Multiple Choice:

1. For students who attend public colleges, the average opportunity cost of foregone wages is:
a. less than the cost of college tuition
b. more than the cost of college tuition
c. equal to the cost of college tuition

2. The info provided in Application 3.1 provides the following assessment of Bill Gates' decision to drop out of Harvard
a. This was a wise decision for Bill Gates because the opportunity cost of attending college exceeded the long-term benefit of attending college. His opportunity cost was high because of his unusual entrepreneurial skill.
b. This would probably be a wise decision for most people; statistics show that our society places too much emphasis on education.
c. This was an unwise decision. Bill Gates could have started Microsoft after he graduated from college.
d. None of the above

3. In-text exercise 3.2 provides information about total benefit. Use this information to compute marginal benefits. Which of the following statements is true?
a. The marginal benefit of the third quarter hour of repair time is 20.
b. The marginal benefit of the fifth quarter hour of repair time is 20.
c. The marginal benefit of the second quarter hour of repair time is 20.
d. The marginal benefit of the seventh quarter hour of repair time is 20.

4. Application 3.2 focuses on a commuter who is free to choose the number of hours she works each week. She earns a set amount (equal to her wage rate) for each hour she works. When she is not working, she is enjoying leisure activities. Assuming that (i) she is allocating her time optimally and (ii) she does not dislike her work, the "No Marginal Improvement Principle" tells us that:
a. Her marginal benefit from leisure activities is equal to her wage rate.
b. We cannot use the wage rate to estimate the value of leisure time because people do not earn wages while they are engaged in leisure activities.
c. The value of time cannot be measured in dollars because each individual life is precious.
d. None of the above

5. Application 3.2 states that estimates of the value of time are useful because:
a. Time is money.
b. Knowing the value of time will help students realize that they should study more.
c. Highway construction projects can reduce commuting time substantially by reducing highway congestion. However, these projects can be extremely expensive. When policy-makers are evaluating project proposals, they need to compare costs and benefits. The cost estimates are provided by highway engineers. If the primary benefit is reduced commuting time, then it is necessary to estimate the value of that time.
d. None of the above

6. Application 3.2 states that:
a. If a commuter dislikes her job, then the value of an extra hour spent working is less than her wage rate.
b. If a commuter does not dislike her job, then the value of an extra hour spent working is equal to her wage rate.
c. Both a and b.
d. None of the above.

7. Application 3.3 is very interesting. Construction of the English Channel tunnel was started in 1987. Construction was finance by private investors, who clearly expected to earn a profit. By 1990, however, it was clear that the actual construction costs would be much higher than the initial estimates. Suppose accurate cost information had been available in 1987, prior to the decision to start construction. In 1987:
a. The investors would have decided to build the tunnel even though they knew that the costs would exceed the revenues. The costs were sunk costs, so the investors would have ignored them.
b. The cost of constructing the tunnel was an avoidable cost.
c. The investors were concerned that France would use the tunnel to invade England.
d. None of the above.

8. Use the marginal cost information provided in the table to compute the total cost of producing 3 items:

Quantity	Marginal cost
0	
1	10
2	12
3	16

a. 28
b. 16
c. 38
d. none of the above

9. Use Figure 4.5 for this question. Sam's car has horsepower equal to 120 and fuel efficiency equal to 15 mpg. If you trade his car for a car with horsepower equal to 90 and fuel efficiency equal to 30, will he agree to make the trade? Will he be willing to pay some amount of money to be able to make this trade? (We are assuming that all other characteristics of the car are equal.)
a. He will not agree to make an even trade (no money changes hands on an even trade).
b. He would make an even trade, but he would not be willing to pay anything to make the trade possible.
c. He would make an even trade, and he would be willing to pay some amount of money to make the trade possible.
d. Figure 4.5 does not provide enough information to answer this question.

10. In-text exercise 4.2 asks you to draw indifference curves represented by the formula: $C = U-1.2\ P$. Use this indifference curve equation to compute U when $C = 1$ and $P = 0$.
a. $U = 1$
b. $U = 1.2$
c. $U = 1/1.2$
d. None of the Above

11. In-text exercise 4.4 focuses on the utility function: $U(C,M) = C + 3\sqrt{M}$, where C is liters of Coke and M is liters of Mountain Dew. Compute Bert's utility if he consumes 8 liters of Coke and 9 liters of Mountain Dew.
a. 72
b. 17
c. 35
d. none of the above

12. In-text exercise 4.5 asks you to figure out the formula for an indifference curve by plotting points for the utility equation provided in In-text exercise 4.4. To get ready for this exercise, write the equation for utility equal to 20: $U = 20 = C + 3\sqrt{M}$. Now you can rearrange this equation to put C on the left-hand side (remember that the axes for the indifference curve diagram represent the quantity of C and the quantity of M. The new equation is:

a. $C = 20 / (3\sqrt{M})$
b. $C = 20+3\sqrt{M}$
c. $C = 20-3\sqrt{M}$
d. None of the above

13. Mary is willing to give up 3 cups of soup to obtain 5 slices of bread. For Mary,
a. Bread and soup are complements.
b. Bread and soup are substitutes.
c. You can't tell whether bread and soup are complements or substitutes.
d. None of the above.

