Interest: Investing Money

Michaela just purchased her first home in Yorkton. She saved money for the down payment. She also needs to save for large purchases and other expenses for her home.

A. What are some large expenses Michaela might need to save for when she moves to her new home?

_____

_____

B. Michaela used savings plans and investments to save for the down payment. What savings plans or investments might Michaela have used?

_____

_____

Getting Started

1. Calculate.

   a) $500 \times 0.03 =$ _____

   b) $1.25 \times 137.6 =$ _____

   c) $(1250)(0.25)(3) =$ _____

   d) $18.5 \times \dfrac{73}{365} =$ _____

2. Write each percent as a decimal.

   a) $8\% =$ _____

   b) $12.5\% =$ _____

   c) $73.4\% =$ _____

   d) $0.79\% =$ _____

3. Calculate each percent.

   a) 1% of $1500 =$ _____

   b) 10% of $45 =$ _____

   c) 25% of $80 =$ _____

   d) 0.1% of $6000 =$ _____

Tech Tip

Percent of a Number

Calculate 1.5% of 315. If your calculator has a _%_ key, enter

315 _×_ 1.5 _%_ _=_ or 315 _×_ 1.5 _2nd_ _%_ _=_

If your calculator does not have a _%_ key, enter

315 _×_ 0.015 _=_ or 315 _×_ 1.5 _÷_ 100 _=_

4. Calculate each percent to one decimal place.

   a) 7% of $2000 =$ _____

   b) 13.5% of $240 =$ _____

   c) 0.5% of $528 =$ _____

   d) 8.25% of $290 =$ _____

5. Solve for x.

   a) $2x = 12$

   $x =$ _____

   b) $7x = 21$

   $x =$ _____

   c) $x - 7 = 32$

   $x =$ _____

   d) $\dfrac{x}{5} = 45$

   $x =$ _____

6. Solve for each variable.

a) $4d + 15 = 295$

c) $\dfrac{p}{3} - 15 = 120$

b) $11s + 8 = 96$

d) $6.5t + 73 = 83.4$

7. Substitute and solve.

a) $P = 2l + 2w$

$l = 4, w = 1.5$

$P = 2(\underline{}) + \underline{}$

$P = \underline{}$

b) $A = lw$

$l = 3, A = 12$

$\underline{} = \underline{} w$

$\underline{} = w$

8. Write each length of time as a fraction of the unit given.

a) $3 \text{ wk} = \dfrac{\square}{52} \text{ yr}$

c) $23 \text{ d} = \dfrac{\square}{\square} \text{ mo}$

b) $7 \text{ wk} = \dfrac{\square}{\square} \text{ yr}$

d) $5 \text{ mo} = \dfrac{\square}{\square} \text{ yr}$

Hint

Use
1 yr (year)
= 365 d (days)
= 52 wk (weeks)
= 12 mo (months)

1 mo = 30 d

9. Rahm decided to put some money in the bank for 1.36 yr.

a) How long is this in days? Round up.

1.36 yr × _____ d/yr is about _____ d

b) How long is this in weeks? Round up.

1.36 yr × _____ wk/yr is about _____ wk

10. Hank worked in Nunavut as a journeyman welder on a temporary contract. His contract was for 7 mo.

a) What is the length of Hank's contract in days? _____ d

b) What is the length of Hank's contract in years? _____ yr

1.1 Understanding Simple Interest

Try These

i) $500 × 2.5% × 3
   = $500 × _____ × 3
   = $_____

ii) $1000 × 3% × $\frac{35}{365}$
   = $1000 × _____ × $\frac{35}{365}$
   = $_____

You can **invest** money and earn **interest**.

Investing with Simple Interest

invest	use savings to earn extra income
interest	the money paid for the use of invested or borrowed money
principal	the money invested or borrowed
interest rate	the percent of the principal that is paid or earned as interest
time	the length of time for an investment in years
simple interest	interest calculated only on the principal invested or borrowed
amount	sum of the principal and interest

To calculate the **simple interest** earned on an investment, use:

Interest (I) = **Principal** (P) × **interest rate** (r) × **time** (t)

$$I = Prt$$

Hint
2.5%/yr means interest is charged at a rate of 2.5% per year, or an annual rate of 2.5%.

David is a sprinkler-system installer. He invested $1500 in a Guaranteed Investment Certificate (GIC) for 2 yr. The interest rate is 2.5%/yr. How much interest will David earn?

