Chapter Summary

An **externality** is a benefit or cost that affects someone not directly involved in the production or consumption of a good or service. Negative externalities are costs imposed on individuals not directly involved in producing or consuming a good or service. Positive externalities are benefits received by individuals not directly involved in producing or consuming a good or service. When there is a negative externality as the result of production, the market supply curve understates the full economic cost, the **social cost**, of production. Economic efficiency would be increased if less of the good or service were produced. When there is a positive externality, the market demand curve understates the full economic benefit, the **social benefit**, from consumption and too little of the good is produced.

Negative and positive externalities lead to **market failure**. The absence of private **property rights** or the lack of sufficient enforcement of existing property rights is the underlying cause of externalities and other forms of market failure. Private solutions are possible and efficient if there are low transactions costs. When private solutions to externalities are not feasible, government intervention may be required. For example, if a negative externality is present, government can impose a tax equal to the additional external costs (the difference between the social cost and the private cost). When there are positive externalities, government can provide a subsidy to consumers equal to the external benefits.

To reduce pollution, governments have often used a **command and control approach**. With this approach, the government sets specific quantitative limits on each pollutant emitted, or the government may dictate the installation of specific pollution control devices. One notable exception to the command and control approach was the U.S. government’s attempt to reduce acid rain pollution using a market-based approach. In the Clean Air Act of 1990, Congress required electric utilities to reduce their emissions of sulfur dioxide, a major cause of acid rain. The success of the sulfur dioxide program, which used a system of tradable permits, has led some to suggest that a similar program be used to reduce emissions of so-called “greenhouse gases” that contribute to global warming.

Other reasons for government intervention may include cases in which products are **rival** or **excludable**. **Rivalry** occurs when consumption of one unit of a good precludes its consumption by someone else. **Excludability** means that anyone who does not pay for a good cannot consume it. Because common resources are not privately owned, they are often non-rival, non-excludable, or both. There is a tendency for these common resources to be overused. This result is called the **tragedy of the commons**. One person’s use of a common resource can impose costs on others, as when one person adding a cow to a common field reduces the grass available to eaten by other people’s cows. Because the private cost of using a common resource is less than the social cost, the market equilibrium for the resource occurs where the marginal cost exceeds the marginal benefit. Left to its own devices, the market equilibrium will result
in too much of the common resource being consumed. Government intervention in this market may involve restricting access to the common resource.

**Learning Objectives**

When you finish this chapter you should be able to:

1. **Identify examples of positive and negative externalities and use graphs to show how externalities affect economic efficiency.** A negative externality causes the social cost of production of a good or service to exceed the private cost borne by the producer. The social cost includes the private cost and the external cost from production. A negative externality causes output to exceed the economically efficient amount. A positive externality causes the social benefit from consuming a good or service to exceed the private benefit. The social benefit includes the private benefit received by the consumer and the external benefit. A positive externality causes output to be less than the economically efficient amount.

2. **Discuss the Coase Theorem and explain how private bargaining can lead to economic efficiency in a market with an externality.** Private bargaining can result in an efficient solution to problems arising from externalities if the transactions costs from the bargaining are low. Private parties to the bargaining agreement must have full information regarding the benefits and costs associated with the externality, and all parties must be willing to accept a reasonable agreement.

3. **Analyze government policies to achieve economic efficiency in a market with an externality.** When private efforts to solve externality problems fail, government intervention may be warranted. When there is a negative externality in production, government can impose a tax equal to the cost of the externality. When there is a positive externality in consumption, government can give consumers a subsidy equal to the value of the externality. Government may use direct controls to deal with externalities such as imposing a quantitative limit on the amount of pollution firms are allowed to emit. Government can also use a market-based approach by setting up a system of tradeable emissions allowances to reduce pollution.

4. **Explain how goods can be categorized on the basis of whether they are rival or excludable and use graphs to illustrate the efficient quantities of public goods and common resources.** Rivalry occurs when one person’s consumption of a good prevents anyone else from consuming it. Excludability means that anyone who has not paid for a good cannot consume it. A good that is rival and excludable is a private good, and markets can supply the efficient quantity of the good without government intervention. If a good is not rival or excludable markets, are not likely to produce the efficient quantity of the good. A public good is both nonrivalrous and nonexcludable. A public good is usually supplied by the government. A common resource is rival but not excludable. Since no one owns a common resource, it will often be overused.

**Chapter Review**

**Chapter Opener: Economic Policy and the Environment (pages 136-137)**

Economic analysis is a useful tool in formulating efficient pollution policies. The Duke Energy Corporation is a participant in the federal government’s program to reduce acid rain emissions through a market-based approach. Duke and other utility companies are allowed to trade emissions allowances.
Each allowance permits the holder to emit one ton of sulfur dioxide. Utilities are free to buy and sell allowances so long as they end up with one allowance for every ton of sulfur dioxide they emit.

Helpful Study Hint

**Making the Connection** “Can Tradable Permits Reduce Global Warming?” and **An Inside Look** discuss how the government can apply the lessons from the sulfur dioxide reduction program to the more complex problem of reducing carbon dioxide emissions to reduce global warming. **An Inside Look** discusses the carbon emissions permit scheme introduced in the European Union, where permits were issued to firms that emit carbon dioxide. Those firms can choose to use the permits or sell the permits in the market to firms who are interested in buying them. Too many permits were issued, so the scheme did not work. A second phase of the program is being implemented, where fewer pollution permits will be issued. The hope is that the price of the permit will be high enough that people will switch from coal to natural gas, which will reduce carbon dioxide emissions.

Is there such a thing as a “good” or “best” level of carbon emissions and other types of pollution? Or, should there be no pollution at all? **Economics in YOUR Life!** at the start of this chapter poses these questions. Keep the questions in mind as you read the chapter. The authors will answer the questions at the end of the chapter.