14. Consider Figure 4.6. Assume that Sam starts at the point that represents 4 pints of soup and 5 ounces of bread. Which of the following statements is true?
a. Sam will not be willing to move to the point with 5 pints of soup and 6 ounces of bread, unless you pay him money to do it.
b. Sam would be willing to pay you some money for the privilege of moving to the point with 5 pints of soup and 6 ounces of bread.
c. Sam' utility would not change if he moved to the point with 5 pints of soup and 6 ounces of bread.
d. None of the above

15. If an indifference curve has the shape shown in Figure 4.14, then
a. the indifference curves have diminishing MRS
b. the item graphed on the horizontal axis is a "bad", while the other item is a "good"
c. the two goods are perfect substitutes
d. None of the above.

16. The indifference curves shown in this Figure 4.14 represent
a. one "good" and one "bad"
b. perfect substitutes
c. perfect complements
d. None of the above

Answers to Multiple Choice

1b, 2a, 3b, 4a, 5c, 6c, 7b, 8c, 9c, 10a, 11b, 12c, 13b, 14b, 15a, 16d

Answers to End-of-Chapter 3 Questions

3.1

First, since costs have changed, we need to make a new version of Table 3.2 so we have updated Total Cost information to make a new version of Table 3.3.

Repair Time (Hours)	*New* Cost of Mechanic and Parts	Lost Earnings from Pizza Delivery Job	*New* Total Cost
0	0	0	0
1	200	10	210
2	400	25	425
3	600	45	645
4	800	75	875
5	1,000	110	1,110
6	1,200	150	1,350

Now we add the *New* Total Cost information to Table 3.3 and calculate *New* Net Benefit as Total Benefit minus *New* Total Cost. Net benefit is now maximized at 5 hours.

Repair Time (Hours)	Total Benefit	*New* Total Cost	*New* Net Benefit
0	0	0	0
1	615	210	405
2	1,150	425	725
3	1,600	645	955
4	1,975	875	1,100
5	**2,270**	**1,110**	**1,160**
6	2,485	1,350	1,135

3.2
The approach is the same as for End-of-Chapter problem 3.1.

Repair Time (Hours)	*New* Cost of Mechanic and Parts	Lost Earnings from Pizza Delivery Job	*New* Total Cost
0	0	0	0
1	200	10	210
2	400	25	425
3	600	45	645
4	800	75	875
5	1,100	110	1,210
6	1,400	150	1,550

Again, we add the *New* Total Cost information to Table 3.3 and calculate *New* Net Benefit as Total Benefit minus *New* Total Cost. Net benefit is now maximized at 4 hours.

Repair Time (Hours)	Total Benefit	*New* Total Cost	*New* Net Benefit
0	0	0	0
1	615	210	405
2	1,150	425	725
3	1,600	645	955
4	**1,975**	**875**	**1,100**
5	2,270	1,210	1,060
6	2,485	1,550	935

3.3

The benefits involved may include a good grade, a sense of accomplishment, a higher GPA, a higher likelihood of getting into a good graduate school, any extra income that is earned due to the higher GPA and better graduate school, and a more complete understanding of the topic. The costs include things that could have been done in the time spent studying, like sleeping, spending time with friends and family, playing sports, earning a wage, etc. Further, any direct money costs to studying, like buying highlighters and notebook paper, should be counted as well.

3.4

He was simply stating that there are costs associated with every decision, because making a decision implies facing a choice. A choice implies at least two options, which means that when one is chosen, another is forgone. Even if a lunch is “free” from a money point-of-view, it still takes time to eat lunch, and time spent eating lunch is time that is not spent doing other things. Further, if someone were to buy lunch for you, you might feel indebted to that person or obliged to converse with that person over lunch. Depending on who it is that bought the lunch, this could cause significant psychic costs.

3.5

In the absence of any other changes (specifically changes to benefits), this statement is correct. In the language of economists, it would be more correct to say “*ceteris paribus*, if the cost of repairing your car goes up you should do less of it.” The only way that a higher cost could inspire a higher best choice would be if the benefits also increase, and if the benefits increased by more than the costs. (Note that if benefits and costs both increase by the same amount, the best choice should remain unchanged.)

3.6

Since we can hire the mechanic for anywhere from 0 to 6 hours, the best choice is one of the following three choices: hire the mechanic for 0 hours, hire the mechanic for 6 hours, or hire the mechanic for the number of hours at which $MB = MC$. To decide which is best, we should compare the total benefits of these three choices. First we need to find out where $MB = MC$:

$MB(H) = MC(H)$
$654 - 80H = 110 + 240H$
$544 = 320H$
$\boldsymbol{H = 1.7}$

So the correct answer is 0, 1.7 or 6. To figure out which, we calculate the net benefit (benefit minus cost) of each. The highest net benefit occurs at 1.7 hours of repair time.

