When simplifying expressions, use the following rules for *order of operations:*

- First, perform operations within parentheses or other grouping symbols.
- Next, simplify any exponents.
- Then, multiply and divide in order from left to right.
- Last, add and subtract in order from left to right.

Simplify each expression. Round your answer to the nearest hundredth.

1. $7 + (4 \bullet 2)$
2. $(7 + 4) \bullet 2$
3. $3 \bullet \left(8 + \dfrac{4}{3}\right)^4$
4. $3 \bullet 8^4 + \dfrac{4}{3}$

5. $13^2[(2 \bullet 9)^3(7 \div 9)]$
6. $[13^2(2 \bullet 9^3)][7 \div 9]$

7. $2.78(9876 - 500 \div 25)$
8. $16[4 - 3.1(42 - 3^4 \div 9) + 7]$

A *relation* is a set of ordered pairs of numbers. The set of ordered pairs $\{(0, 2), (1, 3), (2, 5), (3, 10), (5, 14)\}$ is a relation. The set of replacements for the first variable x is called the *domain* of the relation. The set of replacements for the second variable y is called the *range* of the relation. A *function* is a relation in which each member of the domain is paired with exactly one member of the range. The above relation *is* a function because for each x there is only one y. The relation $\{(2, 3), (3, 4), (2, 6)\}$ is *not* a function because the x value of 2 is paired with y values of 3 *and* 6.

Find the domain and range of each relation.

9. $\{(7, 3), (3, 7), (2, 4)\}$
10. $\{(8, 3), (3, 8), (8, 8)\}$

11. Is the relation in Exercise 8 a function? Why or why not?

12. Is the relation in Exercise 9 a function? Why or why not?

Solve for y if $x = 16$.

13. $y = x^2 + x$
14. $y = x^3$
15. $y = x^{\frac{1}{4}}$

16. $y = x^4 - x$
17. $y = \sqrt{x}$
18. $y = \sqrt[3]{x + 11}$

19. The Berger family spent the following amount of money on food in 1993:

January: $500	February: $610	March: $715
April: $650	May: $509	June: $636
July: $702	August: $653	September: $619
October: $515	November: $598	December: $550

Determine the percent of their 1993 food costs that occurred in each month to the nearest hundredth of a percent.

CREDIT CARDS

THE AMERICAN ECONOMY HAS GRADUALLY shifted away from a system in which individuals and families produced or grew most of what they needed, and offered these products in exchange for goods and services provided by others. In America today, the production and distribution of goods and services is on a much larger scale. Our economy is so specialized that companies exist not only to create products and services, but also to convince us that we should acquire more of these products. The banking industry processes the money exchanged among businesses and offers many services that keep our economy flowing.

One major service offered to consumers by banks, retailers, and other companies is the credit card (or charge card). Bankers and merchants have realized that if they make credit convenient and painless for us, merchants will sell more. The banks can then charge both the consumer and the merchant for the use of their credit cards. We seem to be more willing to hand over a plastic card than money, so we have a tendency to spend more with credit cards.

If we use our credit cards for a period of time and pay small finance charges each month, we may be tempted to use them over and over again until the monthly finance charges become quite large. Our wants become needs. We can no longer afford to buy items that we really need because all of our extra money is spent keeping up the minimum payments for the items that we previously bought on credit.

Fortunately, we do not have to go completely under and declare bankruptcy.

BUYER'S *plus*

4409 393 212 480

If we watch our spending and begin to repay our debts, we can slowly diminish our credit load. Congress has passed laws to help protect us from ourselves. However, part of the price we pay for living in a free society is the opportunity to make bad choices and the responsibility for coping with the consequences of those choices.

In this chapter our high school students will take a close look at the costs and conveniences of using credit cards. They will learn how individuals qualify for credit cards. They will observe some of the warning signs of credit overload, as well as some of the difficulties we face once we are in over our heads. They will also examine some steps to take to regain financial stability.

