



Answers to the Review Quizzes

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- 1. How does the production possibilities frontier illustrate scarcity?**

The unattainable combinations of production that lie *beyond* the *PPF* illustrate the concept of *scarcity*. There are not enough resources to produce any of these combinations. And moving along the *PPF* to increase the production of one good requires that the production of another good be reduced, which also illustrates scarcity.
- 2. How does the production possibilities frontier illustrate production efficiency?**

The production points that lie on the *PPF* illustrate the concept of production efficiency. These points are attained only by producing the goods and services at the lowest possible cost. At any point inside the frontier, production of one good can be increased without decreasing production of the other good. Such points cannot be production efficient.
- 3. How does the production possibilities frontier show that every choice involves a tradeoff?**

Movements along the *PPF* illustrate that producing more of one good requires producing less of the other good. This observation reflects the result that a *tradeoff* must be made when producing efficiently.
- 4. How does the production possibilities frontier illustrate opportunity cost?**

The negative slope of the production possibility curve illustrates the concept of *opportunity cost*. Moving along the production possibilities frontier, producing additional units of a good requires that the output of the other good must fall. This tradeoff is the opportunity cost of producing more of the first good.
- 5. Why is opportunity cost a ratio?**

The slope of the *PPF* is a *ratio* that expresses the quantity of lost production of the good on the *y*-axis to the increase in the production of the good on the *x*-axis moving downward along the *PPF*. The steeper the slope, the greater is the ratio, and the greater is the opportunity cost of increasing the output of the good measured on the horizontal axis.
- 6. Why does the *PPF* bow outward and what does that imply about the relationship between opportunity cost and the quantity produced?**

Some resources are better suited to produce one type of good or service, like pizza. Other resources are better suited to produce other goods or services, like DVDs. If society allocates resources wisely, it will use each resource to produce the kind of output for which it is best suited. Consider a *PPF* with pizza measured on the *x*-axis and DVDs measured on the *y*-axis. A small increase in pizza output when pizza production is relatively *low* requires only a small increase in the use of those resources still good at making pizza and not good at making DVDs. This yields a small decrease in DVD production for a large increase in pizza production, creating a relatively *low opportunity cost* reflected in the gentle slope of the *PPF* over this range of output. However, the same small increase in pizza output when pizza production is relatively *large* will require society to devote to pizza production those

resources that are less suited to making pizza and more suited to making DVDs. This reallocation of resources yields a relatively small increase in pizza output for a large decrease in DVD output, creating a relatively *high opportunity cost* reflected in the steep slope of the *PPF* over this range of output. The opportunity cost of pizza production increases with the quantity of pizza produced as the slope of the *PPF* becomes ever steeper. This effect creates the *bowed-out* effect (the concavity of the *PPF* function) and means that as more of a good is produced, the opportunity cost of producing additional units increases.

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1. What is marginal cost? How is it measured?

Marginal cost is the opportunity cost of producing *one more unit* of a good or service. Along a *PPF* marginal cost is reflected in the absolute value of the slope of the *PPF*. In particular, the magnitude of the slope of the *PPF* is the marginal cost of a unit of the good measured along the *x*-axis. As the magnitude of the slope changes moving along the *PPF*, the marginal cost changes.

2. What is marginal benefit? How is it measured?

The *marginal benefit* from a good or service is the benefit received from consuming one more unit of it. It is measured by what an individual is willing to give up (or pay) for an additional unit.

3. How does the marginal benefit from a good change as the quantity produced of that good increases?

As more of a good is consumed, the marginal benefit received from each unit is smaller than the marginal benefit received from the unit consumed immediately before it, and is larger than the marginal benefit from the unit consumed immediately after it. This set of results is known as the principle of *decreasing marginal benefit* and is often assumed by economists to be a common characteristic of an individual's preferences over most goods and services in the economy.

4. What is allocative efficiency and how does it relate to the production possibilities frontier?

Allocative efficiency is a situation in which goods and services are produced at the lowest possible cost and in the quantities that provide the greatest possible benefit. We cannot produce more of any good without giving up some of another good that we value more highly. The allocative efficient level of output is the point on the *PPF* (and hence is a production efficient point) for which the marginal benefit equals the marginal cost.

5. What conditions must be satisfied if resources are used efficiently?

Resources are used efficiently when more of one good or service cannot be produced without producing less of some other good or service that is *valued more highly*. This is known as *allocative efficiency* and it occurs when: 1) production efficiency is achieved, and 2) the marginal benefit received from the last unit produced is equal to the marginal cost of producing the last unit.

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1. What generates economic growth?

The two key factors that generate economic growth are *technological change* and *capital accumulation*. Technological change is the development of new goods and of better ways of producing goods and services. Capital accumulation is the growth of capital resources, including human capital.

2. **How does economic growth influence the production possibilities frontier?**
Economic growth shifts the *PPF* outward.
3. **What is the opportunity cost of economic growth?**
When a society devotes more of its scarce resources to research and development of new technologies, or devotes additional resources to produce more capital equipment, both decisions lead to increased consumption opportunities in future periods at the cost of less consumption today. The loss of consumption today is the opportunity cost borne by society for creating economic growth.
4. **Explain why Hong Kong has experienced faster economic growth than Canada.**
Hong Kong devotes a greater proportion of its available resources to the production of capital than Canada. Canada devotes one-fifth of its resources to accumulating capital. Hong Kong devotes one-third of its resources to accumulating capital. This allows Hong Kong to grow at a faster rate than Canada.
5. **Does economic growth overcome scarcity?**
Scarcity reflects the inability to satisfy all our wants. Regardless of the amount of economic growth, scarcity will remain present because it will never be possible to satisfy all our wants. Economic growth allows more wants to be satisfied but it does not eliminate scarcity.