5.1 Externalities and Economic Efficiency (138-141)

**Learning Objective 1** Identify examples of positive and negative externalities and use graphs to show how externalities affect economic efficiency.

An **externality** is a benefit or cost that affects someone who is not directly involved in the production or consumption of a good or service. Positive externalities refer to benefits received from a good or service by consumers who do not pay for them. Negative externalities refer to costs incurred by individuals not involved in the production or consumption of a good or service. Externalities interfere with the economic efficiency of market equilibrium by causing a difference between the private cost of production and the social cost, or between the private benefit from consumption and the social benefit.

A **private cost** is a cost borne by the producer of a good or service. A **social cost** is the total cost of production, including both the private cost and any external cost. A **private benefit** is the benefit received by the consumer of a good or service. A **social benefit** is the total benefit from consuming a good, including both the private benefit and any external benefit.

A negative externality causes the social cost of production for a good to be greater than the private cost. As a result, more than the economically efficient level of output is produced. A positive externality causes the social benefit from the production of a good to be to be greater than the private benefit. As a result, less than the economically efficient level of output is produced. Externalities result from the absence of property rights for resources (for example, air) or inadequate legal enforcement of property rights. **Property rights** are the rights individuals or businesses have to the exclusive use of their property, including the right to buy or sell it.
Market failure refers to situations where the market fails to produce the efficient level of output. Figure 5-1 illustrates the effect of acid rain on the market for electricity and the deadweight loss that occurs due to a negative externality. Figure 5-2 illustrates the impact of a positive externality in the market for a college education and the deadweight loss caused by this externality.

Helpful Study Hint

In chapter 4, you learned that the equilibrium price in a competitive market results in the economically efficient level of output, where marginal benefit equals marginal cost. In this chapter we learn that sometimes a competitive market does not produce the economically efficient level of output.

In America in the 1950s, summertime was a time of fear and anxiety for many parents; this was the season when children by the thousands became infected with the infectious and crippling disease poliomyelitis, or polio. Jonas Salk, Albert Sabin, and their colleagues developed a vaccine for polio in 1955. Their research provides a good example of a positive externality. Parents whose children receive polio vaccines would gladly pay for research that provided this protection. If parents paid even a small amount ($5 per child), the total would run into the hundreds of millions of dollars for the scientists’ efforts. Of course, no market mechanism exists to transfer revenue from these parents to the researchers. As a result, markets produce less medical research than people are willing to pay for.

Source: http://www.achievement.org/autodoc/page/sal0bio-1

Extra Solved Problem 5-1

Chapter 5 of the textbook includes two Solved Problems. Here is an extra Solved Problem to help you build your skills solving economic problems.

Supports Learning Objective 5-1: Identify examples of positive and negative externalities and use graphs to show how externalities affect economic efficiency.

The Influenza Pandemic of 1918

From 1914 to 1918, World War I caused over 8 million military deaths, a total that dwarfed the number of deaths suffered in any previous war in history. But this total is much lower than the number of people who died during the influenza pandemic of 1918-19. There were at least 20 million, perhaps as many as 40 million, victims of the so-called “Spanish Flu” or “La Grippe.” Ironically, many American soldiers who survived the war would carry the influenza virus home with them from Europe. An estimated 675,000 Americans died during the pandemic, ten times the number who died in the war. With no known cure for the deadly disease, public health officials distributed gauze masks for people to wear in public. Stores were forbidden to hold sales and railroads refused to carry passengers who did not have signed certificates stating that they were free of the virus. There were serious shortages of health care workers, morticians, and gravediggers, conditions not unlike those experienced during the Black Death of the Middle Ages.
a. Draw a graph illustrating the demand and supply for research directed at finding a cure for a highly contagious disease such as the 1918 flu. Assume that all research efforts are funded through private markets.

b. Describe how an externality causes an equilibrium level of output that is not economically efficient.


**SOLVING THE PROBLEM**

**Step 1:** Review the chapter material.
This problem is about externalities and efficiency, so you may want to review the section “Externalities and Economic Efficiency,” which appears on page 138 in the textbook.

**Step 2:** Draw a graph to illustrate the externality associated with privately funded research to cure malaria.

![Graph showing demand and supply with positive externality](image)

**Step 3:** Describe how the externality causes a deviation from economic efficiency.
There is a positive externality associated with medical research because of the external benefits the research generates. Assume that researchers had found a cure for the so-called “Spanish Flu” in 1918 at the beginning of the pandemic. The benefits to those people who would be protected from contracting the deadly disease would be substantial. If we estimate the benefit at $100 for each person, the external benefits range in the billions of dollars. Of course, medical research is by nature uncertain and scientists and doctors can work many years without finding a cure for any disease. Private hospitals and research laboratories are likely to receive a relatively small amount of the social benefit from their efforts. As the graph in Step 2 shows, the demand curve for medical research that includes only private benefits will be below the demand curve that includes all social benefits. The private market equilibrium price and quantity would be $P_1$ and $Q_1$. At this point the marginal (social) benefit ($MB$) would exceed the marginal cost ($MC$). The economically efficient level price and quantity would be $P_2$ and $Q_2$ where marginal (social) benefit is equal to marginal cost.
5.2 Private Solutions to Externalities: The Coase Theorem
(pages 141-147)

Learning Objective 2  Discuss the Coase Theorem and explain how private bargaining can lead to economic efficiency in a market with an externality.

Ronald Coase argued that private bargaining may improve inefficient market results caused by externalities. The **Coase Theorem** states that if transactions costs are low, private bargaining will result in an efficient solution to the problem of externalities. **Transactions costs** are the costs in time and other resources that parties incur in the process of agreeing to and carrying out an exchange of goods and services. Successful application of the Coase Theorem requires that the bargaining parties have full information regarding the costs and benefits associated with the externalities and are willing to accept a reasonable agreement. In practice, private solutions are often not feasible because transactions costs are too high.

