that once a public good is consumed by one person, it is still available for consumption by another person. In the case of street lighting, even if one person enjoys the benefits from having streets illuminated (consumes it), that situation does not diminish or reduce the benefit of the lighting for another person. **Nonexcludability** means that those individuals who do not pay for the public good can still obtain the benefits from the public good. For street lighting, once it is provided to one person, other persons will benefit from having it available even if they do not pay for it. These two characteristics create a **free-rider problem** where once a producer provides a public good everyone including nonpayers can receive the benefits.

c. The **optimal quantity of a public good** can be evaluated using demand and supply analysis.

(1) The **demand for a public good** is determined by summing the prices that people are willing to pay collectively for the last unit of the public good at each possible quantity demanded, whereas the demand for a private good is determined by summing the quantities demanded at each possible price. The demand curve for a public good is down-sloping because of the law of diminishing marginal utility.

(2) The **supply curve of a public good** is up-sloping because of the law of diminishing returns. The provision of additional units of the public good reflects increasing marginal costs.

(3) The optimal allocation of a public good is determined by the intersection of the supply and demand curves. If the marginal benefit (MB) is greater than the marginal cost (MC) of the public good, there is an underallocation of a public good. If MB is less than MC, there is an overallocation of the public good. Only when the MB = MC is there an optimal allocation of the public good.

d. Government uses **cost-benefit analysis** to decide if it should use resources for a project and to determine the total quantity of resources it should devote to a project. The **marginal cost = marginal benefit rule** is used to make the decision. Additional resources should be devoted to a project only so long as the marginal benefits to society from the project exceed society's marginal costs. In this case, the total benefits minus the total costs (net benefits) are at a maximum amount.

e. Government also provides **quasi-public goods** that have large external benefits. Although these goods (such as education or highways) can be provided by the private market because people can be excluded from obtaining them if they do not pay for them, if left to be provided by the private market, these goods will be underproduced or underconsumed. Government provides access to these quasi-public goods at a reduced cost to encourage their production or consumption and increase the external benefits for society.

f. Government reallocates resources from the private economy (consumption and investment) to produce public and quasi-public goods. This reallocation is achieved by levying taxes on the private economy and using the tax revenues to produce these public and quasi-public goods, thereby changing the composition of the economy's total output.

3. An **externality** is a spillover from a market transaction to a third party that did not purchase the product. The spillover to the third party can be either positive or negative depending on the conditions.

a. **Negative externalities** occur when the cost for the product does not reflect the full cost of producing it from society's perspective, and therefore a third party who is not part of the private transaction winds up bearing some of the production cost. For example, if a corporation pollutes the environment while making a product and neither the corporation nor the consumer of the product pays for the cost of that pollution, then the pollution cost is an external cost that is borne by third parties, who are the other members of society adversely affected by the pollution. Negative externalities cause supply-side market failures. All the costs associated with the product are not reflected in the supply curve, and therefore, the producer's supply curve lies to the right of the full-cost supply curve. This situation results in an **overallocation** of resources to the production of a product and an efficiency loss.

b. **Positive externalities** are outcomes that benefit third parties without these parties paying for the benefits. Health immunizations and education are examples of services that have external benefits to others who do not pay for the services. Positive externalities cause demand-side market failures. All the benefits from the production of the product are not fully reflected in the demand curve, and therefore, the demand curve lies to the left of the full-benefits demand curve. This situation results in an **underallocation** of resources to the production of a product and an efficiency loss.

c. Government can intervene in the private market to increase economic efficiency when there are substantial external costs or benefits from the production of a product.

(1) **Direct controls** use legislation to ban or limit the activities that produce a negative externality. In the ideal case, these direct controls raise the cost of production so that it reflects the full cost, thus shifting the original supply curve to the left and reducing equilibrium output. Examples of such direct controls include federal legislation for clean air or clean water.

(2) **Taxes** can be imposed as another way to reduce or limit negative externalities. Such taxes raise the cost of production, thereby shifting the original supply curve leftward and reducing equilibrium output. Some negative externalities get resolved through private bargaining if the externalities are not widespread and the negotiating costs can be kept low.

