

## ALGEBRA REFRESHER

Evaluate each expression. Recall that for all real numbers  $a$ ,  $a \neq 0$ , and for all integers  $n$ :

$$a^{-n} = \frac{1}{a^n}$$

Examples:  $3^{-2} = \frac{1}{3^2} = \frac{1}{9}$        $(2^{-4})^2 = 2^{-8} = \frac{1}{2^8} = \frac{1}{256}$

- |                 |                    |                    |
|-----------------|--------------------|--------------------|
| 1. $4^{-3}$     | 2. $5^{-5}$        | 3. $(3^{-4})^3$    |
| 4. $(2^{-3})^2$ | 5. $(4^{-2})^{-3}$ | 6. $(3^{-1})^{-3}$ |

Express with positive exponents. Recall that for all nonzero real numbers  $a$  and all integers  $m$  and  $n$ :

$$\frac{a^m}{a^n} = a^{m-n} \quad \text{if } m \geq n \quad \frac{a^m}{a^n} = \frac{1}{a^{n-m}} \quad \text{if } m < n \quad a^0 = 1$$

Example: Express  $\frac{x^{-3}y^2z^{-5}}{x^2y^{-4}z^{-5}}$  with positive exponents:  $\frac{x^{-3}y^2z^{-5}}{x^2y^{-4}z^{-5}} = \frac{y^6}{x^5}$

- |  |  |  |
|--|--|--|
| 7. $\frac{x^{-3}y^{-4}z^{-1}}{x^{-5}y^3z^{-12}}$ | 8. $\frac{x^0y^3z^{-4}}{x^{-8}y^2z^0}$ | 9. $\frac{x^9y^{-8}z^{-7}}{x^{-3}y^{-4}z^7}$ |
|--|--|--|

Express each percent as a decimal. Recall that *percent* means *per hundred*.

Examples:  $7.5\% = 0.075$        $0.02\% = 0.0002$        $135\% = 1.35$

- |           |           |            |
|-----------|-----------|------------|
| 10. 8.9%  | 11. 13.6% | 12. 0.095% |
| 13. 0.78% | 14. 128%  | 15. 1600%  |

Evaluate to the nearest hundredth. Use your calculator.

Example:  $\frac{1500(0.07)(1 + 0.07)^{24}}{(1 + 0.07)^{24} - 1}$

Use the exponent key  $\boxed{x^y}$  or  $\boxed{\wedge}$  and parentheses as necessary.

1500  $\boxed{\times}$  0.07  $\boxed{\times}$   $\boxed{}$  1  $\boxed{+}$  0.07  $\boxed{)}$   $\boxed{x^y}$  24  $\boxed{\div}$

$\boxed{}$   $\boxed{}$  1  $\boxed{+}$  0.07  $\boxed{)}$   $\boxed{x^y}$  24  $\boxed{-}$  1  $\boxed{)}$   $\boxed{\text{ENTER}}$

130.78      *To the nearest hundredth*

- |  |   |
|--|---|
| 16. $\frac{1275(0.005)(1 + 0.005)^{48}}{(1 + 0.005)^{48} - 1}$ | 17. $\frac{1225(0.0025)(1 + 0.0025)^{60}}{(1 + 0.0025)^{60} - 1}$ |
| 18. $\frac{2400[1 - (1 + 0.015)^{-13}]}{0.015}$                | 19. $\frac{325[1 - (1 + 0.0125)^{-24}]}{0.0125}$                  |





# CONSUMER CREDIT

USING SOMEONE ELSE'S MONEY WHILE we wait to acquire our own gives us an inflated sense of wealth. We can now buy almost everything that is for sale without using money that we currently possess.

With an installment loan, we can have a house or a car before we can afford to pay for them. Banks and other lending institutions are willing to finance these purchases if we enter into an installment loan agreement that guarantees repayment of the borrowed money. Banks generate profits in the process because we are willing to repay two or three times as much as we borrow if it enables us to purchase a house.

As Americans, we think of ourselves as honest and hardworking. We have been convinced that owing money and being in debt are fine as long as we can keep up with the payments. Skillful advertisers understand our basic desires for more than

we have. Once we buy one item on credit, we find it easier and easier to buy more items on credit. Lending institutions capitalize on our false sense of wealth by offering more and more credit to those of us who can make the installment payments.