1 Use the simple interest formula $I = Prt$.

I = $_____ × _____/yr × _____ yr
     interest   principal   interest rate   time

I = $_____   David will earn $_____.

To calculate the total **amount** of an investment, use:

Amount (A) = Principal (P) + Interest (I)

$$A = P + I$$

Example 1

Robyn is a motorcycle mechanic. She is saving for a new helmet.

- Robyn has saved $600. She invested it for 6 mo in a GIC.
- The interest rate was 1.5%/yr.

How much money will Robyn have to buy the helmet?

Solution

A. How much interest will Robyn earn on her GIC?

$$I = \$\underline{\quad\quad} \times \underline{\quad\quad}/yr \times \frac{\square}{\square}\ yr$$

  interest   principal   interest rate   time

$$I = \$\underline{\quad\quad}$$

B. What is the amount Robyn will have in 6 mo?

$$A = \$\underline{\quad\quad} + \$\underline{\quad\quad}$$

  total amount   principal   interest

$$A = \$\underline{\quad\quad}$$

Robyn will have $\underline{\quad\quad}$ to buy the helmet.

Example 2

Sue is planning a trip to the United States.

- She invested $5000 in a U.S. Foreign Currency Term Deposit.
- The annual interest rate is 0.5%.
- The deposit matures in 120 d.

How much money will Sue have for her trip?

Solution

A. How much simple interest will Sue earn?

$$I = \$\underline{\quad\quad} \times \underline{\quad\quad}/yr \times \frac{\square}{\square}\ yr$$

  interest   principal   interest rate   time

$$I = \$\underline{\quad\quad}$$

B. What is the amount Sue will have in 120 d?

A = \$_____ + \$_____

  = \$_____

Sue will have \$_____ for her trip.

Practice

1. a) Match each variable with a value.

Variable	Value
principal	280 d
interest	1.95%
rate	\$2000.00
time	\$29.92

b) Use the values in Part a) to calculate the interest earned. Is the interest that was given correct?

I = _____

  = \$_____ × _____ /yr × $\frac{\square}{\square}$ yr

  = \$_____, or \$_____

The interest is _____.

c) What is the amount at the end of the investment?

A = __ + __

  = \$_____ + \$_____

  = \$_____

2. Saskia is a golf pro in Banff. She invested \$1400 for 36 wk in a GIC. She will use the money for new golf clubs. The interest rate is 1.75%/yr.

How much will Saskia have to spend?

3. Derain is a tour guide in the Rocky Mountains. He works about 8 mo a year. Derain invests some of his salary while he works so he has money when he is not working.

   a) Complete the chart.

Interest	Principal	Interest rate (per year)	Time
$I = (\$850)(0.015/\text{yr})\left(\dfrac{6}{12}\ \text{yr}\right)$ $= \$6.38$	$850	1.5%	6 mo
	$1200	1.75%	1 yr
	$1500	1.65%	215 d
	$500	1.0%	21 wk

   b) What is the total interest earned on all Derain's investments?

4. Tamara is a broker's assistant. She invested $750 for 6 mo at an annual interest rate of 1.5%. She calculated the interest earned as $56.25. However, the paperwork showed she earned $5.63.

   Tamara's Calculation:

   $$I = (\$750)(0.15/\text{yr})\left(\frac{6}{12}\ \text{yr}\right)$$

   $$= \$56.25$$

   What mistake did Tamara make? Show the correct solution.

1.2 Simple Interest Problems

Try These

Solve for x.

i) $2x = 14$ **ii)** $(3)(4)(x) = 6$ **iii)** $18x + 2 = 38$ **iv)** $1.5x - 3 = 12$

$x =$ _____ $x =$ _____ $x =$ _____ $x =$ _____

Sierra is completing her tax form.
- She earned $30.24 in simple interest from her bank.
- She remembered investing $1200 with her bank for 1 yr. She cannot remember the interest rate.

What was the interest rate on Sierra's investment?

① Substitute into the formula for simple interest.

$$I = Prt$$

$\$$_____ $= \$$_____ $\times r \times$ _____ yr

② Solve for r.   _____ $=$ _____ $\times r$

$$\frac{\boxed{}}{\boxed{}} = \frac{1200 \times r}{\boxed{}}$$

_____ $= r$

Hint
Interest rates are expressed as percents. So, multiply the decimal interest rate by 100%.

③ What interest rate did Sierra earn on her $1200 investment?