(3) **Subsidies and government provision** are options that can be used when there are positive externalities from a product. External benefits can be encouraged by subsidizing consumers to purchase a product or by subsidizing producers to make them, such as is done with certain types of health immunizations. When the positive externalities are large, it may make sense from an economic efficiency perspective for the government to provide the product at no cost to the consumer.
d. (Consider This). As shown by Ronald Coase in the Coase Theorem, some negative or positive externality situations can be addressed through individual or private bargaining and without government intervention.

e. In most cases, the optimal reduction of an externality is not zero from society's perspective and there is a price to be paid. This condition means that society must consider the marginal benefit and marginal cost of reducing a negative externality.

1. The equilibrium occurs where the marginal cost to society from reducing the negative externality is just equal to the marginal benefit from reducing the negative externality (MB = MC).

2. Over time, shifts in the marginal-cost and marginal-benefit curves change the optimal level of externality reduction.

3. When positive externalities are extremely large, government may decide to provide the good or service.

4. Market failures can be used to justify government interventions in the private economy to encourage or discourage the production and consumption of particular products and increase economic efficiency. However, the expanded economic role of government to correct market failure is conducted in the context of politics. This political process can lead to imperfect and inefficient outcomes.

5. (Last Word). There are market-based approaches to externality problems that establish property rights where none existed before. A cap-and-trade program creates a market for property rights to a negative externality. In this program, the government sets a limit for the amount of CO₂ emissions permitted in a region (a cap) and allocates pollution permits to firms in the region based on their typical amount of output and emissions. Then if a firm wanted to expand its output and emissions, it would have to purchase pollution permits from other firms (trade) that wanted to reduce their output or emissions or did not use their limit. A firm would only expand production if the marginal benefit of the additional output was greater than the marginal cost of buying the additional pollution permits. One major problem, however, with this system is the difficulty of monitoring CO₂ emissions by firms and ensuring compliance with permits. As an alternative, many economists have proposed a tax on the use of carbon-based resources such as coal or oil. This alternative would raise the cost of using carbon resources that contribute to pollution and reduce the enforcement costs.

**IMPORTANT TERMS**

- public goods
- nonrivalry
- nonexcludability
- free-rider problem
- cost-benefit analysis
- quasi-public goods
- externality
- Coase theorem
- optimal reduction of an externality

**SELF-TEST**

**FILL-IN QUESTIONS**

1. When it is impossible to charge consumers what they are willing to pay for a product, the situation that arises is a market failure on the _________.

2. A consumer surplus is the difference between the actual price and the (minimum, maximum) ___________ price a consumer is (or consumers are) willing to pay for a product. In most markets, consumers individually or collectively gain more total utility or satisfaction when the actual or equilibrium price they have to pay for a product is (less, more) ___________ than what they would have been willing to pay to obtain the product.

3. A producer surplus is the difference between the actual or equilibrium price and the (minimum, maximum)
acceptable price a producer is (or producers are) willing to accept in exchange for a product. In most markets, sellers individually or collectively benefit when they sell their product at an actual or equilibrium price that is (less, more) acceptable price. Producer surplus and price are (positively, negatively) related. This means that higher prices (increase, decrease) producer surplus and lower prices (increase, decrease) it.

4. When competition forces producers to use the best techniques and combinations of resources to make a product, then (allocative, productive) efficiency is being achieved. When the correct or optimal quantity of output of a product is being produced relative to the other goods and services, then (allocative, productive) efficiency is being achieved.

5. Allocative efficiency occurs at quantity levels where marginal benefit is (greater than, less than, equal to) marginal cost, maximum willingness to pay by consumers is acceptable price for producers, and the combined consumer and producer surplus is at a (minimum, maximum) level.

6. When there is overproduction of a product, there are efficiency (gains, losses) and when there is underproduction there are efficiency (gains, losses). In both cases, the combined consumer and producer surplus is (greater than, less than) the maximum that would occur at the efficient quantity of output.

7. Rivalry means that when one person buys and consumes a product, it (is, is not) available for purchase and consumption by another person. Excludability means that the seller (can, cannot) keep people who do not pay for the product from obtaining its benefits. Rivalry and excludability apply to (private, public) goods.

8. One characteristic of a public good is (rivalry, nonrivalry) and the other characteristic of a public good is (excludability, nonexcludability). A private firm will not find it profitable to produce a public good because there is a (free-rider, principal-agent) problem because once the good is provided, everyone, including those who do not pay for it, can obtain the benefits.

