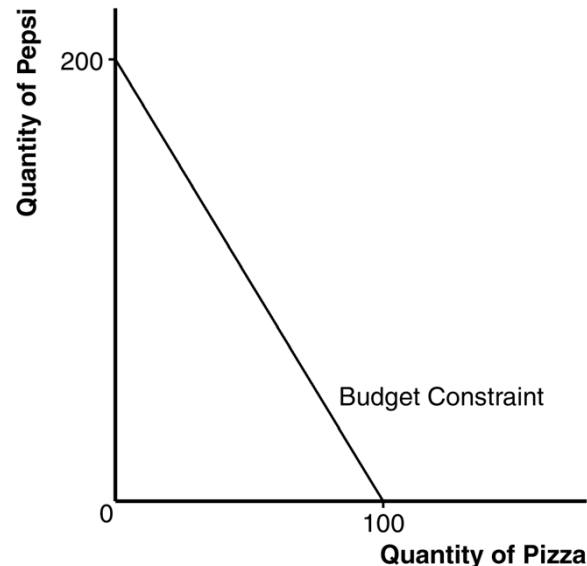# SOLUTIONS TO TEXT PROBLEMS:

Quick Quizzes

Figure 1

1.   A person with an income of $1,000 could purchase $1,000/$5 = 200 pints of Pepsi if she spent all of her income on Pepsi or she could purchase $1,000/$10 = 100 pizzas if she spent all of her income on pizza.   Thus the point representing 200 pints of Pepsi and no pizzas is the vertical intercept and the point representing 100 pizzas and no Pepsi is the horizontal intercept of the budget constraint, as shown in Figure 1. The slope of the budget constraint is the rise over the run, or -200/100 = -2.

2.   Figure 2 shows indifference curves between Pepsi and pizza.   The four properties of these indifference curves are: (1) higher indifference curves are preferred to lower ones because consumers prefer more of a good to less of it; (2) indifference curves are downward sloping because if the quantity of one good is reduced, the quantity of the other good must increase in order for the consumer to be equally happy; (3) indifference curves do not cross because if they did, the assumption that more is preferred to less would be violated; and (4) indifference curves are bowed inward because people are more willing to trade away goods that they have in abundance and less willing to trade away goods of which they have little.
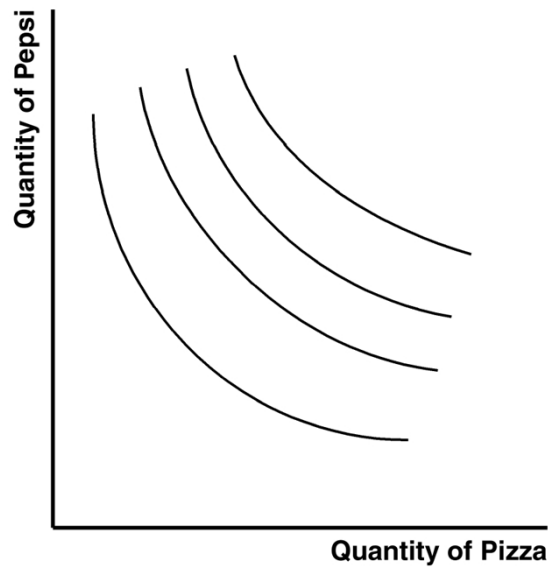
Quantity of Pepsi (vertical axis)

Quantity of Pizza (horizontal axis)

Figure 2

3.   Figure 3 shows the budget constraint (BC_1) and two indifference curves.   The consumer is initially at point A, where the budget constraint is tangent to an indifference curve.   The increase in the price of pizza shifts the budget constraint to BC_2, and the consumer moves to point C where the new budget constraint is tangent to a lower indifference curve.   To break this move down into income and substitution effects requires drawing the dashed budget line shown, which is parallel to the new budget constraint and tangent to the original indifference curve at point B.   The movement from A to B represents the substitution effect, while the movement from B to C represents the income effect.
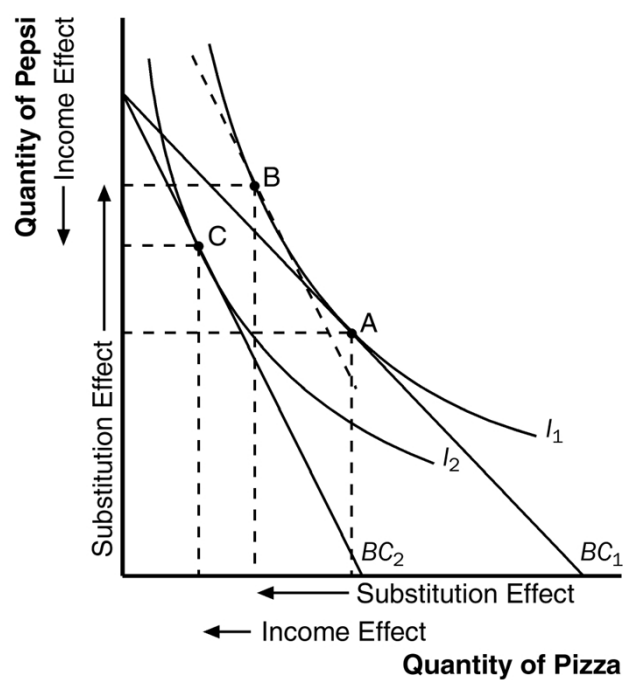