$r =$ _____ $\times 100\%$, or _____ %

The interest rate on Sierra's investment was _____ %.
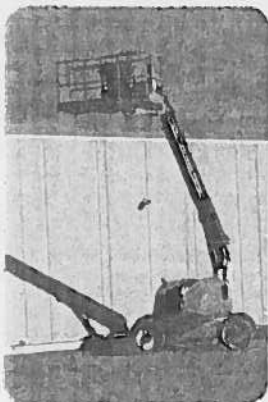
Example

Stephan is saving to buy a used boom lift for his tree-trimming business.
- He needs $9800. He has $9475 saved.
- He plans to invest his savings at an annual rate of 1.59%, or 1.59%/yr.

How long must Stephan invest to earn the additional $325 in interest he needs?

Solution 1

A. Substitute the given information into the simple interest formula. Then solve for t.

$$I = Prt$$

$$\$\underline{\hspace{1cm}} = \$\underline{\hspace{1cm}} \times \underline{\hspace{1cm}} \times t$$

$$\$\underline{\hspace{1cm}} = \$\underline{\hspace{1cm}} \times t$$

$$\frac{\$\boxed{}}{\$\boxed{}} = t, \text{ so } t = \underline{\hspace{1cm}} \text{ yr}$$

B. What is the time in years and days? Round up.

$$t = \underline{\hspace{1cm}} \text{ yr} \times 365 \text{ d/yr}$$

$$= \underline{\hspace{1cm}} \text{ d, or } \underline{\hspace{1cm}} \text{ d}$$

So $\underline{\hspace{0.5cm}}$ d − 365 d − 365 d = $\underline{\hspace{0.5cm}}$ d

$$\underline{\hspace{0.5cm}} \text{ d} = \underline{\hspace{0.5cm}} \text{ yr} \underline{\hspace{0.5cm}} \text{ d}$$

Stephan needs to invest for $\underline{\hspace{0.5cm}}$ yr $\underline{\hspace{0.5cm}}$ d.

REFLECTING
Why do you subtract 365 twice?

Solution 2

A. Solve for t in the simple interest formula.

$$I = Prt$$

$$\frac{I}{\boxed{}} = \frac{Prt}{\boxed{}}, \text{ so } \frac{\boxed{}}{\boxed{}} = t$$

B. Substitute into the formula you rearranged for Part A.

$$\frac{\$\boxed{}}{\$\boxed{} \times \boxed{}} = t$$

$$\frac{\$\boxed{}}{\$\boxed{}} = t$$

$$\underline{\hspace{1cm}} \text{ yr} = t$$

C. What is the time in years and days? Round up.

$$t = \underline{\hspace{1cm}} \text{ yr} \times 365 \text{ d/yr}$$

$$\underline{\hspace{1cm}} \text{ yr} = 2 \text{ yr} + 0.157 \ldots \text{ yr} \times 365 \text{ d/yr}$$

$$\underline{\hspace{1cm}} \text{ yr} = \underline{\hspace{0.5cm}} \text{ yr} + \underline{\hspace{1cm}} \text{ d, or } \underline{\hspace{0.5cm}} \text{ yr} \underline{\hspace{0.5cm}} \text{ d}$$

Stephan needs to invest for $\underline{\hspace{0.5cm}}$ yr $\underline{\hspace{0.5cm}}$ d.

REFLECTING
How are Solution 1 and Solution 2 different?

Practice

1. Complete the chart. Round interest rates to the nearest hundredth of a percent, time to the nearest day, and money to the nearest cent.

Principal (P)	Interest rate per year (r)	Time (t)	Simple interest (I)
$	8.25%	240 d	$138.25
$735.00	$5\frac{1}{2}$%	27 d	$
$2600.00		2 mo	$16.67
$182.65	6.75%	d	$9.12

2. Dan is an RV service technician in Saskatchewan. He invested $3200 in a savings account 2 yr ago. The interest rate was 0.8%/yr. He wants to spend the money fixing up an RV to sell. How much does Dan have to spend on the repairs?

3. a) Graham needs to purchase a line-striping machine for his painting business. He has saved $4200. He invested his savings in a 9 mo term GIC for his new machine. At the end of the term, his GIC paid $51.26.

   What was the annual interest rate on Graham's GIC? Round to the nearest hundredth of a percent.

   b) What are two ways to write the simple interest formula for Part a)?