### Helpful Study Hint

Industrial pollution is an example of a negative externality in production. Cigarette smoking causes a negative externality in consumption. Today’s college students grew up in an era when smoking was much less socially acceptable than when their parents and grandparents were young. You may be surprised to learn that smoking by both students and instructors was allowed in many college classrooms as late as the 1970s. Although few, if any, colleges allow smoking in classrooms now, many bars and restaurants have smoking and non-smoking sections. Decisions by colleges and restaurants to limit smoking are examples of private actions designed to limit the external costs smokers impose on non-smokers.

**Making the Connection** “The Clean Air Act: How a Government Policy Reduced Infant Mortality” explains that the federal government’s Clean Air Act of 1970 has caused a significant reduction in six main air pollutants. As pollution fell due to the Act, infant mortality also fell.

In the **Don’t Let This Happen to YOU!** “Remember That It’s the Net Benefit That Counts” the authors remind us that even though the total benefit to society would be largest if we reduced all pollution to zero, this would not be economically efficient. To find the economically efficient amount of pollution reduction we should compare the marginal benefit to the marginal cost of each unit of pollution reduction. If the marginal benefit is greater than the marginal cost, then an additional unit of pollution reduction should be pursued. Pollution reduction should continue until the maximum net benefit to society is reached, which occurs when the marginal benefit of the last unit of reduction equals the marginal cost of that unit of pollution reduction.

**Making the Connection** “The Fable of the Bees” discusses a traditional example of externalities. Beekeepers and apple growers realized that honeybees could use the nectar from apple trees to produce honey and that bees are useful in pollinating apple trees. Private solutions to this
externality have been reached so that there are about $14 billion worth of crops pollinated by bees annually now through bee rental programs.

**Extra Solved Problem 5-2**

Chapter 5 of the textbook includes two Solved Problems. Here is an extra Solved Problem to help you build your skills solving economic problems.

Supports Learning Objective 5-2: Discuss the Coase Theorem and explain how private bargaining can lead to economic efficiency in a market with an externality.

**The Dog Next Door**

Assume that your next-door neighbor owns a large dog named “Rufus” that spends a significant amount of the night in the backyard. While in the yard, Rufus barks continuously and prevents you from getting a good night’s sleep. Consider an attempt by you and your neighbor to come to an agreement that would deal with this negative externality.

a. What would you be willing to pay the neighbor to have him get rid of Rufus? What would the neighbor require in payment to get rid of Rufus?

b. Who will pay? Will you pay the neighbor to get rid of his dog or will he pay you to listen to the dog bark?

**SOLVING THE PROBLEM**

**Step 1:** Review the chapter material.
This problem is about private solutions to externalities, so you may want to review the section “Private Solutions to Externalities: The Coase Theorem,” which begins on page 141 in the textbook.

**Step 2:** Consider the value to you of being able to sleep, and consider the value of Rufus to the neighbor.
You would be willing to pay the neighbor a dollar amount up to the value of the bark-free nights. Your neighbor would only agree to get rid of Rufus if you paid him an amount greater than the value he places on owning Rufus.

**Step 3:** Compare the value you place on quiet nights to the value the neighbor places on the ownership of the dog.
If the neighbor values the ownership of his dog more than you value a good night’s rest, the neighbor will pay you to listen to Rufus’ barking. If you value a good night’s rest more than the neighbor values owning Rufus, you will pay the neighbor to get rid of his dog. But who pays also depends on the local government’s regulations on barking dogs. If your town has a strict rule against dogs being allowed to bark at night, then your neighbor may have to pay you to allow him to keep his barking dog. In this case you would only accept the payment if it is greater than the value you place on a good night’s sleep.
5.3 Government Policies to Deal With Externalities (pages 147-152)

Learning Objective 3  Analyze government policies to achieve economic efficiency in a market with an externality.

In the absence of private solutions to externalities, government intervention may be warranted. To achieve economic efficiency, governments may intervene in different ways. The government may impose a \textit{Pigovian tax} or provide a \textit{subsidy} to cause consumers and firms to internalize the externalities associated with production and consumption. The tax or subsidy would be equal to the dollar amount of the externality. To reduce pollution, governments have often used a command and control approach. A \textit{command and control approach} refers to government-imposed quantitative limits on the amount of pollution firms are allowed to generate. Under this approach, the government may require installation of specific pollution control devices. Since 1990, a market-based approach of tradable permits has reduced emissions of sulfur dioxide from electric utilities at lower than expected cost. The success of this approach has led economists to advocate more extensive use of market-based approaches, and less use of command and control policies.

\textbf{Helpful Study Hint}

Economists working for the private research group Resources for the Future (RFF) are among the strongest supporters of a system of tradable emissions allowances to reduce the problem of acid rain. One of the difficulties of formulating environmental policy is placing a dollar value on environmental damage; for example, the breathing difficulty people with asthma experience due to sulfur dioxide pollution. Economists at RFF have pioneered techniques for measuring the value of things for which no market price exists. RFF has an excellent web site (\url{www.rff.org}) that you can use to access discussion papers, publications, and Congressional testimony regarding a wide range of environmental issues.

\textit{Solved Problem 5-3} provides an example of a government-imposed tax to deal with a negative externality. If the government imposed a tax equal to the value of the externality, the tax would increase the cost to the producer up to the point where it equals the social cost. This would cause the production of toilet paper to fall from the equilibrium level to the efficient level of production.