Quantity of Pepsi
Income Effect
Substitution Effect

B

C

A

I_1

I_2

BC_2

BC_1

Substitution Effect

Income Effect

Quantity of Pizza

Figure 3

4.   An increase in the wage can potentially decrease the amount that a person wants to work because a higher wage has an income effect that increases both leisure and consumption and a substitution effect that increases consumption and decreases leisure.   Since less leisure means more work, a person will work more only if the substitution effect outweighs the income effect.
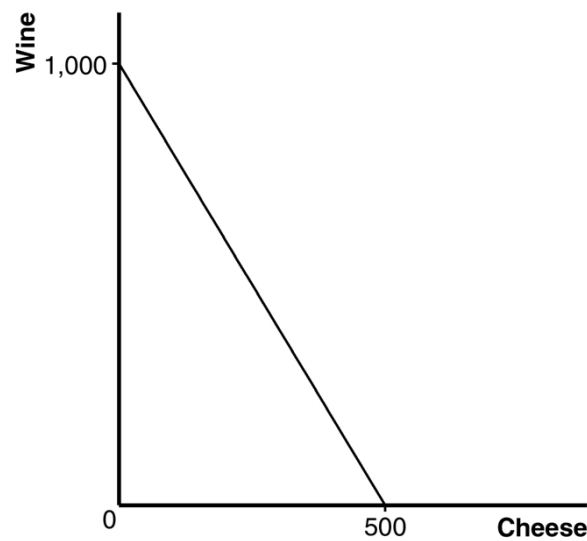
Questions for Review

Figure 4

1.   Figure 4 shows the consumer's budget constraint.   The intercept on the horizontal axis shows how much cheese the consumer could buy if she bought only cheese; with income of $3,000 and the price of cheese $6 a pound, she could buy 500 pounds of cheese.   The intercept on the vertical axis shows how much wine the consumer could buy if she bought only wine; with income of $3,000 and the price of wine $3 a glass, she could buy 1,000 glasses of wine.   With cheese on the horizontal axis and wine on the vertical axis, the budget constraint has a slope of -1,000/500 = -2.   Note that if you would put wine on the horizontal axis and cheese on the vertical axis, the budget constraint would have a slope of -500/1,000 = -1/2.

2.   Figure 5 shows a consumer's indifference curves for wine and cheese.   Four properties of these indifference curves are: (1) higher indifference curves are preferred to lower ones because more is preferred to less; (2) indifference curves are downward sloping because if the quantity of wine is reduced, the quantity of cheese must increase for the consumer to be equally happy; (3) indifference curves do not cross since a consumer prefers more to less; and (4) indifference curves are bowed

inward since a consumer is more willing to trade away wine if she has a lot of it and less willing to trade away cheese if she has little of it.
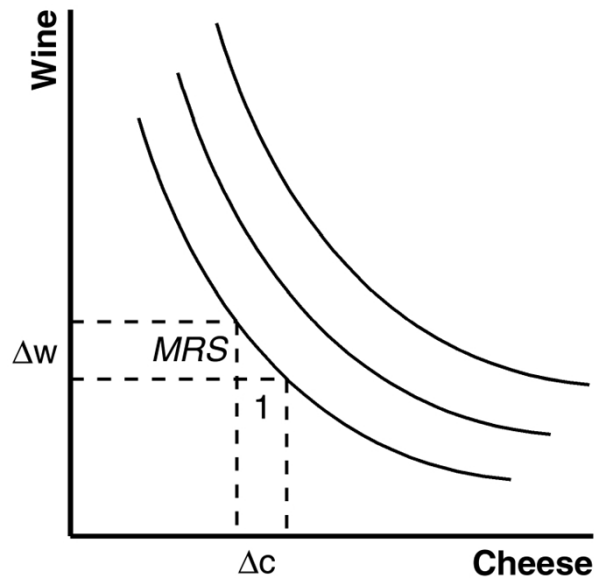

Figure 5

3.   In Figure 5, the marginal rate of substitution (*MRS*) of one point on an indifference curve is shown.   The marginal rate of substitution shows the amount of wine the consumer would be willing to give up to get one more pound of cheese.

