

9.1 Earning Income

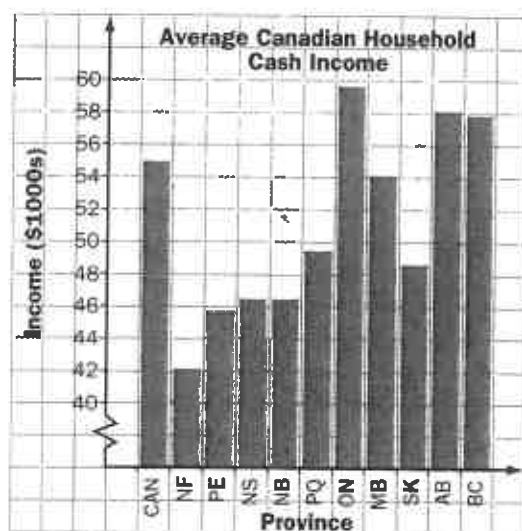
British North America adopted its own decimal system of coinage in 1858. The coins of the Province of Canada, formed in the 1841 union of Upper Canada and Lower Canada, consisted of silver 5¢, 10¢, and 20¢ pieces, and bronze cents. All of these coins became legal tender in the Dominion of Canada after Confederation. In 1937, a completely new set of coinage was introduced, with designs closely resembling those used today.



Explore: Interpret the Graph

The bar graph shows the average cash income for Canadian households, in each province, for one year.

- a) In which province was the average cash income the least? the greatest?
- b) In which provinces did the average cash income exceed the average Canadian cash income?



Inquire

- 1. Why are average incomes in some provinces lower than in others?
- 2. Does a lower income represent a lower standard of living? Explain.
- 3. a) Use your research skills to find the latest figures for the average cash income for Canadian households by province.
b) Use your data to draw a bar graph similar to the one shown.
c) Compare your bar graph with the one shown. Write a description of the similarities and the differences in the two graphs.

Gross income is the amount of money earned through employment. There are various methods of calculating an employee's gross income. Some positions have an annual salary, while others have an hourly rate of pay. Most sales positions have some form of commission built into the employee's payment scheme.

Example 1 Earning an Hourly Rate

Suhanna, a financial assistant, is paid \$15.50/h for a 37.5-h week. She is paid time-and-a-half for overtime. One week she worked 45 h. What was her gross income for the week?

Solution

Total number of hours worked in the week = 45

Regular number of hours in the week = 37.5

Number of hours of overtime = $45 - 37.5$
 $= 7.5$

Number of regular hours equivalent to overtime hours = 1.5×7.5
 $= 11.25$

Total number of regular hours is $37.5 + 11.25 = 48.75$

Hourly rate of pay is \$15.50.

Gross income = total number of hours worked $\times$ hourly rate of pay
 $= 48.75 \times \$15.50$
 $= \$755.63$

Estimate

$$50 \times 15 = 750$$

Suhanna's gross income for the week was \$755.63.

Many employees in restaurants earn an hourly wage plus tips or gratuities. Often, the employees who wait on tables are required to give part of their tips to those employees who do not earn tips directly.

Example 2 Earning Gratuities

Tom has a choice of two restaurants at which to work. At Plato's, he will be paid \$8/h, and tips average \$25 per day. At Donald's, he will be paid \$7.25/h and receive tips averaging \$40 daily, but 25% of tips are given to the kitchen staff. If Tom works 35 h per week, spread over 5 days, how much can he expect to earn at each restaurant?

Solution

At Plato's:

Gross Income = pay for regular hours + tips
 $= 35 \times \$8 + 5 \times \25
 $= \$405$

Estimate

$$30 \times 10 + 125 = 425$$

At Donald's:

Gross Income = pay for regular hours + 75% of tips
 $= 35 \times \$7.25 + 0.75 \times 5 \times \40
 $= \$403.75$

Estimate

$$40 \times 7 + 150 = 430$$

Tom can expect to earn \$405 at Plato's restaurant and \$403.75 at Donald's.

Many sales positions involve commission as an incentive for the salesperson. Some salespeople receive **straight commission**, that is, they receive a percent of the total value of their sales but no salary. Other salespeople receive a **salary and commission**. Some sales positions pay commission only on sales above a predetermined **sales quota**, which is a set amount sometimes called their sales base. As a further incentive, some sales positions involve **graduated commission**, where the rate of commission increases as the sales increase.

Example 3 Earning Commission

Rajan, Eric, and Lucy are all sales representatives, but they are paid in different ways. Rajan is paid straight commission of 5% of his total sales. Eric is paid a base salary of \$250 a week, plus 2% commission on sales above his sales quota of \$5000. Lucy is paid graduated commission of 2.5% on sales up to \$3000, plus 6% on sales in excess of \$3000. If each person's sales for one week are \$12 000, what is each person's gross income?

Solution

Rajan:

Total sales are \$12 000.

$$\begin{aligned}\text{Gross Income} &= 5\% \text{ of } \$12\,000 \\ &= 0.05 \times \$12\,000 \\ &= \$600\end{aligned}$$

Eric:

Total sales are \$12 000.

Eric is paid commission on sales above his sales quota of \$5000, so he earns commission on \$12 000 - \$5000, or \$7000.

$$\begin{aligned}\text{Gross Income} &= \text{Salary} + \text{Commission} \\ &= \$250 + 2\% \text{ of } \$7000 \\ &= \$250 + 0.02 \times \$7000 \\ &= \$390\end{aligned}$$

Lucy:

Total sales are \$12 000.

Her sales in excess of \$3000 are \$9000.

$$\begin{aligned}\text{Gross Income} &= 2.5\% \text{ of } \$3000 + 6\% \text{ of } \$9000 \\ &= 0.025 \times \$3000 + 0.06 \times \$9000 \\ &= \$615\end{aligned}$$

Rajan's gross income is \$600, Eric's gross income is \$390, and Lucy's gross income is \$615.

Employees in some situations are paid for each item they produce or each service they provide. This method of earning income is called **piecework**.

Example 4 Earning Income by Piecework

Tanya works at a service station, cleaning cars. She is paid \$22 per car and cleans an average of 6 cars each day. If she works 5 days per week, what is her average gross income for one week?

