The quantities of goods and services that can be produced are limited by the available amount of resources and by technology. The production possibilities frontier (PPF) is the boundary between those combinations of goods and services that can be produced and those that cannot.

A PPF is illustrated in Figure 2.1. All production possibilities frontiers have two characteristics in common:

♦ Production points inside and on the PPF are attainable. Points beyond the PPF are not attainable.
♦ Production points on the PPF achieve production efficiency because more of one good can be obtained only by producing less of the other good. Production points inside the PPF are inefficient, with misallocated or unused resources.

Moving between points on the PPF involves a tradeoff because something must be given up to get more of something else. The opportunity cost of an action is the highest-valued alternative foregone. In Figure 2.1, the opportunity cost of obtaining 20 million more tapes by moving from point a to point b is the 10 million bottles of soda that are foregone. Opportunity cost is a ratio. It equals the decrease in the production of one good divided by the increase in the production of the other.

When resources are not equally productive in producing different goods and services, the PPF has increasing opportunity costs and bows outward, as illustrated in Figure 2.1. As more and more tapes are produced, the opportunity cost of a tape increases.

Preferences are a description of a person’s likes and dislikes. Preferences can be described using the concept of marginal benefit. The marginal benefit from a good is the maximum amount someone is willing to pay for another unit of it. The marginal benefit of a good is measured as the maximum amount someone is willing to pay for another unit of it. The marginal benefit from additional units of a good decreases as more is consumed. So the marginal benefit curve, which shows the relationship between the marginal benefit of a good and
the quantity consumed, slopes downward as illustrated in Figure 2.2.

Allocative efficiency is reached when it is impossible to produce more of one good without giving up some other good that is valued more highly. Allocative efficiency occurs when the marginal benefit from another unit of a good equals its marginal cost. In Figure 2.2, producing 30 million tapes is the efficient allocation of resources between tapes and soda.

Economic Growth

Economic growth occurs when production expands. Technological change, the development of new goods and better ways of producing goods and services, and capital accumulation, the growth in capital resources, are two key factors that affect economic growth.

- Economic growth shifts the PPF outward. The faster it shifts, the more rapid is economic growth.
- The opportunity cost of economic growth is today’s consumption.
- Nations that devote more resources to capital accumulation grow more rapidly.

Gains from Trade

- A person has a comparative advantage in producing a good if he or she can produce it at a lower opportunity cost than anyone else.

- Comparative advantage differs from absolute advantage. Absolute advantage occurs when a person can produce more goods in a given amount of time that another person.

Specialization according to comparative advantage and trading for other goods creates gains from trade because such specialization and exchange allows consumption (not production) at points outside the PPF.

- Learning-by-doing occurs when people become more productive in producing a good by repeatedly producing the good.

- Dynamic comparative advantage occurs when comparative advantage is the result of specializing in a good and becoming the lowest opportunity cost provider because of learning-by-doing.

The Market Economy

Property rights and markets have evolved to help reap the gains from specialization and trade.

- Property rights are social arrangements that set the terms of the ownership, use, and disposal of resources, goods, and services.

- A market is any arrangement that allows buyers and sellers to do business with each other. Markets pool information into a price, which signals buyers and sellers about the actions they should take.

Goods markets are where goods and services are bought and sold; factor markets are where factors of production are bought and sold. Markets coordinate decisions in the circular flow through price adjustments.

Helpful Hints

1. ASSUMPTIONS OF THE PPF: The PPF provides an example of the role played by simplifying assumptions in economic analysis. Clearly, no society in the world produces only two items but by assuming that there are such "two-good" nations, we can gain invaluable insights into the real world. For instance, we see that once a nation is producing on its production possibilities frontier, no matter how many goods it produces, to increase the production of one good necessarily has an opportunity cost in terms of some other good or goods that must be foregone. In addition, we also see that countries that devote a larger proportion of their resources to capital accumulation will have more rapid growth.
2. **Inefficient Production Points**: Points within the PPF curve are attainable but are inefficient. These production points occur whenever some inefficiency or misallocation emerges within the economy, such as excessive unemployment of any resource or an inefficient use of resources. Points beyond the PPF are unattainable. They are not classified as either efficient or inefficient because they are not production combinations that the society can reach.