4. Kazuhiro invested $2000 of the money he earned working on a farm near Edmonton. He earned $14.96 in interest. The interest rate was 1.4%/yr. For how long did Kazuhiro invest the principal? Round up for the number of days.
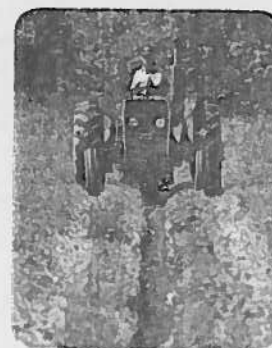
5. Joti earned $48.74 in interest on money in a savings account. She invested her principal at an annual rate of 2.3% for 17 wk. How much money did Joti invest?

6. a) Sally is a student-support worker. She is creating problems to help a student study for a math test. She needs a question, solving for P, using these values: $I = \$29.50$, $r = 3.1\%$/yr. She can use any value for t.

Rearrange the formula $I = Prt$ so P is isolated.

b) Use the values in Part a). Create and solve a word problem.

1.3 Understanding Compound Interest

Try These

i) $3^3 =$ _____

ii) $2.5^2 =$ _____

iii) $(2 + 3)^4 =$ _____

iv) $(1 + 2.1)^3 =$ _____

compound interest

interest calculated on the principal and the interest earned

Madelyn invested $10 000 4 yr ago. The investment earned **compound interest** at 2.1%/yr, compounded annually. She will use the interest to buy equipment for her cupcake business. How much interest does Madelyn have for the equipment?

① Complete the chart.

Year	Principal (amount at start of year)	Simple interest $I = Prt$	Amount at end of year $A = P + I$
1	$10 000	$I = (10000)(0.021)(1)$ $= \$210$	$A = \$10000 + \$210$ $= \$10210$
2	$10210	$I = (10210)($ $)($ $)$ $=$	$A =$ $=$
3		$I = ($ $)($ $)($ $)$	
4			

Hint

At the end of each year, the interest earned is added to the principal. The sum is the principal for the next year.

② Use simple interest calculations in the chart to determine how much compound interest Madelyn earned.

After 4 yr, Madelyn's investment is worth $_____.
To calculate the interest, subtract the starting principal.

$I = \$10866.83 - \$$_____ $= \$$_____

Madelyn has $_____ in interest for the equipment.

To calculate the amount of compound interest earned on an investment, use this formula:

$$A = P(1 + i)^n$$

amount   principal   interest per compounding period

n is the number of compounding periods

Example 1

Use the compound interest formula to calculate how much interest Madelyn earned.

Solution

A. What information do you know?

Amount (A) = ?

Principal (P) = $_____

Interest rate per compounding period (i) = 2.1%, or _____

Number of compounding periods (n) = _____

B. What is the total amount (A) Madelyn had after 4 yr?

$A = P(1 + i)^n$

$= \$\underline{\quad}(1 + \underline{\quad})^4$

$= \$\underline{\qquad}$

C. How much interest did she earn?

$I = \$10\,866.83 - \$\underline{\quad} = \$\underline{\quad}$

Madelyn earned $_____ in interest.

Example 2

Owen sold his auto body shop in Regina. He invested $80 000 in a savings account that earned 2.75%/yr, compounded annually.

How much will Owen's savings be worth after 3 yr?

Solution

Determine the value of Owen's savings after 3 yr.

$A = P(1 + i)^n$

$= \$\underline{\quad}(1 + \underline{\quad})^3$

$= \$\underline{\qquad}$

Owen's savings will be worth $_____ after 3 yr.

Practice

1. Rebecca invested $6000 in a savings account that paid 3.2%/yr, compounded annually.

Complete this chart to determine the amount after Rebecca's account after 3 yr.

Year	Principal	Simple interest $I = Prt$	Amount at end of year $A = P + I$
1	$6000	$I = (\$6000)(\underline{\quad})(\underline{\ })$ $= \$\underline{\quad}$	$A = \$6000 + \$\underline{\quad}$ $= \$\underline{\quad}$
2	$\underline{\quad}$	$I = (\$\underline{\quad})(\underline{\quad})(\underline{\ })$ $= \$\underline{\quad}$	$A = \$\underline{\quad} + \$\underline{\quad}$ $= \$\underline{\quad}$
3	$\underline{\quad}$		$A = \$\underline{\quad} + \$\underline{\quad}$ $= \$\underline{\quad}$

2. Islay is a jeweller in Fort McMurray.
- Islay uses Canadian diamonds mined in Lac de Gras.
- She makes an annual trip to Yellowknife to buy stock at wholesale prices.
- To save money for her next trip, she bought a $12 000 GIC for 1 yr. It paid 2.1%/yr.