Solution

Tanya cleans, on average, 6 cars a day.

She works 5 days a week.

Average number of cars cleaned in one week = 6×5
= 30

Tanya is paid \$22 per car.

Gross Income = $30 \times \$22$
= \$660

Tanya's average gross income for one week is \$660.

Practice

Round answers to 2 decimal places, where necessary.

Overtime is calculated at time-and-a-half. How many regular hours are equivalent to each number of overtime hours?

- | | | |
|-------|--------|---------|
| 1. 10 | 2. 6 | 3. 15 |
| 4. 19 | 5. 3.5 | 6. 12.5 |

7. Reiko's gross annual income is \$43 680.

- What is her gross monthly income?
- What is her gross weekly income?
- What is her hourly rate of pay, if she works 35 h each week?

8. Raymond is paid \$9/h, plus time-and-a-half for overtime on hours in excess of 40 h each week. If he worked 50 h last week, what was his gross income for the week?

Find the gross weekly income for each restaurant employee.

- Gabriella works 40 h per week at \$9/h. Her tips average \$200 per week.
- Chas works six 5-h shifts per week. He is paid \$8.80/h, and tips average \$20 per shift.
- Li works 7.5 h per day, 5 days a week. She is paid \$9.90/h, and tips average \$30 daily.

Find the gross monthly earnings for each of the following commissioned sales.

	Rate of Commission	Total Monthly Sales
12.	17%	\$4789
13.	2.5%	\$222 800
14.	34%	\$5765
15.	0.05%	\$720 000

16. Aziz has the option of taking a position as a computer operator at a weekly salary of \$675, or working a 40-h week at \$16.90/h.

- Which option generates the greater gross weekly income?
- How much more would he earn from this option in a year?

17. During a 2-week period, Zoraida worked 64 h at her regular hourly rate and 3 h of overtime at time-and-a-half. On the weekend, she worked 16 h at double time. If Zoraida's regular hourly rate is \$22/h, calculate her gross income for the 2-week period.

18. April is self-employed and teaches piano at \$15 per half-hour lesson. She has 26 students who take one lesson each week, and she teaches 40 weeks each year. What is her gross income for the year?

19. Nirmala sells photography equipment and earns a salary plus commission. She is paid \$14.85/h, plus 15% commission on total sales. Last week, she worked 35 h and sold \$4800 worth of equipment. Calculate Nirmala's gross earnings for the week.

Applications and Problem Solving

20. Pay raise Chet is guaranteed 40 h of work each week. His hourly rate is \$17.50. If he is awarded a 3% pay increase on the first anniversary of his employment, by what amount will his gross salary increase for a 2-week period?

21. Waiting tables Bonnie is a waitress and is paid \$8.25/h for a 35-h week. She receives 15% of the total tips earned by all the staff. Last week, the tips totalled \$1569. What was her gross income for that week?

22. Home business Louis weaves upholstery fabric in his home. Each week, he is paid \$250 to weave 50 m of fabric. For every metre in excess of 50 m, he is paid \$7.50. One week, Louis produced 73 m of fabric. What were his gross weekly earnings?

23. Computer sales Elmo sells computer equipment and is paid a base salary of \$500, plus 4% on sales above his quota of \$5000. If he sells \$7200 of computer equipment in one week, what is his gross income for the week?

24. Financial services Nadia is a sales representative in a financial planning services company. She earns 12% on her first \$3000 of sales, 15% on the next \$2000, and 19% on all other sales. In December, she sold \$15 850 worth of products and services. What was Nadia's gross monthly income if, in addition to the regular commission, the manager included a 2% bonus on total sales?

25. Delivering pizzas Myrna delivers pizzas. She works 3 days each week and is paid \$2 for each delivery.

- a) Would you describe her method of payment as a salary, an hourly rate of pay, commission, or piecework? Explain.
- b) If she delivers 235 pizzas in one week, what is her gross income for that week?
- c) By what other method does a pizza delivery person receive income for delivering pizzas?

26. Magazine sales Adriana sold magazine subscriptions worth \$243 and received \$36.45 in straight commission. What rate of commission was she paid?

27. Keyboarding Anton is offered a part-time job keying documents at a law firm. He is given two payment options.

Option A: \$2.15 per page (Anton averages 120 pages per week.)

Option B: \$345 per week

- a) What is the difference in the gross weekly income earned for each option?
- b) What are the advantages and the disadvantages of each method of payment?

28. Retail clothing Liam works in the retail business, selling men's clothing. He earns a monthly base salary of \$2000, plus 6.5% commission on his total sales. His total sales for each of the last four months were \$3000, \$2885, \$5088, and \$5227.

- a) Find his gross monthly earnings for each of the four months.
- b) Draw a bar graph to show his earnings for the four months.

29. Advertising sales The Zinger Advertising Company has three plans for paying its sales representatives each month.

Plan A: \$750, plus 15% commission on all sales
Plan B: 20% on sales up to \$5000, 25% on sales from \$5000 up to \$10 000, 30% on sales of \$10 000 and over

Plan C: 25% straight commission on all sales

- a) Calculate the gross monthly income on sales of \$12 500 using each of the plans.
- b) On the same set of axes, draw a line graph to show gross income versus sales, for sales up to \$15 000 in one month, for each plan.
- c) At what value in sales does Plan B begin to pay the highest gross income?

9.2 Net Income

Tax Freedom Day is the day of the year on which Canadians start to work for themselves. Until that day, gross earnings are equal to the amount paid out in taxes to the federal, provincial, and municipal governments. Some of the taxes, such as income tax, sales tax, and property tax, are very visible. Other taxes are hidden in the price of certain consumer products, such as gasoline. Tax Freedom Day varies in different provinces because provincial tax rates vary.

Explore: Use a Table

The table shows the Tax Freedom Day for each province in one year.

For Newfoundland, Tax Freedom Day was June 8. From January 1 to June 7, there are 158 days, which is 43.3% of the 365 days in the year. Thus, the average household in

Newfoundland spent 43.3% of its gross income on federal, provincial, and municipal taxes.

a) Which province had the highest taxes?

b) How did your province rank?

