**Air Pollution**

 **Balancing Benefits and Costs**

**True/False Questions**

1. Urban air quality is measured in terms of atmospheric concentrations of six common air pollutants.

 ANSWER: T

2. Global warming is caused by the accumulation of greenhouse gases.

 ANSWER: T

3. Reduction in stratospheric ozone could cause global warming to occur at a faster pace.

 ANSWER: F

4. Measurements taken to date show no significant decrease in the ozone layer.

 ANSWER: F

5. When external costs exist the market outcome will generally be inefficient.

 ANSWER: T

6. When a marginal external cost exists, the market produces an amount that is greater than the efficient amount.

 ANSWER: T

7. For a competitive industry, the marginal cost curve is also its demand curve.

 ANSWER: F

8. If the market is producing where marginal social cost exceeds marginal social benefit, there will be a net loss to society.

 ANSWER: T

9. The efficient level of pollution will generally be greater than zero.

 ANSWER: T

10. The Coase theorem argues that government must correct market failures through the use of extensive regulations.

 ANSWER: F

11. If a resource is a common property resource, clear property rights exist.

 ANSWER: F

12. The Clean Air Act places restrictions on technologies that can be used to achieve air standards.

 ANSWER: T

13. NAAQSs set lower limits for permissible concentrations of six common air pollutants.

 ANSWER: F

14. An offset is a regulation that allows a unit to contain several sources of pollution and be evaluated according to the total emissions it produces rather than by emissions produced by each source.

 ANSWER: F

15. Under the netting program, a firm can add a new source of emissions if it can reduce emissions from other sources.

 ANSWER: T

16. On a nationwide basis, many areas of the country still do not meet the NAAQS.

 ANSWER: T

17. The provisions of the Clean Air Act Amendments of 1990 that are designed to achieve ground-level ozone standards probably imposes a net loss on society.

 ANSWER: T

18. Improved air quality results in improved health and visibility, reduced soiling and cleaning costs, and reduced damage to vegetation, materials, and structures.

 ANSWER: T

19. While economists acknowledge that the use of an emissions tax can bring about the efficient level of pollution, they generally agree that regulation is a less costly method of achieving this goal.

 ANSWER: F

20. Emissions taxes help to achieve the efficient level of production by forcing firms to bear the cost of pollution.

 ANSWER: T

21. Instead of controlling pollutants through the use of regulation, government could use taxes or create marketable pollution permits.

 ANSWER: T

22. Under a system of marketable pollution permits, each firm would be issued a fixed number of permits. These could not be traded among firms.

 ANSWER: F

**Multiple-Choice Questions**

1. Which of the following is the most important problem related to air pollution?

 a. ozone depletion.

 b. the manner in which nuclear wastes are being disposed of.

 c. poor quality of air in non-urban areas.

 d. non-hazardous air pollutants.

 ANSWER: a

2. Electrical generating plants contribute to a sulfuric acid solution known as:

 a. nitrogen oxide.

 b. sulfur dioxide.

 c. acid rain.

 d. a volatile organic compound.

 ANSWER: c

3. The warming of the Earth's surface caused by burning fossil fuels and clearing land is known as:

 a. ozone depletion.

 b. global warming.

 c. a greenhouse gas.

 d. a volatile organic chain reaction.

 ANSWER: b

4. The main culprit in global warming is:

 a. ozone.

 b. sulfuric acid.

 c. sulfur dioxide.

 d. carbon dioxide.

 ANSWER: d

5. The Environmental Protection Agency (EPA) targeted 189 chemicals for regulation in the Clean Air Act of 1990. The primary impetus for these regulations:

 a. is evidence that these chemicals impair domesticated animal health.

 b. is evidence that these chemicals have detrimental impact on agriculture.

 c. is evidence that these chemicals impair human health, especially in the form of central nervous system damage and cancer.

 d. is evidence that these chemicals deplete the ozone.

 ANSWER: c

6. In a market economy the amount of pollution is:

 a. likely to be greater than the efficient amount because polluters do not bear the full costs of pollution.

 b. likely to be the efficient amount because in general the price system causes production to be carried out to the point where quantity demanded and quantity supplied are equal.

 c. likely to be less than the efficient amount because the government regulations designed to reduce pollution increase firms' production costs causing them to decrease output.

 d. is likely to be the efficient amount due to the regulatory powers of agencies like the Environmental Protection Agency.

 ANSWER: a

7. The costs of pollution are known as:

 a. marginal social cost.

 b. marginal cost.

 c. marginal external cost.

 d. marginal common property cost.