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1. **What gives a person a comparative advantage?**
A person has a comparative advantage in an activity if that person can perform the activity at a lower opportunity cost than anyone else. If the person gives up the least amount of other goods and services to produce a particular good or service, the person has the lowest opportunity cost of producing that good or service.
2. **Distinguish between comparative advantage and absolute advantage.**
A person has a *comparative advantage* in producing a good when he or she has the lowest opportunity cost of producing it. Comparative advantage is based on the output forgone. A person has an *absolute advantage* in production when he or she uses the least amount of *time or resources* to produce one unit of that particular good or service. Absolute advantage is a measure of productivity in using inputs.
3. **Why do people specialize and trade?**
People can compare consumption possibilities from producing all goods and services through *self-sufficiency* against specializing in producing only those goods and services that reflect their comparative advantage and trading their output with others who do the same. People can then see that the consumption possibilities from specialization and trade are greater than under self-sufficiency. So it is in people's own *self-interest* to specialize.
4. **What are the gains from specialization and trade?**
From society's standpoint, the total output of goods and services available for consumption is greater with specialization and trade. From an individual's perspective, each person who specializes enjoys being able to consume a larger bundle of goods and services after trading with others who have also specialized, than would otherwise be possible under self-sufficiency. These increases are the gains from specialization and trade for society and for individuals.
5. **What is the source of the gains from trade?**
As long as people have different opportunity costs of producing goods or services, total output is higher with specialization and trade than if each individual produced goods and

services under self-sufficiency. This increase in output that arises from divergent opportunity costs is the gains from trade.

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1. Why are social institutions such as firms, markets, property rights, and money necessary?

These social institutions are necessary for a decentralized economy to coordinate production. *Firms* are necessary to allow people to specialize. Without firms, specialization would be limited because a person would need to specialize in the *entire* production of a good or service. With firms people are able to specialize in producing particular bits of a good or service. For a society to enjoy the fruits of specialization and trade, the individuals who comprise that society must voluntarily desire to specialize in the first place. Discovering trade opportunities after a person has specialized in his or her comparative advantage in production is what allows that person to gain from his own specialization efforts. Trading opportunities can only take place if a *market* exists where people observe prices to discover available trade opportunities. *Money* is necessary to allow low-cost trading in markets. Without money, goods would need to be directly exchanged for other goods, a difficult and unwieldy situation. Finally people must enjoy social recognition of and government protection of *property rights* to have confidence that their commitments to trade arrangements will be respected by everyone in the market.

2. What are the main functions of markets?

The main function of a market is to enable buyers and sellers to get information and to do business with each other. Markets have evolved because they facilitate trade, that is, they facilitate the ability of buyers and sellers to trade with each other.

3. What are the flows in the market economy that go from firms to households and the flows from households to firms?

On the real side of the economy, goods and services flow from firms to households. On the money side of the economy, payments for factors of production, wages, rent, interest, and profits, flow from firms to households. Flowing from households to firms on the money side of the economy are the expenditures on goods and services and on the real side are the factors of production, labour, land, capital, and entrepreneurship.

Answers to the Study Plan Problems and Applications

Use the following information to work Problems 1 to 3. Brazil produces ethanol from sugar, and the land used to grow sugar can be used to grow food crops. The table sets out Brazil's production possibilities for ethanol and food crops.

Ethanol (barrels per day)	and	Food crops (tonnes per day)
70	and	0
64	and	1
54	and	2
40	and	3
22	and	4
0	and	5

1. a. **Draw a graph of Brazil's *PPF* and explain how your graph illustrates scarcity.**

Figure 2.1 shows Brazil's *PPF*. The production possibilities frontier indicates scarcity because it shows the limits to what can be produced. In particular, production combinations of ethanol and food crops that lie outside the production possibilities frontier are not attainable.

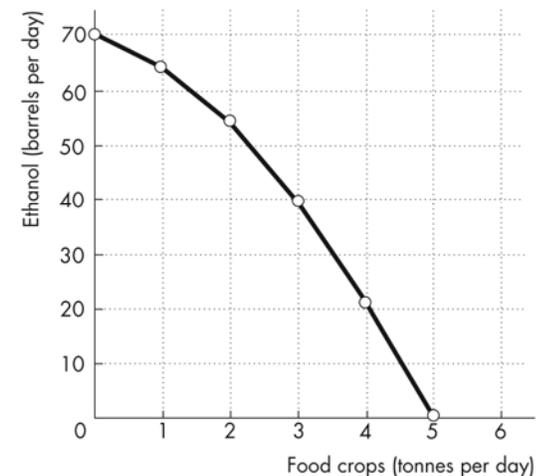
- b. **If Brazil produces 40 barrels of ethanol a day, how much food must it produce to achieve production efficiency?**

If Brazil produces 40 barrels of ethanol per day, it achieves production efficiency if it also produces 3 tonnes of food per day.

- c. **Why does Brazil face a tradeoff on its *PPF*?**

Brazil faces a tradeoff on its *PPF* because Brazil's resources and technology are limited. For Brazil to produce more of one good, it must shift factors of production away from the other good. To increase production of one good requires decreasing production of the other—a tradeoff.