British Columbia	June 30
Alberta	June 12
Saskatchewan	June 17
Manitoba	June 23
Ontario	June 26
Quebec	June 24
New Brunswick	June 18
Nova Scotia	June 9
Prince Edward Island	May 28
Newfoundland	June 8

Inquire

1. What percent of gross income did the Tax Freedom Day represent for Alberta? for British Columbia?

2. For the year shown, the average Canadian household income was \$56 322, and the average amount paid out in taxes was \$27 017. What was Tax Freedom Day for Canada that year?

3. Use your research skills to find the current Tax Freedom Day data. What is the current Tax Freedom Day for your province? If you earn a gross income of \$40 000, about how much can you expect to spend on all types of taxation?

As well as income tax, there are two other statutory deductions that employers must withhold from their employees' gross income. These are the employee contributions to the Canada Pension Plan (CPP) and to Employment Insurance (EI). Some employees also have deductions for a registered pension plan, union or professional fees, and health insurance plans. All payroll deductions are shown on the employee's pay slip. The net amount, after all deductions are subtracted from the gross income, is the amount that the employee actually receives as **net income**.

WEEK END	EMPLOYEE SIN	REGULAR EARNINGS	OVERTIME EARNINGS	GROSS PAY
Aug 31	321 654 987	323.75	37.00	360.75
DEDUCTIONS				
Description	Current	Year to Date		
CPP	11.54	355.83		
EI	9.74	311.04		
Income Tax	79.20	2535.20		
TOTAL DEDUCTIONS	100.48		NET PAY	260.27

The **Canada Pension Plan (CPP)** contribution is money that the government collects toward an employee's future pension. When the employee reaches the qualifying age, the government guarantees a minimum income based on the person's contributions to the plan. One year, the CPP contributions were 3.2% of gross income between \$3500.01 and \$36 900. The first \$3500 of a person's income is the **basic CPP exemption** and is not subject to CPP contributions.

Employment Insurance (EI) is an insurance plan, supported by employee and employer premiums, and by federal government contributions. If employees have paid the minimum number of required premiums, then the plan provides some income during periods of unemployment. One year, the EI premiums were 2.7% of gross income, up to a maximum premium of \$1053.

Example 1 Calculating CPP and EI

Roman's gross income is \$925 biweekly. Calculate his CPP contribution and his EI premium for each pay period.

Solution

$$\begin{aligned}\text{Gross Annual Income} &= 26 \times \$925 \\ &= \$24\,050\end{aligned}$$

Estimate

$$30 \times 900 = 27\,000$$

Biweekly means every two weeks.

Canada Pension Plan (CPP) contribution:

$$\begin{aligned}\text{Contributory earnings} &= \text{Gross Annual Income} - \text{Basic CPP Exemption} \\ &= \$24\,050 - \$3500 \\ &= \$20\,550\end{aligned}$$

$$\begin{aligned}\text{Annual CPP contribution} &= 3.2\% \text{ of } \$20\,550 \\ &= 0.032 \times \$20\,550 \\ &= \$657.60\end{aligned}$$

Estimate

$$0.03 \times 20\,000 = 600$$

$$\begin{aligned}\text{Biweekly CPP contribution} &= \$657.60 \div 26 \\ &= \$25.29\end{aligned}$$

Estimate

$$660 \div 26 = 25.38$$

Employment Insurance (EI) premium:

$$\begin{aligned}\text{Biweekly EI premium} &= 2.7\% \text{ of } \$925 \\ &= 0.027 \times \$925 \\ &= \$24.98\end{aligned}$$

Estimate

$$0.03 \times 900 = 27$$

Roman's biweekly CPP contribution is \$25.29, and his EI premium is \$24.98.

The amount of income tax deducted from an employee's gross pay depends on the employee's income and tax credits. Employees must pay two levels of income tax, federal and provincial. The rates for one year are shown in the tables.

Federal Tax Table		
Income	Basic Federal Tax	Provincial Tax
\$0 - \$29 590	17%	
\$29 590 - \$59 180	26%	
\$59 180 - \$98 280	29%	

Provincial Tax Table	
Province	Provincial Tax Rate*
British Columbia	50.5% of basic federal tax
Alberta	45.5% of basic federal tax
Saskatchewan	50% of basic federal tax
Manitoba	52% of basic federal tax

*Some provinces charge provincial surtaxes, but the percents shown provide reasonable estimates of provincial tax rates.

Taxable income is gross income minus any **tax-exempt deductions**: union or professional dues, Registered Pension Plan (RPP) contributions, Registered Retirement Savings Plan (RRSP) contributions, and child care expenses.

Basic personal tax credits are deductions granted for each person that the employee supports.

Several steps are needed to find an employee's federal and provincial taxes. The following is an outline of how to determine these amounts.

Step 1: Calculate the person's tax credits.

Tax credits = basic personal tax credit + CPP contribution + EI premium

Step 2: Find the person's annual taxable income.

Annual taxable income = gross annual income - tax-exempt deductions

Step 3: Determine the person's basic federal tax, using the rates given in the Federal Tax Table. Then, use the basic federal tax to calculate the provincial tax, using the rates given in the Provincial Tax Table.

Basic Federal Tax = Federal tax on taxable income - 17% of tax credits

The employee's net annual income can be found by deducting CPP contributions, EI premiums, federal and provincial income tax, and all other voluntary deductions from the employee's gross annual income.

Example 2 Calculating Net Annual Income

Dina lives and works in Calgary. Her annual salary is \$35 000. Her basic personal tax credit is \$6456. Each week she has the following tax-exempt deductions taken from her gross income: \$5.50 for professional dues and \$60 to a Registered Retirement Savings Plan. She also has \$8 per week deducted for medical insurance.

- Calculate Dina's annual deductions for CPP and EI.
- Find the total amount of income tax that Dina will have deducted in a year.
- Determine her net annual income.