 ANSWER: c

8. The efficient level of pollution:

 a. is usually zero.

 b. will usually be some amount greater than zero.

 c. occurs when marginal cost and marginal benefit are equal.

 d. occurs when marginal social cost is less than marginal social benefit.

 ANSWER: b

9. As a result of pollution:

 a. marginal social cost exceeds marginal cost.

 b. marginal cost exceeds marginal social cost.

 c. marginal external cost exceeds marginal social cost.

 d. marginal social cost exceeds marginal external cost.

 ANSWER: a

10. A marginal external cost is:

 a. the cost associated with producing an additional unit of a product.

 b. the cost of producing an additional unit of a product that accrues to a third party who is not involved in producing or consuming the product.

 c. the cost imposed on society by the production of an additional unit of a product.

 d. the cost imposed on consumers by the production of an additional unit of a product.

 ANSWER: b

11. According to Ronald Coase:

 a. pollution can be controlled by using the appropriate government regulations.

 b. efficient levels of production could occur regardless of who receives property rights.

 c. efficient levels of production will occur only if property rights are assigned to non-polluters.

 d. regulations could be made more efficient by eliminating technology restrictions.

 ANSWER: b

12. A common property resource is:

 a. a resource that belongs exclusively to one individual.

 b. a resource that has clearly identifiable property rights.

 c. a resource that one individual allows another to use.

 d. a resource that belongs to all.

 ANSWER: d

13. The Environmental Protection Agency has authority to:

 a. set emission limits.

 b. specify the type of technology that can be used to achieve emissions standards.

 c. regulate toxic pollutants.

 d. All of the above.

 ANSWER: d

14. Offset requirements refer to the requirements that:

 a. gasoline stations in non-attainment carbon monoxide zones must offset pollutants by using oxygenated gasoline.

 b. areas that have not attained ozone and carbon monoxide standards can permit new pollution sources only by reducing pollutants from existing sources.

 c. areas that have not attained ozone and carbon monoxide standards must offset pollutants by using state-of-the-art technologies for new emissions sources.

 d. the Environmental Protection Agency set national ambient air quality standards (NAAQSs) in order to offset pollutants.

 ANSWER: b

15. Which of the following would most likely lead to excessively high costs of pollution regulation?

 a. excise taxes.

 b. the use of regulations.

 c. the use of marketable pollution permits.

 d. the use of emissions taxes.

 ANSWER: b

16. The Clean Air Act has had an impact on:

 a. visibility.

 b. health.

 c. damage to structures.

 d. All of the above.

 ANSWER: d

17. Environmental Protection Agency (EPA) believes that the Clean Air Act:

 a. imposes costs on society that are greater than the benefits receive.

 b. gives society benefits that are greater than the costs imposed.

 c. imposes equal costs and benefits on society.

 d. has not provided any benefit to society.

 ANSWER: b

18. Environmental regulation has likely caused:

 a. the level of GDP to be greater than it would in the absence of such regulation.

 b. the level of GDP to be less than it would in the absence of such regulation.

 c. the level of GDP to be unaffected by such regulation.

 d. air quality to fall relative to what would exist in the absence of such regulation.

 ANSWER: b

19. Higher energy prices:

 a. could trigger rising GDP and falling unemployment.

 b. could trigger falling GDP and rising unemployment.

 c. could leave the GDP unaffected.

 d. could trigger higher consumption of energy.

 ANSWER: b

20. Which of the following have economists suggested as alternatives to regulating pollution?

 a. the assignment of property rights.

 b. an emissions tax.

 c. the creation of a market for pollution permits.

 d. All of the above.

 ANSWER: d

21. A common property resource is a resource that:

 a. is owned by the government in a command economy.

 b. is owned by taxpayers in a market economy, but administered by government.

 c. is the property of all individuals.

 d. crosses the boundary of two or more landowners.

 ANSWER: c

22. An emissions tax can bring about an efficient solution to the pollution problem because it:

 a. forces firms to bear the full cost of the tax.

 b. forces both firms and households to bear the full cost of their decisions.

 c. eliminates the external cost associated with pollution.

 d. allows government agencies to use benefit-cost analysis to determine the efficient level of pollution.

 ANSWER: b

23. The costs of environmental regulation could be reduced without reducing environmental quality by:

 a. increasing the use of marketable emissions permits.

 b. relying less on pollution taxes.

 c. enacting stricter environmental regulations.

 d. using technology forcing.