Repair time, H	**Total benefit, $B(H)$ $654H - 40H^2$**	**Total cost, $C(H)$ $110H + 24H^2$**	**Net benefit, $B(H) - C(H)$**
0	0	0	0
1.7	**996.2**	**533.8**	**462.4**
6	2,484	4,980	–2,496

3.7

The approach is the same as for question 3.6. Since we can hire the mechanic for anywhere from 0 to 6 hours, the best choice is one of the following three choices: hire the mechanic for 0 hours, hire the mechanic for 6 hours, or hire the mechanic for the number of hours at which $MB = MC$. To decide which is best, we should compare the total benefits of these three choices. First we need to find out where $MB = MC$:

$MB(H) = MC(H)$
$420 - 80H = 100 + 240H$
$320 = 320H$
$\mathbf{H = 1}$

So the correct answer is 0, 1 or 6. To figure out which, we calculate the net benefit (benefit minus cost) of each. The highest net benefit occurs at 1 hour of repair time.

Repair time, *H*	**Total benefit, *B*(*H*)** **$654H - 40H^2$**	**Total cost, *C*(*H*)** **$110H + 24H^2$**	**Net benefit, *B*(*H*) – *C*(*H*)**
0	0	0	0
1	**380**	**220**	**160**
6	1,080	4,920	–3,840

3.8

The approach is the same as for questions 3.6 and 3.7. The approach is the same as for question 3.6. Since we can hire the mechanic for anywhere from 0 to 6 hours, the best choice is one of the following three choices: hire the mechanic for 0 hours, hire the mechanic for 6 hours, or hire the mechanic for the number of hours at which $MB = MC$. To decide which is best, we should compare the total benefits of these three choices. First we need to find out where $MB = MC$:

$MC(H) = MB(H)$
$$100 = \frac{200}{\sqrt{H}}$$
$\sqrt{H} = 2$
$\mathbf{H = 4}$

So the correct answer is 0, 4 or 6. To figure out which, we calculate the net benefit (benefit minus cost) of each. The highest net benefit occurs at 4 hours of repair time.

Repair time, *H*	**Total benefit, *B*(*H*)** **$654H - 40H^2$**	**Total cost, *C*(*H*)** **$110H + 24H^2$**	**Net benefit, *B*(*H*) – *C*(*H*)**
0	0	0	0
4	**800**	**400**	**400**
6	979.7959	600	379.7959

3.9
If the $1,500 fee is non-refundable, then it is a sunk cost. Sunk costs should not be considered when making decisions. Even if the additional $1,500 costs were included in the analysis, however, we would arrive at the same conclusion. The total cost of every different amount of repair work would increase by exactly $1,500, making the net benefit of every different amount of repair work decrease by exactly $1,500. Therefore, instead of comparing a net benefit of $0 for $H = 0$, a net benefit of $385 for $H = 6$ and a net benefit of $924.80 for $H = 2.4$, we would be comparing a net benefit of –$1,500 for $H = 0$, a net benefit of –$1,115 for $H = 6$ and a net benefit of –$575.20 for $H = 3.4$; it is clear that the highest (least negative) net benefit still occurs at 3.4 hours of repair time.

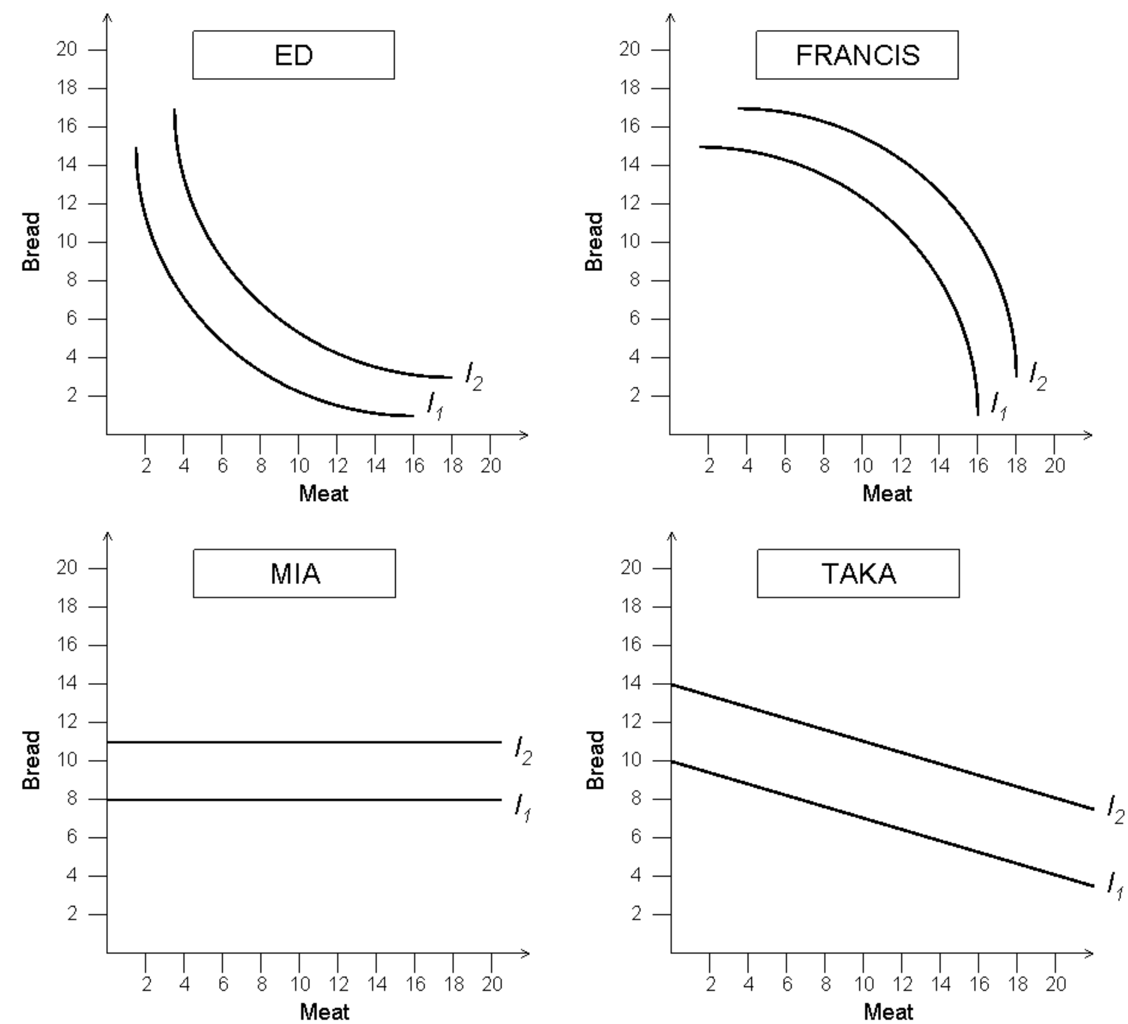
3.10
Once the investors had incurred expenses of ₤2.5 million, this cost became sunk and was no longer relevant to the decision about whether or not to complete the project. At this point, they compare the cost of an action to its benefit. Suppose the cost of quitting is ₤0, which would only be the case if they can just leave everything where it is and do not have contracts, which is not likely. For the sake of argument, however, let's suppose this cost is zero. The benefit of abandoning the project is also ₤0, since there would be no revenue earned. Therefore, the net benefit of abandoning the project is ₤0. They compare this to the benefit of completing the project (clearly, they would not choose to do more work, incurring more expenses, but still not complete the project). The benefit of completing the project is ₤4 million in revenue that they expect to earn. If the cost of completing the project is ₤X million, then the net benefit is ₤$(4 – X)$ million. So long as $X < 4$, this net benefit would be positive, making it greater than the net benefit of quitting. In other words, given that the initial ₤2.5 million is a sunk cost, investors will complete the project as long as they can break even starting from the present.