**FIGURE 2.3**

A PPF Between Corn and Cloth

3. **Calculating Opportunity Cost**: A helpful formula for opportunity cost results from the fact that opportunity cost is a ratio. Opportunity cost equals the quantity of goods you must give up divided by the quantity of goods you will get. For instance, consider the nation whose PPF is in Figure 2.3. If we move along the PPF from point \( a \) to \( b \), what is the opportunity cost of an additional yard of cloth? The nation must give up 2 pounds of corn \((25 - 23)\) to get 1 yard of cloth \((1 - 0)\). So the opportunity cost of the first yard of cloth is 2 pounds of corn divided by 1 yard of cloth or 2 pounds of corn per yard of cloth. Next, if we move from \( b \) to \( c \), the opportunity cost of the second yard of cloth is calculated the same way and is 3 pounds of corn per yard of cloth.

**Questions**

- **True/False and Explain**
  **Production Possibilities and Opportunity Cost**

  **FIGURE 2.4**
  **True/False Questions 1 and 2**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In Figure 2.4 point ( a ) is NOT attainable.</td>
<td></td>
</tr>
<tr>
<td>2. In Figure 2.4 the opportunity cost of moving from point ( b ) to point ( c ) is 10 computers.</td>
<td></td>
</tr>
<tr>
<td>3. From a point on the PPF, rearranging production and producing more of all goods is possible.</td>
<td></td>
</tr>
<tr>
<td>4. From a point within the PPF, rearranging production and producing more of all goods is possible.</td>
<td></td>
</tr>
<tr>
<td>5. Production efficiency requires producing at a point on the PPF.</td>
<td></td>
</tr>
<tr>
<td>6. Along a bowed-out PPF, as more of a good is produced, the opportunity cost of producing the good diminishes.</td>
<td></td>
</tr>
</tbody>
</table>

**Using Resources Efficiently**

- 7. The marginal cost of the 20th ton of cement equals the cost of producing all 20 tons of cement.
- 8. As people have more of a product, the product’s marginal benefit decreases.
- 9. Efficiency is achieved by producing the amount of a good such that the marginal benefit of the last unit...
produced exceeds its marginal cost by as much as possible.

**Economic Growth**

10. Economic growth is illustrated by outward shifts in the PPF.

11. Increasing a nation’s economic growth rate has an opportunity cost.

**Gains from Trade**

12. Daphne definitely has a comparative advantage in producing sweaters if she can produce more than Lisa.

13. If two individuals have different opportunity costs of producing goods, both can gain from specialization and trade.

14. If the United States has an absolute advantage in growing corn and making computers, it must have a comparative advantage in growing corn.

15. Learning-by-doing can lead to dynamic comparative advantage.

**The Market Economy**

16. Buyers and sellers must meet face-to-face in a market.

17. Price adjustments coordinate decisions in goods markets, but not in factor markets.

---

**Multiple Choice**

**Production Possibilities and Opportunity Cost**

1. Production points on the PPF itself are
   a. efficient but not attainable.
   b. efficient and attainable
   c. inefficient but not attainable.
   d. inefficient and attainable.

2. If the United States can increase its production of automobiles without decreasing its production of any other good, the United States must have been producing at a point
   a. within its PPF.
   b. on its PPF.
   c. beyond its PPF.
   d. None of the above are correct because increasing the production of one good without decreasing the production of another good is impossible.

---

3. In Figure 2.5, at point a what is the opportunity cost of producing one more video tape?
   a. 14 audio tapes
   b. 3 audio tapes
   c. 2 audio tapes
   d. There is no opportunity cost.

4. In Figure 2.5, at point b what is the opportunity cost of producing one more video tape?
   a. 12 audio tapes
   b. 3 audio tapes
   c. 2 audio tapes
   d. There is no opportunity cost.

5. Production efficiency means that
   a. scarcity is no longer a problem.
   b. producing more of one good without producing less of some other good is not possible.
   c. as few resources as possible are being used in production.
   d. producing another unit of the good has no opportunity cost.

6. The existence of the tradeoff along the PPF means that the PPF is
   a. bowed outward.
   b. linear.
   c. negatively sloped.
   d. positively sloped.
7. The bowed-outward shape of a PPF
   a. is due to capital accumulation.
   b. reflects the unequal application of technology in production.
   c. illustrates the fact that no opportunity cost is incurred for increasing the production of the good measured on the horizontal axis but it is incurred to increase production of the good measured along the vertical axis.
   d. is due to the existence of increasing opportunity cost.

A nation produces only two goods — yak butter and rutabagas. Three alternative combinations of production that are on its PPF are given in Table 2.1. Use this information to answer the next three questions.