9. With a private good, to compute the market demand you add together the (prices people are willing to pay, quantities demanded) at each possible (price, quantity demanded). With a public good, to compute the collective demand you add together the (prices people are willing to pay, quantities demanded) for the last unit of the public good at each possible (price, quantity demanded).

10. The demand curve slopes downward for a public good because of the law of diminishing marginal (returns, utility); the supply curve for a public good is upsloping because of the law of diminishing . The demand curve for a public good is, in essence, a marginal- (benefit, cost) curve; the supply curve for a public good reflects rising marginal . The optimal quantity of a public good will be shown by the intersection of the collective demand and supply curves, which means that marginal (benefit, cost) of the last unit equals that unit's marginal .

11. In applying cost-benefit analysis, government should use more resources in the production of public goods if the marginal (cost, benefit) from the additional public goods exceeds the marginal that results from having fewer private goods. This rule will determine which plan from a cost-benefit analysis will result in the (maximum, minimum) net benefit to society.

12. To reallocate resources from the production of private goods to the production of public and quasi-public goods, government reduces the demand for private goods by (taxing, subsidizing) consumers and then uses the (profits, tax revenue) to buy public or quasi-public goods.

13. There is a negative externality whenever some of the costs of producing a product spill over to people other than the immediate (seller, buyer) and there is a positive externality when some of the benefits from consuming a product spill over to people other than the immediate .

14. When there is a negative externality firms do not pay the full cost of production and therefore their supply curves will increase or shift more to the (left, right) than would be the case if firms paid the full cost of production. When there is a positive externality, consumers do not capture the full benefits of the product and therefore the demand curves will decrease or shift more to the (right, left) than would be the case if all the benefits were captured by the buyers of the product.

15. When there are negative externalities in competitive markets, the result is an (over, under) allocation of resources to the production of the good or service. When there are positive externalities, the result is an (over, under) allocation of resources to the production of the good or service.
16. Government may use direct controls to reduce negative externalities by passing legislation that restricts business activity. When direct controls are imposed, the cost of production will (increase, decrease) _____. The supply curve will (increase, decrease) _____. And output will ___________.

17. Government also can place taxes on specific products to reduce negative externalities. With these excise taxes, the costs of production will (increase, decrease) ___________, the supply curve will _________, and output will ___________.

18. The government may correct for the underallocation of resources where (negative, positive) ______ externalities are large and diffuse. This objective can be achieved by (taxing, subsidizing) ______ buyers or producers and through government (provision, consumption) ______ of a good or service.

19. In the case of positive externalities, the government can give a subsidy to consumers that will increase the (supply, demand) ______ for a product or it can give a subsidy to businesses that will increase the ______ for the product. In either case, the output of the product will (increase, decrease) _________.

20. Reducing negative externalities comes at a "price" to society, and therefore society must decide how much of a decrease it wants to (buy, sell) "______." Further abatement of a negative externality increases economic efficiency if the marginal cost is (greater than, equal to, less than) ______ the marginal benefit, but it is economically inefficient if the marginal benefit is ______ the marginal cost. The optimal reduction of a negative externality occurs where the society's marginal benefit is (greater than, equal to, less than) ______ society's marginal cost.

**TRUE-FALSE QUESTIONS**

Circle T if the statement is true, F if it is false.

1. Demand-side market failures arise when demand curves do not reflect consumers' full willingness to pay for a product. T F

2. If demand and supply reflected all the benefits and costs of producing a product, there would be economic efficiency in the production of the product. T F

3. Consumer surplus is the difference between the minimum and maximum price a consumer is willing to pay for a good. T F

4. Consumer surplus is a utility surplus that reflects a gain in total utility or satisfaction. T F

5. Consumer surplus and price are directly or positively related. T F

6. Producer surplus is the difference between the actual price a producer receives for a product and the minimum price the producer would have been willing to accept for the product. T F

7. The higher the actual price, the less the amount of producer surplus. T F

8. Efficiency losses are increases in the combined consumer and producer surplus. T F

9. Private goods are characterized by rivalry and excludability and public goods are characterized by nonrivalry and nonexcludability. T F

10. When determining the collective demand for a public good, you add the prices people are willing to pay for the last unit of the public good at each possible quantity demanded. T F