FIGURE 2.1
Problem 1



2. a. **If Brazil increases ethanol production from 40 barrels a day to 54 barrels a day, what is the opportunity cost of the additional ethanol?**

When Brazil is production efficient and increases its production of ethanol from 40 barrels a day to 54 barrels a day, it must decrease its production of food crops from 3 tonnes a day to 2 tonnes a day. The opportunity cost of the additional ethanol is 1 tonne of food a day for the entire 14 barrels of ethanol or $1/14$ of a tonne of food per barrel of ethanol.

- b. **If Brazil increases its production of food crops from 2 tonnes per day to 3 tonnes per day, what is the opportunity cost of the additional food?**

When Brazil is production efficient and increases its production of food crops from 2 tonnes per day to 3 tonnes per day, it must decrease its production of ethanol from 54 barrels per day to 40 barrels per day. The opportunity cost of the additional 1 tonne of food crops is 14 barrels of ethanol.

- c. **What is the relationship between your answers to parts (a) and (b)?**

The opportunity cost of an additional barrel of ethanol and the opportunity cost of an additional tonne of food crops are reciprocals of each other. That is, the opportunity cost of 1 tonne of food crops is 14 barrels of ethanol and the opportunity cost of 1 barrel of ethanol is $1/14$ of a tonne of food crops.

3. Does Brazil face an increasing opportunity cost of ethanol? What feature of Brazil's PPF illustrates increasing opportunity cost?

Brazil faces an increasing opportunity cost of ethanol production. For example, when increasing ethanol production from 0 barrels per day to 22 barrels the opportunity cost of a barrel of ethanol is $1/22$ of a tonne of food crops. Increasing ethanol production by another 18 barrels per day (to a total of 40 barrels per day) has an opportunity cost of $1/18$ of a tonne of food crops per barrel of ethanol. The PPF's bowed-out shape reflects increasing opportunity cost.

Use the above table (for Problems 1 to 3) to work Problems 4 and 5.

4. Define marginal cost and calculate Brazil's marginal cost of producing a tonne of food when the quantity produced is 2.5 tonnes per day.

The marginal cost of a good is the opportunity cost of producing one more unit of the good. When the quantity of food produced is 2.5 tonnes, the marginal cost of a tonne of food is the opportunity cost of increasing the production of food from 2 tonnes per day to 3 tonnes per day. The production of ethanol falls from 54 barrels per day to 40 barrels per day, a decrease of 14 barrels per day. The opportunity cost of increasing food production is the decrease in ethanol production, so the opportunity cost of producing a tonne of food when 2.5 tonnes of food per day are produced is 14 barrels of ethanol per day.

5. Define marginal benefit. Explain how it is measured and why the data in the table does not enable you to calculate Brazil's marginal benefit from food.

The marginal benefit from a good is the benefit received from consuming one more unit of the good. The marginal benefit from a good or service is measured by the most people are willing to pay for one more unit of it. The data in the table do not provide information on how much people are willing to pay for an additional unit of food. The table has no information on the marginal benefit from food.

6. Distinguish between *production efficiency* and *allocative efficiency*. Explain why many production possibilities achieve production efficiency but only one achieves allocative efficiency.

Production efficiency occurs when goods and services are produced at the lowest possible cost. This definition means that production efficiency occurs at any point *on* the PPF. Therefore *all* of the production points on the PPF are production efficient. Allocative efficiency occurs when goods and services are produced at the lowest cost *and* in the quantities that provide the greatest possible benefit. The allocatively efficient production point is the *single* point on the PPF that has the greatest possible benefit.

7. A farm grows wheat and produces pork. The marginal cost of producing each of these products increases as more of it is produced.

a. Make a graph that illustrates the farm's PPF.

Measure the quantity of pork produced on the x-axis and measure the quantity of wheat produced on the y-axis. *Because* the marginal cost of both wheat and pork increase as more of the good is produced, the PPF has a bowed-out shape.

b. The farm adopts a new technology that allows it to use fewer resources to fatten pigs. Use your graph to illustrate the impact of the new technology on the farm's PPF.

The new technology rotates the PPF outward. If the farm puts all of its resources into pork production, it can produce more pork. But if the farm puts all of its resources into wheat production, it still produces the same quantity of wheat.

- c. **With the farm using the new technology described in part (b), has the opportunity cost of producing a tonne of wheat increased, decreased, or remained the same? Explain and illustrate your answer.**

With the new technology, the opportunity cost of producing pork decreases. To increase pork production, the production of wheat decreases by less than prior to the implementation of the new technology. The opportunity cost of producing wheat is the inverse of the opportunity cost of producing pork. So the opportunity cost of producing wheat increases.

- d. **Is the farm more efficient with the new technology than it was with the old one? Why?**

The farm is able to produce more with the new technology than with the old, but it is not necessarily more efficient. If the farm was producing on its *PPF* before the new technology and after, the farm was production efficient both before the new technology and after.

8. **In one hour, Sue can produce 40 caps or 4 jackets and Tessa can produce 80 caps or 4 jackets.**

- a. **Calculate Sue's opportunity cost of producing a cap.**

Sue forgoes 4 jackets to produce 40 caps, so Sue's opportunity cost of producing one cap is $(4 \text{ jackets}) / (40 \text{ caps})$ or 0.1 jackets per cap.