4.   Figure 6 shows the consumer's budget constraint and indifference curves for wine and cheese.   The consumer's optimum consumption choice is shown as w^* and c^*. Since the marginal rate of substitution equals the relative price of the two goods at the optimum, the marginal rate of substitution is $6/$3 = 2.
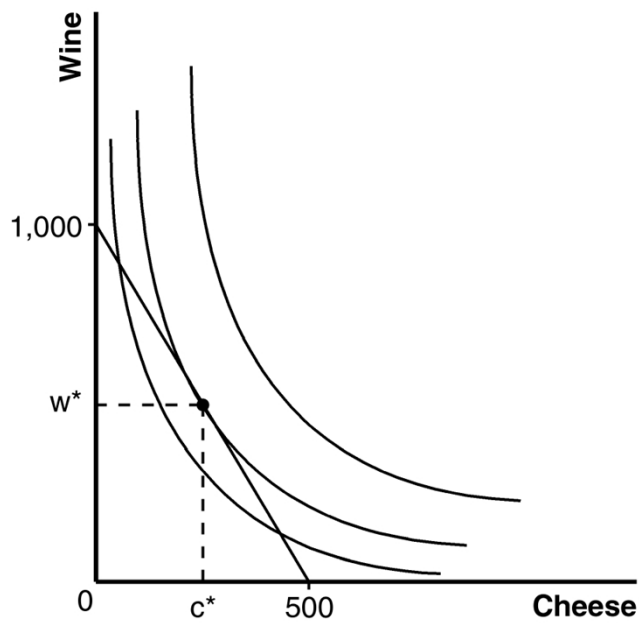
Figure 6

5.   Figure 7 shows the effect of an increase in income.   The rise in income shifts the budget constraint out from BC_1 to BC_2.   If both wine and cheese are normal goods, consumption of both increases.   If cheese is an inferior good, the increase in income causes the consumption of cheese to decline, as shown in Figure 8.
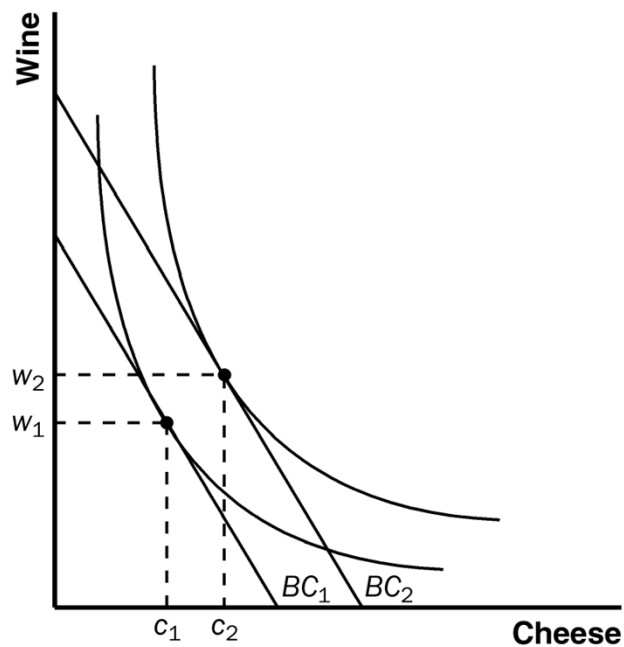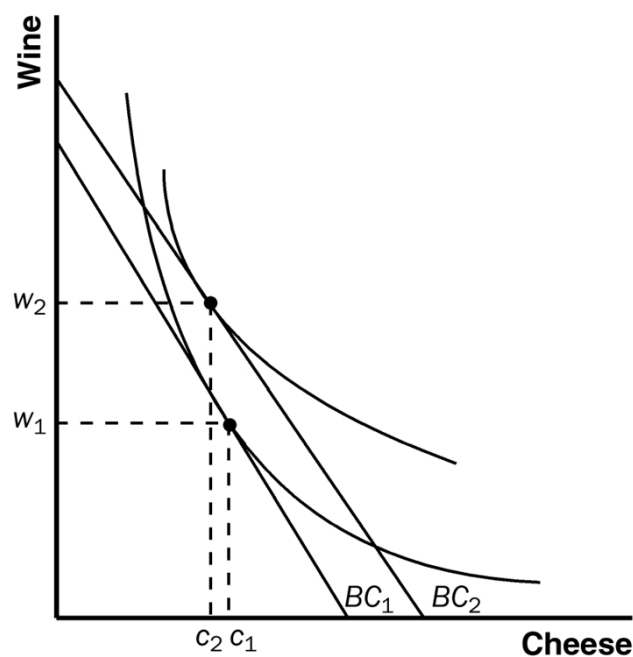