11. When the marginal benefit of a public good exceeds the marginal cost, there will be an overallocation of resources to that public use. T F

12. The optimal allocation of a public good is determined by the rule that marginal cost (MC) equals marginal revenue (MR). T F

13. An externality is a cost or benefit accruing to an individual or group—a third party—which is external to the market transaction. T F

14. In a competitive product market and in the absence of negative externalities, the supply curve reflects the costs of producing the product. T F

15. If demand and supply reflected all the benefits and costs of a product, the equilibrium output of a competitive market would be identical with its optimal output. T F

16. There is an underallocation of resources to the production of a commodity when negative externalities are present. T F

17. One way for government to correct for a negative externality from the production of a product is to increase the demand for the product. T F

18. When negative externalities are involved in the production of a product, more resources are allocated to the production of that product and more of the product is produced than is optimal or most efficient. T F

19. The Coase theorem suggests that government intervention is required whenever there are negative or positive externalities. T F

20. Taxes that are imposed on businesses that create an externality will lower the marginal cost of production and increase supply. T F

21. Subsidizing the firms producing goods that provide positive externalities will usually result in a better allocation of resources. T F

22. If a society has marginal costs of $10 for pollution abatement and the marginal benefit of pollution abate-
ment is $8, to achieve an optimal amount of the pollution the society should increase the amount of pollution abatement.

23. Changes in technology or changes in society's attitudes toward pollution can affect the optimal amount of pollution abatement. \( T \) \( F \)

24. One solution to the negative externalities caused by pollution is to create a market for pollution rights in which the negative externalities from pollution are turned into private costs. \( T \) \( F \)

25. Political pressure can make it difficult to find and implement an economically efficient solution to an externality problem. \( T \) \( F \)

■ MULTIPLE-CHOICE QUESTIONS

Circle the letter that corresponds to the best answer.

1. Katie is willing to pay $50 for a product and Tom is willing to pay $40. The actual price that they have to pay is $30. What is the amount of the consumer surplus for Katie and Tom combined?
   (a) $30
   (b) $40
   (c) $50
   (d) $60

2. Given the demand curve, the consumer surplus is
   (a) increased by higher prices and decreased by lower prices
   (b) decreased by higher prices and increased by lower prices
   (c) increased by higher prices, but not affected by lower prices
   (d) decreased by lower prices, but not affected by higher prices

3. The difference between the actual price that a producer receives (or producers receive) and the minimum acceptable price is producer
   (a) cost
   (b) wealth
   (c) surplus
   (d) investment

4. The minimum acceptable price for a product that Juan is willing to receive is $20. It is $15 for Carlos. The actual price they receive is $25. What is the amount of the producer surplus for Juan and Carlos combined?
   (a) $10
   (b) $15
   (c) $20
   (d) $25

5. When the combined consumer and producer surplus is at a maximum for a product,
   (a) the quantity supplied is greater than the quantity demanded
   (b) the market finds alternative ways to ration the product
   (c) the market is allocatively efficient
   (d) the product is a nonpriced good

6. When the output is greater than the optimal level of output for a product there are efficiency
   (a) gains from the underproduction of the product
   (b) losses from the underproduction of the product
   (c) gains from the overproduction of the product
   (d) losses from the overproduction of the product

7. How do public goods differ from private goods? Public goods are characterized by
   (a) rivalry and excludability
   (b) rivalry and nonexcludability
   (c) nonrivalry and excludability
   (d) nonrivalry and nonexcludability

8. There is a free-rider problem when people
   (a) are willing to pay for what they want
   (b) are not willing to pay for what they want
   (c) benefit from a good without paying for its cost
   (d) want to buy more than is available for purchase in the market

Answer Questions 9, 10, 11, and 12 on the basis of the following information for a public good. \( P_1 \) and \( P_2 \) represent the prices individuals 1 and 2, the only two people in the society, are willing to pay for the last unit of a public good. \( P_c \) represents the price (or collective willingness to pay) for a public good, and \( Q_s \) represents the quantity supplied of the public good at those prices.