\textit{Making the Connection} “Can Tradable Permits Reduce Global Warming?” discusses the beliefs of some scientists regarding global warming. Some scientists believe that the recent increase in global temperatures is due to the production of greenhouse gases. Tradable pollution permits for CO$_2$ could be an efficient way to reduce greenhouse gases and combat global warming. Tradable permits allow those who can reduce their pollution for less than the market price of the permits to sell their permits and cut their pollution, while firms that cannot cheaply reduce emissions will buy permits and continue to pollute.
5.4 Four Categories of Goods (pages 152-162)

Learning Objective 4  Explain how goods can be categorized on the basis of whether they are rival or excludable and use graphs to illustrate the efficient quantities of public goods and common resources.

Goods may be classified into four categories based on whether or not their consumption is rival and/or excludable. If I consume one more unit of a product and that means you cannot consume the same unit, the product is called rival. If anyone who wants to consume one unit of a product must pay for that unit, the product is excludable. Products can be either rival or nonrival and excludable or nonexcludable. This gives us four possible combinations of characteristics.

A private good is a good that is both rival and excludable. The economically efficient quantity of a private good can be supplied in a market without government intervention. Quasi-public goods are goods that are excludable but not rival. A common resource is a good that is rival but not excludable. There are typically externalities associated with common resources. A public good is a good that is both nonrival and nonexcludable. Free riding refers to benefiting from a good without paying for it. Because of free riders, public goods are usually supplied by government rather than private firms.

In contrast with private goods, each consumer will consume the same quantity of a public good as every other consumer. The demand for a public good is determined by adding the price each consumer is willing to pay for each quantity of the good. Because no consumer can be excluded from receiving the good, it is difficult to determine consumers’ true preferences and willingness to pay because of the free rider problem. Governments typically provide public goods, such as national defense, and determine the quantity supplied through cost-benefit analysis or a political process.

Helpful Study Hint

According to the U.S. Department of Agriculture, the average American consumes 223 pounds of beef, pork, and chicken annually. Despite the large and continuing demand for meat, we don’t read news reports about shortages of cows, pigs, and chickens. In contrast, there are occasional media reports of over-fishing and the possible extinction of some animal species. When resources are privately owned, owners have incentives to use the resources efficiently. For example, producers have strong incentives to maintain the stocks of cows, pigs, and chickens to ensure future supplies. Property rights to some parts of oceans, rivers, lakes, and habitat areas of endangered species don’t exist or are poorly enforced. On the other hand, some formerly endangered species have been saved from extinction by simply granting the property rights of the herd to a particular group.

Making the Connection “Should the Government Run the Health Care System?” presents the debate as to whether the United States should have a centralized health care system instead of the government-subsidized private system that exists. There are a number of positive and negative externalities that may justify further intervention. However, some economists support the current private system because of the incentives it provides for innovation.
Solved Problem 5-4 “Determining the Optimal Level of Public Goods” shows how we aggregate individual demand curves to determine the optimal level of public goods. The demand curves are summed vertically to create a marginal social benefit curve, and the optimal quantity is determined by the intersection of the marginal social benefit curve with the marginal social cost curve.

At the start of the chapter, Economics in YOUR Life! asked you to consider if there’s a “best” level of pollution. Scientists disagree about how much carbon emissions are contributing to the damage from climate change. In addition, the cost of reducing carbon emissions depends on the method of reduction used. As a result, neither the marginal cost curve nor the marginal benefit curve for reducing carbon emissions is known with certainty. This uncertainty makes it difficult for policymakers to determine the correct level of carbon emissions and is the source of much of the current debate. In any case, economists agree that the total cost of completely eliminating carbon emissions is much greater than the total benefits.

Key Terms

Coase Theorem. The argument of economist Ronald Coase that if transactions costs are low, private bargaining will result in an efficient solution to the problem of externalities.

Command and control approach. An approach that involves government imposing quantitative limits on the amount of pollution firms are allowed to emit or requiring firms to install specific pollution control devices.

Common resource. A good that is rival but not excludable.

Excludability. The situation in which anyone who does not pay for a good cannot consume it.

Externality. A benefit or cost that affects someone who is not directly involved in the production or consumption of a good or service.

Free riding. Benefiting from a good without paying for it.

Market failure. A situation in which the market fails to produce the efficient level of output.

Pigovian taxes and subsidies. Government taxes and subsidies intended to bring about an efficient level of output in the presence of externalities.

Private benefit. The benefit received by the consumer of a good or service.

Private cost. The cost borne by the producer of a good or service.

Private good. A good that is both rival and excludable.

Property rights. The rights individuals or businesses have to the exclusive use of their property, including the right to buy or sell it.
Public good. A good that is both nonrivalrous and nonexcludable.

Quasi-public good. A good that is excludable but not rival.

Rivalry. The situation that occurs when one person’s consuming a unit of a good means no one else can consume it.

Social benefit. The total benefit from consuming a good or service, including both the private benefit and any external benefit.

Social cost. The total cost of producing a good, including both the private cost and any external cost.

Tragedy of the commons. The tendency for a common resource to be overused.

Transactions costs. The costs in time and other resources that parties incur in the process of agreeing to and carrying out an exchange of goods or services.

Self-Test

(Answers are provided at the end of the Self-Test.)

Multiple-Choice Questions

1. What is the cost that affects someone who is not directly involved in the production or consumption of a good called?
   a. Private cost
   b. Indirect cost
   c. An externality
   d. All of the above fit that definition

2. What is the term used to describe the total cost of producing a good?
   a. Private cost
   b. Social cost
   c. Externality
   d. All of the above fit that definition.

3. What is the difference between private benefit and social benefit?
   a. An external benefit
   b. Private cost
   c. Social cost
   d. A negative externality

4. What is the benefit received by the consumer of a good or service called?
   a. Private benefit
   b. Social benefit
   c. Private cost
   d. A positive externality
5. Refer to the graphs below. In which of these markets is an externality present?