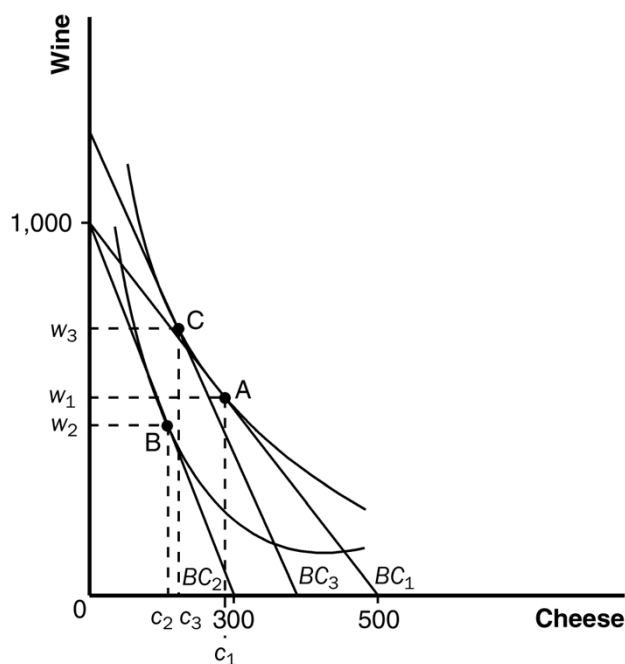**Figure 7**

Figure 8

Figure 9

6.   A rise in the price of cheese from \$6 to \$10 a pound makes the horizontal intercept of the budget line decline from 500 to 300, as shown in Figure 9.   The consumer's budget constraint shifts from BC_1 to BC_2 and her optimal choice changes from point A (c_1 cheese, w_1 wine) to point B (c_2 cheese, w_2 wine).   To decompose this change into income and substitution effects, we draw in budget constraint BC_3, which is parallel to BC_2 but tangent to the consumer's initial indifference curve at point C.

The movement from point A to C represents the substitution effect. Since cheese became more expensive, the consumer substitutes wine for cheese as she moves from point A to C. The movement from point C to B represents an income effect. The rise in the price of cheese results in an effective decline in income.

7.   An increase in the price of cheese could induce a consumer to buy more cheese if cheese is a Giffen good. In that case, the income effect of the rise in the price of cheese induces the consumer to buy more cheese if cheese is an inferior good. If the income effect is bigger than the substitution effect (which induces the consumer to buy less cheese), the consumer would buy more cheese.

Problems and Applications

1.   a.   Figure 10 shows the effect of the frost on Jennifer's budget constraint. Since the price of coffee rises, her budget constraint swivels from BC_1 to BC_2.

      b.   If the substitution effect outweighs the income effect for croissants, Jennifer buys more croissants and less coffee, as shown in Figure 10. She moves from point A to point B.
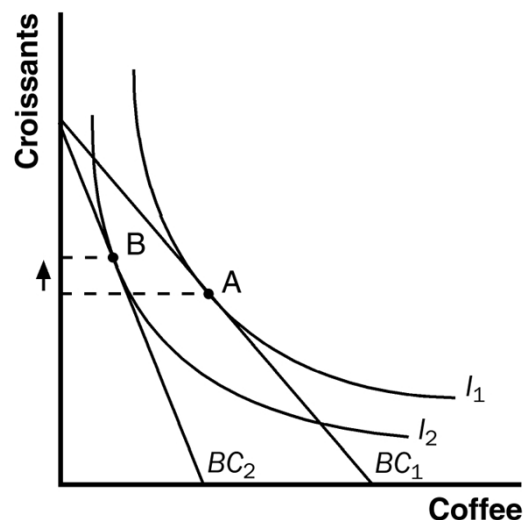

Figure 10

      c.   If the income effect outweighs the substitution effect for croissants, Jennifer buys fewer croissants and less coffee, moving from point A to point B in Figure 11.
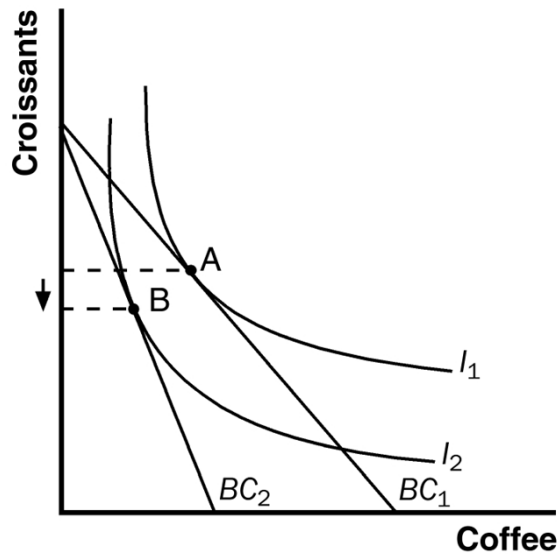
Figure 11

2.   Indifference curves between Coke and Pepsi are fairly straight, since there is little to distinguish them, so they are nearly perfect substitutes.   Indifference curves between skis and ski bindings are very bowed, since they are complements.   A consumer will respond more to a change in the relative price of Coke and Pepsi, possibly switching completely from one to the other if the price changes.