Sylvia Shawn enjoys spending money. She has a bumper sticker on her car that reads "When the Going Gets Tough, the Tough Go Shopping." Her parents are divorced, and she lives with her mother. Since her mother rarely takes her shopping, Sylvia looks forward to shopping with her father during the two weekends that she sees him every month. Paying for everything seems simple for him, but he rarely carries any cash.

Their first stop is usually at a gas station to fill up the tank of his yellow sports car. While there, Sylvia picks up a snack and a soft drink, and her father grabs several packs of baseball cards. He pays for these purchases with his handy oil credit card. Then they are off to Sylvia's favorite shopping mall, where he waits patiently while she tries on eight or ten outfits before selecting two or three. He also lets her buy jewelry and accessories to match her outfits. He always pays with a credit card. It seems as though he has a credit card for every department store!

Since Sylvia will be going away to college next year, her father has been helping her select an elaborate nine-piece set of luggage. For this purchase, he uses a card called a VISA card. He has several VISA cards from different banks across the country. He calls them his "plastic money" cards.

When they finish shopping, Sylvia's dad often takes her to a fancy restaurant for dinner, where he uses his American Express card. He calls it his "entertainment expense account" card, and he uses it for restaurant meals, airline tickets, car rentals, and other travel expenses.

Sylvia does not understand how he got so many cards and why he does not carry real money instead. Her mother has several credit cards, but she rarely uses them. When her parents were still married, they frequently argued about the use of credit cards. Her mother is particularly against using credit cards for cash advances. Sylvia would like to know more about credit cards.

In this lesson, we will help Sylvia to:

Describe how credit cards are used.

Identify three categories of credit cards and several companies that offer the cards in each category.

Determine the new balance that will be shown on a credit card statement after a purchase is made.

Calculate the effective rate of interest on a credit card purchase.

WHAT IS A CREDIT CARD AND HOW DOES IT WORK?

A **credit card** is a small plastic card, approximately 2" by $3\frac{1}{2}$", that identifies the holder and extends to the cardholder an unsecured line of credit. Most cards entitle the holder to charge purchases up to a maximum **credit limit.** By signing the application for the card, the cardholder agrees to pay for purchases according to the credit card terms. The **Truth in Lending Act** requires that the credit card company disclose all terms associated with its card, including the annual percentage rate, finance charges, **late payment penalties,** grace period, membership fee, and so on. Examples of companies that issue these cards are local department stores, national retail chains, car rental companies, travel and entertainment companies, airlines, telephone companies, oil companies, hotel/motel chains, and commercial banks.

When a customer uses a credit card in a store, the merchant turns in the charge to the store's bank. The store's bank notifies the bank that issued the card that a purchase has been made. The issuing bank then bills the cardholder for all purchases made that month. The cardholder writes one check for all purchases payable to the issuing bank. Through the bank card system, the card issuer then pays the merchant's bank. The merchant's bank has already paid the merchant.

TYPES OF CARDS

There are four categories of cards: (1) single-purpose credit cards; (2) multipurpose travel, food, and entertainment cards; (3) all-purpose bank credit cards; and (4) debit cards.

Single-purpose credit cards include those from oil companies such as Exxon, Mobil, and Shell and those from stores such as Sears, Montgomery Ward, and Neiman Marcus. Sylvia's father uses an oil company card and cards from the stores in the mall, which are all single-purpose cards. There is no fee for this kind of card, and the card allows him to make purchases or obtain services at the store, station, or company that issued it. The purpose of such a card is to encourage you to buy exclusively from a particular company. If you have a credit card from one specific oil company, you are likely to buy much of your gasoline at that company's stations.