Owning something now that we cannot afford to pay for now, except in small monthly installments, is a very attractive and luxurious way to live. However, we can overextend ourselves easily without even realizing it. We may continue to enjoy the use of credit, but as intelligent consumers we should be aware of the hazards. We should know the high price spending what we do not have and who receives the profits from our use of credit.

In this chapter our high-school students will examine installment buying. They will become aware of the risks of using credit and learn ways to reduce its cost.

## **5-1 Monthly Payments: How Much Can You Afford to Borrow?**

## **5-2 Problems With Credit: Credit Overload**

## **5-3 Credit Management: Keeping Credit Costs Down**

## **5-4 Amortization Schedules: Shrinking Interest Payments**

## **5-5 The Lure of Credit Terms: The Merchant Profits**





**\$169.95**



**\$75.00**



**\$15.99**



**\$69.95**



## MONTHLY PAYMENTS: HOW MUCH CAN YOU AFFORD TO BORROW?



**P**atrick is impressed by Maria's ability to save so much money from her weekly paycheck. He has a job at Paradise Department Store, where he is a cashier in the camera/luggage department. He will graduate from high school this year and would like to attend a community college for at least a year or two.

Patrick and his father have been trying to save money for the state university tuition, but it has been very difficult since Patrick's mother died three years ago. They lost her income, and her illness used up a large portion of their savings. Therefore if Patrick wants to go to college, he will have to help pay the expenses.

Before making a loan, a lending institution must have faith in the borrower's ability to

repay it at a future date. Patrick knows that Maria's father is helping her to borrow money to buy a car. Maria will be making monthly payments to the bank to pay back the loan.

Patrick hopes that he too can borrow from the bank for school tuition. He can afford only a certain amount in monthly payments, and he would like to know how much he will be able to borrow.

Maria told Patrick that he will have to pay back more than he borrows over the course of his loan. He is not sure that this is fair, but he wants to go to college, and he knows that the bank will need to make a fair profit as a condition of granting him a loan.

**OBJECTIVES:** *In this lesson, we will help Patrick to:*

- *Identify the major functions of credit.*
- *Recognize the features of installment credit.*
- *Calculate monthly payments on a loan.*
- *Compute total payments on a loan.*
- *Determine how much he can afford to borrow.*



## NATURE OF CREDIT

Patrick has heard the phrase “Buy now, pay later” in commercial advertising. The use of credit has become a way of life for many consumers, and Patrick thinks that he can handle it too. His economics teacher mentioned that the word *credit* actually means *debt*. People do not like the sound of being in debt, so they use the word *credit* instead.

**Credit** is a form of debt that occurs whenever cash, goods, or services are provided in exchange for a promise to pay at a future date. Many people cannot afford to pay cash for a large purchase such as a house or an automobile. Therefore they borrow the amount they need for the purchase and pay back that amount plus interest. The total amount paid to the bank is known as the **deferred payment price**. The deferred payment price is considerably more than the original loan amount. The difference between the two amounts is the *interest* or the **finance charge**. It is the profit made by the bank or lending institution. It is also the price paid by the borrower for using someone else’s money.



## FUNCTIONS OF CREDIT

Patrick has discovered from doing research that the use of credit has the following positive effects:

1. *Credit stabilizes the economy.* It steadies economic activity because it enables individuals and businesses to purchase goods and services even when their incomes are temporarily limited.
2. *Credit promotes business growth.* Many people borrow money to start new businesses or to maintain established ones.

## ALGEBRA REVIEW

Evaluate. Round answers to the nearest hundredth.

1.  $x = \frac{2^3}{3^2}$

2.  $x = \frac{6^4}{3^3}$

3.  $x = 4(3 + 2)^3$

4.  $x = \frac{5}{(5 + 3)^2}$

5.  $x = (1 + 0.01)^3$

6.  $x = \frac{(1 + 0.02)^6}{0.02}$

7.  $x = \frac{1200(2)^5}{(5 - 3)^3}$

8.  $x = \frac{600(1 + 5)^3}{(6 - 3)^4}$

9.  $x = \frac{98(0.005)(1 + 0.005)^{24}}{(1 + 0.005)^{24} - 1}$

10.  $x = \frac{900(0.0025)(1 + 0.0025)^{36}}{(1 + 0.0025)^{36} - 1}$

Solve for  $x$ .