<table>
<thead>
<tr>
<th>Possibility</th>
<th>Pounds of yak butter</th>
<th>Number of rutabagas</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>600</td>
<td>0</td>
</tr>
<tr>
<td>b</td>
<td>400</td>
<td>100</td>
</tr>
<tr>
<td>c</td>
<td>0</td>
<td>200</td>
</tr>
</tbody>
</table>

8. In moving from combination a to b, the opportunity cost of producing more rutabagas is
   a. 6 pounds of yak butter per rutabaga.
   b. 4 pounds of yak butter per rutabaga.
   c. 2 pounds of yak butter per rutabaga.
   d. 0 pounds of yak butter per rutabaga.

9. In moving from combination b to a, the opportunity cost of producing more pounds of yak butter is
   a. 0.10 rutabaga per pound of yak butter.
   b. 0.50 rutabaga per pound of yak butter.
   c. 1.00 rutabaga per pound of yak butter.
   d. 2.00 rutabagas per pound of yak butter.

10. Producing 400 pounds of yak butter and 50 rutabagas is
    a. not possible for this nation.
    b. possible and is an efficient production point.
    c. possible, but is an inefficient production point.
    d. an abhorrent thought.

Using Resources Efficiently
11. Moving along a bowed-out PPF between milk and cotton, as more milk is produced the marginal cost of an additional gallon of milk
    a. rises.
    b. does not change.
    c. falls.
    d. probably changes, but in an ambiguous direction.

12. The most anyone is willing to pay for another purse is $30. Currently the price of a purse is $40, and the cost of producing another purse is $50. The marginal benefit of a purse is
    a. $50.
    b. $40.
    c. $30.
    d. An amount not given in the answers above.

13. If the marginal benefit from another computer exceeds the marginal cost of the computer, then to use resources efficiently,
    a. more resources should be used to produce computers.
    b. fewer resources should be used to produce computers.
    c. if the marginal benefit exceeds the marginal cost by as much as possible, the efficient amount of resources are being used to produce computers.
    d. none of the above is correct because marginal benefit and marginal cost have nothing to do with using resources efficiently.

Economic Growth
14. Economic growth
    a. creates unemployment.
    b. has no opportunity cost.
    c. shifts the PPF outward.
    d. makes it more difficult for a nation to produce on its PPF.

15. The PPF shifts if
    a. the unemployment rate falls.
    b. people decide they want more of one good and less of another.
    c. the prices of the goods and services produced rise.
    d. the resources available to the nation change.
16. An increase in the nation’s capital stock will
   a. shift the PPF outward.
   b. cause a movement along the PPF upward and leftward.
   c. cause a movement along the PPF downward and rightward.
   d. move the nation from producing within the PPF to producing at a point closer to the PPF.

17. One of the opportunity costs of economic growth is
   a. capital accumulation.
   b. technological change.
   c. reduced current consumption.
   d. the gain in future consumption.

18. In general, the more resources that are devoted to technological research, the
   a. greater is current consumption.
   b. higher is the unemployment rate.
   c. faster the PPF shifts outward.
   d. more the PPF will bow outward.

Gains from Trade

19. In order to achieve the maximum gains from trade, people should specialize according to
   a. property rights.
   b. PPF.
   c. absolute advantage.
   d. comparative advantage.

In one day Brandon can either plow 40 acres of land or plant 20 acres. In one day Christopher can either plow 28 acres of land or plant 7 acres. Use this information to answer the next four questions.

20. Which of the following statements about absolute advantage is correct?
   a. Brandon has an absolute advantage in both plowing and planting.
   b. Brandon has an absolute advantage only in plowing.
   c. Brandon has an absolute advantage only in planting.
   d. Christopher has an absolute advantage both in plowing and planting.

21. Brandon has
   a. a comparative advantage both in plowing and planting.
   b. a comparative advantage only in plowing.
   c. a comparative advantage only in planting.
   d. a comparative advantage in neither in plowing and planting.

22. Christopher has
   a. an absolute advantage only in planting.
   b. an absolute advantage only in plowing.
   c. a comparative advantage only in planting.
   d. a comparative advantage only in plowing.

23. Brandon and Christopher can
   a. both gain from exchange if Brandon specializes in planting and Christopher in plowing.
   b. both gain from exchange if Brandon specializes in plowing and Christopher in planting.
   c. exchange, but only Brandon will gain from the exchange.
   d. exchange, but only Christopher will gain from the exchange.