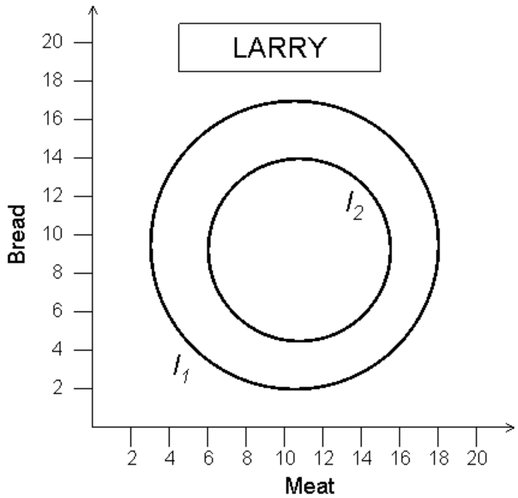
3.11
The answer would not change. Since sunk costs do not change as the choice changes, they are not captured by the *MC* curve. Therefore, no part of the drawing changes and the analysis remains the same.

Answers to End-of-Chapter 4 Questions

4.1
No. This is not a problem with consumer preference theory. Consumer preference theory does not require that preferences never change (such as with mood). What it does require is that, at any given time, a consumer *can* rank all possible alternatives (though possibly with ties). A great number of things, like mood, weather, income, expectations about the future, could possibly change these rankings from time to time—and this is perfectly in accord with consumer preference theory, so long as a ranking of some sort still exists and the consumer always chooses the alternative ranked most highly.

4.2
In each of the following, two indifference curves are given. In each case, they are drawn so that I_2 represents a higher level of utility than does I_1. The scale may vary on student responses, but the shapes should be contain the basic features as the curves given below.