<table>
<thead>
<tr>
<th>( Q_d )</th>
<th>( P_1 )</th>
<th>( P_2 )</th>
<th>( P_c )</th>
<th>( Q_s )</th>
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</thead>
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<tr>
<td>1</td>
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<td>0</td>
<td>1</td>
<td>1</td>
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</tbody>
</table>

9. What amount is this society willing to pay for the first unit of the public good?
   (a) $10
   (b) $9
   (c) $8
   (d) $7

10. What amount is this society willing to pay for the third unit of the public good?
    (a) $5
    (b) $6
    (c) $7
    (d) $8

11. Given the supply curve \( Q_s \), the optimal price and quantity of the public good in this society will be
    (a) $9 and 5 units
    (b) $5 and 3 units
    (c) $5 and 4 units
    (d) $3 and 2 units

12. If this good were a private good instead of a public good, the total quantity demanded at the $4 price would be
    (a) 3 units
    (b) 4 units
    (c) 5 units
    (d) 6 units
Answer Questions 13, 14, and 15 for a public good on the basis of the following graph.

13. Where the marginal benefits equal the collective marginal costs is represented by point
(a) b
(b) c
(c) d
(d) e

14. Which line segment would indicate the amount by which the marginal benefit of this public good is less than the marginal cost?
(a) ab
(b) bc
(c) fa
(d) gh

15. If 3 units of this public good are produced, the marginal
(a) cost of $10 is greater than the marginal benefit of $3
(b) cost of $10 is greater than the marginal benefit of $5
(c) benefit of $10 is greater than the marginal cost of $5
(d) benefit of $10 is greater than the marginal cost of $3

16. Assume that a government is considering a new anti-pollution program and may choose to include in this program any number of four different projects. The marginal cost and the marginal benefits of each of the four projects are given in the table below.

<table>
<thead>
<tr>
<th>Project</th>
<th>Marginal cost</th>
<th>Marginal benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>$ 2 million</td>
<td>$ 5 million</td>
</tr>
<tr>
<td>#2</td>
<td>5 million</td>
<td>7 million</td>
</tr>
<tr>
<td>#3</td>
<td>10 million</td>
<td>9 million</td>
</tr>
<tr>
<td>#4</td>
<td>20 million</td>
<td>15 million</td>
</tr>
</tbody>
</table>

What total amount should this government spend on the anti-pollution program?
(a) $2 million
(b) $7 million
(c) $17 million
(d) $37 million

17. When the production and consumption of a product entail negative externalities, a competitive product market results in a(n)
(a) underallocation of resources to the product
(b) overallocation of resources to the product
(c) optimal allocation of resources to the product
(d) higher price for the product

18. A positive externality in the production of some product will result in
(a) overproduction
(b) underproduction
(c) the optimal level of production if consumers are price takers
(d) the optimal level of production if consumers are utility maximizers

Use the following graph which shows the supply and demand for a product to answer Questions 19, 20, and 21.

19. If there are neither negative nor positive externalities, the output that results in the optimal allocation of resources to the production of this product is
(a) q1
(b) q2
(c) q3
(d) 0

20. If the market for a product was in equilibrium at output level q2 but the optimal level of output for society was at q1, the government could correct for this
(a) negative externality with a subsidy to consumers
(b) negative externality with a subsidy to producers
(c) positive externality with a subsidy to producers
(d) negative externality with a tax on producers

21. If the market for a product was in equilibrium at output level q2 but the optimal level of output for society was at q3, the government could correct for this
(a) overallocation of resources by direct controls on consumers
(b) underallocation of resources through taxes on producers
(c) overallocation of resources through a market for externality rights
(d) underallocation of resources through subsidies to producers

22. How does government try to capture more of the benefits for society when there is a positive externality?
(a) by taxing consumers
(b) by taxing producers
(c) by subsidizing producers
(d) by ignoring the free-rider problem

Use the following table to answer Questions 23, 24, and 25. The data in the table show the marginal costs and marginal benefits to a city for five different levels of pollution abatement.