- b. **Calculate Tessa's opportunity cost of producing a cap.**

Tessa forgoes 4 jackets to produce 80 caps, so Tessa's opportunity cost of producing one cap is $(4 \text{ jackets}) / (80 \text{ caps})$ or 0.05 jackets per cap.

- c. **Who has a comparative advantage in producing caps?**

Tessa's opportunity cost of a cap is lower than Sue's opportunity cost, so Tessa has a comparative advantage in producing caps.

- d. **If Sue and Tessa specialize in producing the good in which each of them has a comparative advantage, and they trade 1 jacket for 15 caps, who gains from the specialization and trade?**

Tessa specializes in caps and Sue specializes in jackets. Both Sue and Tessa gain from trade. Sue gains because she can obtain caps from Tessa at a cost of $(1 \text{ jacket}) / (15 \text{ caps})$, which is 0.067 jackets per cap, a cost that is lower than what it would cost her to produce caps herself. Tessa also gains from trade because she trades caps for jackets for 0.067 jackets per cap, which is higher than her cost of producing a cap.

9. **Suppose that Tessa buys a new machine for making jackets that enables her to make 20 jackets an hour. (She can still make only 80 caps per hour.)**

- a. **Who now has a comparative advantage in producing jackets?**

Sue forgoes 40 caps to produce 4 jackets, so Sue's opportunity cost of producing one jacket is $(40 \text{ caps}) / (4 \text{ jackets})$ or 10 caps per jacket. Tessa forgoes 80 caps to produce 20 jackets, so Tessa's opportunity cost of producing one jacket is $(80 \text{ caps}) / (20 \text{ jackets})$ or 4 caps per jacket. Tessa has the comparative advantage in producing jackets because her opportunity cost of a jacket is lower than Sue's opportunity cost.

- b. **Can Sue and Tessa still gain from trade?**

Tessa and Sue can still gain from trade because Tessa (now) has a comparative advantage in producing jackets and Sue (now) has a comparative advantage in producing caps. Tessa will produce jackets and Sue will produce caps.

c. Would Sue and Tessa still be willing to trade 1 jacket for 15 caps? Explain your answer.

Sue and Tessa will not be willing to trade 1 jacket for 15 caps. In particular, Sue, whose comparative advantage lies in producing caps, can produce 1 jacket at an opportunity cost of only 10 caps. So Sue will be unwilling to pay any more than 10 caps per jacket.

10. For 50 years, Cuba has had a centrally planned economy in which the government makes the big decisions on how resources will be allocated.

a. Why would you expect Cuba's production possibilities (per person) to be smaller than those of the United States?

Cuba's economy is almost surely less efficient than the U.S. economy. The Cuban central planners do not know people's production possibilities or their preferences. Because firms in Cuba are owned by the government rather than individuals, no one in Cuba has the self-interested incentive to operate the firm efficiently and produce goods and services that consumers desire. Additionally Cuba does not actively trade so Cuba produces most of its consumption goods rather than buying them from nations with a comparative advantage. Because Cuba uses its resources to produce consumption goods, it cannot produce many capital goods so its economic growth rate has been low.

b. What are the social institutions that Cuba might lack that help the United States to achieve allocative efficiency?

Of the four social institutions, firms, money, markets, and property rights, Cuba's economy has firms and money. Markets, however, are less free of government intervention in Cuba. But the major difference is the property rights in the Cuban economy. In Cuba the government owns most of the firms; that is, the government has the property right to run the producers. Because the firms are not motivated to make a profit, the managers of these firms have little incentive to operate the firm efficiently or to produce the goods and services that consumers desire. In the United States, firms are owned by individuals; that is, people have the property right that allows them to run firms. These owners have the self-interested incentive to operate the firm efficiently and to produce the goods and services people want, an incentive sorely lacking in the Cuban economy.

Answers to Additional Problems and Applications

Use the table to work Problems 11 and 12. Suppose that Yucatan’s production possibilities are given in the table.

Food (kilograms per month)	and	Sunscreen (litres per month)
300	and	0
200	and	50
100	and	100
0	and	150

- 11. a. Draw a graph of Yucatan’s PPF and explain how your graph illustrates a tradeoff.**

Yucatan’s PPF is illustrated in Figure 2.2. The figure illustrates a tradeoff because moving along Yucatan’s PPF producing more of one good requires producing less of the other good. Yucatan trades off more production of one good for less production of the other.

- b. If Yucatan produces 150 kilograms of food per month, how much sunscreen must it produce if it achieves production efficiency?**

If Yucatan produces 150 kilograms of food per month, then the point labelled A on the PPF in Figure 2.2 shows that Yucatan must produce 75 litres of sunscreen per month to achieve production efficiency.

- c. What is Yucatan’s opportunity cost of producing (i) 1 kilogram of food and (ii) 1 litre of sunscreen?**