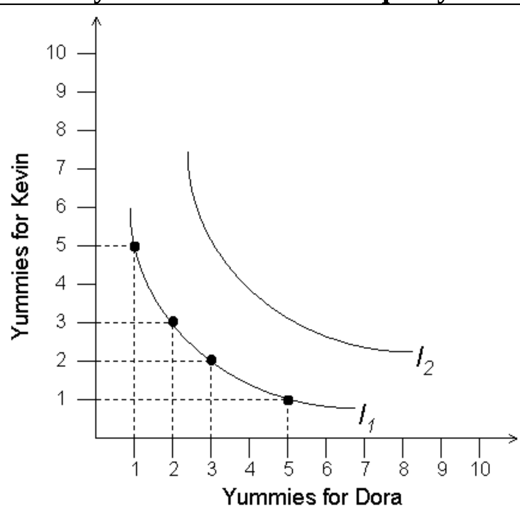




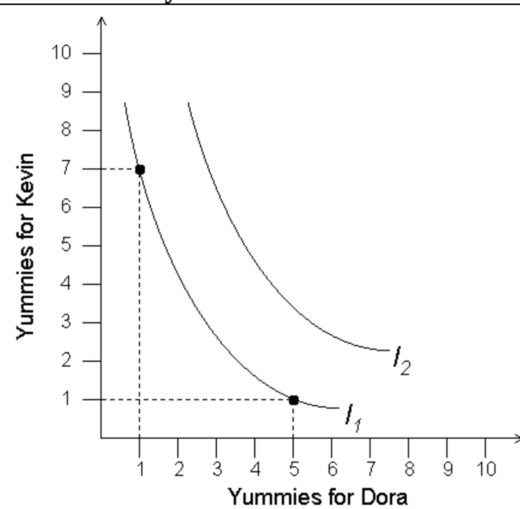
4.3

If Gary loved both children equally but preferred their yummy consumption to be closer to equal his indifference curves would be downward-sloping (he loves both children), symmetric about a 45-degree line (he loves the equally), and bowed inward (he prefers their consumption to be closer to equal). The indifference curves would look like the set of indifference curves on the left below.

Gary loves both children equally.



Gary loves Dora more.



If Gary loved one child more (suppose it was Dora), then that would mean that it would give Gary more pleasure to give yummies to Dora. In other words, the easiest way to make Gary happier would be to allow him to give Dora more yummies. This would make his indifference curves steeper (as drawn, with Dora's yummies on the horizontal axis), as in the set of indifference curves to the right above.

Be careful: just because the point (1,7) and the point (5,1) are on the same indifference curve doesn't mean that Gary loves Kevin more. What it in fact means is that, if the other child is only going to have one yummy, he has to see Kevin consume seven yummies just to get the same happiness he would get from watching Dora consume five yummies. Since he loves Dora more, he gets the same happiness out of her consuming fewer yummies than her brother (or stated differently, he gets more happiness from each yummy Dora gets to consume).

4.4

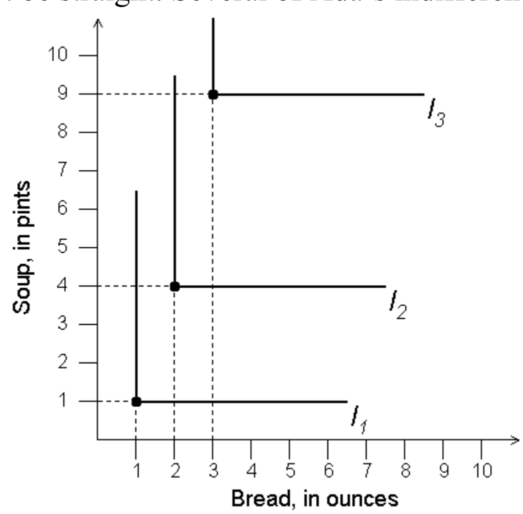
Gary's *MRS* for Kevin's yummies with Dora's yummies is equal to 1 when both Kevin and Dora have the same number of yummies. Because he loves them equally, if they each had the same number, giving one additional yummy to Kevin would provide the same additional happiness as giving one additional yummy to Dora.

If we are discussing MRS_{KD}, Gary's MRS for Kevin's yummies with Dora's yummies, then it becomes smaller when Kevin has more yummies (and larger when Dora has more yummies). The MRS_{KD}, tells us how much Gary values another yummy given to Kevin in terms of another yummy given to Dora. Since he prefers that his two children have equal numbers of yummies, when Kevin has more yummies than Dora, additional yummies to Dora are more valuable than additional yummies to Kevin (so MRS_{KD} falls). If Dora were to have more yummies, then the MRS_{KD} would rise, because additional yummies to Kevin would increase in value.

(Note: if the student discusses the MRS_{DK} instead, then the answer should be that it rises when Kevin has more yummies and falls when Dora has more yummies.)

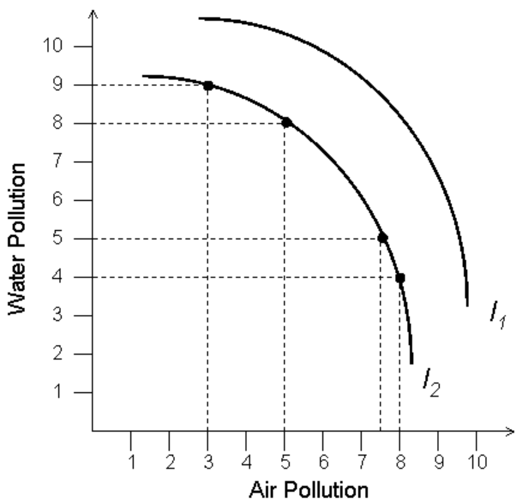
4.5

Since Ada eats soup and bread in fixed proportions, it must be that they are perfect complements, but the ratio of soup to bread is not constant. So, Ada has right angle indifference curves, but a line connecting the "corners" of the indifference curves would not be straight. Several of Ada's indifference curves are drawn below.



4.6
Student answers will vary considerably, but some acceptable answers include illness/heath, clear cutting/forests, war/peace, water pollution/clean water, inefficiency/efficiency, deceptive advertising/honest advertising, time spent studying/time spent partying (or vice versa, depending on the student's outlook).

4.7
Ryan's indifference curves look like the indifference curves below, where indifference curve I_2 represents a higher level of utility than indifference curve I_1. Since Ryan feels the same way about the two goods, the indifference curves should be downward-sloping, to indicate trades he is willing to make to leave his happiness unchanged: more of one makes him unhappy, but less of the other makes him more happy.