24. A nation can produce at a point outside its PPF
   a. when it trades with other nations.
   b. when it is producing products as efficiently as possible.
   c. when there is no unemployment.
   d. at no time ever.

25. A nation can consume at a point outside its PPF
   a. when it trades with other nations.
   b. when it is producing products as efficiently as possible.
   c. when there is no unemployment.
   d. at no time ever.

The Market Economy

26. Which of the following does NOT help organize trade?
   a. Property rights
   b. Markets
   c. The production possibilities frontier
   d. None of the above because all these answers given help organize trade.
27. In markets, people’s decisions are coordinated by
a. specialization according to absolute advantage.
b. changes in property rights.
c. learning-by-doing.
d. adjustments in prices.

Short Answer Problems
1. What does the negative slope of the PPF mean? Why is a PPF bowed out?
2. In Figure 2.6 indicate which points are production efficient and which are inefficient. Also show which points are attainable and which are not attainable.

FIGURE 2.6
Short Answer Problem 2

3. Sydna is stranded on a desert island and can either fish or harvest dates. Six points on her production possibilities frontier are given in Table 2.2.
   a. In Figure 2.7 plot these possibilities, label the points, and draw the PPF.
   b. If Sydna moves from possibility c to possibility d, what is the opportunity cost per fish?
   c. If Sydna moves from possibility d to possibility e, what is the opportunity cost per fish?
   d. In general, what happens to the opportunity cost of a fish as more fish are caught?
   e. In general, what happens to the opportunity cost of dates as more dates are harvested?
   f. Based on the original PPF you plotted, is a combination of 40 dates and 1 fish attainable? Is this combination an efficient one? Explain.

<table>
<thead>
<tr>
<th>Table 2.2</th>
<th>Sydna’s Production Possibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possibility</td>
<td>Dates gathered (per day)</td>
</tr>
<tr>
<td>a</td>
<td>54</td>
</tr>
<tr>
<td>b</td>
<td>50</td>
</tr>
<tr>
<td>c</td>
<td>42</td>
</tr>
<tr>
<td>d</td>
<td>32</td>
</tr>
<tr>
<td>e</td>
<td>20</td>
</tr>
<tr>
<td>f</td>
<td>0</td>
</tr>
</tbody>
</table>

FIGURE 2.7
Short Answer Problem 3

4. If the following events occurred (each is a separate event, unaccompanied by any other event), what would happen to the PPF in Problem 3?
   a. A new fishing pond is discovered.
   b. The output of dates is increased.
   c. Sydna finds a ladder that enables her to gather slightly more dates.
   d. A second person, with the same set of fishing and date-gathering skills as Sydna, is stranded on the island.
5. A nation produces only pizza and tacos. Table 2.3 shows the marginal benefit and marginal cost schedules for slices of pizza in terms of tacos per slice of pizza.
   a. Complete Table 2.3.
   b. For the first slice of pizza, after paying the marginal cost, how much marginal benefit — if any — is left?
   c. For the second slice, after paying the marginal cost, how much marginal benefit — if any — is left? How does your answer to this question compare to your answer to part (b)?
   d. Should the first slice of pizza be produced? Should the second one be produced? Explain your answers, especially your answer about the second slice.
   e. In a diagram, draw the marginal benefit and marginal cost curves. Indicate the quantity of pizza slices that uses resources efficiently.
6. Bearing in mind the point that resources are limited, explain why it is important for a nation to use its resources efficiently.
7. Suppose that both the United States and France produce computers and wine. Table 2.4 shows what each country can produce in an hour.
   a. On graph paper, draw the PPF for the United States for one hour.
   b. On graph paper, draw the PPF for France for one hour.
   c. Complete Table 2.5.
   d. In what good(s) does the United States have a comparative advantage? France?
   e. Initially the United States uses half its resources to produce wine and half to produce computers.

---

<table>
<thead>
<tr>
<th>Slice of pizza</th>
<th>Marginal benefit of slice</th>
<th>Marginal cost of slice</th>
<th>Marginal benefit minus marginal cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.0</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5.0</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4.0</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3.0</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2.0</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1.0</td>
<td>4.0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Computers produced in an hour</th>
<th>Bottles of wine produced in an hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>10,000</td>
<td>20,000</td>
</tr>
<tr>
<td>France</td>
<td>12,000</td>
<td>8,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Opportunity cost of one computer</th>
<th>Opportunity cost of one bottle of wine</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How much wine and how many computers are produced in an hour in the United States? France also devotes half her resources to computers and half to wine. How many computers and bottles of wine does France produce in an hour? What is the total amount of wine produced by France and the United States in an hour? The total number of computers?

f. Suppose that the United States specializes in wine and France in computers. What is the total amount of wine produced by France and the United States now? The total number of computers?

g. What do your answers to parts (e) and (f) show?