How much money will Islay have after 1 yr?

3. Darby is a cabinetmaker in Watson Lake. She used $1500 profit from the sale of a cabinet to buy a GIC. It is a 3 yr GIC with an interest rate of 2.2%/yr, compounded annually.

a) How much money will Darby have at the end of the 3 yr?

b) How much interest will Darby earn?

4. Gordon manages a recreation facility. He wants to upgrade the gym equipment. He needs $32 000. He is reviewing the facility's investments that are up for renewal.

Complete the chart. Is there enough money for the upgrades?

Savings account	Principal (P)	Interest rate per compounding period (i)	Number of compounding periods (n)	Amount (A)
1	$4200	2.7%	3	$ _____ (1 + _____)$^{\square}$ $\doteq$ $ _____
2	$9500	4.3%	6	
3	$6800	1.9%	2	
4	$7400	3.9%	5	

Total savings: $ _____ + $ _____ + $ _____ + $ _____ = $ _____

Is there enough money for the upgrades to the gym equipment? _____

5. Henny is a plumber in Kamloops. She installed 17 toilets in a new townhouse complex.
   - She charged $50 per toilet installed.
   - She invested the money for 2 yr into a savings account.
   - The account paid 1.3%/yr, compounded annually.

   How much will Henny have after 2 yr?

Hint
The interest is compounded annually, which means once each year. So, the interest earned is added to the principal.

6. Suppose you have these choices for saving money. Both accounts have the same interest rate. Which would you choose? Explain.
   - One account uses simple interest.
   - The other account uses compound interest.

7. Describe a situation where someone might need to use the compound interest formula in their job.

Mid-Chapter Review

1. Describe each term in your own words.

   a) interest _____

   b) annual interest rate _____

   _____

   c) principal _____

2. Renée runs a hair salon in Flin Flon. She was saving for new salon chairs. She earned $75.25 in simple interest on a 3 yr investment. The interest rate was 2.4%/yr.

   a) How much did Renée invest?

   b) How much does Renée have to spend on new chairs?

3. Darryl is a rock climber. He needs to buy some new gear for an upcoming climbing trip. He cashed in a 2 yr $1500 investment. It paid 2.75%/yr, compounded annually. How much money does he have to buy the gear?

4. Giacomo earned $12.17 in simple interest on his investment of $1000. The interest rate was 1.5%/yr. How long did he invest the money? Round up the number of days.

Interest Game: Do They Match?

Create 12 pairs of cards. Use information from this chapter. Follow these rules when creating the cards:

> **You will need**
> - blank cards or pieces of paper
> - a coin

- A pair of cards can have a term on one card and a definition on the other.

compound interest	interest calculated on the amount invested and the interest earned

- A pair of cards can have a formula on one card and the formula in words on the other.

$I = Prt$	Interest equals principal times the rate of interest times the length of time

- A pair of cards can have a formula on one card and a calculation on the other.

$A = P(1 + I)^p$	$\$1045.68 \doteq 1000(1 + 0.015)^3$

Play the game with two players.

A. Shuffle the cards. Spread out the cards face down.

B. Flip the coin. The player with heads is the first player.

C. The first player turns over two cards so that both players can see them.

D. The first player to correctly say whether the cards are a pair takes the cards. The turn ends. If a player calls incorrectly, the other player takes the cards.

E. Play until all the cards are taken, or until the game time is over. The player with more cards wins.

F. What strategies did you use in the game? How might someone make a mistake using these strategies? How could you help correct this?

G. Make up a different game with the cards. Play your game.

1.5 Compounding Periods

Try These

i) $3(4)^2 = $ _____

ii) $6(3.2)^2 = $ _____

iii) $2(1 + 0.5)^3 = $ _____

iv) $400\left(1 + \dfrac{0.8}{2}\right)^2 = $ _____

Interest rates are usually expressed as a rate for 1 yr.

However, interest can be compounded in different ways. The number of compounding periods depends on the type of investment and the institution.

The chart shows some compounding periods.

Compounding period	Frequency of compounding
annually	interest compounded once per year
semi-annually	interest compounded 2 times per year
quarterly	interest compounded 4 times per year
monthly	interest compounded 12 times per year
weekly	interest compounded 52 times per year
daily	interest compounded 365 times per year

Kevin wants to invest the money he earns teaching piano lessons. He found an online bank that has a high-interest savings account rate of 1.8%/yr. The interest is compounded monthly.