 ANSWER: a

24. Which of the following is not an external cost attributed to the automobile?

 a. air pollution

 b. congestion

 c. noise

 d. purchase price of gasoline

 ANSWER: d

25. Which of the following is not a way economists have suggested for imposing the external costs of driving on consumers?

 a. higher gasoline taxes

 b. uniform mileage limitations

 c. congestion pricing

 d. parking cash-outs

 ANSWER: b

26. The Kyoto Protocol is an agreement designed to reduce international emissions of:

 a. carbon dioxide, a greenhouse gas.

 b. sulfate, the source of acid rain.

 c. chlorofluorocarbons, which damage ozone in the earth’s stratosphere.

 d. all hazardous air pollutants.

 ANSWER: a

27. Which statement is true?

a. The Kyoto Protocol will force less-developed countries to reduce emissions.

b. The Kyoto Protocol will not be financially difficult for developed countries like the United States.

c. An international agreement on emission permit trading would have no noticeable impact on the cost associated with the Kyoto Protocol.

 d. Some estimates show that GDP in 2010 in the United States could be as much as 5% lower as a result of the changes required to achieve the Kyoto target.

 ANSWER: d

**Critical Thinking Multiple Choice**

28. First Rate Corporation emits airborne pollutants in connection with the production of its product. If there is no government regulation, it is likely that the amount of pollutants emitted by the corporation will be:

 a. the efficient amount.

 b. less than the efficient amount.

 c. greater than the efficient amount.

 d. this judgment cannot be made without further information.

 ANSWER: c

29. Which of the following is an example of a marginal external cost?

 a. A patron of McDonald's is burned when coffee is spilled on their lap.

 b. A firm's production costs increase because government regulations force it to provide more employee health benefits.

 c. The people who fish in a river find their catch decreasing because pollution from a factory is killing the fish.

 d. The price a corporation must pay for pollution control devices such as scrubbers.

 ANSWER: c

30. Suppose that in the process of production, Energy Incorporated emits large amounts of sulfur dioxide into the atmosphere. This is an example of:

 a. a marginal social cost.

 b. a marginal cost.

 c. a marginal external cost.

 d. a private external cost.

 ANSWER: c

Use the following diagram to answer questions 31 – 34.

0

5

10

15

20

25

500

1000

1500

2000

2500

3000

Miles

MB, D

MC

MSC

Dollars

31. In the absence of any government regulation individuals will travel:

 a. 1,000 miles.

 b. 1,500 miles.

 c. 2,000 miles.

 d. between 1,500 and 2,000 miles.

 ANSWER: c

32. The efficient number of miles for individuals to travel is:

 a. 1,000 miles.

 b. 1,500 miles.

 c. 2,000 miles.

 d. anything over 500 miles.

 ANSWER: b

33. Suppose individuals are currently traveling 2,000 miles. The marginal external cost is:

 a. $20

 b. $15

 c. $10

 d. $5

 ANSWER: d

34. Suppose individuals are currently traveling at the efficient level of 1,500 miles. The level of pollution would be:

 a. greater than zero.

 b. zero.

 c. less than zero.

 d. inefficient.

 ANSWER: a

35. Pig Pen Industries is currently producing 5000 tons of paper per day. At this level of production, marginal social costs are $10 per ton while marginal social benefits are $12 per ton. We know that Pig Pen:

 a. is producing efficiently.

 b. is producing an amount less than the efficient amount.

 c. is producing an amount greater than the efficient amount.

 d. could increase net benefits for society by increasing production.

 ANSWER: c

36. ZAPCO Refinery is currently producing 100,000 barrels of refined oil per day. The marginal cost of this production is $40 per barrel and the marginal external cost is $30 per barrel. Suppose the marginal social benefit is $65 per barrel. In this case, ZAPCO is:

 a. imposing too much harm on the environment and should cut back production.

 b. is producing an efficient amount.

 c. is producing an amount less than the efficient amount.

 d. could make society better off by increasing production.

 ANSWER: a

37. Suppose that at current production levels, A Major Corporation's marginal cost is $15, its marginal external cost is $5, and the marginal social benefit of production is $25. In this case, the corporation:

 a. is imposing too much harm on the environment and should cut back production.

 b. is producing the efficient amount.

 c. is producing an amount less than the efficient amount.

 d. could make society better off by decreasing production.

 ANSWER: c

38. Suppose that at current production levels, Big Dog Inc. estimates its marginal cost to be $25, its marginal external cost to be $10, and its marginal social benefit to be $35. In this case, the corporation:

 a. is imposing too much harm on the environment and should cut back production.

 b. is producing the efficient amount.

 c. is producing an amount less than the efficient amount.

 d. could make society better off by decreasing production.