Solution**a) CPP contribution:**

Contributory earnings = gross annual income – basic CPP exemption
 = \$35 000 – \$3500
 = \$31 500

Annual CPP contribution = 3.2% of \$31 500
 = $0.032 \times \$31\,500$
 = \$1008

$$0.03 \times 30\,000 = 900$$

EI premium:

Annual EI premium = 2.7% of \$35 000
 = $0.027 \times \$35\,000$
 = \$945

Dina's annual deduction for CPP is \$1008 and for EI is \$945.

b) Annual Taxable Income:

Annual taxable income = gross annual income – tax-exempt deductions
 = \$35 000 – 52(\$60 + \$5.50)
 = \$31 594

Estimate

$$35\,000 - 50 \times 70 = 31\,500$$

Federal Tax:

Using the Federal Tax Table,

Federal tax = 17% of \$29 590 + 26% of (\$31 594 – \$29 590)
 = $0.17 \times \$29\,590 + 0.26 \times \2004
 = \$5551.34

Estimate

$$0.2 \times 30\,000 + 0.25 \times 2000 = 6500$$

Tax credits = basic personal tax credit + CPP contribution + EI premium
 = \$6456 + \$1008 + \$945
 = \$8409

Basic federal tax = federal tax – 17% of tax credits
 = $\$5551.34 - 0.17 \times \8409
 = \$4121.81

Estimate

$$5600 - 0.2 \times 8000 = 4000$$

Alberta Provincial Tax:

Provincial tax = 45.5% of basic federal tax
 = $0.455 \times \$4121.81$
 = \$1875.42

Estimate

$$0.5 \times 4000 = 2000$$

Total income tax = basic federal tax + provincial tax
 = \$4121.81 + \$1875.42
 = \$5997.23

Dina will have a total of \$5997.23 deducted for income tax in a year.

e) Total deductions = CPP + EI + income tax + tax-exempt deductions + any other deductions
 = \$1008 + \$945 + \$5997.23 + 52(\$5.50 + \$60 + \$8)
 = \$11 772.73

$$8000 + 50 \times 70 = 11\,500$$

Net annual income = gross annual income – total deductions
 = \$35 000.00 – \$11 772.73
 = \$23 227.27

Dina's net annual income is \$23 227.27.

Practice

- Use the rates given on pages 533 and 534 for CPP, EI, and income tax calculations, or use your research skills to find the current rates. Round answers to 2 decimal places, where necessary.

How many pay periods are there per year for an employee paid at each of the following time intervals?

1. weekly
2. monthly
3. biweekly
4. semi-monthly

For questions 5 to 11, find the employee's Canada Pension Plan contribution that is required for each pay period.

5. Corinne is paid \$1305 semi-monthly.
6. Kostas earns \$586 each week.
7. Atholl is paid \$2267 monthly.
8. Greg is paid \$1856 every two weeks.
9. Paul is paid \$11.25/h and works 38 h per week. He is paid weekly.
10. Mara's annual income is \$34 000. She is paid semi-monthly.

For questions 11 to 16, find the employee's Employment Insurance premium for each pay period.

11. Todd is paid \$408 per week.
12. Shai earns \$28 650 per year and is paid biweekly.
13. Barb is paid \$2175 per month.
14. Helga earns a salary of \$39 000 and is paid semi-monthly.
15. Raj is paid \$18/h and works a 38 h week with no overtime. He is paid weekly.
16. Daniel earns \$18.70/h and works a 37.5-h week with no overtime. He is paid biweekly.

Use the Federal Tax Table to find the federal tax for each employee.

17. Steve has an annual taxable income of \$26 800.
18. Martine's annual taxable income is \$18 305.
19. Jose has an annual taxable income of \$32 138.
20. Carmen's annual taxable income is \$48 220.
21. Jackie's annual taxable income is \$65 160.

Find the provincial tax payable by each employee.

22. Paul lives in Alberta and his basic federal tax is \$3620.50.
23. Ellen lives in British Columbia. Her basic federal tax is \$2815.17.
24. Leah lives in Manitoba, and her basic federal tax is \$4907.36.
25. Mohammed lives in Saskatchewan, and his basic federal tax is \$3015.89.
26. Heather lives in Alberta. Her basic federal tax is \$1987.56.

For questions 27 and 28, find the annual deductions for CPP and EI, the taxable income, and the basic federal tax for each employee.

27. Kerri earns a monthly income of \$3500. She pays monthly union dues of \$25.50 and has a monthly RRSP contribution of \$200 deducted from her pay. Her basic personal tax credit is \$6456.
28. Jack is paid \$1150 every two weeks. His basic personal tax credits are \$8809.

Applications and Problem Solving

29. **Ski instructor** Sonya works in Whistler, British Columbia, as a ski instructor, and is paid \$2625 every month. Her basic personal tax credit is \$6456.
 - a) Calculate Sonya's annual deductions for CPP and EI.
 - b) Determine her total amount of income tax.
30. Marcus works in Winnipeg and has a semi-monthly gross income of \$1950. His basic personal tax credit is \$6456. He pays 2% of his gross income into a registered pension plan.
 - a) Calculate his annual deductions for CPP and EI.
 - b) Determine his total amount of income tax.
 - c) Find his net annual income.
31. **Oil engineer** Carla is an engineer and works for a large oil company in Alberta. She has a basic personal tax credit of \$6456. Her gross income is \$4818.21 per month. She has professional dues of \$57, registered pension plan contributions of \$500, and \$23 for a health insurance plan deducted from her gross income each month. Calculate her net annual income.

32. Bernice lives in Saskatoon. Her basic personal tax credit is \$6456. Her biweekly gross income is \$1554. Each pay period, \$17 in union dues and \$60 for a Registered Retirement Savings Plan are deducted from her earnings. What is her net annual income?

33. Computer sales Felix is a sales representative for a computer store in Vancouver. His gross monthly earnings are \$1250, plus 10% commission on any sales above his monthly sales quota of \$35 000. His sales average \$52 300 per month.

- Calculate his gross income for an average month.
- If his basic personal tax credits are \$11 836, and he contributes 2% of his gross earnings to a registered pension plan, determine his net annual income.

34. For each employee, employers must pay a matching contribution to the CPP and 1.4 times the employee's EI premium. These amounts are not deductions from employees' earnings.

- Where does the money come from?
- Why does the government require employers to pay these contributions?
- Do you think these contributions and premiums are taken into account when an employer presents a wage or salary package to a potential employee? Explain.

35. Canada Pension Plan In 1998, the Canada Pension Plan contribution was 3.2% of gross earnings between \$3500.01 and \$36 900. The federal government plans to increase the contribution rate gradually to a total of 10.1% from the employee and employer by the year 2016.