Multipurpose travel and entertainment cards include American Express, Diners Club, and Carte Blanche. There is an annual membership fee for these cards. For this membership fee, these cards
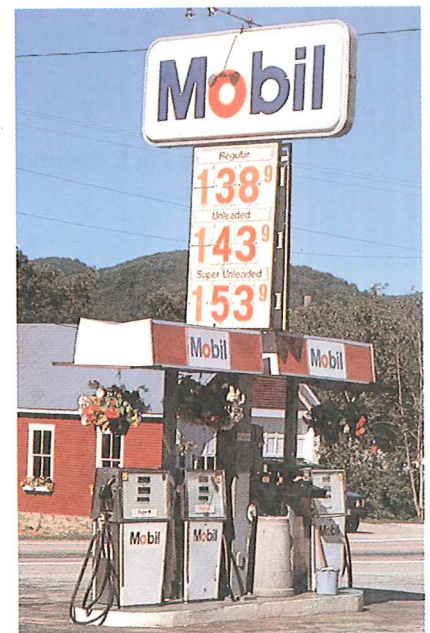
provide a variety of services that some credit cards do not provide, such as guaranteed check cashing at hotels and airline counters, free travel insurance, and emergency card replacement. Usually no credit limit is imposed on the cardholder. However, these are *charge cards,* not credit cards, so the cardholder is expected to pay the entire unpaid balance upon receipt of the monthly statement.

All-purpose bank cards include VISA, MasterCard, and Discover cards. These cards usually carry an annual membership fee. They are widely accepted by retailers as well as by restaurants, hotels, airlines, and other companies that wish to cash in on the boost in sales that accompanies the acceptance of credit cards. Some banks offer cardholders special purchase insurance and worldwide travel assistance.

An advantage to using credit cards is that cardholders are covered by Regulation Z, which is the regulation that enforces the Truth in Lending Act passed by Congress. This regulation protects consumers in cases of error, if merchandise is not received, or if services are not rendered. Card users may receive more protection than they would if they paid by check or cash, since it may be easier to get a credit card credit than to get a cash refund.

You can often use these cards to get instant cash up to a limited amount at the bank, credit union, or 24-hour teller facility. Some banks provide special checks with your credit card that you can use to pay for a purchase or to make a deposit into your regular checking or savings account. Using these checks is similar to getting a cash advance.

Debit cards are essentially electronic checks. They enable cardholders to use their automated teller machine (ATM) cards to pay for purchases at local stores. The purchase amount is deducted directly from the cardholder's checking account. Debit cards enable merchants to use credit card companies' existing authorization, draft transmission, and settlement systems.

ALGEBRA *REVIEW*

Express each percent as a decimal.

1. 12.5%

2. 3.6%

3. 119%

4. 125.6%

Express each decimal as a percent.

5. 33.3

6. 122.3

7. 0.76

8. 1.234

Evaluate. Give answer to the nearest hundredth.

9. $\left(1 + \frac{0.125}{12}\right)^{12} - 1$

10. $\left(1 + \frac{0.065}{12}\right)^{11} - 1$

ASK YOURSELF

1. What are three terms that must be disclosed by a bank according to the Truth in Lending Act?

2. What are two companies that offer credit or charge cards in each of the following categories?

   a. Single-purpose cards

   b. Multipurpose travel and entertainment cards

   c. All-purpose bank cards

One major difference between an *installment credit* purchase and a *credit card* purchase is the amount of time that elapses before you must pay interest on the purchase. Remember that interest is charged in the first month on an installment loan. However, for a credit card, when you receive the monthly statement, it tells you how much time you have to pay the bill before a finance charge is added. This amount of time is called the **grace period.** Thus you will have the amount of time that elapses between the time of your purchase and the time you receive your statement *plus* the grace period to pay for the purchase before receiving any finance charges. (Usually there is no grace period if you use your credit card to get a cash advance.) Assume here and throughout the lesson that payments on credit card accounts are received on the last day of the month.

EXAMPLE 1 Sylvia wants her father to buy her a sewing machine that costs $550. He charges it on a new VISA card with which he has made no other purchases. He will make monthly payments of $60.

QUESTION What new balance will be shown on his first three monthly statements if his bank applies a 1.5% monthly finance charge and he refrains from using the credit card during this time?

SOLUTION

His first monthly statement will show a previous balance of $0 and a purchase of $550. No interest is charged this month, so the new balance for the first month is $550.