What is the monthly rate? How often will his money be compounded in 5 yr?

Hint

To calculate the interest rate per compounding period, divide the interest rate by the number of compounding periods in 1 yr.

1. What is the monthly interest rate?

   $1.8\% = \dfrac{\boxed{}}{100}$, or _____

   So _____ /yr $\times \dfrac{1 \text{ yr}}{12 \text{ mo}}$

   $= \dfrac{\boxed{}}{\boxed{} \text{ mo}}$, or _____ per month

2. How many times will interest be compounded in 5 yr?

   12/yr $\times$ _____ yr = _____

   The interest will be compounded _____ times in 5 yr.

Example

Sheryl manages a high-rise building in Vancouver. She invested $40 000 from this year's condo fees for a reserve fund.

- She invested $20 000 in an account that pays 1.8%/yr, compounded semi-annually.
- She invested $20 000 in an account that pays 1.8%/yr, compounded daily.

How does the interest earned on each investment compare after 3 yr?

Solution

A. What is the value of the investment with semi-annual compounding?

$A = P(1 + i)^n$

$= \$\underline{\hspace{2em}}\left(1 + \dfrac{0.018}{\square}\right)^{\square \times 3}$

$= \$\underline{\hspace{2em}}(\underline{\hspace{2em}})^{\square}$

$= \$\underline{\hspace{3em}}$

The value of the investment with semi-annual compounding will be $\underline{\hspace{3em}} after 3 yr.

B. What is the value of the investment with daily compounding?

$A = P(1 + i)^n$

$= \$\underline{\hspace{2em}}\left(1 + \dfrac{0.018}{\boxed{}}\right)^{\boxed{} \times 3}$

$= \$\underline{\hspace{2em}}(\underline{\hspace{3em}})^{\boxed{}}$

$= \$\underline{\hspace{2em}}$

The value of the investment with daily compounding will be $\underline{\hspace{3em}} after 3 yr.

C. How does the interest earned on each investment compare?

$I = \$\underline{\hspace{3em}} - \$\underline{\hspace{2em}}$

$= \$\underline{\hspace{2em}}$

The investment that had more compounding periods earned $\underline{\hspace{2em}} more in interest over the same period of time.
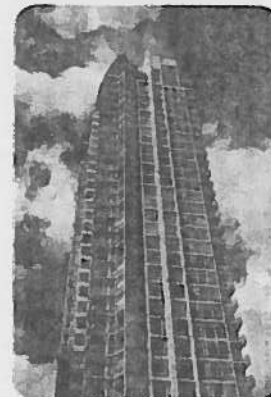
Practice

1. An investment earns interest at 9%/yr. Calculate i and n.

   a) semi-annually for 6 yr   b) weekly for 2 yr

$$i = \frac{}{2} \qquad n = \underline{} \times 2$$

$$i = \underline{} \qquad n = \underline{}$$

2. Brynn is an assistant to an investment banker. Brynn is preparing a presentation on investments made at 3.2%/yr.

   a) Complete the chart.

Frequency of compounding	Principal (P)	Interest rate per compounding period (i)	Number of compounding periods (n)	Compound interest formula	Amount (A)
annually (1 time/yr)	$100 000	$\dfrac{0.032}{1}$	1	$A = P(1 + i)^1$ $= \$\underline{}(1 + \underline{})^1$	$
semi-annually (2 times/yr)	$100 000	▯	2	$A = P(1 + i)^{\square}$ $= \$\underline{}\left(1 + \dfrac{\square}{\square}\right)^{\square}$	$
monthly (12 times/yr)	$100 000	▯		$A = P(1 + i)^{\square}$ $= \$\underline{}\left(1 + \dfrac{\square}{\square}\right)^{\square}$	$
daily (365 times/yr)	$100 000	▯		$A = P(1 + i)^{\square}$ $= \$\underline{}\left(1 + \dfrac{\square}{\square}\right)^{\square}$	$

   b) What frequency of compounding pays the most interest? How can you tell?

3. Haley invests $10 000 for 2 yr. The interest rate is 2.3%/yr, compounded daily. How much money will Haley have?

$$A = P\left(1 + \frac{0.023}{\square}\right)^{2 \times \square}$$

4. Kwame invests $1600 at 3.2%/yr, compounded quarterly. How much money will Kwame have after 18 mo?

5. Gwyneth's family sold their restaurant in Saskatoon. They plan to move to Victoria and open a bookstore in a year. During this year, they have $150 000 to invest.