![Market A and Market B graphs]

a. In the market on the left  
b. In the market on the right  
c. In both markets  
d. Neither market exhibits an externality.

6. Refer to the graphs below. Only one statement below is entirely correct. Which one?

![Market A and Market B graphs]

a. Market A exhibits a negative externality because the private benefit exceeds the social benefit.  
b. Market B exhibits a negative externality because the social cost exceeds the private cost.  
c. Market A exhibits a negative externality because the social benefit exceeds the private benefit.  
d. Market B exhibits a positive externality because the private cost exceeds the social cost.
7. Refer to the graphs below. In which of the markets is the quantity \( Q_1 \) less than the economically efficient quantity?

7. a. In market A  
    b. In market B  
    c. In both markets  
    d. In neither of the two markets

8. Refer to the graph below. What term would you ascribe to the magnitude of the arrow in the graph?

8. a. A positive externality  
    b. A negative externality  
    c. Private cost  
    d. Social cost
9. Refer to the graph below. When an externality is present, which combination of price and quantity does the market yield without intervention?

\[ P_0, Q_0 \]
\[ P_1, Q_1 \]
\[ P_0, Q_1 \]
\[ P_1, Q_0 \]

10. Fill in the blanks. When a negative externality is present in producing a good or service, ________ of the good or service will be produced at market equilibrium.

a. too much
b. too little
c. the optimal quantity
d. none

11. What is the situation called in which the market fails to produce the efficient level of output?

a. An externality
b. Market failure
c. External disequilibrium
d. The Coase Theorem

12. When we talk about property rights in the discussion of externalities, which rights do we refer to?

a. The rights of individuals to pollute
b. The rights of individuals to have exclusive use of their property
c. The rights of individuals to buy but not sell their property
d. All of the above

13. What are the sources of externalities and market failure?

a. Incomplete property rights
b. The difficulty of enforcing property rights in certain situations.
c. Both a. and b.
d. Lack of understanding of the market system
14. What type of solution to externalities is the Coase Theorem?
   a. A private solution to externalities
   b. A public solution to externalities
   c. The only solution to externalities
   d. The least preferred solution

15. Which of the following statements is correct according to Ronald Coase’s argument for dealing with externalities and market failure?
   a. In some situations, a private solution to the problem of externalities can be found.
   b. Only public solutions exist for solving externalities.
   c. Completely eliminating an externality is almost always the most efficient solution.
   d. The only cure to externalities is taxation.

16. Which of the following is correct?
   a. Completely eliminating an externality is usually not economically efficient.
   b. As reductions in pollution increase, the additional benefits will decline.
   c. When levels of pollution are high, the marginal benefit of reducing pollution is also high.
   d. All of the above

17. The net benefit to society from reducing pollution is equal to
   a. the sum of the benefits of reducing pollution and the costs.
   b. the difference between the benefits and the costs.
   c. the additional benefit plus the additional costs.
   d. the quantity of pollution, such as the tons of reduction in sulfur dioxide.

18. If we are considering further reductions in pollution, what rule should we follow in order to maximize the net benefit to society?
   a. The marginal benefit from another ton of reduction should be greater than the marginal cost.
   b. The marginal benefit from another ton of reduction should be less than the marginal cost.
   c. The marginal benefit from another ton of reduction should be equal to the marginal cost.
   d. The marginal benefit from another ton of reduction should equal zero.
19. Refer to the graph below. Which of the following is true when the reduction in sulfur dioxide equals seven tons?

![Graph showing cost or benefit vs. reduction in sulfur dioxide emissions]

a. The marginal benefit of reducing sulfur dioxide emissions is greater than the marginal cost.
b. Further reductions will make society worse off.
c. The optimal amount of pollution reduction has been found.
d. All of the above

20. Refer to the graph below. Which of the following is true when the reduction in sulfur dioxide equals ten tons?

![Graph showing cost or benefit vs. reduction in sulfur dioxide emissions]

a. The marginal benefit of reducing sulfur dioxide emissions is greater than the marginal cost.
b. Further reductions will make society worse off.
c. The optimal amount of pollution reduction has been found.
d. All of the above
21. Refer to the graph below. How much reduction in sulfur dioxide can be considered economically efficient?

![Graph showing cost or benefit vs. reduction in sulfur dioxide emissions.]

a. 7.0 tons  
b. 8.5 tons  
c. 10.0 tons  
d. All of the above

22. Refer to the graph below. What area represents the total benefit of increasing the reduction of sulfur dioxide from 7.0 million to 8.5 million tons of sulfur dioxide?

![Graph showing cost or benefit vs. reduction in sulfur dioxide emissions.]

a. Area A  
b. Area B  
c. Area A + B  
d. None of the above; the graph shows only marginal benefit.
23. Refer to the graph below. What area represents the total cost of increasing the reduction of sulfur dioxide from 7.0 million to 8.5 million tons of sulfur dioxide?

![Graph](image)

a. Area A 

b. Area B 

c. Area A + B 

d. None of the above; the graph shows only marginal benefit.

24. Refer to the graph below. What is the net benefit of increasing the reduction of sulfur dioxide from 7.0 million to 8.5 million tons of sulfur dioxide?

![Graph](image)

a. Area A 

b. Area B 

c. Area A + B 

d. None of the above; the graph shows only marginal benefit.
25. Refer to the graph below. How much is the net benefit (in millions) of increasing the reduction of sulfur dioxide from 7.0 million tons to 8.5 million tons?

![Graph showing cost or benefit (dollars per ton) vs. reduction in sulfur dioxide emissions (in millions of tons).]

- a. $255
- b. $120
- c. $200
- d. None of the above

26. Which of the following assertions is made by Ronald Coase in finding an efficient solution to the problem of negative externalities?