His second monthly statement will show a previous balance of $550, an interest charge of $0.015(550) = $8.25, and a payment of $60, which was received on the last day of the month. Therefore

New balance = old balance + interest − payment
$$= 550.00 + 8.25 - 60.00$$
$$= 498.25$$

The new balance for the second month is $498.25.

His third monthly statement will show a previous balance of $498.25, an interest charge of $0.015(498.25) = $7.47, and a payment of $60. Thus

New balance = 498.25 + 7.47 − 60.00 = 445.72

The new balance for the third month is $445.72.

EXAMPLE 2 Sylvia noticed that there is a section on the credit card statement that summarizes information each month. For the second month, it appeared as follows:

QUESTION What numbers would be included in this section of the statement for the first 8 months of the loan?

SOLUTION

Use a spreadsheet program to calculate the previous balance, new charges, payment received, finance charges, and new balance for each month. Remember that there is a 1.5% monthly finance charge. Be sure to use a rounding function when calculating the finance charges.

	A	B	C	D	E	F	
1	Month	Previous	New	Finance	Payment	New	
2		Balance	Charges	Charges	Received	Balance	@ROUND(0.015*B4,2)
3	1	0.00	550.00	0.00	0.00	550.00	
4	2	550.00	0.00	8.25	60.00	498.25	+B4+C4+D4−E4
5	3	498.25	0.00	7.47	60.00	445.72	
6	4	445.72	0.00	6.69	60.00	392.41	
7	5	392.41	0.00	5.89	60.00	338.30	
8	6	338.30	0.00	5.07	60.00	283.37	
9	7	283.37	0.00	4.25	60.00	227.62	
10	8	227.62	0.00	3.41	60.00	171.03	

SKILL 2

As interest rates in the economy fluctuate, banks may change the interest rates they charge their credit card customers. When interest rates are high, banks often advertise their *monthly* rates. When interest rates are low, they often advertise their *yearly* rates.

When an **annual percentage rate (APR)** of 21% is advertised, the 21% is simple interest. However, credit card interest is charged on a monthly basis. The **monthly interest rate** for an APR of 21% is $0.21 \div 12 = 0.0175$, or 1.75%. Because the interest charge is compounded, you must determine the **effective interest rate** being charged. The following formula can be used to determine the effective interest rate i_{eff} when the APR i is known.

Effective Interest Rate Formula

$$i_{\text{eff}} = \left(1 + \frac{i}{12}\right)^{12} - 1$$

where i_{eff} = effective interest rate
i = APR (annual percentage rate)

The effective interest rate on an APR of 21% is

$$i_{\text{eff}} = \left(1 + \frac{0.21}{12}\right)^{12} - 1 \qquad i = 21\%$$

$$= 0.2314, \quad \text{or } 23.14\%$$

EXAMPLE 3 Sylvia's mother has a credit card with an APR of 15%. Sylvia claims that the effective interest rate is actually more than 15%. Her mother claims that she pays less than 15% during the first 12 months following a purchase because of the 1-month grace period.

a. What is the effective interest rate on the credit card?

b. What is the effective interest rate for the first year following a purchase?

c. Who is correct, Sylvia or her mother?

d. What is the monthly interest rate?

SOLUTIONS

a. To determine the effective rate on an APR of 15%, substitute $i = 0.15$ into the effective interest rate formula.

$$i_{\text{eff}} = \left(1 + \frac{0.15}{12}\right)^{12} - 1 \ = 0.1608$$

The effective interest rate is 16.08%.

b. To determine the effective rate for the first year, note that Sylvia's mother pays interest for only 11 of the 12 months following a purchase because of the grace period. Her effective rate for the first 12 months is

$$i_{\text{eff}} = \left(1 + \frac{0.15}{12}\right)^{11} - 1 \ = 0.1464$$

The effective interest rate is 14.64%.

c. Both are correct. An APR of 15% on a credit card produces an effective rate of 16.08%. However, the rate is only 14.64% in the 12 months following a purchase because of the grace period.

d. The monthly interest rate is $0.15 \div 12 = 0.0125$, or 1.25%.