3.   a.   Cheese and crackers cannot both be inferior goods, since if Mario's income rises he must consume more of something.

      b.   If the price of cheese falls, the substitution effect means Mario will consume more cheese and fewer crackers.   The income effect means Mario will consume more cheese (since cheese is a normal good) and fewer crackers (since crackers are an inferior good).   So, both effects lead Mario to consume more cheese and fewer crackers.

Figure 12

4.   a.   Figure 12 shows Jim's budget constraint.   The vertical intercept is 50 quarts of milk, since if Jim spent all his money on milk he would buy $100/$2 = 50 quarts of it.   The horizontal intercept is 25 dozen cookies, since if Jim spent all his money on cookies he would buy $100/$4 = 25 dozen cookies.

      b.   If Jim's salary rises by 10 percent to $110 and the prices of milk and cookies rise by 10 percent to $2.20 and $4.40, Jim's budget constraint would be unchanged.   Note that $110/$2.20 = 50 and $110/$4.40 = 25, so the intercepts of the new budget constraint would be the same as the old budget constraint.   Since the budget constraint is unchanged, Jim's optimal consumption is unchanged.
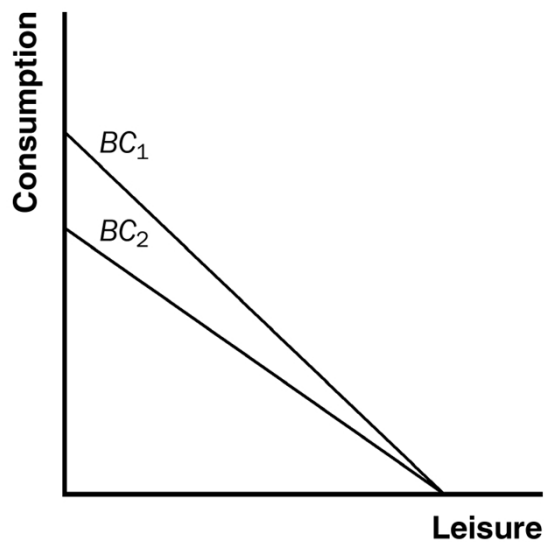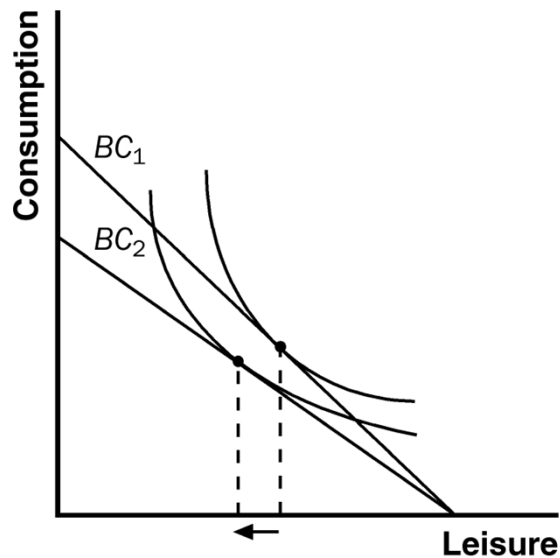

Figure 13

Figure 14

5.   a.   Budget constraint BC_1 in Figure 13 shows the budget constraint if you pay no taxes. Budget constraint BC_2 shows the budget constraint with a 15 percent tax.