- For an annual gross salary of \$35 000, how much more will the employee's CPP contribution be in 2016 than in 1998?

36. Suggest reasons why the government might feel that increases to CPP deductions are necessary.

38. Use your research skills to investigate the tables used by the payroll department of a company.

- What is a net claim code?
- How are net claim codes assigned?
- When might a 0 net claim code be assigned?

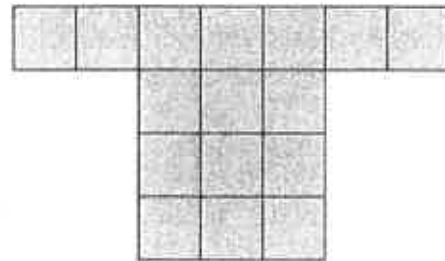
37. Employment Insurance Find out how a person goes about collecting employment insurance benefits after becoming unemployed.

- What is the procedure?
- What criteria must be satisfied to be eligible?
- How much money can a person expect to receive each week?
- For how long can an unemployed person receive these payments?

38. Income tax Draw a graph showing the total amount of income tax deducted versus taxable income in a year. Use taxable incomes of up to \$75 000 and your provincial tax rate. Assume only CPP contributions and EI premiums are deducted from the gross income, and that the basic personal tax credit of \$6456 applies.

LOGIC POWER

The diagram represents 16 flower beds in a botanical garden and the grass-covered paths that run between them. The paths are all the same width, and the path along one side of each flower bed is 20 m long.



Tabitha uses a lawn tractor to cut the grass on the paths once a week.

- Copy the diagram and use it to find the route that Tabitha should follow to travel the shortest possible distance when she cuts the grass. She may have to travel along some paths more than once.
- Find the shortest distance she can travel.

9.3 Interest and Annuities

Paying interest on money borrowed, and earning interest on money invested, has been going on for thousands of years. Interest rates have varied. Around 1800 B.C., Hammurabi, King of Babylonia, developed a system of laws known as the Code of Hammurabi. The code dealt with many matters, including interest rates that could be charged. The code permitted a maximum interest rate of 33% per year for loans of grain and 20% per year for loans of silver. In twelfth century England, people with the best credit paid 50% per year for loans.

The formula for **simple interest** is $I = Prt$, where I is the interest, P is the principal, r is the annual rate of interest, and t is the time in years. Interest paid at regular intervals and added to the principal for the next interest period is called **compound interest**.

Explore: Use a Table

Serena invests \$1000 in a one-year Guaranteed Investment Certificate (GIC) that pays interest at 5.5% per annum. The amount of the GIC at the end of the year is the total of the principal and interest. At the end of each year, Serena reinvests the amount of the GIC at the same rate. Copy and complete the table to show the growth of the \$1000 GIC over a 6-year period.

Year	Principal	Rate	Total
1	1000.00	5.5	1055.00
2	1055.00	5.5	1113.03
3		5.5	
4		5.5	
5		5.5	
6		5.5	

Inquire

1. What is the total amount of interest earned on Serena's GIC in 6 years?
2. If the \$1000 had earned simple interest for 6 years at 5.5% per annum, how much interest would it have earned?
3. Compare the simple interest on Serena's \$1000 over 6 years with the compound interest on Serena's \$1000 over 6 years. Describe situations in which people might prefer simple interest to compound interest.
4. If you had borrowed \$100 in twelfth century England, and paid the loan back after 4 years, how much would you have paid if the interest was
 - a) simple?
 - b) compounded annually?



Two kinds of Canada Savings Bonds are regular Canada Savings Bonds and compound Canada Savings Bonds. Regular Canada Savings Bonds earn simple interest. Each year the interest is deposited into the owner's bank account or mailed to the owner. Compound Canada Savings Bonds earn compound interest. The whole amount of the bond is paid when it is cashed.

Consider the growth of one \$500 Canada Savings Bonds of each type, with interest at 6%, over a 5-year period. The simple interest formula can be used to find the value of each bond at the end of each year. A graph of the data from the tables shows that the regular savings bond is growing in a linear pattern, whereas the compound savings bond is growing more quickly, in the pattern of an exponential function.

Regular Savings Bond				Compound Savings Bond			
Year	P (\$)	I (\$)	A (\$)	Year	P (\$)	I (\$)	A (\$)
1	500	30	530	1	500	30	530
2	500	60	560	2	530	31.80	561.80
3	500	90	590	3	561.80	33.71	595.51
4	500	120	620	4	595.51	35.73	631.24
5	500	150	650	5	631.24	37.87	669.11
6	500	180	680	6	669.11	40.15	709.26
7	500	210	710	7	709.26	42.56	751.82
8	500	240	740	8	751.82	45.11	796.92

$$I = Prt$$

$$= 500 \times 0.06 \times 2$$

$$= 60$$

$$I = Prt$$

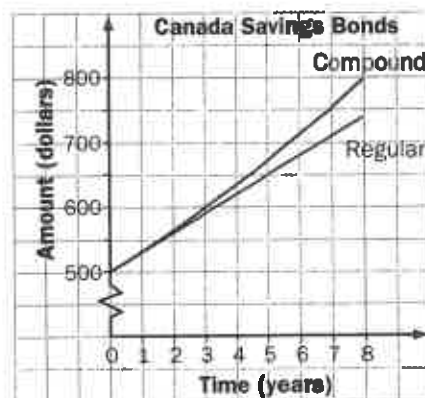
$$= 530 \times 0.06 \times 1$$

$$= 31.80$$

The formula for compound interest is

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

where A is the amount, P is the principal, i is the rate of interest per compounding period, and n is the number of compounding periods. The interest rate per period, i , is found by dividing the annual rate by the number of compounding periods per year.



Compounding Period	Number of Periods in one Year	Interest Rate for the Period (where r is the annual interest rate)
semi-annually	2	$\frac{r}{2}$
quarterly	4	$\frac{r}{4}$
monthly	12	$\frac{r}{12}$
daily	365	$\frac{r}{365}$

Example 1 Calculating Compound Interest

Lloyd arranged a personal loan of \$2500 at 10.75% per annum compounded quarterly. He made no payments for 2 years.