- a. The solution usually depends on which party has a legal property right in the dispute.
- b. The solution does not depend on who has the property rights in the dispute.
- c. If we are to find a solution, property rights could not be enforced because they distort efficiency.
- d. In finding a solution, property rights are usually ignored.

27. Fill in the blanks. When there are many people involved, the transactions costs are often _______ than the net benefits from reducing the externality. In such cases, a private solution to an externality problem _______ feasible.

- a. higher; is
- b. higher; is not
- c. lower; is
- d. lower; is not

28. Fill in the blanks. According to the Coase Theorem, if transactions costs are _______, private bargaining will result in an _______ solution to the problem of externalities.

- a. low; efficient
- b. low; inefficient
- c. high; efficient
- d. high; optimal
29. Refer to the graph below. Which of the following best represents a tax equal to the value of the negative externality?

![Graph showing supply and demand with marginal social cost and marginal private cost]

a. $S_1$

b. $S_2$

c. The vertical distance (or arrow) between $S_1$ and $S_2$

d. $P_2 - P_1$

30. Refer to the graph below. After the negative externality has been internalized, which point would best represent market equilibrium?

![Graph showing supply and demand with marginal social cost and marginal private cost]

a. Point $A$

b. Point $B$

c. Point $C$

d. None of the above
31. Refer to the graph below. To bring about social efficiency, what should the magnitude of the arrow in the graph be equal to?

\[
\begin{align*}
\text{Price} & \quad \text{Supply} \\
\text{Quantity} & \quad P_2 \quad P_1 \\
D_1 & = \text{marginal private benefit} \\
D_2 & = \text{marginal social benefit}
\end{align*}
\]

- a. The amount of a subsidy
- b. The amount of a tax
- c. The amount of a price increase
- d. The social benefit of education

32. What is the focus of a *command and control approach* to reducing pollution?

- a. Imposing taxes intended to bring about an efficient level of output in the presence of externalities.
- b. Offering subsidies intended to bring about an efficient level of output in the presence of externalities.
- c. Imposing quantitative limits on the amount of pollution firms are allowed to generate.
- d. Trading licenses to pollute for cash payments.

33. When firms sell their pollution permits in the tradable emissions allowances market, which of the following does not occur?

- a. Over time, pollution will be completely eliminated.
- b. The social cost of pollution reduction is reduced.
- c. All firms that participate in the market benefit.
- d. The total amount of pollution is the same as if the permits were not tradable.

34. What does the term *excludability* refer to?

- a. A situation in which one person’s consumption of a good means that no one else can consume it.
- b. The fact that anyone who does not pay for a good cannot consume it.
- c. The idea that someone can benefit from a good without paying for it.
- d. The possibility that public goods may become private goods.

35. What does the term *rivalry* refer to?

- a. A situation in which one person’s consumption of a good means that no one else can consume it.
- b. The fact that anyone who does not pay for a good cannot consume it.
- c. The idea that someone can benefit from a good without paying for it.
- d. The possibility that public goods may become private goods.
36. What does the term *free riding* refer to?
   a. A situation in which one person’s consumption of a good means that no one else can consume it.
   b. The fact that anyone who does not pay for a good cannot consume it.
   c. The idea that someone can benefit from a good without paying for it.
   d. The possibility that public goods may become private goods.

37. Refer to the table below. From the examples given, which box applies to the concept of *common resources*?

<table>
<thead>
<tr>
<th></th>
<th>Examples:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Big Macs</td>
</tr>
<tr>
<td></td>
<td>Levi’s Jeans</td>
</tr>
<tr>
<td>B</td>
<td>Examples:</td>
</tr>
<tr>
<td></td>
<td>Tuna in the ocean</td>
</tr>
<tr>
<td></td>
<td>Public pasture land</td>
</tr>
<tr>
<td>C</td>
<td>Examples:</td>
</tr>
<tr>
<td></td>
<td>Cable TV</td>
</tr>
<tr>
<td></td>
<td>Toll road</td>
</tr>
<tr>
<td>D</td>
<td>Examples:</td>
</tr>
<tr>
<td></td>
<td>National defense</td>
</tr>
<tr>
<td></td>
<td>Court system</td>
</tr>
</tbody>
</table>

   a. A
   b. B
   c. C
   d. D

38. Refer to the table below. Which of the boxes applies to goods that are excludable and nonrival?

<table>
<thead>
<tr>
<th></th>
<th>Examples:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Examples:</td>
</tr>
<tr>
<td></td>
<td>Big Macs</td>
</tr>
<tr>
<td></td>
<td>Levi’s Jeans</td>
</tr>
<tr>
<td>B</td>
<td>Examples:</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>Public pasture land</td>
</tr>
<tr>
<td>C</td>
<td>Examples:</td>
</tr>
<tr>
<td></td>
<td>Cable TV</td>
</tr>
<tr>
<td></td>
<td>Toll road</td>
</tr>
<tr>
<td>D</td>
<td>Examples:</td>
</tr>
<tr>
<td></td>
<td>National defense</td>
</tr>
<tr>
<td></td>
<td>Court system</td>
</tr>
</tbody>
</table>

   a. A
   b. B
   c. C
   d. D
39. Refer to the graphs below. What procedure does this series of graphs show?

a. The construction of market demand for a private good
b. The construction of market demand for a public good
c. The construction of market demand for a rival good
d. The construction of market demand for an excludable good

40. Refer to the graph below. Which quantity is the optimal quantity of this public good?

a. 12 units
b. 15 units
c. 18 units
d. None of the above
41. Refer to the table below. The table refers to the Solved Problem on page 158 in the textbook. How many hours of protection maximize economic surplus?