TRY YOUR SKILLS

Using the chart below, determine the new balance shown on your monthly statement for the first 4 months after making a $2300 purchase with your new MasterCard. The card has an APR of 12% and a 1-month grace period. Your monthly payment is $275 and you make no additional purchases.

	Month	Previous Balance	New Charges	Finance Charges	Payment Received	New Balance
1.	1	0.00	$2300.00			
2.	2					
3.	3					
4.	4					

5. Determine the effective interest rate on a credit card with an APR of 12%.

6. Determine the effective interest rate for the credit card in Exercise 5 during the first 12 months following a purchase if the card has a 1-month grace period.

EXERCISE YOUR SKILLS

1. Name one major difference between an installment credit purchase and a credit card purchase.

2. Describe the difference between an annual percentage rate and an effective interest rate.

3. What is the major difference between what you must pay VISA and American Express each month?

Complete the chart below to determine the new balance shown on your monthly statement for the first 3 months after you make a $3000 purchase on your new VISA card that has an APR of 16%. The card carries a 1-month grace period. Assume that you make monthly payments of $325 and that you make no additional purchases.

	Month	Previous Balance	New Charges	Finance Charges	Payment Received	New Balance
4.	1	0.00	$3000.00		0.00	
5.	2					
6.	3					

Use a spreadsheet program to determine the previous balance, new charges, payment received, finance charges, and new balance that would be shown on Ming's first 12 MasterCard statements after a purchase of $3215 if he makes monthly payments of $345. The card has a 1-month grace period and an APR of 13.9%. Assume that he has never used the card and that he makes no further charges on it during this time period.

	Month	Previous Balance	New Charges	Finance Charges	Payment Received	New Balance
7.	1	0.00	$3215.00		0.00	
8.	2					
9.	3					
10.	4					
11.	5					
12.	6					
13.	7					
14.	8					
15.	9					
16.	10					
17.	11					
18.	12					

Determine the effective interest rate and monthly interest rate for each APR. Give answers to the nearest hundredth of a percent.

19. 13.5%   **20.** 11.9%   **21.** 16%   **22.** 19.9%

Determine the effective interest rate on each credit card during the first 12 months following a purchase if each card has a 1-month grace period. Give answers to the nearest hundredth of a percent.

23. 13.5%   **24.** 11.9%   **25.** 16%   **26.** 19.9%

MIXED REVIEW

1. Determine the monthly payment on a loan of $68,500 at 7.9% for 15 years.

2. How much will Sanchez save by prepaying a loan of $5000 at 9% for 5 years for which his monthly payments are $103.79 if he repays it 3 years early?

3. How much will $7500 be worth at the end of 2 years if it earns 4% interest, compounded quarterly?

4. Alberto earns $12.50 per hour. He works 35 hours per week for 48 weeks and receives 4 weeks of paid vacation. His other benefits cost his employer $5200 per year. What is the annual cost to the company of his salary and benefits?

5. Lynn saves $52 per week. She wants to buy a sofa that costs $798. How many weeks must she save before she can buy the sofa?

6. Peter has a loan of $12,000 at an annual rate of 5%. The term of the loan is 7 years and the monthly payments are $169.61. How much will he save by repaying the loan 2 years early?

Suppose that your bank statement shows a closing balance of $325.89. The following transactions occurred but were not shown in the statement: a deposit of $150, an ATM withdrawal of $80, a check in the amount of $200.

7. What amount or amounts must be added to the balance in the statement?

8. What amount or amounts must be subtracted from the statement balance?

9. If no error has occurred, what should your current checkbook balance be?

A company manufactures widgets in two models, plain and fancy. The unit cost for the plain model is $4 and for the fancy model is $6. The selling price is $10 for the plain model and $20 for the fancy model. Let x represent the plain model and y represent the fancy model.

10. What is the objective function for the cost?

11. What is the objective function for the revenue?

12. What is the objective function for the profit?

13. The company can produce 50 widgets a week. Find the weekly profit if it decides to manufacture 30 of the fancy model.