        b.   Figure 14 shows indifference curves for which a person will work more as a result of the tax because the income effect (less leisure) outweighs the substitution effect (more leisure), so there is less leisure overall. Figure 15 shows indifference curves for which a person will work fewer hours as a result of the tax because the income effect (less leisure) is smaller than the substitution effect (more leisure), so there is more leisure overall. Figure 16 shows indifference curves for which a person will work the same number of hours after the tax because the income effect (less leisure) equals the substitution effect (more leisure), so there is the same amount of leisure overall.
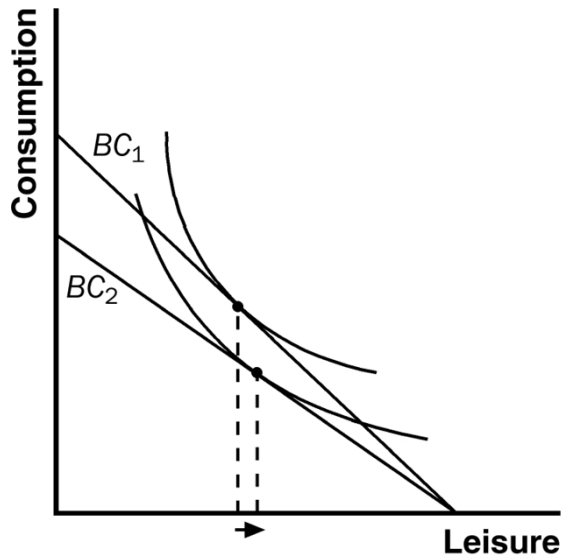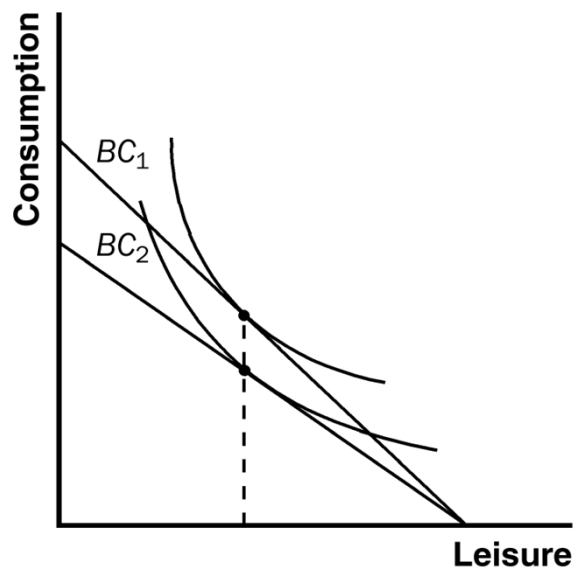
Figure 15

Figure 16

6. Figure 17 shows Sarah's budget constraints and indifference curves if she earns $6 ($BC_1$), $8 ($BC_2$), and $10 ($BC_3$) per hour. At a wage of $6 per hour, she works 100 - L_6 hours; at a wage of $8 per hour, she works 100 - L_8 hours; and at a wage of $10 per hour, she works 100 - L_{10} hours. Since the labor supply curve is upward sloping when the wage is between $6 and $8 per hour, $L_6 > L_8$; since the labor supply curve is backward sloping when the wage is between $8 and $10 per hour, $L_{10} > L_8$.
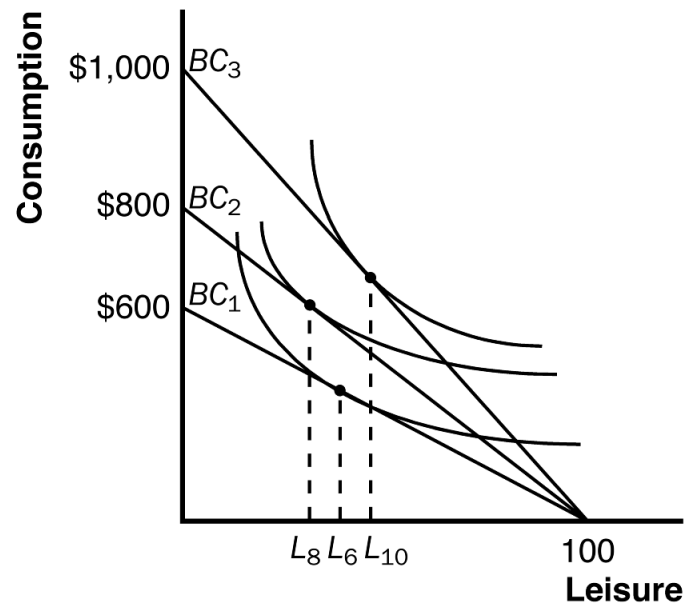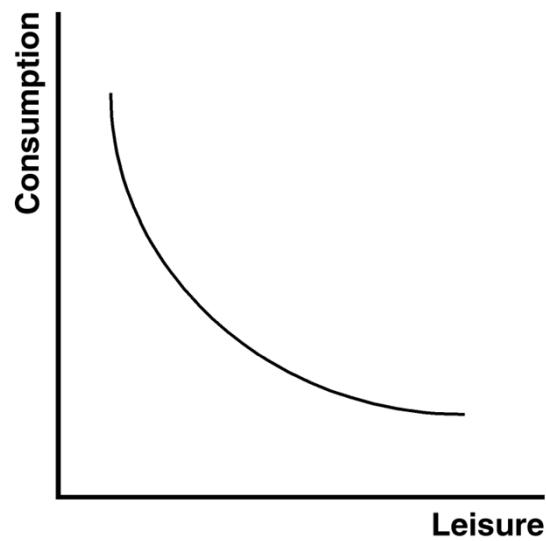
Figure 17