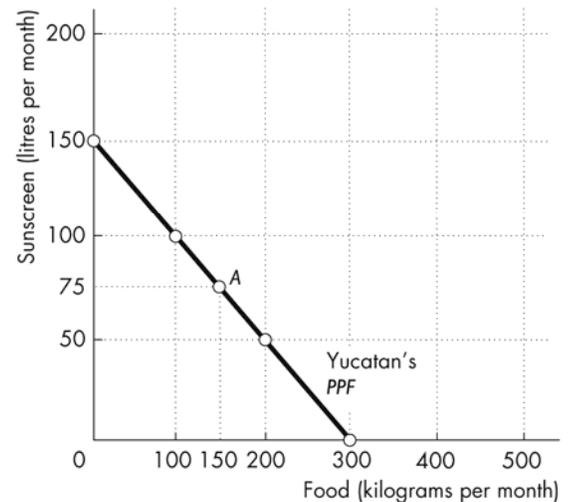
Yucatan’s PPF is linear so the opportunity cost of producing 1 kilogram of food is the same at all quantities. Calculate the opportunity cost of producing 1 kilogram of food when increasing the production of food from 0 to 100 kilograms per month. The quantity of sunscreen produced falls from 150 litres per month to 100 litres per month, a decrease of 50 litres. The opportunity cost is 50 litres of sunscreen to gain 100 kilograms of food. The opportunity cost per kilogram of food equals $(50 \text{ litres of sunscreen}) / (100 \text{ kilograms of food})$, which is an opportunity cost of 0.5 litres of sunscreen per kilogram of food.

Similarly, the opportunity cost of producing 1 litre of sunscreen is the same at all quantities. Calculate the opportunity cost of producing 1 litre of sunscreen when increasing the production of sunscreen from 0 to 50 litres per month. The quantity of food produced falls from 300 kilograms per month to 200 kilograms per month, a decrease of 100 kilograms. The opportunity cost is 100 kilograms of food to gain 50 litres of sunscreen, or $(100 \text{ kilograms of food}) / (50 \text{ litres of sunscreen})$ which is an opportunity cost of 2.0 kilograms of food per litre of sunscreen.

- d. What is the relationship between your answers to part (c)?**

The answer to part (c) reflects the fact that opportunity cost is a ratio. The opportunity cost of gaining a unit of a good moving along the PPF equals the quantity of the other good or service forgone divided by the quantity of the good or service gained. The opportunity cost of one good, food, is equal to the inverse of the opportunity cost of the other good, sunscreen.

FIGURE 2.2
Problem 11



12. What feature of a *PPF* illustrates increasing opportunity cost? Explain why Yucatan's opportunity cost does or does not increase.

If opportunity cost increases as more of a good is produced, the *PPF* bows outward. Yucatan's *PPF* is linear and along a linear *PPF* the opportunity cost is constant. Yucatan's opportunity cost of food remains constant, equal to 0.5 litres of sunscreen per kilogram of food. Yucatan's resources are equally productive in both activities.

13. In problem 11, what is the marginal cost of 1 kilogram of food in Yucatan when the quantity produced is 150 kilograms per day? What is special about the marginal cost of food in Yucatan?

The marginal cost of a kilogram of food in Yucatan is constant at all points along Yucatan's *PPF* and is equal to 0.5 litres of sunscreen per kilogram of food. The special point about Yucatan's marginal cost is the fact that the marginal cost is constant. This result reflects Yucatan's linear *PPF*.

14. The table describes the preferences in Yucatan.

a. What is the marginal benefit from sunscreen and how is it measured?

The marginal benefit from sunscreen is the benefit enjoyed by the person who consumes one more litre of sunscreen. It is equal to the willingness to pay for an additional litre.

Sunscreen (litres per month)	Willingness to pay (kilograms of food per litre)
25	3
75	2
125	1

b. What does Yucatan produce to achieve allocative efficiency?

When allocative efficiency is achieved, Yucatan is producing at the point on the *PPF* that is most preferred. At this point, the marginal benefit from sunscreen equals the marginal cost of sunscreen. The marginal cost of sunscreen is 2 kilograms of food per litre. The table shows that the marginal benefit from sunscreen is 2 kilograms of food per litre when the quantity produced is 75 litres of sunscreen per month.

Downtown Music Stores Squeezed out of Business

Music retailing is changing: Sony Music and Amazon are selling online, discount stores are selling at low prices, and downtown music retailers are all struggling.

Source: *The Economics*, January 20, 2007

15. a. Draw the *PPF* curves for downtown music retailers and online music retailers before and after the Internet became available.

Before the introduction of the Internet, a tradeoff existed between Main Street music retailing services and other goods and services. The *PPF* is bowed outward. With the introduction of the Internet, production of both Main Street music retailing services and other goods and services increases. The *PPF* shifts outward.

Before the introduction of the Internet, online music retailing did not exist. There was no tradeoff between online music retailing services and other goods and services. So for every quantity of other goods and services produced, there was no online music retailing services produced. The *PPF* is the *y*-axis. But with the introduction of the Internet, online music retailing became available. The *PPF* becomes a bowed-out shape, showing that a tradeoff exists between online music retailing services and other goods and services.

- b. **Draw the marginal cost and marginal benefit curves for downtown music retailers and online music retailers before and after the Internet became available.**

With the technology of the Internet, other goods and services become cheaper to produce, so more other goods and services must be given up to obtain a given quantity of Main Street music retailing services. So the expansion of the Internet increases the marginal cost of Main Street music retailing services. The marginal cost curve for Main Street music retailing services shifts leftward.

The expansion of the Internet results in the marginal cost of online music retailing services being less than the marginal cost of Main Street music retailing services prior to the introduction of the Internet. At every quantity of music retailing services, the marginal cost curve of online music retailing services is lower than the marginal cost curve of Main Street music retailing services.

The marginal benefit curve from Main Street music retailing services and from online music retailing is a downward-sloping curve.

- c. **Explain how changes in production possibilities, preferences or both have changed the way in which recorded music is retailed.**

Easier access to the Internet has decreased the cost of downloading online music and the marginal cost of online music retailers has decreased. The marginal benefit from listening to music has not changed. The result is an increase in online music retailers and a decrease in Main Street music retailers.