11.  $y = x(1 - r)^2$

12.  $y = \frac{2x(1 + r)}{r^2z}$

13.  $z = \frac{3rq^{24}}{x(q + 2)^{24}}$

- Credit expands productivity and production.* By borrowing money to attend college, Patrick may increase his earning potential. Similarly, a business that must sell what it produces will have no income until its products are sold. The initial costs of production must be financed by funds that are already in the business or by borrowed funds.
- Credit raises the standard of living.* Individuals or couples do not have to wait to build up savings before buying things that make life comfortable, such as a house, a car, furniture, and appliances.

### USING INSTALLMENT CREDIT

Using installment credit means making purchases and then making regular payments over a period of months or years. Maria will be getting an **installment loan** when she buys a car. Purchases made on an installment plan often have the following features:

- A **down payment** is required at the time of the purchase. A down payment is the portion of the purchase that must be paid up front in cash.
- A substantial finance charge is added to the price.
- Payments of equal amounts are spread over a specified period of time.
- To insure that payments on a purchase loan are made as scheduled, protection may be provided to the lender in the form of a security agreement.

### Ask Yourself

- What are the four major functions of credit?
- What are three features of installment credit?
- In what must a bank have faith when it approves a loan?



## SHARPEN YOUR SKILLS

### SKILL 1

Maria can use the monthly payment formula to determine the monthly cost of a car loan. The monthly interest rate is the annual interest rate divided by 12.

#### Monthly Payment Formula

$$M = \frac{Pr(1+r)^n}{(1+r)^n - 1}$$

where  $M$  = monthly payment  
 $P$  = amount of loan  
 $r$  = monthly interest rate  
 $n$  = number of payment periods

**EXAMPLE 1** Maria finds a used car that she might want to buy. To pay for the car, she must borrow \$6500.

**QUESTION** What is her monthly payment if she borrows \$6500 for a 3-year period at an annual interest rate of 9%? How much will she pay for the car in the course of 3 years?

#### SOLUTION

Use the monthly payment formula and your calculator.

$$M = \frac{Pr(1+r)^n}{(1+r)^n - 1}$$

$$M = \frac{6500(0.0075)(1 + 0.0075)^{36}}{(1 + 0.0075)^{36} - 1}$$

$P = 6500; r = 0.09 \div 12 = 0.0075;$   
 $n = 3 \cdot 12 = 36$

$$M = 206.70$$

To the nearest cent

To input this calculation in your calculator, remember to use the exponent key  $\boxed{x^y}$  (sometimes labeled  $\wedge$  or  $a^b$ ) and to use parentheses around the denominator as follows:

$$6500 \boxed{\times} 0.0075 \boxed{\times} \boxed{(} 1 \boxed{+} 0.0075 \boxed{)} \boxed{x^y} 36 \boxed{\div}$$
$$\boxed{(} \boxed{(} 1 \boxed{+} 0.0075 \boxed{)} \boxed{x^y} 36 \boxed{-} 1 \boxed{)} \boxed{\text{ENTER}}$$

Maria's monthly payment is \$206.70.

The answer to the above calculation is given to many decimal places in your calculator. Use that answer to calculate the deferred payment price by using the answer key  $\boxed{\text{ANS}}$  on your calculator.

$$\boxed{\text{ANS}} \boxed{\times} 36 = 7441.14$$

Deferred payment price

Notice that  $206.70 \cdot 36 = 7441.20$ . The bank adjusts your last payment so that the deferred payment price is \$7441.14.

**EXAMPLE 2** If Maria buys a new car instead, she will have to borrow \$12,825.

**QUESTION** What is her monthly payment if she borrows \$12,825 for a 4-year period at an annual interest rate of 6%? How much will she pay for the car in the course of 4 years?