8. How do property rights affect people’s incentives to create new music?

---

**You’re the Teacher**

1. “The idea of the production possibilities frontier is stupid. I mean, after all, who ever heard of a nation that produces only two goods. Come on, every nation produces millions, probably billions of goods. Why do I have to bother to learn about the production possibilities frontier when it is so unrealistic?” One reason for this student to learn about the production possibilities frontier is that it will probably be on the exams. But there are other reasons, too. Explain some of them to help motivate this student.
Answers

True/False Answers

Production Possibilities and Opportunity Cost
1. F Any point on the production possibilities frontier is attainable, even points where the PPF intersects the axes.
2. T The opportunity cost equals the number of computers foregone, in this case the fall from 30 computers at point b to 20 at point c.
3. F Points on the frontier are production efficient, so increasing the production of one good necessarily requires producing fewer of some other good.

FIGURE 2.8
True/False Question 4

4. T Points within the frontier are inefficient, which means its possible to rearrange production and boost the production of all goods and services. This condition is illustrated in Figure 2.8, where from (the inefficient) point a, it is possible to move to points such as b or c where more of both books and magazines are produced.
5. T Production efficiency implies that the production of one good can be increased only if the production of another good is decreased, which is true only on the PPF itself.
6. F As more of a good is produced, the opportunity cost of additional units increases.

Using Resources Efficiently
7. F The marginal cost is the cost of the 20th ton itself, not the cost of producing all 20 tons.
8. T As people have more of a product, they are willing to pay less for additional units, which means that the marginal benefit of the product will decrease.
9. F For resources to be allocated efficiently, it is necessary for the marginal benefit of the last unit produced to equal the marginal cost of the unit.

Economic Growth
10. T As the PPF shifts outward, the nation is able to produce more of all goods.
11. T The opportunity cost is the loss of current consumption.

Gains from Trade
12. F Based on the information in the problem, Daphne has an absolute advantage, but without more information we cannot tell whether she has a comparative advantage.
13. T A key observation is that both individuals gain.
14. F Comparative advantage requires comparing the opportunity cost of producing corn in the United States with the opportunity cost of producing it elsewhere.
15. T Learning-by-doing means that the cost of producing a good falls as more is produced, so the nation (or person) ultimately acquires a comparative advantage in making the good.

The Market Economy
16. F Buyers and sellers communicate with each other in markets, but in most markets they do not meet face-to-face.
17. F Price adjustments coordinate decisions in all markets.

Multiple Choice Answers

Production Possibilities and Opportunity Cost
1. b Only points on the frontier are both attainable and efficient.
2. a Only from points within the frontier can the production of a good increase without decreasing the production of another good.
3. c By producing 1 more video tape, audio tape production falls by 2 (from 14 to 12), so the op-
opportunity cost of the video tape is the ratio of 2 audio tapes to the 1 video tape, that is, 2 audio tapes per video tape.

4. **b** As more video tapes are produced, the opportunity cost of an additional video tape gets larger.

5. **b** This answer is the definition of production efficiency.

6. **c** When production is on the PPF, the tradeoff is that if more of one good is produced, then some other good must be foregone. This result means that the PPF has a negative slope.

7. **d** Increasing opportunity cost means that, as more of a good is produced, its opportunity cost increases. As a result, the PPF bows outward.

8. **c** Moving from a to b gains 100 rutabagas and loses 200 pounds of yak butter, so the opportunity cost is (200 pounds of yak butter)/(100 rutabagas), or 2 pounds of yak butter per rutabaga.

9. **b** 100 rutabagas are foregone, so the opportunity cost is (100 rutabagas)/(200 pounds of yak butter), or 0.50 rutabagas per pound of yak butter. Note how the opportunity cost of a rutabaga is the inverse of the opportunity cost of a pound of yak butter, as calculated in the answer to the previous question.

10. **c** When 400 pounds of yak butter are produced, a maximum of 100 rutabagas can be produced; if only 50 rutabagas are produced, the combination is inefficient.