- Gwyneth suggests a no-fee, high-interest savings account. The interest rate is 2.8%/yr, compounded semi-annually.
- Martin suggests a high-interest savings account with an interest rate of 2.8%/yr, compounded daily. The account has a $40 annual service fee.

REFLECTING
When might someone who owns a bookstore use the compound interest formula?

a) Suppose they invest as Gwyneth suggests. What would be the value of the investment after 1 yr?

e.g., $A = P(1 + i)^n$

$$= \$\underline{\hspace{1cm}}\left(1 + \frac{\boxed{}}{2}\right)^2$$

$$= \$\underline{\hspace{1.5cm}}$$

b) Suppose they invest as Martin suggests. What would be the value of the investment after 1 yr?

Hint
Subtract service fees from the investment.

c) What savings account should they use? Why?

1.6 Compound Interest Problems

Try These

Calculate to two decimal places.

i) $\dfrac{500}{(1 + 0.1)^4} = $ _____

ii) $\dfrac{1000}{(1 + 0.05)^2} = $ _____

May is a cashier at a wallpaper store in Calgary. She invests in a savings account each month.

- The interest rate is 1.3%/yr, compounded annually.
- After 2 yr, one of May's monthly investments is worth $97.49.

How much did she invest that month?

① How can you use this interest formula?

$$A = P(1 + i)^n$$

$\$$_____ $= P(1 + $ _____ $)^2$

② How much did May invest in that month?

$\$$_____ $= P($ _____ $)$

$\$\dfrac{\boxed{}}{\boxed{}} = P$

$\$$_____ $= P$ May invested $\$$_____ that month.

Example 1

Daisy wants to start saving for a party for her business in 5 yr. The interest rate for Daisy's investment is 3.2%/yr. The interest is compounded annually.

How much does Daisy need to invest now to have $4000 after 5 yr?

Solution

A. What information do you know?

Amount $(A) = \$4000$

Interest rate per compounding period $(i) = $ _____%, or _____

Number of compounding periods $(n) = $ _____

B. How much money (the principal) does Daisy need to invest now?

$$A = P(1 + i)^n$$

$$\$\underline{\hspace{2cm}} = P(1 + \underline{\hspace{1.5cm}})^{\underline{\hspace{0.5cm}}}$$

$$\$\underline{\hspace{2cm}} = P \times \underline{\hspace{1.5cm}}$$

$$\$\frac{\boxed{}}{\boxed{}} = P$$

$$\$\underline{\hspace{2cm}} = P$$

Daisy needs to invest $\$\underline{\hspace{1.5cm}}$.

Suppose you know the interest rate and the compounding period for an investment. You can use the Rule of 72 to estimate how long it will take for the investment to double.

The Rule of 72 formula is:

$$\text{Years to double} = \frac{72}{\text{Annual interest rate (as a percent)}}$$

Example 2

James runs his own business as a locksmith. He is responsible for saving for his retirement. He invests in his RRSP (Registered Retirement Savings Plan) every year.

One year, he invested $3000 at 3.6%/yr, compounded annually. About how long will it take for James's money to double?

Solution

A. Estimate the doubling time for James's investment.

Interest = _____ %

Years to double: $\dfrac{72}{\boxed{}} = \underline{\hspace{1.5cm}}$ yr

It will take about _____ yr for James's money to double.

B. Check that your estimate in Part A is reasonable.

$$A = P(1 + i)^n$$

$$= \underline{\hspace{1.5cm}}(1 + \underline{\hspace{1.5cm}})^{\boxed{}}$$

$$= \underline{\hspace{1.5cm}}$$

The amount is about _____ $3000. So the estimate is

_____.

Practice

1. Pearl, a refrigeration mechanic, wants to open her own shop in 3 yr.
   - She needs a $20 000 down payment to start the business.
   - She plans to invest at a rate of 2.9%/yr, compounded annually.

   How much does Pearl need to invest now to have $20 000 in 3 yr?
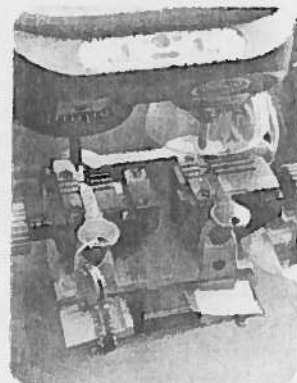
REFLECTING
Would it be better for Pearl if her investment was compounded monthly? Explain.