To understand the bowed-outward shape, consider the points plotted on indifference curve I_2. When water pollution is at a level of 8, a 1-unit increase causes Ryan so much additional unhappiness that he must be compensated (in order for his happiness to remain unchanged) with a 2-unit reduction in air pollution (from 5 to 3). However, when water pollution is at a lower level, like 4, a 1-unit increase in water pollution can be compensated for by just a ½-unit decrease in air pollution (from 8 to 7½). The bowed outward shape of the indifference curves shows that water (air) pollution has a worse marginal impact the higher the level of water (air) pollution; it shows that Ryan needs to be compensated more for such increases at higher levels.

4.8
If the consumer's preferences satisfy the condition of declining *MRS*, then the indifference curves are bowed-inward. If this is the case, then bundle *C* is preferred to bundles *A* and *B* because *C* lies on an indifference curve above the indifference curve on which bundles *A* and *B* lie. Bundle *C* will provide a more equal mix of the two goods than *A* and *B*, regardless of where they lie.

The drawing to the right shows this situation.

4.9
For the first two rabbits that Nora obtains, the principle of declining *MRS* may not hold. When Nora has zero rabbits, she may be willing to give up a certain amount of other goods to obtain the first rabbit. However, once she has the first rabbit, she is likely to be willing to give up much more to obtain the second rabbit so that she may begin breeding them. After that, the *MRS* may begin to decline as typically described. This situation could easily be described in terms of an always-declining *MRS*, however, if instead of thinking of individual rabbits as one good, we considered pairs of rabbits, for example, or if we considered male and female rabbits separately, which would be complementary goods. The declining *MRS* principle does not hold for Nora's rabbits. Students will probably come up with many examples similar to this one, where more than one unit of a good is needed to truly enjoy it. Other kinds of examples are goods that have characteristics similar to positive network externalities (though students will not use that term): one baseball card does not a collection make, but the more baseball cards a person has, the more of a "collector" they are, and so the more valuable cards become. Addictive substances also fit this description, because current consumption of cigarettes, for example, can increase the marginal benefit (or perceived marginal benefit) of future cigarettes.

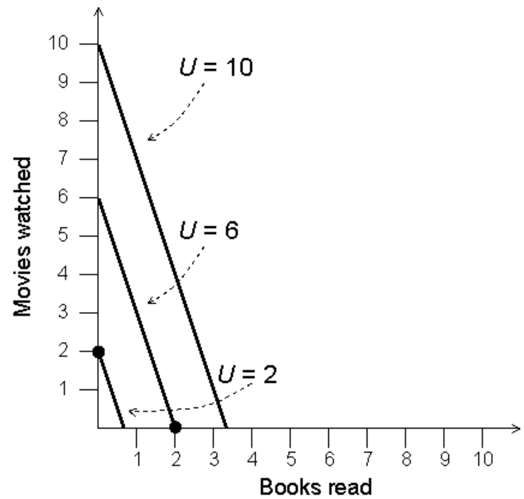
4.10
A person who prefers a sports car considers horsepower a more important feature than fuel economy. Consistent with Figure 4.10 on page 109, a person who considers the good on the vertical axis more important will have flatter indifference curves. Therefore, in Figure 4.5, a person who prefers a sports car will have flatter indifference curves. He or she will be willing to give up more fuel economy for additional horsepower than an individual who does not prefer a sports car. Or, stated differently, a reduction in horsepower needs to be compensated with a greater increase in fuel economy, since the reduction in horsepower has a greater negative effect on this person's utility. A person who prefers a compact car probably considers fuel economy more important than horsepower, and therefore will have steeper indifference curves (because fuel economy is on the horizontal axis). Again, Figure 4.10 on page 109 is helpful here. This person will give up more horsepower for smaller increases in fuel economy.

4.11
John is always willing to give up three movies for one book, meaning that his *MRS* for reading books for watching movies is equal to 3. ($MRS_{BM} = M/B$) To John, books and movies are perfect substitutes at the ratio of three movies to one book. If this is the case, then his indifference curves are linear, meaning that his utility function is also linear. John's utility function is of the form $U(B, M) = M + 3B$ (or some monotonic transformation of this). Students may accidentally put the coefficient of 3 on the *M* because it takes *three movies* to equal *one book*, but since books are more valuable to John, each book should have a greater impact on utility than each movie.

It is easy to understand why John would choose two books and no movies over two movies and no books, since books always bring John more utility. We can also get this result by simply plugging each bundle into the utility function and observing the result.

$U(2, 0) = 0 + 3(2) = \mathbf{6}$
$U(0, 2) = 2 + 3(0) = \mathbf{2}$

Further, we could get this result by examining these straight-line indifference curves, and we would notice that the bundle containing two books and no movies is on a higher indifference curve than the other bundle. Solving the utility function for M gives the formula for an indifference curve: $M = U – 3B$.