 ANSWER: b

39. At Big Dog Inc., the marginal cost of production is $32, the marginal external cost of production is $5, and the marginal benefit of production is $35. The marginal social cost of production is:

 a. $2.

 b. $27.

 c. $37.

 d. $40.

 ANSWER: c

40. Suppose that at current production levels, Bad Boy & Sons finds its marginal cost to be $12, its marginal external cost to be $2, and its marginal social benefit to be $15. In this case the company:

 a. should be encouraged to expand production.

 b. should be encouraged to decrease production.

 c. should not change production levels.

 d. is producing more than the efficient level of output.

 ANSWER: a

41. Suppose that at current consumption levels, the marginal social cost of using the Los Angeles freeway system is $25 while the marginal social benefit is $15. In this instance, government officials should:

 a. take actions to decrease use of the freeway system.

 b. take actions to increase use of the freeway system.

 c. take no actions to change use of the freeway system.

 d. build more freeways.

 ANSWER: a

42. Suppose that at current consumption levels, the marginal social cost of using the Kansas City freeway system is $15 while the marginal social benefit is $18. In this instance, government officials should:

 a. take actions to decrease use of the freeway system.

 b. take actions to increase use of the freeway system.

 c. take no actions to change use of the freeway system.

 d. build more freeways.

 ANSWER: b

43. Which of the following statements is true about the *marketable pollution permits.*

 a. All parties engaged in trading of marketable pollution permits become as well off or better off from trade, except the government.

 b. All parties engaged in trading of marketable pollution permits become as well off or better off from trade, including the government.

 c. Sellers engaged in trading of marketable pollution permits become worse off from trade.

 d. Buyers engaged in trading of marketable pollution permits become worse off from trade.

 ANSWER: a

44. The I Don't Care Corporation dumps pollution into the river that Mike uses for his fishing operation. The efficient level of pollution could prevail if government:

 a. assigns the property right to I Don't Care.

 b. assigns the property right to Mike.

 c. assigns the river property rights to itself in the interest of all taxpayers.

 d. Either a and b.

 ANSWER: d

Use the following diagram to answer questions 45 – 46.



45. In the absence of governmental policies the level of output will be:

 a. Q1.

 b. Q2.

 c. Q3.

 d. between Q2 and Q3.

 ANSWER: c

46. The efficient output occurs at:

 a. Q1.

 b. Q2.

 c. Q3.

 d. between Q1 and Q2.

 ANSWER: b

47. An emissions tax can bring about an efficient solution to the pollution problem because it:

 a. shifts the supply curve to the left.

 b. shifts the supply curve to the right.

 c. shifts the demand curve to the left.

 d. shifts the demand curve to the right.

 ANSWER: a

Use the following diagram to answer questions 48 – 52.

 

48. In the absence of governmental policies the level of output will be:

 a. 2,000 gallons.

 b. 1,000 gallons.

 c. 2,500 gallons.

 d. between 1,500 and 2,000 gallons.

 ANSWER: a

49. The efficient output occurs at:

 a. 2,500 gallons.

 b. 5,000 gallons.

 c. 1,000 gallons.

 d. 1,750 gallons.

 ANSWER: d

50. The external cost associated with the production of each gallon of output is:

 a. $5.

 b. $15.

 c. $2.

 d. $3.

 ANSWER: a

51. The quantity produced if oil refiners (producers) were given property rights to the environment that would be:

 a. 2,000 gallons.

 b. 1,500 gallons.

 c. 0 gallons.

 d. 1,750 gallons.

 ANSWER: a

52. Suppose that the production level was at 2,000 gallons where MC=MB. What would be the maximum amount that consumers would pay producers to reduce production (and pollution)?

 a. $2 per gallon.

 b. $12.50 per gallon.

 c. $1.50 per gallon.

 d. $5 per gallon.

 ANSWER: d

Use the following table to answer question 53.

# Marginal Cost of Control

## Tons per Day Plant A Plant B

 1 $200 $400

 2 400 800

 3 600 1,600

 4 800 3,200

53. Suppose Plant A and Plant B are currently emitting 4 tons of pollution each. Government requires each plant to reduce emissions by two tons and issues two one-ton marketable pollution permits to each plant. Will any permits be traded?

 a. Yes, Plant A would be willing to buy one permit from Plant B.

 b. Yes, Plant B would be willing to buy one permit from Plant A.

 c. Yes, Plant B would be willing to buy two permits from Plant A.

 d. Both firms' costs of control are so high that no trading will occur.