**SOLUTION**

Use the monthly payment formula and your calculator.

$$M = \frac{Pr(1+r)^n}{(1+r)^n - 1}$$

$$M = \frac{12,825(0.005)(1+0.005)^{48}}{(1+0.005)^{48} - 1} \quad P = 12,825; r = 0.06 \div 12 = 0.005; n = 4 \cdot 12 = 48$$

$$M = 301.20 \quad \text{To the nearest cent}$$

Maria's monthly payment is \$301.20. Over four years she will pay   48 = \$14,457.38, which is the deferred payment price or total payment.



**EXAMPLE 3** Maria is also considering five other cars on which she can obtain 8% financing for 3 years, 4 years, or 5 years.

**QUESTION** What are her monthly and total payments (deferred payment price) on loans of \$4200, \$5500, \$6325, \$8275, and \$9750?



**SOLUTION**

Use a spreadsheet program to find the monthly and total payments for the loan amounts at 8% over the periods of 3 years, 4 years, and 5 years. When entering the formula for the monthly payment, use 0.08/12 for the rate. For 3 years at 8% the monthly payment formula in cell C3 is

$$+A3*(0.08/12)*(1+(0.08/12))^{36}/((1+(0.08/12))^{36}-1)$$

For the monthly payment formula for 4 years, use 48 for the number of payment periods. You can use the COPY command of your spreadsheet



program to copy the formula of cell C3 to C4. This will automatically change A3 to A4. Then you can use the EDIT command to change 36 to 48.

$$+A4*(0.08/12)*(1+(0.08/12))^{48}/((1+(0.08/12))^{48}-1)$$

The monthly payment formula for 5 years is

$$+A5*(0.08/12)*(1+(0.08/12))^{60}/((1+(0.08/12))^{60}-1)$$

For the total payment, type  $12*B3*C3$  in cell D3. Then use the COPY command to copy the formula in the total payment column.

	A	B	C	D
1	Loan	Number	Monthly	Total
2	Amount	of Years	Payment	Payment
3	4200	3	131.61	4,738.06 $\leftarrow 12*B3*C3$
4	4200	4	102.53	4,921.65 $\leftarrow 12*B4*C4$
5	4200	5	85.16	5,109.65
6	5500	3	172.35	6,204.60
7	5500	4	134.27	6,445.01
8	5500	5	111.52	6,691.21
9	6325	3	198.20	7,135.29
10	6325	4	154.41	7,411.76
11	6325	5	128.25	7,694.89
12	8275	3	259.31	9,335.10
13	8275	4	202.02	9,696.81
14	8275	5	167.79	10,067.23
15	9750	3	305.53	10,999.06
16	9750	4	238.03	11,425.25
17	9750	5	197.69	11,861.69

If you use  $(12*B3)$  instead of 36 in cell C3, you can use the COPY command to complete the entire monthly payment column. The formula is

$$+A3*(0.08/12)*(1+(0.08/12))^{(12*B3)}/((1+(0.08/12))^{(12*B3)}-1)$$

## SKILL 2

**EXAMPLE 4** Patrick is an excellent student and will probably receive a scholarship for college. However, his father explains that Patrick will still have to borrow money.

**QUESTION** If Patrick can afford monthly payments of \$225 and would like to borrow an even multiple of \$1000, what is the largest amount of money that he can borrow at 8% for 3 years, 4 years, and 5 years?





### SOLUTION

Use a spreadsheet program to determine the monthly payments for \$7000 to \$12,000 in increments of \$1000. The monthly payment formulas are

$$\begin{aligned}
 &+A3*(0.08/12)*(1+(0.08/12))^{36}/((1+(0.08/12))^{36}-1) && \text{For 3 years} \\
 &+A3*(0.08/12)*(1+(0.08/12))^{48}/((1+(0.08/12))^{48}-1) && \text{For 4 years} \\
 &+A3*(0.08/12)*(1+(0.08/12))^{60}/((1+(0.08/12))^{60}-1) && \text{For 5 years}
 \end{aligned}$$

	A	B	C	D
1	Amount	3 years	4 years	5 years
2	Borrowed			
3	7,000	219.35	170.89	141.93
4	8,000	250.69	195.30	162.21
5	9,000	282.03	219.72	182.49
6	10,000	313.36	244.13	202.76
7	11,000	344.70	268.54	223.04
8	12,000	376.04	292.96	243.32

Patrick can afford to borrow \$7000 for 3 years, \$9000 for 4 years, or \$11,000 for 5 years.