<table>
<thead>
<tr>
<th>DEMAND FOR PROTECTION</th>
<th>SUPPLY OF PROTECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price (dollars per hour)</strong></td>
<td><strong>Quantity (hours of protection)</strong></td>
</tr>
<tr>
<td>$20</td>
<td>0</td>
</tr>
<tr>
<td>$18</td>
<td>1</td>
</tr>
<tr>
<td>$16</td>
<td>2</td>
</tr>
<tr>
<td>$14</td>
<td>3</td>
</tr>
<tr>
<td>$12</td>
<td>4</td>
</tr>
<tr>
<td>$10</td>
<td>5</td>
</tr>
<tr>
<td>$8</td>
<td>6</td>
</tr>
<tr>
<td>$6</td>
<td>7</td>
</tr>
<tr>
<td>$4</td>
<td>8</td>
</tr>
<tr>
<td>$2</td>
<td>9</td>
</tr>
</tbody>
</table>

a. 1 hour  
b. 9 hours  
c. 5 hours  
d. 6 hours

42. What is the *tragedy of commons*?
   a. The tragedy of commons refers to the fact that some people benefit from a good without paying for it.  
   b. The tragedy of commons is the tendency for some goods to be excluded from public consumption.  
   c. The tragedy of commons refers to the fact that a good can be rival but nonexcludable.  
   d. The tragedy of commons refers to the tendency for a common resource to be overused.
43. Refer to the graphs below. Which graph best describes the move from an inefficient use of a common resource to an efficient use of it?

![Graphs A, B, C, D]

a. A  
b. B  
c. C  
d. D

Short Answer Questions

1. Explain why the marginal benefit from reducing air pollution in the United States in 1970 were greater than the marginal benefit of reducing air pollution an equivalent amount would be today.

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

2. Steven Cheung of the University of Washington has written about the positive externalities associated with beekeeping and apple growing. Explain why the solution to this externalities problem is an application of the Coase Theorem.

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

3. Air and water pollution impose external costs on people without their consent. Why isn’t it economically efficient to completely eliminate these external costs by reducing the amounts of air and water pollution to zero?

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

4. Public radio and television stations periodically interrupt their regular broadcast schedules to solicit funds from their listeners and viewers. Why?

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

5. Ronald Coase argued that private solutions can solve externality problems without government intervention. Why is government intervention used more often than private bargaining to solve externality problems?

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
True/False Questions

T F 1. The benefits of reducing air pollution are much higher today than in 1970 because the level of air pollution has increased since 1970.

T F 2. The Coase Theorem proves that government intervention is necessary to solve externalities problems.

T F 3. A common resource is a good that is excludable but not rival.

T F 4. A quasi-public good describes a good that is excludable but not rival.

T F 5. The federal government rather than private firms provide national defense because consumers of national defense have an incentive to be free riders.

T F 6. Congress authorized a command and control approach to reducing sulfur dioxide emissions by electric utilities in 1990.

T F 7. A social benefit is the private benefit plus any external benefit from consuming a good or service.

T F 8. In the two years following the passage of the Clean Air Act of 1970 there was a decline in infant mortality in the United States.

T F 9. If the marginal cost of reducing emissions of some pollutant is greater than the marginal benefit, society will be better off if these emissions are increased.

T F 10. A.C. Pigou received the 1991 Nobel Prize in Economics for his work on finding private solutions to problems arising from externalities.

T F 11. Government payments to students to attend college are one way to internalize a positive externality.

T F 12. The 1983 requirement by the federal government to install catalytic converters on all new automobiles is an example of a command and control approach to reducing pollution.

T F 13. The actual cost to electric utilities companies of complying with Congress’ program to reduce sulfur dioxide emissions in 2010 is greater than was originally estimated by the General Accounting Office in 1994.

T F 14. Most European governments favor a system of tradable emissions permits to reduce carbon dioxide emissions. The U.S. government favors a program that would require individual countries to reduce emissions by a specified amount.

T F 15. The demand for a public good is determined by adding the price each consumer is willing to pay for each quantity of the public good.

Answers to the Self-Test

Multiple Choice Questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>c</td>
<td>An externality is a benefit or cost that affects someone who is not directly involved in the production or consumption of a good or service.</td>
</tr>
<tr>
<td>2</td>
<td>b</td>
<td>The total cost of producing a good is the social cost. The social cost is the private cost plus any external cost resulting from production, such as the cost of pollution.</td>
</tr>
<tr>
<td>3</td>
<td>a</td>
<td>A positive externality causes there to be a difference between the private benefit from consumption and the social benefit.</td>
</tr>
<tr>
<td>4</td>
<td>a</td>
<td>The private benefit is the benefit received by the consumer of a good or service.</td>
</tr>
<tr>
<td>5</td>
<td>c</td>
<td>There is a difference between private and social benefits and/or costs in both markets.</td>
</tr>
<tr>
<td>6</td>
<td>b</td>
<td>When the social cost is greater than the private cost of production, the market suffers from a negative externality.</td>
</tr>
</tbody>
</table>
The economically efficient quantity of output in market A is $Q_2$, where the private cost equals the social benefit.

An external benefit exists when the social benefit is greater than private benefit. The private market produces less than the efficient quantity.

The free market fails to account for external costs. The market produces too much output and charges too low a price when external costs are present.

When there is a negative externality in producing a good or service, too much of the good or service will be produced at market equilibrium.

Market failure refers to situations where the market fails to produce the efficient level of output. (Answer a. is incorrect because an externality is only one type of market failure.)

Property rights refer to the rights individuals or businesses have to the exclusive use of their property, including the right to sell it.

A main conclusion in the textbook is that externalities and market failures result from incomplete property rights or the difficulty of enforcing property rights in certain situations.

According to Coase, under some circumstances private solutions to the problem of externalities will occur.

According to Coase, under some circumstances private solutions to the problem of externalities will occur.