Figure 18

7.   Figure 18 shows the indifference curve between leisure and consumption that determines how much a person works.   An increase in the wage leads to both an income effect and a substitution effect.   The higher wage makes the budget constraint steeper, so the substitution effect increases consumption and reduces leisure.   But the higher wage has an income effect that increases both consumption and leisure if both are normal goods.   The only way that consumption could decrease when the wage increased would be if consumption is an inferior good and if the negative income effect outweighs the positive substitution effect.   This could

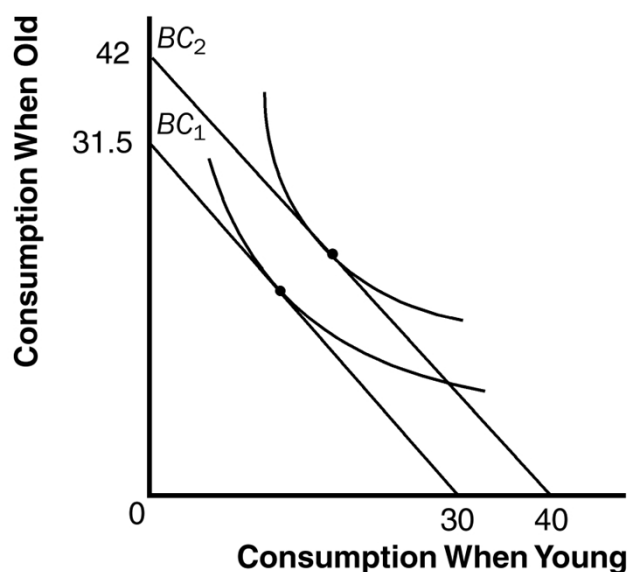happen for a person who really placed an exceptionally high value on leisure.

Figure 19

8.   a. Figure 19 shows the situation in which your salary increases from $30,000 to $40,000.   With numbers shown in thousands of dollars in the figure, your initial budget constraint, BC_1, has a horizontal intercept of 30, since you could spend all your income when young.   The vertical intercept is 31.5, since if you spent nothing when young and saved all your income, earning 5 percent interest, you would have $31,500 to spend when old.   If your salary increases to $40,000, your budget constraint shifts out in a parallel fashion, with intercepts of 40 and 42, respectively.   This is an income effect only, so if consumption when young and old are both normal goods, you will spend more in both periods.

          b.   If the interest rate on your bank account rises to 8 percent, your budget
                  constraint rotates.   If you spend all your income when young, you will spend
                  just $30,000, as before.   But if you save all your income, your old-age
                  consumption increases to $30,000 x 1.08 = $32,400, compared to $31,500
                  before.   As Figure 20 indicates, the steeper budget line leads you to
                  substitute future consumption for current consumption.   But the income
                  effect of the higher return on your saving leads you to want to increase both
                  future and current consumption if both are normal goods.   The result is that
                  your consumption when old certainly rises and your consumption when
                  young could increase or decrease, depending on whether the income or
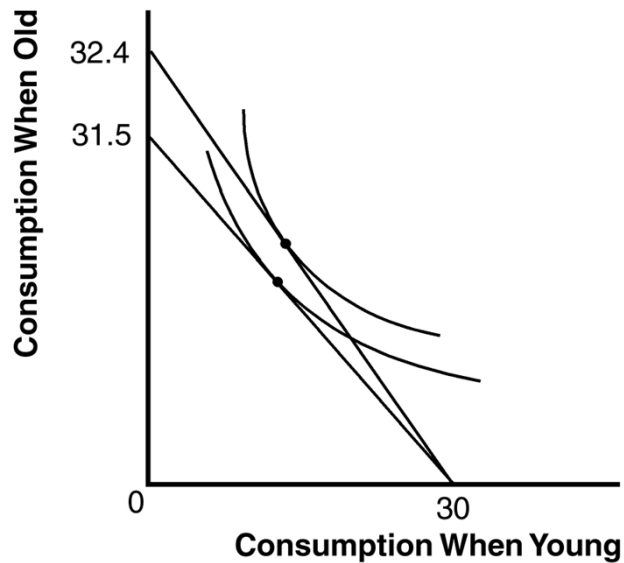   substitution effect dominates.

Figure 20

9.   The decline in the interest rate on savings has both income and substitution effects, since it causes the budget constraint to rotate.   Since consumption when old effectively becomes more expensive relative to consumption when young, there is a substitution effect that increases consumption when young and decreases consumption when old.   The lower interest rate also leads to a negative income effect, causing both consumption when young and consumption when old to decline if both are normal goods.   Combining both effects, consumption when old definitely declines and consumption when young might rise or fall, depending on whether the income or substitution effect is stronger.