Use the following news clip to work Problems 16 and 17.

Malaria Eradication Back on the Table

In response to the Gates Malaria Forum in October 2007, countries are debating the pros and cons of eradication. Dr. Arata Kochi of the World Health Organization believes that with enough money malaria cases could be cut by 90 percent, but it would be very expensive to eliminate the remaining 10 percent of cases, so countries should not strive to eradicate malaria.

Source: *The New York Times*, March 4, 2008

16. **Is Dr. Kochi talking about *production efficiency* or *allocative efficiency* or both?**

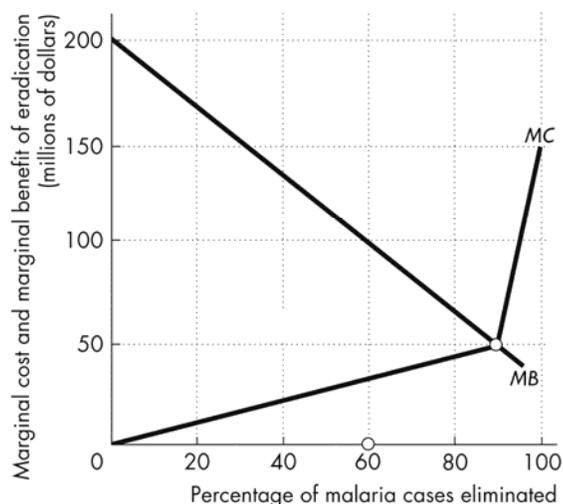
Dr. Kochi is talking about allocative efficiency. His assessment is that the last 10 percent eradication has such a high marginal cost that it almost surely exceeds its marginal benefit.

17. **Make a graph with the percentage of malaria cases eliminated on the x-axis and the marginal cost and marginal benefit of driving down malaria cases on the y-axis. On your graph:**

- (i) **Draw a marginal cost curve and marginal benefit curve that are consistent with Dr. Kochi's opinion.**
- (ii) **Identify the quantity of malaria eradicated that achieves allocative efficiency.**

Figure 2.3 shows a marginal cost curve and a marginal benefit curve that are

FIGURE 2.3
Problem 17



consistent with Dr. Kochi's views. Dr. Kochi believes that the last 10 percent of malaria would be very expensive to eradicate. The marginal cost curve in the figure reflects this view because the marginal cost curve rises rapidly after 90 percent of malaria is eradicated. The marginal benefit curve is downward sloping, reflecting diminishing marginal benefit from malaria eradication. The allocatively efficient quantity of malaria eradicated is 90 percent because that is the quantity for which the marginal benefit of eradication equals the marginal cost of eradication. This outcome demonstrates Dr. Kochi's conclusion that countries should not attempt to completely eradicate malaria.

18. Capital accumulation and technological change bring economic growth: Production that was unattainable yesterday becomes attainable today; production that is unattainable today will become attainable tomorrow. Why doesn't economic growth bring an end to scarcity one day?

People's wants are infinite—regardless of what a person already possesses, everyone can easily visualize something else he wants. Because people's wants are insatiable, scarcity will always exist regardless of economic growth.

Toyota Plans to Build a Better Company

Toyota will continue to produce 3 million cars per year and use the balance of its resources to upgrade its workers' skills and create new technology. In three years' time, Toyota plans to produce better cars and be more productive.

Source: *Financial Post*, April 7, 2014

19. a. What is the opportunity cost of Toyota upgrading its workers' skills and creating new technology?

When Toyota puts resources into workers' skills and creating new technology, there are fewer resources to produce cars today. The decrease in car production is the opportunity cost of Toyota upgrading workers' skills and creating new technology.

b. Sketch Toyota's PPF and mark its production point in 2014. Now show on your graph Toyota's PPF in 2018.

Measure new skills and new technology on the *y*-axis and cars on the *x*-axis. Toyota's PPF has a bowed-out shape, which shows increasing opportunity cost. In 2014, Toyota produces at the point on the PPF where production is 3 million cars a year. When workers' skills are upgraded and new technology is implemented, Toyota's PPF rotates outward. The *x*-axis intercept of the PPF increases. The *y*-axis intercept of the PPF does not change.

Use the following data to work Problems 19 and 20.

Kim can produce 40 pies or 400 cakes an hour. Liam can produce 100 pies or 200 cakes an hour.

20. a. Calculate Kim's opportunity cost of a pie and Liam's opportunity cost of a pie.

If Kim spends an hour baking pies, she gains 40 pies but forgoes 400 cakes. Kim's opportunity cost of 1 pie is $(400 \text{ cakes}) / (40 \text{ pies})$, or 10 cakes per pie. If Liam spends an hour baking pies, he gains 100 pies but forgoes 200 cakes. Liam's opportunity cost of 1 pie is $(200 \text{ cakes}) / (100 \text{ pies})$, or 2 cakes per pie.

b. If each spends 30 minutes of each hour producing pies and 30 minutes producing cakes, how many pies and cakes does each produce?

Kim produces 20 pies and 200 cakes. Liam produces 50 pies and 100 cakes. The total number produced is 70 pies and 300 cakes.

c. Who has a comparative advantage in producing (i) pies and (ii) cakes?

Liam has the comparative advantage in producing pies because his opportunity cost of producing a pie is less than Kim's opportunity cost of producing a pie. Kim has the comparative advantage in producing cakes because her opportunity cost of producing a cake is less than Liam's opportunity cost of producing a cake.