- a) What was the amount owing on the loan at the end of 2 years?
b) How much interest was Lloyd charged for the 2 years?

Solution

a) $P = \$2500$

$i = \frac{10.75\%}{4}$, since there are four interest periods per year.

$n = 8$, since there are 4×2 interest periods in 2 years.

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

$$= 2500 \left(1 + \frac{0.1075}{4} \right)^8$$

$$= 3090.87$$

The amount owing after 2 years was \$3090.87.

b) Interest = Amount - Principal
 $= \$3090.87 - \2500
 $= \$590.87$

Lloyd was charged \$590.87 interest for the 2 years.

Example 2 Comparing Amounts with Different Compounding Periods

Tara has \$1000 to invest. The current rate of interest is 4% per annum. Calculate the amount at the end of the year for Option A: compounding annually, Option B: compounding monthly, and Option C: compounding daily.

Solution

Option A: $P = \$1000$, $i = 4\%$, $n = 1$

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

$$A = 1000(1 + 0.04)^1$$

$$= 1000(1.04)$$

$$= 1040$$

Option B: $P = \$1000$, $i = \frac{4\%}{12}$, $n = 12$

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

$$= 1000 \left(1 + \frac{0.04}{12} \right)^{12}$$

$$= 1040.74$$

Option C: $P = \$1000$, $i = \frac{4\%}{365}$, $n = 365$

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

$$= 1000 \left(1 + \frac{0.04}{365} \right)^{365}$$

$$= 1040.81$$

The amount at the end of one year is \$1040.00 with interest compounding annually, \$1040.74 with interest compounding monthly, and \$1040.81 with interest compounding daily.

Registered Retirement Savings Plans (RRSPs) are designed to help people save for their retirement. Many people choose to invest in RRSPs because these plans provide a method of deferring some of the taxes on income. The principal invested in an RRSP, and the interest earned on it, is only taxable when it is withdrawn. Many different types of investments are available within RRSPs. Guaranteed funds pay a fixed rate of interest for an agreed term. Other types of investments, such as mutual funds, earn variable rates of interest.

Example 3 Comparing RRSP Investments

By the end of his first year working full time, George had saved \$2000. He decided to invest the money in an RRSP. He chose to invest in a 5-year guaranteed fund. Bank A offered an interest rate of 8% per annum, compounded quarterly, for the 5-year term. For the same term, Bank B offered 8.5% compounded annually. At which bank would George's RRSP investment earn more interest? How much more?

Solution

$$\text{Bank A: } P = \$2000, i = \frac{8\%}{4}, n = 20$$

$$\begin{aligned} A &= P(1 + i)^n \\ &= 2000(1 + 0.02)^{20} \\ &= 2971.89 \end{aligned}$$

$$\begin{aligned} \text{Interest} &= \text{Amount} - \text{Principal} \\ &= \$2971.89 - \$2000 \\ &= \$971.89 \end{aligned}$$

At Bank A, George's \$2000 RRSP investment would earn \$971.89 interest by the end of the 5-year term.

$$\text{Bank B: } P = \$2000, i = 8.5\%, n = 5$$

$$\begin{aligned} A &= P(1 + i)^n \\ &= 2000(1 + 0.085)^5 \\ &= 3007.31 \end{aligned}$$

$$\begin{aligned} \text{Interest} &= \text{Amount} - \text{Principal} \\ &= \$3007.31 - \$2000 \\ &= \$1007.31 \end{aligned}$$

At Bank B, George's \$2000 RRSP investment would earn \$1007.31 interest by the end of the 5-year term.

$$\$1007.31 - \$971.89 = \$35.42$$

So, George's RRSP investment would earn \$35.42 more interest at Bank B.

$$\begin{aligned} &2000 \times (1.02)^{20} \\ &2971.894792 \end{aligned}$$

$$\begin{aligned} &2000 \times (1.085)^5 \\ &3007.31338 \end{aligned}$$

An **annuity** is a sequence of equal payments made at equal intervals of time. For example, if you deposit \$100 each month into an RRSP plan, you are saving in the form of an annuity. If you pay a car loan off at \$250 each month for 36 months, you are paying an annuity. If you receive \$3500 from an investment every 6 months for 10 years, you are receiving an annuity.

Example 4 Calculating the Amount of an Annuity

Stephanie wants to buy a car when she graduates from college. She decides to deposit \$750 on October 15, and additional \$750 amounts on the 15th of the following April, October, and April, into a savings account that pays 5% per annum compounded semi-annually. What amount will Stephanie have in her account at the end of two years?

Solution 1

Consider each deposit separately and use the compound-interest formula.

The interest rate per 6-month period is $\frac{5\%}{2}$ or 2.5%.

First \$750, compounded semi-annually, after 2 years:

$$\begin{aligned} A &= P(1 + i)^n, \text{ where } P = \$750, i = 0.025, n = 4 \\ &= 750(1 + 0.025)^4 \\ &= 827.86 \end{aligned}$$

Second \$750, compounded semi-annually, after 1.5 years:

$$\begin{aligned} A &= P(1 + i)^n, \text{ where } P = \$750, i = 0.025, n = 3 \\ &= 750(1.025)^3 \\ &= 807.67 \end{aligned}$$

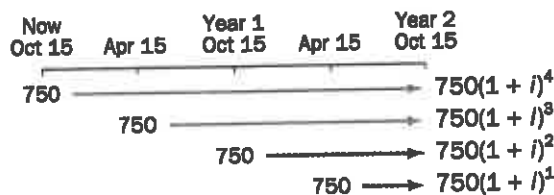
Third \$750, compounded semi-annually, after 1 year:

$$\begin{aligned} A &= P(1 + i)^n, \text{ where } P = \$750, i = 0.025, n = 2 \\ &= 750(1.025)^2 \\ &= 787.97 \end{aligned}$$

Fourth \$750, compounded semi-annually, after 0.5 years:

$$\begin{aligned} A &= P(1 + i)^n, \text{ where } P = \$750, i = 0.025, n = 1 \\ &= 750(1.025)^1 \\ &= 768.75 \end{aligned}$$

The total amount at the end of two years is $\$827.86 + \$807.67 + \$787.97 + \$768.75 = \$3192.25$. Stephanie will have \$3192.25 in her account at the end of two years.