It is important to recognize that completely eliminating an externality is usually not economically efficient. For example, if emissions of sulfur dioxide fall to low levels, even people with asthma will no longer be affected. Further reductions in sulfur dioxide will have little additional benefit.

The net benefit to society from reducing pollution is equal to the difference between the benefit of reducing pollution and the cost.

It is optimal to reduce pollution up to the point where the marginal benefit of the last unit of pollution eliminated is equal to the marginal cost of eliminating that unit.

If the marginal benefit of reducing sulfur dioxide emissions is greater than the marginal cost, further reductions will make society better off.

Further reductions have an additional cost which is greater than the additional benefit. If the marginal benefit of reducing sulfur dioxide emissions is less than the marginal cost, further reductions will make society worse off. Refer to Figure 5-3.

The economically efficient quantity is found where marginal benefit is equal to marginal cost.

The total benefit equals the area under the marginal benefit curve.

The total cost equals the area under the marginal cost curve.

The value of the benefits is $375 million or (1.5 million tons x $200 per ton) + (½ x 1.5 million tons x $100 per ton). The value of the costs is $255 million (or (1.5 million tons x $140 per ton) + (1/2 x 1.5 million tons x $60 per ton)). If the people who would benefit from a reduction in pollution could get together, they could offer to pay the electric utilities $255 million to reduce the pollution to the optimal level. After making the payment, they would still be left with a net benefit of $120 million. Since the net benefit (see previous question) equals area A, the value of net benefits is equal to ($300 – $140) x 0.5 x 1.5 million = $120 million.

Rights determine who pays for the externality.

When there are many people involved, the transactions costs are often higher than the net benefits from reducing the externality, so the cost of transacting ends up exceeding the gain from the transaction. In such cases, a private solution to an externality problem is not feasible.
28 a The Coase Theorem states that if transactions costs are low, private bargaining will result in an efficient solution to the problem of externalities.

29 c The amount of tax imposed by government is the length of the upward arrow on the graph. The tax is equal to the difference between private cost and social cost.

30 a At point A marginal social cost equals marginal benefit.

31 a When there is a positive externality, a subsidy can bring about the efficient level of output.

32 c In a command and control approach to reducing pollution, quantitative limits are set on the amount of pollution that firms are allowed to generate.

33 a The tradable allowances will not reduce pollution emissions to zero.

34 b For example, private goods are excludable.

35 a Definition of rival.

36 c Definition of free riding.

37 b Common resources are rival and nonexcludable.

38 c These goods are quasi-public goods.

39 b To arrive at a demand curve for a public good we don’t add quantities at each price, as with a private good. Instead, we add the price each consumer is willing to pay for each quantity of the public good. This gives us a value for the total dollar amount consumers as a group would be willing to pay for that quantity of the public good.

40 b The optimal quantity of a public good will occur where the demand curve intersects the supply curve. When this quantity is produced, the sum of consumer surplus plus producer surplus is maximized.

41 d For example, for every hour beyond 6, the supply curve is above the demand curve. Therefore, the additional benefits received will be less than the additional cost of supplying these hours. This results in a deadweight loss and a reduction in economic surplus. Joe is willing to pay $8, and Jill is willing to pay $10, for 6 hours of protection. Their total willingness to pay is equal to the price needed ($18) to provide six hours of protection. Joe and Jill are willing to pay more than the price needed to provide fewer than 6 hours of protection, but they are not willing to pay more than the price needed to provide more than 6 hours of protection.

42 d The tragedy of the commons is the tendency for a common resource to be overused. A modern example is the forests in many poor countries.

43 d As Figure 5-12 in the textbook describes, an upward shift in the supply curve reflects the adjustment from private cost to social cost, which eliminates the deadweight loss associated with overuse.

Short Answer Responses

1. Since the passage of the Clean Air Act in 1970, emissions of the six main forms of air pollution have fallen by almost half. With the lower level of air pollution the marginal benefit (due to the reduction in illness, etc.) of reducing air pollution by an equivalent amount today would be much less.

2. Cheung noted that intervention by government was not necessary to address the problem because beekeepers and apple growers came to their own solution. Contracts are written between these two groups that specify payments between the parties.

3. The marginal cost of reducing the last amounts of air and water pollution – the amounts that would remain when nearly all forms of pollution were eliminated – would be very high. It might be necessary, for example, to ban all automobiles. The marginal benefit from reducing the last amounts of pollution would be low.
4. Public radio and television do not rely heavily on funding from commercial sponsors to cover their costs of production. Fund-raising programs are designed to solicit membership contributions to cover programming costs, but such contributions are voluntary. Free riding is common since people can enjoy programming without making contributions.

5. For most externalities problems, the number of individuals affected would require complex and costly private solutions. Often these parties do not have complete information regarding the costs and benefits associated with the externalities. Under these circumstances private solutions are not feasible.

True/False Answers

1. F The level of air pollution is lower today than in 1970.
2. F Coase Theorem states that private individuals may arrive at their own solutions to externalities.
3. F A common resource is rival but not excludable.
4. T This is the definition of quasi-public goods.
5. T As with many goods, the government provides the good due to free riders.
6. F In 1990, Congress enacted the tradable emissions allowances program.
7. T This is the definition of social benefit.
9. T Reduce emissions up to the point where the marginal benefit from reduction is equal to the marginal cost of pollution reduction.
11. T These government payments are Pigovian subsidies to help students internalize the positive externality associated with consuming education.
12. T See page 150 of the textbook.
13. F The actual cost of the program is much lower than original estimates.
14. F The United States refused to sign the Kyoto Treaty, which required countries to reduce emissions by some fixed percentage. This would indicate that the U.S. government is not in favor of these blanket reductions.
15. T See page 157 of the textbook.