2. Lorraine invested $2300 at a rate of 2.9%/yr, compounded annually.

   a) Estimate how long it will take for her to double her money.

Hint
Use the Rule of 72. Round up to the nearest whole number of years because the investment is compounded annually.

   b) Lorraine used the estimation from Part a) to determine how much she would have at the end of that time period. These are Lorraine's calculations.

   $$A = \$2300(1 + 0.29)^{25}$$
   $$= \$2300(1.29)^{25}$$
   $$= \$1 338 044.612, \text{ or } \$1 338 044.61$$

   She knows the total amount should be about double her original investment. Where is Lorraine's error?

   c) Determine the correct amount of money Lorraine will have at the end of her investment.

3. Khameron has created a "Double Your Money with Us" campaign for a bank.

   What is the annual interest rate clients will need so they can double their money in about 8 yr?

   $$\underline{\quad} \text{ yr to double} = \frac{72}{\text{annual interest rate (\%)}} = \frac{72}{\square}$$

4. Mishak plans on retiring from his job as a gas fitter in 25 yr. This year, he invests $10 000 in his retirement plan at 3.2%/yr. Will Mishak double this investment before he retires?

5. Theresa is investing $7100 in a 3 yr savings plan. It pays 3.15%/yr, compounded semi-annually. How much money will Theresa have after 3 yr?

6. Create and solve a word problem using these values:
   Amount = $5500

   Interest rate = 2.7%/yr, compounded semi-annually

   Time = 4 yr

REFLECTING
When might someone use the Rule of 72 in their job?

Chapter Review

1. Allie is a carpenter. She is saving for new tools. She invested $1200, at 1.9%/yr simple interest, for 2 yr. How much will she have at the end of 2 yr to spend on tools?

2. Carlos earned $19.83 in simple interest on his investment of $1280. The interest rate was 1.2%/yr. He wanted to calculate the number of days he invested for. Here are his calculations.

$$\$19.83 = \$1280(0.012)(t)$$

$$\$19.83 = \$15.36(t)$$

$$\frac{\$19.83}{\$15.36} = t \quad \text{So } t = 1.291... \ d$$

a) Where did Carlos make an error?

b) For how many days did Carlos invest?

3. Karim earned $93.26 in simple interest in 1 yr on a $2900 investment. What was the interest rate on Karim's investment? Round to one decimal place.

4. Ming is a realtor. She earned $6200 in commission from the sale of a property. Ming invested the commission in a 5 yr GIC that paid 2.7%/yr, compounded annually. How much will Ming have after 5 yr?

5. Complete the chart.

Compounding	Principal (P)	Interest rate	Number of years	Number of compounding periods (n)	Compound interest formula	Amount (A)
semi-annually	$4000	3.1%/yr	3		$A = P(1 + i)^n$	
monthly	$9800	1.9%/yr	2		$A = P(1 + i)^n$	

6. Susie is a landscaper. She leases a truck for her business. She plans to buy out the lease in 6 yr. She has half the money now.

At what interest rate, compounded annually, does Susie need to invest now in order to double her money in 6 yr?

7. Gair will need $10000 in 2 yr to upgrade his farm equipment. He is investing at a rate of 2.4%/yr, compounded quarterly. How much does Gair need to invest now to have $10000 in 2 yr?

Chapter Test

1. Use the simple interest formula. Complete the chart. Round interest rates to the nearest tenth of a percent.

Principal	Interest rate	Time	Interest Formula: _____	Amount at end of investment Formula: _____
$7500	_____ %/yr	30 wk	$69.23	$ _____
$23 000	2.5%/yr	_____ d	$447.65	$ _____

2. José invested $2600 in a 5 yr GIC that paid 2.95%/yr, compounded annually. How much will José have?

3. Marie and her brother Damien work for their family's auto repair shop. They each invested all of their first paycheque, $1473.92, for 1 yr at an interest rate of 3.7%/yr.
   - Marie's investment compounded interest daily.
   - Damien's investment paid simple interest.

   a) How much interest did Marie earn in 1 yr?

   b) How much interest did Damien earn in 1 yr?

   c) Who earned more interest? How much more was it?

4. Estimate how many years it will take for an investment to double at the following interest rates. Round up.

   a) 3.3%: _____ yr   b) 6.1%: _____ yr   c) 9.2%: _____ yr