4.12
Answers will vary. Most obvious answers are given first, with descriptions of some other possible interpretations where likely or appropriate. The key is that students understand the differences between complements and substitutes, and further that they recognize that these characteristics are not contained within the goods *themselves*, but rather are revealed by the particular consumer's preferences.
(1) *Complements*. *Low*. There are lots of different goods that can be paired with either bread or butter. Context matters here: at a table in a restaurant, bread and butter are used together more often than they are at home.
(2) *Substitutes*. *High.* Context matters here as well: substitutability is high for many uses like writing down information, marking appointments on a calendar, performing mathematical operations. In some situations, they could even be complements; what if a customer needs a pen to fill out an order form that is then processed by a person who enters the information into a computer?
(3) *Substitutes*. *High*. Like in (2), only in very specific situations might these be complements. A student might point out that fax machines (needed for facsimile service) ordered over the phone or internet might be shipped via mail service, making them complements.
(4) *Substitutes*. *Low*. While both movies and video games provide entertainment, they do so in very different ways. Video games are active and possibly competitive, making them also substitutes for card games or sports. Movies are passive and sometimes involve going out, making them substitutes also with the ballet or opera. When video games are made based on movies or vice versa (yes, it has happened!) then the two goods are complements.
(5) Most students will probably say *Substitutes* with *Low* substitutability, because they are both fuels but fuels are not easily interchangeable. A better answer might be that they are *Complements*, however, since most or all gasoline sold now has some ethanol in it.
(6) *Substitutes*, *High*.

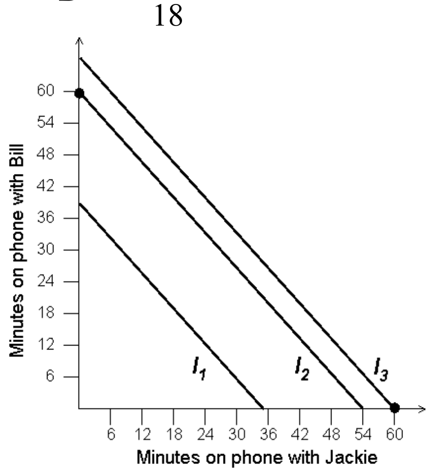
(7) This will depend on the student. The student will say *Substitutes* (*High*) if the goal of owning CDs is simply to listen to music by that artist. The student will say *Complements* (probably *Low*) if owning more of an artists' catalogue makes that artists' music more enjoyable, or if the goal is to have as complete a collection as possible.
(8) *Complements*. *Low*. Though they are both foods, in most situations lettuce and beef are not interchangeable. More likely they are used together in applications like burgers or tacos.

4.13
Kate will willingly give up at most four M&Ms for every one Milk Dud that she receives. This means that she would give up all her M&Ms for anything more than six-and-a-quarter Milk Duds. For Antonio to willingly trade, he must be given at least three M&Ms for every one Milk Dud that he gives up. This means that he would give away up to eight-and-a-third Milk Duds for all of Kate's M&Ms. There are not enough M&Ms in play to convince Antonio to give up all of his Milk Duds (there would have to be 30).

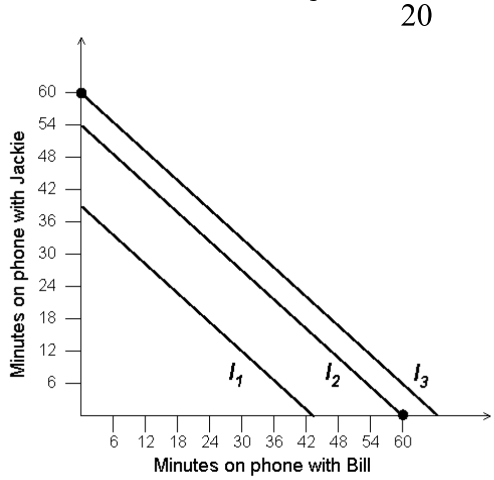
Kate would probably give all of her M&Ms to Antonio, and Antonio would give either seven or eight Milk Duds to Kate. If the trade involves seven Milk Duds, Kate is still better off, because this would be equivalent to her of having 28 M&Ms. If the trade involved eight Milk Duds for 25 M&Ms, this would still make Antonio better off because these 25 M&Ms are worth eight-and-a-third Milk Duds. Since Antonio values M&Ms more than Kate does (by valuing Milk Duds less) and since he has enough Milk Duds to purchase all of the M&Ms, he will end up with all the M&Ms.

4.14
If Latanya's utility function is $U(B, J) = 18B + 20J$, then that means she believes that 20 minutes on the phone with Bill is a perfect substitute for 18 minutes on the phone with Jackie. In other words, she values time spent on the phone talking with Jackie more. Because a minute speaking with Jackie is equal in length to a minute speaking with Bill, she should not waste her time speaking with Bill, but use all of it to speak with Jackie, with whom she prefers to speak. Her indifference curves are of the form:

$$B = \frac{U - 20J}{18} \quad \text{or} \quad J = \frac{U - 18B}{20}$$



or



Notice that spending all 60 minutes on the phone with Jackie puts Latanya on a higher indifference curve than does spending all 60 minutes on the phone with Bill.
We could also calculate her utility from each conversation and draw the same conclusion.