21. a. Draw a graph of Kim's PPF and Liam's PPF and show the point at which each produces when they spend 30 minutes of each hour producing pies and 30 minutes producing cakes.

Kim's PPF is illustrated in Figure 2.4; Liam's PPF is illustrated in Figure 2.5 (on the next page).

Point A in both figures shows their production points when each spends 30 minutes making cakes and 30 minutes making pies.

b. On your graph, show what Kim produces and what Liam produces when they specialize.

Kim will specialize in cakes and Liam will specialize in pies. Point B in both figures shows the production points when each specializes.

c. When they specialize and trade, what are the total gains from trade?

Kim will specialize in cakes and Liam will specialize in pies. If they specialize and trade, the total production of both cakes and pies increase. When each spends 30 minutes making cakes and 30 minutes making pies, together they produce 300 cakes and 70 pies. When they specialize, together they produce 400 cakes and 100 pies. The 100 increase in cakes and the 30 increase in pies is the gains from trade.

d. If Kim and Liam share the total gains equally, what trade takes place between them?

Kim will trade 50 cakes (half of the gain in cake production) to Liam in exchange for 15 pies (half of the increase in pie production).

FIGURE 2.4
Problem 21

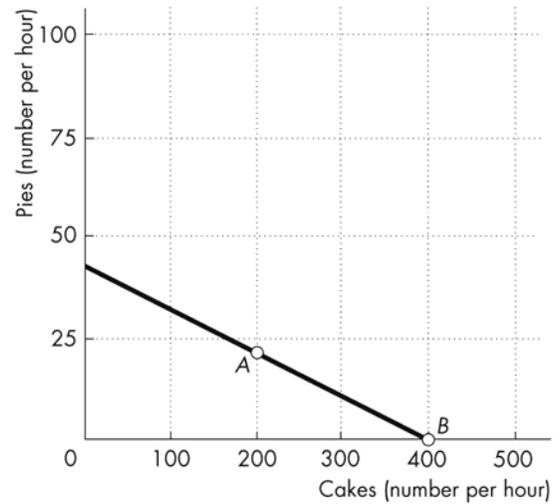
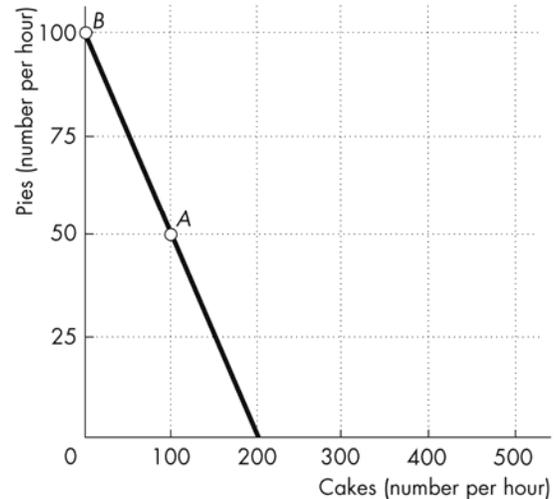


FIGURE 2.5
Problem 21



- 22. Tony and Patty produce skis and snowboards. The top table shows Tony's production possibilities and the bottom table shows Patty's production possibilities. Tony produces 5 snowboards and 40 skis a week; Patty produces 10 snowboards and 5 skis a week.**

a. Who has a comparative advantage in producing (i) snowboards and (ii) skis?

The person with a comparative advantage in producing snowboards is the person who has the lower opportunity cost of producing a snowboard. Tony's production possibilities show that to produce 5 more snowboards he must produce 10 fewer skis. So Tony's opportunity cost of producing a snowboard is 2 skis.

Patty's production possibilities show that to produce 10 more snowboards, she must produce 5 fewer skis. So Patty's opportunity cost of producing a snowboard is $\frac{1}{2}$ of a ski. Patty has a comparative advantage in producing snowboards because her opportunity cost of producing a snowboard is less than Tony's opportunity cost of producing a snowboard.

Tony has a comparative advantage in producing skis. For each ski produced, Tony must give up making $\frac{1}{2}$ a snowboard, whereas for each ski that Patty produces, she must give up making 2 snowboards.

So Tony's opportunity cost of a producing ski is lower than Patty's opportunity cost of producing a ski.

Snowboards (per week)	and	Skis (per week)
25	and	0
20	and	10
15	and	20
10	and	30
5	and	40
0	and	50

Snowboards (per week)	and	Skis (per week)
20	and	0
10	and	5
0	and	10

b. If Tony and Patty specialize and trade 1 snowboard for 1 ski, what are the gains from trade?

Patty has a comparative advantage in producing snowboards, so she specializes in snowboards. Tony has a comparative advantage in producing skis, so he specializes in producing skis. Patty produces 20 snowboards and Tony produces 50 skis.

Before specializing, they produced 15 snowboards (Patty's 10 plus Tony's 5) and 45 skis (Tony's 40 plus Patty's 5). By specializing, they increase their total output by 5 snowboards and 5 skis. They can share this gain by trading 1 ski for 1 snowboard. Patty can obtain skis from Tony for less than it costs her to produce them. Tony can obtain snowboards from Patty for less than it costs him to produce them. Both Patty and Tony achieve gains from specialization and trade.

- 23. Indicate on a graph of the circular flows in the market economy, the real and money flows in which the following items belong:**

a. You buy an iPad from the Apple Store.