**Using Resources Efficiently**

11. **a** Along a bowed-out PPF, as more of a good is produced, its marginal cost — the opportunity cost of producing another unit — rises.

12. **c** The marginal benefit from a good is the maximum that a person is willing to pay for the good.

13. **a** The benefit from the computer exceeds the cost of producing the computer, so society will gain if resources are allocated so that the computer is produced.

**Economic Growth**

14. **c** Economic growth makes attainable previously unattainable production levels.

15. **d** An increase in resources shifts the PPF outward; a decrease shifts it leftward. (A decrease in the unemployment rate moves the nation from a point in the interior of the PPF to a point closer to the frontier.)

16. **a** Increases in a nation’s resources create economic growth and shift the nation’s PPF outward.

17. **c** If a nation devotes more resources to capital accumulation or technological development, which are the main sources of growth, fewer resources can be used to produce goods for current consumption.

18. **c** The more resources used for technological research, the more rapid is economic growth.

**Gains from Trade**

19. **d** Specializing according to comparative advantage reduces the opportunity cost of producing goods and services.

20. **a** Brandon can produce more of both goods than Christopher, so Brandon has an absolute advantage in both goods.

21. **c** Brandon’s opportunity cost of planting an acre of land is plowing 2 acres, whereas Christopher’s opportunity cost of planting an acre is plowing 4 acres.

22. **d** Christopher’s opportunity cost of plowing an acre is planting 1/4 an acre, while Brandon’s opportunity cost is planting 1/2 an acre.

23. **a** By specializing according to their comparative advantages, both can gain from exchange.

24. **d** The PPF shows the maximum amounts that can be produced.

25. **a** When a nation specializes according to its comparative advantage and trades with another specialist nation, both can consume at levels beyond their PPFs.

**The Market Economy**

26. **c** The production possibilities frontier shows the limits to production and does not help organize trade.

27. **d** Changes in prices create incentives for people to change their actions.

**Answers to Short Answer Problems**

1. The negative slope of the PPF indicates that increasing the production of one good means that the production of some other good decreases.
A PPF is bowed out because the existence of non-identical resources creates an increasing opportunity cost as the production of a good is increased. Because resources are not identical, some are better suited for producing one good than another. So when resources are switched from producing items for which they are well suited to producing goods for which they are ill suited, the opportunity cost of increasing the output of these goods rises.

**FIGURE 2.9**

Short Answer Problem 2

2. Figure 2.9 shows the efficient/inefficient points and attainable/not attainable points. The attainable but inefficient points are shaded; the attainable and efficient points lie on the PPF itself; and the unattainable points are located beyond the PPF.

3. a. Figure 2.10 shows the PPF.

b. Moving from c to d means that the number of fish caught increases by 1 while the number of dates gathered falls from 42 to 32. Catching 1 fish costs 10 dates, so the opportunity cost of the fish is 10 dates. In terms of a formula, the opportunity cost of this fish is:

\[
\frac{42 \text{ dates} - 32 \text{ dates}}{3 \text{ fish} - 2 \text{ fish}} = 10 \text{ dates per fish.}
\]

c. Moving from d to e indicates that the opportunity cost of the fish is 12 dates: The number of dates gathered falls from 32 to 20 while the number of fish caught increases by 1.

d. As more fish are caught, the opportunity cost of an additional fish rises. In particular, the first fish has an opportunity cost of only 4 dates; the second, 8 dates; the third, 10 dates; the fourth, 12 dates; and the fifth, 20 dates.

e. As more dates are gathered, the opportunity cost of a date rises. Moving from f to e shows that the first 20 dates cost only 1 fish so that the opportunity cost of a date here is \(\frac{1}{20}\) of a fish. Going from e to d, however, makes the opportunity cost of a date \(\frac{1}{12}\) of a fish. This pattern continues so that as more dates are gathered, their opportunity cost increases. Finally, moving from b to a has the largest opportunity cost for a date, \(\frac{1}{4}\) of a fish.