$U(B, J) = 18B + 20J$
$U(60, 0) = 18(60) + 20(0) = \mathbf{1{,}080}$
$U(0, 60) = 18(0) + 20(60) = \mathbf{1{,}200}$

4.15
Cardinal information from preferences is incredibly difficult to obtain. Utility is not something that is easily measurable. If you asked consumers to measure their happiness, chances are it would be arbitrary and highly variable from person to person. One possible way to measure someone's happiness might be to ask them how much money they would require to be compensated for having goods taken from them, or rather, how much they would be willing to pay in order to prevent this from happening. The reliability of these measures, however, depends on the person's ability to assess these extreme situations and also the current price level of all goods. Fortunately, in economics, we don't require cardinal measures of utility, because we know that an economic actor will always choose the option that provides the *highest* utility, regardless of what that utility level is. Therefore, ordinal measures are good enough.

4.16
The marginal utility of speaking with Bill (MU_B) is the coefficient on B, which is 18. We can see easily that if we increase B by 1 unit, U would always increase by 18. The marginal utility of speaking with Jackie (MU_J) is the coefficient on J, which is 20. Likewise, a 1-unit increase in J increases U by 20.

The MRS for minutes speaking with Bill with minutes speaking with Jackie (MRS_{BJ}) tells us how much she values a minute spent speaking with Bill in terms of a minute spent speaking with Jackie. Since she values speaking with Jackie more, we expect this number to be less than one, which it is. Using the formula for MRS given on page 118, we get an answer of 0.9:

$$MRS_{BJ} = \frac{MU_B}{MU_J} = \frac{18}{20} = 0.9$$

4.17
To construct the family of indifference curves, we need to solve Esteban's utility function for either C or S.

$U(C, S) = C^{1/3}S^{2/3}$
$U^3 = CS^2$
$$C = \frac{U^3}{S^2}$$

or

$U(C, S) = C^{1/3}S^{2/3}$
$U^3 = CS^2$

$$S^2 = \frac{U^3}{C}$$

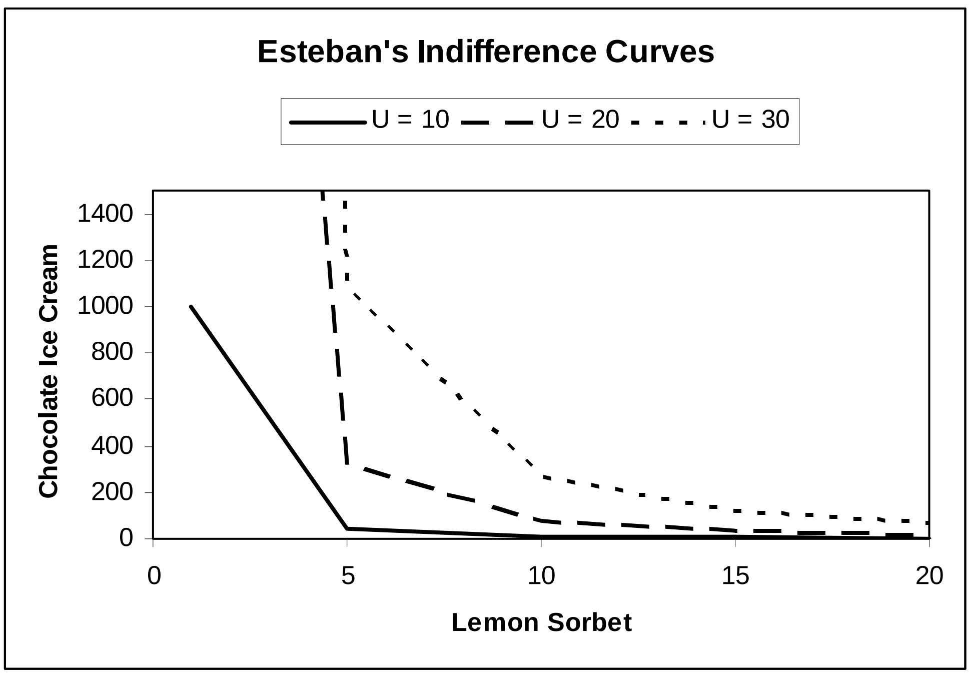
$$S = \frac{U^{3/2}}{C^{1/2}}$$

Now that we have the formula for the family of indifference curves, we can plot some by plugging in arbitrary values for *U*. Here is an example:

***U* = 10**		***U* = 20**		***U* = 30**	
S	***C***	***S***	***C***	***S***	***C***
1	1,000	1	8,000	1	27,000
5	40	5	320	5	1,080
10	10	10	80	10	270
15	4.44	15	35.56	15	120

***U* = 10**		***U* = 20**		***U* = 30**	
C	***S***	***C***	***S***	***C***	***S***
1	32	1	89.44	1	164.31
5	14.14	5	40	5	73.48
10	10	10	28.28	10	51.96
15	8.16	15	23.09	15	42.43

And here are the indifference curves (graphed in Excel) given by the numbers in the leftmost table above:



To compare the two possible bundles for Esteban, we just need to calculate the utility he gets from each bundle.

$U(C, S) = C^{1/3}S^{2/3}$
$U(4, 2) = 4^{1/3}2^{2/3} = (1.587)(1.587) = \mathbf{2.519}$
$U(2, 4) = 2^{1/3}4^{2/3} = (1.260)(2.520) = \mathbf{3.175}$

Since 3.175 > 2.519, Esteban would prefer to have two ounces of chocolate ice cream and four ounces of lemon sorbet.