**Solution 2**

Use a table or spreadsheet and the simple-interest formula for each 6-month period:

Month Period	Principal, P (\$)	Interest, I (\$)	Amount, A (\$)
1	750	18.75	768.75
2	768.75 + 750	37.97	1556.72
3	1556.72 + 750	57.67	2364.39
4	2364.39 + 750	77.86	3192.25

Stephanie will have \$3192.25 in her account at the end of two years.

Practice

The rate of interest is 8% per annum. What is the interest rate for each compounding period?

1. semi-annually
2. quarterly
3. monthly
4. daily

How many interest periods are there in each of the following?

5. compounding semi-annually for 3 years
6. compounding quarterly for 2 years
7. compounding annually for 5 years
8. compounding monthly for 4 years
9. compounding monthly for 6 months
10. compounding quarterly for 18 months
11. compounding daily for the month of August
12. compounding daily for March and April

If the rate of interest is 6% per annum, what is the interest rate per period and the number of periods in each situation?

- 13. compounding quarterly for 3 years
- 14. compounding semi-annually for 6 years
- 15. compounding annually for 10 years
- 16. compounding monthly for one year
- 17. compounding daily for the month of June

The rate of interest is 9% per annum. Find the amount owing on a loan of \$2000 in each case.

- 18. interest compounded semi-annually for 3 years
- 19. interest compounded quarterly for 2 years
- 20. interest compounded annually for 5 years
- 21. interest compounded daily for 60 days

The rate of interest is 4.5% per annum. Find the interest earned on an investment of \$500 for each compound situation.

- 22. semi-annually for 4 years
- 23. monthly for 1.5 years
- 24. quarterly for 2.5 years
- 25. daily for 45 days

Find the amount of each RRSP investment.

- 26. \$3000 at 4.5% per annum, compounded annually, for a 5-year term
- 27. \$1800 at 5% per annum, compounded quarterly, for a 3-year term
- 28. \$2500 at 6% per annum, compounded semi-annually, for a 2-year term

Applications and Problem Solving

- 29. Michel borrowed \$2000 from the bank at 8.5%, compounded semi-annually. If he made no payments, find the amount owing three years later.
- 30. **Education fund** When his daughter was born, Brian invested \$5000 to help provide for her education. If the investment earns an average of 8% compounded quarterly, how much will it be worth in 18 years?
- 31. **Annuity** Pierre deposited \$200 into his savings account at the beginning of each month for 6 months. If the account pays interest at 3% per annum, compounded monthly, how much is in his account at the end of the sixth month?

32. RRSP Amber won \$7500 and decided to invest the money in an RRSP. She put the money in a guaranteed fund for a 4-year term at 7%, compounded quarterly. At the end of that term, interest rates rose by 1%, so she re-invested the whole amount for another 4-year term, again with interest compounded quarterly. What was the value of her investment at the end of the eight years?

33. You have \$1000 to invest for 3 years. Consider three options, all of which have a rate of interest of 5.5% per annum.

Option A: compounded semi-annually

Option B: compounded quarterly

Option C: compounded monthly

- a) Predict which option will earn you the most interest. Explain.
- b) How much more interest is earned by the best option than by the worst option?

34. Annuity Marla opened a savings account on January 1 with a deposit of \$500. The following July 1, January 1, and July 1, she made three more deposits of \$500 each. The account paid interest at 4.75% per annum, compounded quarterly.

- a) What amount was in her account at the end of the second year?
- b) How much interest had she earned by the end of the second year?

35. Functions a) Consider an investment of \$100. Construct a table of values of the amount of the investment for a period of 12 years, with interest at 8% per annum calculated

- as simple interest
- with interest compounding quarterly
- b) Construct broken-line graphs on the same set of axes for an investment calculated each way.
- c) Do both graphs represent functions? Explain.
- d) Describe each graph. Explain why each is the shape it is.

36. Working backward How much should be invested now at 8%, compounded semi-annually, to give an amount of \$5000 in four years time?

37. Inflation If the average annual rate of inflation is 4%, about how long would it take for a pair of roller blades to double in price?

9.5 Consumer Credit

If you purchase an item and agree to pay for it at a later date, you are using consumer credit. You will probably pay more for the item because of interest charges.

Individuals and organizations who buy on credit have a credit rating. A **credit rating** is an assessment by lending institutions of the individual's or organization's ability to pay. This assessment is based on the individual's or organization's past record of debt paying, on character and assets, and on the present ability to repay debt.

Explore: Interpret the Information

A television cost \$599, including taxes. Elton bought the television on an instalment plan of 12 monthly payments of \$54.90.

- What was the cost of the television on the instalment plan?
- How much more was this cost than the original price of the television?