### SKILL 3

Patrick solves the monthly payment formula for  $P$ , the amount of the loan.

$$M = \frac{Pr(1+r)^n}{(1+r)^n - 1}$$

$$M[(1+r)^n - 1] = Pr(1+r)^n \quad \text{Multiply both sides by } [(1+r)^n - 1].$$

$$\frac{M[(1+r)^n - 1]}{r(1+r)^n} = P \quad \text{Divide both sides by } r(1+r)^n.$$

He now has a formula to find the exact amount he can borrow.

#### Amount Formula

$$P = \frac{M[(1+r)^n - 1]}{r(1+r)^n} \quad \text{where } P = \text{amount of loan}$$

$r = \text{monthly interest rate}$   
 $n = \text{number of payment periods}$   
 $M = \text{monthly payment}$

**EXAMPLE 5** If Patrick does not restrict himself to borrowing multiples of \$1000, he can borrow more money over each time interval.

**QUESTION** What is the exact amount of money Patrick can borrow at 8% for 3 years if he can afford a monthly payment of \$225?



### SOLUTION

Use the amount formula. Since the monthly interest rate  $r$  is  $0.08 \div 12$ , which is a repeating decimal, calculate this value, and then use the **ANS** key to enter it in the formula.



$$P = \frac{225((1 + \text{ANS})^{36} - 1)}{\text{ANS}(1 + \text{ANS})^{36}} \quad M = 225; n = 3 \cdot 12 = 36$$

$$P = 7180.16 \quad \text{To the nearest cent}$$

To input this in your calculator use the following keystrokes.

0.08  $\div$  12 **ENTER**  
 225 **(** **(** 1 **+** **ANS** **)** **)** **x<sup>y</sup>** 36 **-** 1 **)** **÷** **ANS** **(** 1 **+** **ANS** **)** **x<sup>y</sup>** 36 **ENTER**

Patrick can afford to borrow \$7180.16 at 8% for 3 years.

The **ANS** key is a temporary memory that stores the latest calculation. You can also store  $0.08 \div 12$  in one of the regular memories of your calculator.

0.08  $\div$  12 **STO**  $\rightarrow$  **ALPHA** **A** **ENTER**

To recall the number stored in memory A, you would enter **ALPHA** **A** in place of **ANS** in the previous calculation.

### TRY YOUR SKILLS

Determine the monthly payment and total payments (deferred payment price) for each car loan. Remember that the deferred payment price is **ANS** times the number of payments.

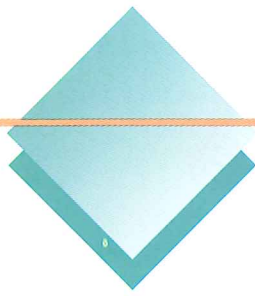
- \$10,000 at 7% for 5 years
- \$12,000 at 8% for 4 years

Paola can afford a monthly payment of \$150 and would like to borrow an even multiple of \$1000. Complete the table below to determine the largest amount of money that she can borrow at 10% for 3 years, 4 years, and 5 years.

	Amount Borrowed	3 years	4 years	5 years
3.	\$3000			
4.	4000			
5.	5000			
6.	6000			
7.	7000			
8.	8000			

- Use the amount formula to determine the exact amount of money that Paola can borrow for each time period in Exercise 3. Remember that Paola can borrow (or afford) a payment of \$150 a month.





## EXERCISE YOUR SKILLS

### KEY TERMS

credit  
deferred payment  
price  
down payment  
finance charge  
installment loan

1. Why is the term *credit* used instead of *debt*?
2. How does the use of credit raise the standard of living?
3. Why do you think consumers are willing to pay substantial finance charges as a condition of an installment loan?
4. Who receives the revenue from finance charges paid by consumers?
5. What do you think the bank or other lending institution would do if a borrower did not make the payments on an installment loan?
6. What is the deferred payment price?