<table>
<thead>
<tr>
<th>Quantity of pollution abatement</th>
<th>Marginal cost</th>
<th>Marginal benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 tons</td>
<td>$500,000</td>
<td>$100,000</td>
</tr>
<tr>
<td>400 tons</td>
<td>300,000</td>
<td>150,000</td>
</tr>
<tr>
<td>300 tons</td>
<td>200,000</td>
<td>200,000</td>
</tr>
<tr>
<td>200 tons</td>
<td>100,000</td>
<td>300,000</td>
</tr>
<tr>
<td>100 tons</td>
<td>50,000</td>
<td>400,000</td>
</tr>
</tbody>
</table>

23. If the city seeks an optimal reduction of the externality, it will select how many tons of pollution abatement?
   (a) 100
   (b) 300
   (c) 400
   (d) 500

24. If the marginal benefit of pollution abatement increased by $150,000 at each level because of the community's desire to attract more firms, the optimal level of pollution abatement in tons would be
   (a) 200
   (b) 300
   (c) 400
   (d) 500

25. What would cause the optimal level of pollution abatement to be 200 tons?
   (a) technological improvement in production that decreases marginal costs by $150,000 at each level
   (b) an increase in the health risk from this pollution that increases marginal benefits by $200,000 at each level
   (c) the need to replace old pollution monitoring equipment with new equipment that increases marginal costs by $200,000 at each level
   (d) reduction in the public demand for pollution control that decreases marginal benefits by $100,000 at each level

PROBLEMS

1. Given the following information, calculate the consumer surplus for each individual A to F.

<table>
<thead>
<tr>
<th>Person</th>
<th>Maximum price willing to pay</th>
<th>Actual price (equilibrium price)</th>
<th>Consumer surplus</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$25</td>
<td>$12</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>23</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>18</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>16</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>13</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>12</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

2. Given the following information, calculate the producer surplus for each producer A to F.

<table>
<thead>
<tr>
<th>Producers</th>
<th>Minimum acceptable price</th>
<th>Actual price (equilibrium price)</th>
<th>Producer surplus</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$4</td>
<td>$12</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>9</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>10</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>12</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

3. Answer this question based on the following graph showing the market supply and demand for a product. Assume that the output level is $Q_1$.

a. The area of consumer surplus would be shown by the area ________.
b. The area of producer surplus would be shown by the area ________.
c. The area that maximizes the combined consumer and producer surplus is ________.
d. If the output level is now $Q_2$, then there are efficiency losses shown by area ________.
e. If the output level is now $Q_3$, then there are efficiency losses shown by area ________.

4. Data on two individuals' preferences for a public good are reflected in the following table. $P_1$ and $P_2$ represent the prices individuals 1 and 2, the only two people in the society, are willing to pay for the last unit of the public good.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>$P_1$</th>
<th>$P_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$6</td>
<td>$6</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
a. Complete the table below showing the collective demand for the public good in this society.

<table>
<thead>
<tr>
<th>$Q_d$</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

b. Given the supply schedule for this public good as shown by the $Q_s$ column, the optimal quantity of this public good is ________ units and the optimal price is $______.

c. When 3 units of this public good are produced, the perceived marginal benefit is $______ and the marginal cost is $______; there will be an (overallocation, underallocation) ________ of resources to this public good.

d. When 6 units of this public good are produced, the perceived marginal benefit is $______ and the marginal cost is $______; there is an (underallocation, overallocation) ________ of resources to this public good.

5. Imagine that a state government is considering constructing a new highway to link its two largest cities. Its estimate of the total costs and the total benefits of building 2-, 4-, 6-, and 8-lane highways between the two cities are shown in the table below. (All figures are in millions of dollars.)

<table>
<thead>
<tr>
<th>Project</th>
<th>$Total cost$</th>
<th>$Marginal cost$</th>
<th>$Total benefit$</th>
<th>$Marginal benefit$</th>
</tr>
</thead>
<tbody>
<tr>
<td>No highway</td>
<td>$0$</td>
<td>$0$</td>
<td>$0$</td>
<td>$0$</td>
</tr>
<tr>
<td>2-lane highway</td>
<td>500</td>
<td>$___$</td>
<td>650</td>
<td>$___$</td>
</tr>
<tr>
<td>4-lane highway</td>
<td>680</td>
<td>750</td>
<td>800</td>
<td>$___$</td>
</tr>
<tr>
<td>6-lane highway</td>
<td>760</td>
<td>800</td>
<td>825</td>
<td>$___$</td>
</tr>
<tr>
<td>8-lane highway</td>
<td>860</td>
<td>825</td>
<td>850</td>
<td>$___$</td>
</tr>
</tbody>
</table>

a. Compute the marginal cost and the marginal benefit of the 2-, 4-, 6-, and 8-lane highways.
b. Will it benefit the state to allocate resources to construct a highway? ________
c. If the state builds a highway,
   (1) it should be a ________-lane highway.
   (2) the total cost will be $______ million.
   (3) the total benefit will be $______ million.
   (4) the net benefit will be $______ million.