As parts (d) and (e) demonstrate, there is increasing opportunity cost moving along the PPF. That is, as more fish are caught, their opportunity cost — in terms of foregone dates — increases and as more dates are gathered, their opportunity cost — in terms of foregone fish — also increases. It is these increasing opportunity costs that account for the bowed-outward shape of the PPF.

f. This combination is within the PPF and is attainable. It is inefficient because Sydna could produce more of either or both goods. Therefore she is not organizing her activities as efficiently as possible.
4. a. A new fishing pond increases the number of fish Sydna can catch, but it does not affect the maximum number of dates she can gather. Her PPF shifts generally as shown in Figure 2.11.

b. Increasing her output of dates does not affect the PPF. Sydna might increase her gathering of dates either by moving from a point within the PPF to a point on (or closer to) the frontier or by moving along the frontier. Neither of these actions shifts the PPF.

c. The ladder increases the number of dates that Sydna can gather, but has no effect on the fish that she can catch. As a result, the maximum number of dates increases, but the maximum number of fish does not change. The PPF shifts in the same general pattern as shown in Figure 2.12.

d. Having a second worker on the island boosts both the number of dates that can be gathered and the number of fish that can be caught. If the second person has the same set of skills as Sydna, the PPF shifts out in a “parallel” manner, as illustrated in Figure 2.13. Be sure to note that the scales on the axes in Figure 2.13 are different from those on the axes in Figures 2.10–2.12.

<table>
<thead>
<tr>
<th>Slice of pizza</th>
<th>Marginal benefit of slice</th>
<th>Marginal cost of slice</th>
<th>Marginal benefit minus marginal cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.0</td>
<td>1.5</td>
<td>4.5</td>
</tr>
<tr>
<td>2</td>
<td>5.0</td>
<td>2.0</td>
<td>3.0</td>
</tr>
<tr>
<td>3</td>
<td>4.0</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>4</td>
<td>3.0</td>
<td>3.0</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>2.0</td>
<td>3.5</td>
<td>-1.5</td>
</tr>
<tr>
<td>6</td>
<td>1.0</td>
<td>4.0</td>
<td>-3.0</td>
</tr>
</tbody>
</table>

5. a. Table 2.6 shows the answers.

b. For the first slice of pizza, after paying the marginal cost, there is 4.5 of marginal benefit left.
c. For the second slice of pizza, after paying the marginal cost, there is 3.0 of marginal benefit left. After paying the marginal cost, there is less marginal benefit left for the second slice of pizza than for the first. There is less surplus because the marginal benefit of the second slice is less than that of the first slice and the marginal cost the second slice is more than that of the first one.

d. The first slice should be produced because the marginal benefit from the first slice exceeds its marginal cost. The second slice also should be produced for the same reason. As long as the marginal benefit from a slice of pizza exceeds its marginal cost, society benefits if the slice is produced. The “net benefit” from the first slice is more than that of the second slice, but as long as there is a positive net benefit, society benefits.

c. Figure 2.14 shows the marginal cost and marginal benefit curves. Four slices of pizza are the quantity that uses resources efficiently because the marginal benefit from the fourth slice equals its marginal cost. The marginal benefit for any greater quantity of pizza slices is less than the marginal cost of the slice, so producing these units would result in a net loss for society.

6. A nation should use its resources efficiently because it has only a limited quantity of them. If resources are used inefficiently, there is waste and fewer of people’s wants can be satisfied. By producing efficiently, society ensures that as many of the most important wants, measured by the marginal benefit from the goods that satisfy those wants, are satisfied.

7. a. Figure 2.15 shows the PPF for the United States. The maximum amount of wine that can be produced is 20,000 bottles and the maximum number of computers that can be produced is 10,000.

c. Figure 2.14 shows the marginal cost and marginal benefit curves. Four slices of pizza are the quantity that uses resources efficiently because the marginal benefit from the fourth slice equals its marginal cost. The marginal benefit for any greater quantity of pizza slices is less than the marginal cost of the slice, so producing these units would result in a net loss for society.

b. Figure 2.16 shows the French PPF.
c. Table 2.7 shows the opportunity costs for the goods. To illustrate how this table was obtained, we can use the opportunity cost of a computer in the United States as an example. To produce one computer in the United States requires that resources work for 1/10,000 of an hour at manufacturing computers. So to produce an additional computer, resources must be switched from the wine industry to the computer industry for 1/10,000 of an hour. During this time, if left in the wine industry, the resources could otherwise have produced (1/10,000) (20,000 bottles of wine) or 2 bottles of wine. Hence to produce one additional computer in the United States, 2 bottles of wine are foregone. Two bottles of wine, then, are the opportunity cost of the computer. The rest of the opportunity costs are calculated similarly.

d. The United States has a comparative advantage in wine because the opportunity cost of a bottle of wine in the United States — ½ computer — is less than the opportunity cost of a bottle of wine in France — 1½ computer. France has a comparative advantage in the production of computers, because its opportunity cost — 2/3 bottle of wine — is less than that in the United States — 2 bottles of wine.