Determine the monthly payment and total payment (deferred payment price) for each car loan.

7. \$13,500 at 7% for 4 years                      8. \$10,500 at 9% for 5 years

Patrick's friend Ricky is also considering various loans for college tuition. Use a spreadsheet program to find the monthly payment and total payment for the loan amounts listed below at 12.5% over the periods of 3 years, 4 years, and 5 years. (Save your results to use in Lesson 5–2.)

	Loan Amount	Number of Years	Monthly Payment	Total Payment
9.	\$ 6,500	3		
10.	6,500	4		
11.	6,500	5		
12.	9,500	3		
13.	9,500	4		
14.	9,500	5		
15.	6,000	3		
16.	6,000	4		
17.	6,000	5		
18.	12,000	3		
19.	12,000	4		
20.	12,000	5		
21.	17,500	3		
22.	17,500	4		
23.	17,500	5		
24.	11,650	3		
25.	11,650	4		
26.	11,650	5		
27.	8,775	3		
28.	8,775	4		
29.	8,775	5		



Kareem can afford a monthly payment of \$300 and would like to borrow a multiple of \$1000. Complete the table below to determine the largest amount of money that he can borrow at 9% for 3 years, 4 years, and 5 years.

	Amount Borrowed	3 years	4 years	5 years
30.	\$ 9,000	\$286.20	\$223.97	
31.	10,000			
32.	11,000			
33.	12,000			
34.	13,000			
35.	14,000			
36.	15,000			

37.–43. Determine the exact amount of money that Kareem can borrow for each time period in Exercises 30–36.

### MIXED REVIEW

- Matthew's monthly check costs are \$0.025 per check for the first 15 checks and \$0.12 for each check over 15. If he writes 33 checks this month, how much will the checks cost him?
- Crystal saves \$12.50 per week. At the end of a year, she deposits her savings into a CD that earns 2% for each six-month period. When the CD matures, she withdraws the interest and reinvests the principal. How much interest will she have earned at the end of two years?
- How much will \$6200 be worth at the end of 4 years if it earns 7% interest, compounded semiannually?
- Olivia earns \$9.50 per hour. She works  $37\frac{1}{2}$  hours per week for 49 weeks and receives 3 weeks of paid vacation. Her other benefits cost her employer \$4000 per year. What is the annual cost to the company of her salary and benefits?
- Arnold saves \$33 per week. He wants to buy a desk that costs \$294. How many weeks must he save before he can buy the desk?
- Alan and Meg are producing and selling sports pennants. The raw materials for each pennant cost \$2.13 and the labor is \$5.50 an hour. Advertising and other fixed costs are \$45. What is the cost of production for 250 pennants, 20 of which can be produced in one hour?

Suppose that the fixed costs of a business are \$350 per week and the variable costs are \$6.50 per item.

- What is the cost of manufacturing 92 items in one week?
- Each item is sold for \$10.99. What is the weekly profit?
- What is the break-even point?

## 5-2 PROBLEMS WITH CREDIT: CREDIT OVERLOAD



**J**oan feels that she must warn Patrick and Maria about credit. The first installment loan that her family accepted seemed quite reasonable because it was a mortgage for their house. Then they bought a brand new car on credit.

After a series of violent thunderstorms, the roof in the den started to leak, so the family took out a second mortgage to pay for a new roof and to replace the damaged carpeting. They will be paying on the second mortgage for 7 years.

When Joan's mom and dad were both working, they were easily making all of the installment payments. Four months ago, Joan's mother lost her job. The electronics company at which she was working had been forced to eliminate some jobs in her department because the company lost money last year.

More bills arrive every day. Joan's parents even borrowed money from the credit union to pay some of the bills, but now they are having trouble making the payments to the credit union. The family members are a little stunned by recent events and are wondering how they managed to get into such a mess so quickly.

Joan's mother feels that one of their problems is that they borrowed the money for short time periods and have high monthly payments. She thinks that they should have taken a second mortgage with a payback period of 15 years instead of 7 years. Her father gets upset because he claims that the total payments and total cost are higher when the term of the loan is longer. Joan will be glad when Mom finds another job. Then Mom and Dad will stop being upset, and the family can get back to normal.