6. The following graph shows the demand and supply curves for a product bought and sold in a competitive market.

a. Assume that there are no negative or positive externalities associated with the production of this product. The optimal level of output would be $(Q_1, Q_2, Q_3)$ ________.

b. Assume that there are negative externalities associated with the cost of production of this product that are not reflected in the optimal output. In this case, the supply curve will shift to the (right, left) ________ and equilibrium level of output would most likely be $(Q_1, Q_2, Q_3)$ ________.

c. Assume that there are positive externalities associated with the production of this product. In this case, the demand curve will shift to the (right, left) ________ and the new equilibrium level of output would most likely be $(Q_1, Q_2, Q_3)$ ________.

7. Assume the atmosphere of a large metropolitan area is able to reabsorb 1500 tons of pollutants per year. The following schedule shows the price polluters would be willing to pay for the right to dispose of 1 ton of pollutants per year and the total quantity of pollutants they would wish to dispose of at each price.
<table>
<thead>
<tr>
<th>Price (per ton of pollutant rights)</th>
<th>Total quantity of pollutant rights demanded (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0</td>
<td>4000</td>
</tr>
<tr>
<td>1000</td>
<td>3500</td>
</tr>
<tr>
<td>2000</td>
<td>3000</td>
</tr>
<tr>
<td>3000</td>
<td>2500</td>
</tr>
<tr>
<td>4000</td>
<td>2000</td>
</tr>
<tr>
<td>5000</td>
<td>1500</td>
</tr>
<tr>
<td>6000</td>
<td>1000</td>
</tr>
<tr>
<td>7000</td>
<td>500</td>
</tr>
</tbody>
</table>

a. If there were no emission fee, polluters would put ____________ tons of pollutants in the air each year, and this quantity of pollutants would exceed the ability of nature to reabsorb them by ____________ tons.

b. To reduce pollution to the capacity of the atmosphere to recycle pollutants, an emission fee of $__________ per ton should be set.

c. Were this emission fee set, the total emission fees set would be $__________.

d. Were the quantity of pollution rights demanded at each price to increase by 500 tons, the emission fee could be increased by $__________ and total emission fees collected would increase by $__________.

**SHORT ANSWER AND ESSAY QUESTIONS**

1. Explain the difference between demand-side market failures and supply-side market failures. Give several examples of each one.

2. How is the consumer surplus related to utility or satisfaction? Explain, using a supply and demand graph.

3. Define, using a supply and demand graph, the meaning of producer surplus.

4. Use consumer and producer surplus to describe efficiency losses in a competitive market. Provide a supply and demand graph to show such losses.

5. Distinguish between a private and a public good. Include in your answer an explanation of rivalry, excludability, and the free-rider problem.

6. Contrast how you construct the demand curve for a public good with the procedure for constructing the demand curve for a private good using individual demand schedules.

7. Explain the relationship between the marginal cost and benefit of a public good when there is an underallocation, an overallocation, and an optimal allocation of resources for the provision of the public good.

8. Describe benefit–cost analysis, and state the rules used to make decisions from marginal and total perspectives.

9. Why are quasi-public goods provided by government even if they could be produce by the private sector?

10. How are resources reallocated from the private economy to produce public or quasi-public goods?

11. What are externalities? Give examples of positive externalities and negative externalities.

12. How does the existence of negative externalities affect the allocation of resources and the prices of products?

13. Describe what happens in a market in terms of demand, supply, output, and price when there are positive externalities associated with a product.

14. What two basic actions can government take to correct for negative externalities in a market?

15. How can government respond to situations in which there are positive externalities associated with a product and it wants to increase output?

16. Explain why the "Fable of the Bee" is a good reminder that it is a fallacy to assume that government must always get involved to remedy externalities.

17. What rule can society use to determine the optimal level of pollution abatement?

18. How does time change answers about the optimal level of pollution abatement?

19. Discuss the economic issues involved in the use of a cap-and-trade program and the use of a carbon tax to reduce or mitigate the adverse effects from carbon dioxide emissions.

20. Why is it difficult for government to correct for externalities through the political process?