10.   a.   Figure 21 shows the effects of the welfare program.   Without the program, the budget constraint would begin on the horizontal axis at point L_{max} when the family earns no labor income and would have a slope equal to the wage rate.   The program provides income of a certain amount if the family earns no labor income, shown as the point A on the figure.   Then, if income is earned, the welfare payment is reduced, so the slope of the budget line is less than the slope of the budget line without welfare.   At the point where the two budget lines meet, the welfare program provides no further support.

  b.   The figure shows how indifference curves could be shaped, indicating a reduction in the number of hours worked by the family because of the welfare program.   Since the welfare budget constraint is flatter, there is a substitution effect away from consumption and towards leisure.   Since the welfare budget constraint is farther from the origin, there is an income effect that increases both consumption and leisure, if both are normal goods.   The overall effect is that the change in consumption is ambiguous and the family will want to have more leisure; hence, it will reduce its labor supply.

c.   There is no doubt that the family's well-being is increased, since the welfare program gives them consumption and leisure opportunities that were not available before and they end up on a higher indifference curve.
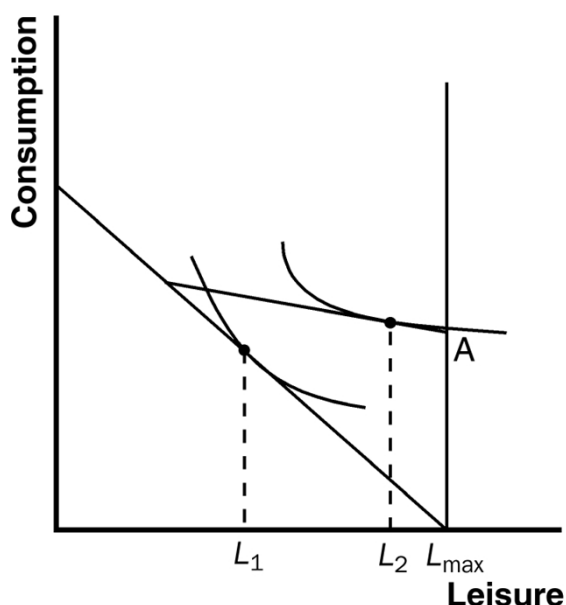

Figure 21

11. a.   A lower tax rate would give rise to income and substitution effects on a person's choice of consumption and leisure.   The income effect would increase both consumption and leisure, if both goods were normal goods, since the reduction in the tax rate leaves more after-tax income.   The lower tax rate would increase the slope of the budget constraint, so the substitution effect would increase consumption and decrease leisure.   The net result is an increase in consumption and an ambiguous effect on leisure, and thus an ambiguous effect on labor supply.

     b.   An increase in the amount on which no tax is owed would be a pure income effect.   If both consumption and leisure are normal goods, both would increase, so labor supply would decrease.

12. a.   If a person's utility depends on the lowest level of consumption during her two periods of life, then her indifference curves between consumption when young and consumption when old will be right angles, with the angle occurring where consumption in the two periods are equal, as shown in Figure 22.

     b.   The budget constraint, BC_1, is shown in the figure.   Note that the optimum occurs where the budget constraint just hits one of the right-angled indifference curves.

c. An increase in the interest rate shifts the budget constraint to BC_2. Since (at the optimum) consumption when young must equal consumption when old, the person increases consumption in both periods. Thus the person saves less even though the interest rate increased. In this case, there is no substitution effect from the higher interest rate, because of the shape of the indifference curves. The only effect is an income effect, leading the person to increase consumption in both periods.
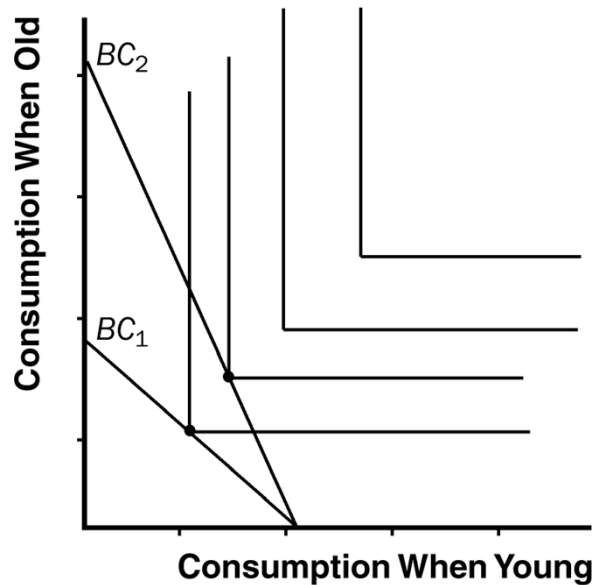

Figure 22

13. If consumers do not buy less of a good when their incomes rise, the good in question must be a normal good. For a normal good, the income and substitution effects both imply that the consumer will buy less if the price rises.