 ANSWER: b

**Essay and Discussion Questions**

1. **Suppose two firms have different marginal costs of emission control. Would a governmental policy that allotted marketable pollution permits be more cost effective than a governmental policy that required all firms to reduce emissions by the same amount?**

If firms do not have identical costs associated with controlling pollution, a system of marketable permits will result in a relatively lower cost of pollution control than will a policy requiring all firms to reduce pollution by the same amount. In this case firms having high costs of pollution control can purchase permits from firms having lower pollution control costs and pollution will be controlled by firms with the lowest cost.

2. **Recent reports of the adverse effects of second-hand smoke have led some cities to place a ban on smoking in public facilities. Discuss the efficiency of such a policy.**

The student should recognize that such a policy would probably result in inefficiency. Just as the efficient level of pollution occurs at some positive level, it is entirely likely that the efficient level of smoking that occurs in public places will be some positive amount.

3. **Evaluate the following statement. "Instead of controlling pollutants through regulation, the government should simply assign property rights."**

The student should recognize that in cases where a limited number of parties is affected, the assignment of property rights could limit pollutants at a lower cost than regulations. However, in most instances, the number of parties affected by pollution are quite large. In this case, the costs of bargaining are prohibitive. Thus, reliance on regulation or some other form of control is necessary.

4. **"Because of market failure, it is necessary to have government regulations in order to deal with the problem of pollution."**

Inefficient levels of pollution occur because of market failure, and generally some type of government action will be needed to correct the problem. However, government action does not necessarily imply the imposition of regulations upon the economy. There are several means (possibly more efficient than regulations) that government could use to deal with pollution. These options include such policies as the assignment of property rights, the imposition of excise taxes, and marketable pollution permits.

5. **Evaluate the following statement. "The market will tend to overproduce when external costs are associated with production."**

This statement is true. Firms base production decisions on marginal costs. Marginal external costs are ignored. If the firm were forced to take these costs into consideration, they would decrease their level of production. Thus, when external costs exist, the market tends to overproduce.

6. **Evaluate the following statement. "Government interferes too much in the market. Since the market tends to operate efficiently, we should eliminate pollution regulations and allow the market to operate on its own."**

Because of standardized regulations, the cost of controlling pollution is probably too high. However, the student should recognize that relying on the market is not the answer. In the case of a marginal external cost, the market will tend to produce an inefficient quantity. Thus, some form of regulation, taxes, or permits are needed to help bring pollution to the efficient amount.

**Problems**

1. **You are asked to estimate any external costs associated with production at Write On Paper. You estimate that at current production levels, marginal social benefit at Write On is $30, marginal social cost is $27 and marginal cost is $25.**

Marginal social cost (MSC) is equal to marginal cost (MC) plus marginal external cost (MEC). Rearranging, we find that:

MEC = MSC - MC.

This means that marginal external cost is $2 ($27 - $25).

2. **Suppose that at current production levels Strong Steel Corporation's marginal cost is $40 and marginal external cost is $6. What is marginal social cost?**

Marginal social cost (MSC) is equal to marginal cost (MC) plus marginal external cost (MEC). Using the equation:

MSC = MC + MEC

we find marginal social cost of $46 ($40 + $6).

3. **Suppose that at current production levels The Maximum Corporation generates $1,000,000 in total social benefits, $700,000 in total private production costs, and $350,000 in total external costs. What is the size of the net benefit or loss imposed on society by the Corporation? Based on your answer, should output at the corporation be increased or decreased?**

The net benefit (or net loss) is equal to total social benefits minus total social costs. Total social benefits are $1,000,000. Total social costs are total private costs, $700,000, plus total external costs, $350,000. Thus, total social costs are $1,050,000. In this instance there is a net loss of $50,000 ($1,000,000 - $1,050,000) imposed on society.

Since there is a net loss, decreasing output would increase efficiency in resource allocation.

4. **Suppose the Zapit Corporation is currently producing 300,000 units of output. Marginal social cost of production is $45, marginal cost is $35, and marginal social benefit is $35. At the efficient level of output, 200,000 units, marginal social cost is $25, marginal cost is $22, and marginal social benefit is $25. If you are a government official wanting to impose a tax on the corporation, what per unit tax would you propose?**

The tax imposed on the corporation should be equal to the difference between marginal social cost and marginal cost at the efficient level of output. This will shift Zapit's marginal cost curve in such a manner that it will intersect the marginal social benefit curve at the efficient level of production. The difference between marginal social benefit and marginal social cost when 200,000 units are produced is $3 ($25 - $22). Thus, a $3 per unit tax should be imposed on Zapit's production.