e. In the United States, 5,000 computers and 10,000 bottles of wine are produced in an hour. In France, 6,000 computers and 4,000 bottles of wine are produced in an hour. Overall, 11,000 computers and 14,000 bottles of wine are produced in an hour.

f. With the United States specializing in wine, 20,000 bottles of wine are produced in an hour. Because France specializes in computers, 12,000 computers are produced in an hour.

g. With specialization, world computer production rises by 1,000 computers per hour and world production of wine rises by 6,000 bottles per hour. The fact that world production of wine and computers both increase demonstrates that specialization, according to comparative advantage, can boost world output of all goods.

8. Property rights play a key role in shaping the incentive to create new music or, more generally, to create any new computer program, book, pharmaceutical drug, and so forth. Creation is costly because resources, time, and effort must be devoted to this process. By securing the property right to new music, the musician stands to benefit greatly from the resources expended. But if the person cannot obtain a property right, anyone can copy the new music. In that case the musician’s return will be dissipated when a lot of people copy the music and, indeed, someone else might reap the rewards. Property rights, by promising that the musician will personally benefit from the effort involved in creating the music, motivate significantly more new music than would occur in the absence of property rights.

■ You’re the Teacher

1. “All economic models vastly simplify the complex reality. But that is no reason to throw them away. The lessons that can be learned from the simple two-good PPF carry over to the real world. For instance, the two-good PPF shows that there are limits to production. These limits are represented by the PPF curve, which divides attainable from unattainable production points. Now, just as you say, in the real world billions of goods are produced. But there are still limits. But no matter how many goods a nation produces, every nation faces a limit of how much it can produce, just as in the simple two-good PPF case.

“Plus, the simple PPF model demonstrates that production can be efficient or inefficient. This result is also true in the real world. “And, the two-good PPF shows that once production is efficient — a point on the PPF — increasing the output of one good has an opportunity cost because the production of the other good must be reduced. The same is true in our real world. If we are producing efficiently, if we want to produce more of one good, we have to give up other goods. So, based on the assumption that there are only two goods, the PPF teaches us stuff that we can apply everywhere, not just on the next test.”
1. Consider a constant slope PPF with a vertical intercept of 80 guns and a horizontal intercept of 120 tons of butter. The opportunity cost of increasing butter output from 30 to 31 tons is
   a. 1/2 gun.
   b. 2/3 gun.
   c. 1 gun.
   d. 1 1/2 guns.

2. A nation produces at a point outside its PPF
   a. when it trades with other nations.
   b. when it produces inefficiently.
   c. when it produces efficiently.
   d. never.

3. Which of the following statements is true?
   a. All resources are made by people.
   b. Human resources are called labor.
   c. Capital is made only by labor.
   d. Human capital is a contradiction in terms.

4. A situation in which some resources are used inefficiently is represented in a PPF diagram by
   a. any point on either the vertical or horizontal axis.
   b. the midpoint of the PPF.
   c. a point outside the PPF.
   d. a point inside the PPF.

5. Robert has decided to write the essay that is due in his economics class rather than watch a movie. The movie he will miss is Robert’s _____ of writing the essay.
   a. opportunity cost
   b. explicit cost
   c. implicit cost
   d. discretionary cost

6. The cost of textbooks ____ and the earnings foregone because of attending college ____ part of the opportunity cost of attending college.
   a. is; are
   b. is; are not
   c. is not; are
   d. is not; are not

7. The best alternative foregone from an action is called the action’s
   a. “loss”.
   b. “money cost”.
   c. “direct cost”.
   d. “opportunity cost”.

8. The marginal benefit of a product is the
   a. benefit that the product gives to someone other than the buyer.
   b. maximum someone is willing to pay for that unit of the product.
   c. benefit of the product that exceeds the marginal cost of the product.
   d. benefit of the product divided by the total number of units purchased.

9. A marginal benefit curve has a _____ slope; a marginal cost curve has a _____ slope.
   a. positive; positive
   b. positive; negative
   c. negative; positive
   d. negative; negative

10. The production possibilities frontier will shift inward as a result of
    a. an increase in the production of consumption goods.
    b. an increase in R&D expenditure.
    c. an increase in population.
    d. destruction of part of the nation’s capital stock.

The answers for this Chapter Quiz are on page 309