Figure 2.6 shows the circular flows in a market economy. Your purchase of an iPad from Apple is the purchase of a good from a firm. This flow is in the black arrow indicated by point *a* in the figure. When you pay for the iPad, the money flow is in the grey arrow in the opposite direction to the black arrow labelled *a*.

b. Apple Inc. pays the designers of the iPad.

Apple's payment to the designers of the iPad is the payment of a wage to a factor of production. This flow is in the grey arrow shown by point *b* in the figure. The flow of design services from the designer to Apple is in the black arrow in the opposite direction to the grey arrow labelled *b*.

c. Apple Inc. decides to expand and rents an adjacent building.

Apple's decision to expand by renting a building means that Apple is increasing the capital it uses. This flow is in the black arrow indicated by point c in the figure. The flow of the payment for the rental services of the building is in the grey arrow in the opposite direction to the black arrow labelled c.

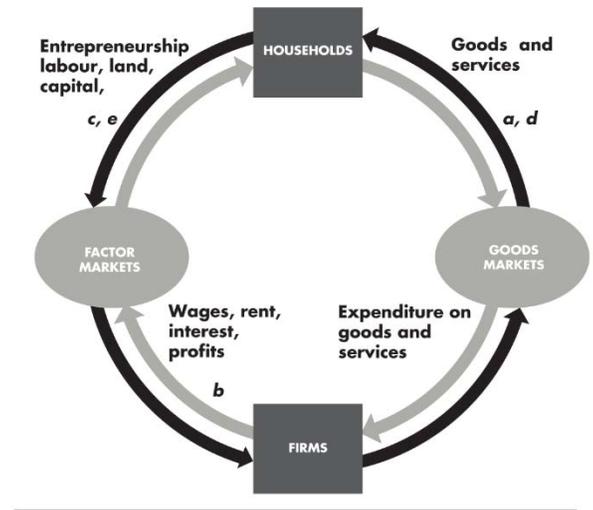
d. You buy a new e-book from Amazon.

Your purchase of an e-book from Amazon is the purchase of a good from a firm. This flow is in the black arrow indicated by point d in the figure. When you pay for the e-book, the money flow is in the grey arrow in the opposite direction to the black arrow labelled d.

e. Apple Inc. hires a student as an intern during the summer.

Apple's decision to hire a student intern is Apple increasing the labour it uses. The flow of labour services is in the black arrow indicated by point e in the figure. The flow of the payment for the labour services is in the grey arrow in the opposite direction to the black arrow labelled e.

FIGURE 2.6
Problem 23



Economics in the News

24. After you have studied *Economics in the News* on pp. 46–47, answer the following questions.

a. How does the discovery of new oil and gas reserves change Canada's PPF?

If we measure oil and gas production on the x-axis of Canada's PPF and other goods and services on the y-axis of Canada's PPF, then with the discovery of new oil and gas reserves, Canada's PPF rotates outward. The x-axis intercept increases. At every quantity of other goods and services produced, Canada can produce more oil and gas.

b. How do technological advances in the production of other goods and services change Canada's PPF?

Measure oil and gas production on the x-axis of Canada's PPF and other goods and services on the y-axis of Canada's PPF. Then with technological advances in the production of other goods and services, Canada's PPF rotates outward. The y-axis intercept increases. At every quantity of oil and gas produced, Canada can produce more other goods and services.

c. How are Husky's discoveries changing Canada's opportunity cost of producing oil and gas?

With Husky's discoveries, fewer other goods and services must be given up to produce an additional barrel of oil or an additional barrel of gas. The opportunity cost of producing oil and gas decreases.

- d. When technological advances in the production of other goods and services occur, how does the opportunity cost of producing oil and gas change? Does it increase or decrease?**

Technological discoveries in the production of other goods and services means that less production of oil and gas must be given up to produce more other goods and services. The opportunity cost of producing other goods and services decreases. The opportunity cost of producing oil and gas is the inverse of the opportunity cost of producing other goods and services. So the opportunity cost of producing oil and gas increases.

25. Lots of Little Screens

Inexpensive broadband access has created a generation of television producers for whom the Internet is their native medium. As they redirect the focus from TV to computers, cell phones, and iPods, the video market is developing into an open digital network.

Source: *The New York Times*, December 2, 2007

- a. How has inexpensive broadband changed the production possibilities of video entertainment and other goods and services?**

Inexpensive broadband has increased the production possibilities.

- b. Sketch a *PPF* for video entertainment and other goods and services before broadband.**

The *PPF* measures video entertainment on one axis and other goods and services on the other axis. The *PPF* is bowed outward.

- c. Show how the arrival of inexpensive broadband has changed the *PPF*.**

The arrival of inexpensive broadband rotates the *PPF*. The intersection of the new *PPF* along the axis measuring video entertainment increases and the intersection of the new *PPF* along the axis measuring other goods and services does not change.

- d. Sketch a marginal benefit curve for video entertainment.**

The marginal benefit curve is a downward-sloping curve. The marginal benefit from video entertainment is measured along the vertical axis and the quantity of video entertainment is measured along the horizontal axis.

- e. Show how the new generation of TV producers for whom the Internet is their native medium might have changed the marginal benefit from video entertainment.**

The marginal benefit increases because these new producers will be better able to take advantage of the Internet since it is their native medium. Because they will be able to create entertainment designed for the Internet, the marginal benefit from video entertainment increases. The marginal benefit curve shifts rightward.