Inquire

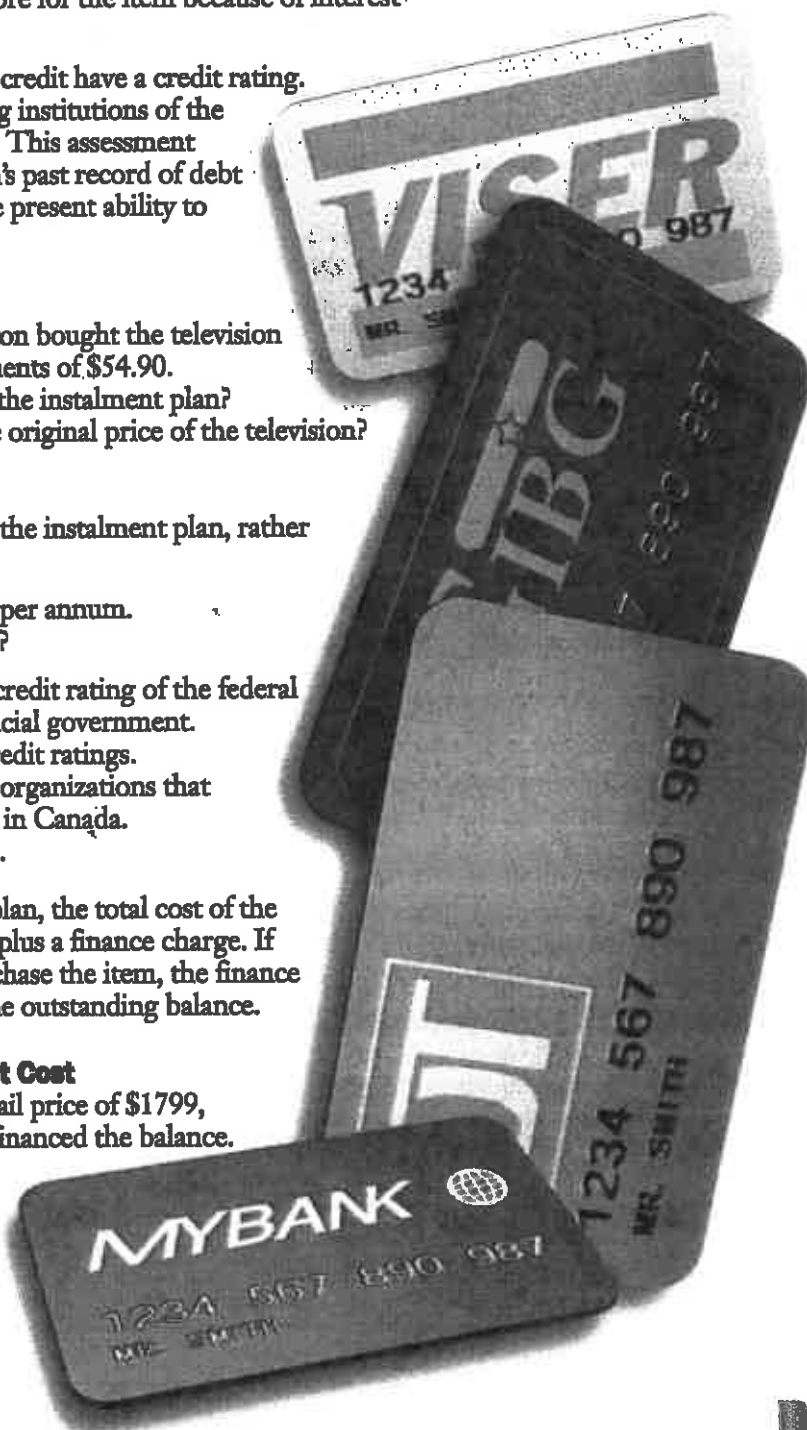
- Why would a store prefer Elton to use the instalment plan, rather than pay cash?
- The store used an interest rate of 10% per annum. How was the monthly payment calculated?
-  a) Use your research skills to find the credit rating of the federal government of Canada and of your provincial government. Identify the organizations that calculate credit ratings.
b) Use your research skills to identify the organizations that determine the credit ratings of individuals in Canada. Determine where credit ratings are stored.

When you buy an item on an instalment plan, the total cost of the item is the list price of the item plus taxes plus a finance charge. If you make a down payment when you purchase the item, the finance charge is the interest calculated only on the outstanding balance.

Example 1 Calculating the Instalment Cost

Tara bought a computer system with a retail price of \$1799, including taxes. She paid 25% down and financed the balance. She agreed to pay the store \$132.50 each month for 12 months.

- What amount was financed?
- What was the finance charge?
- What did the computer system cost Tara?



Solution

a) Cost of computer system including taxes = \$1799

Down payment = 25% of \$1799

$$= 0.25 \times \$1799$$

$$= \$449.75$$

Amount to be financed = retail price – down payment

$$= \$1799 - \$449.75$$

$$= \$1349.25$$

The amount financed was \$1349.25.

b) Tara paid \$132.50 for 12 months.

Total of the monthly payments = \$132.50 × 12

$$= \$1590$$

Finance charge = total monthly payments – amount to be financed

$$= \$1590 - \$1349.25$$

$$= \$240.75$$

The finance charge was \$240.75.

c) Total cost = down payment + total monthly payments

$$= \$449.75 + \$1590.00$$

$$= \$2039.75$$

The computer system cost Tara \$2039.75.

$$25\% \text{ of } 2000 = 500$$

$$1800 - 450 = 1350$$

$$150 \times 10 = 1500$$

$$1600 - 1350 = 250$$

$$450 + 1600 = 2050$$

The credit card is a very popular form of consumer credit. The repayment terms and the interest charges vary depending on the issuer of the credit card. Usually, the cardholder repays each month any amount between the minimum payment required and the entire balance. The **due date** is the day of the month by which the payment should be made.

For most retail-chain, department-store, and oil-company charge accounts, interest is calculated on the balance due after any payments have been deducted from the previous balance and any new purchases have been added.

Example 2 Calculating Interest on a Retail Charge Account

The table shows the summary of a customer's account with a department store for a six-month period. Monthly credit charges are 1.5% of the balance due.

Month	Previous Balance	Payment Made	Purchases Charged	Balance Due	Credit Charge	New Balance
January	\$562.80	\$300.00	\$197.28			
February		\$200.00	\$56.90			
March		\$150.00	\$273.26			
April		\$250.00	\$103.85			
May		\$200.00	\$24.95			
June		\$100.00	\$98.00			

- Complete the table by finding the balance due, credit charge, and new balance for each month.
- How much interest was charged, in total, for the six-month period?

Solution

a) For January:

$$\begin{aligned}\text{Balance due} &= \text{previous balance} - \text{payment made} + \text{purchases} \\ &= \$562.80 - \$300.00 + \$197.28 \\ &= \$460.08\end{aligned}$$

$$\begin{aligned}\text{Credit charge} &= 1.5\% \text{ of balance due} \\ &= 0.015 \times \$460.08 \\ &= \$6.90\end{aligned}$$

$$0.015 \times 500 = 7.5$$

$$\begin{aligned}\text{New balance} &= \text{balance due} + \text{credit charge} \\ &= \$460.08 + \$6.90 \\ &= \$466.98\end{aligned}$$

Enter these amounts into the table, and continue with similar calculations for each month to complete the table.

Month	Previous Balance	Payment Made	Purchases Charged	Balance Due	Credit Charge	New Balance
January	\$562.80	\$300.00	\$197.28	\$460.08	\$6.90	\$466.98
February	\$466.98	\$200.00	\$56.90	\$323.88	\$4.86	\$328.74
March	\$328.74	\$150.00	\$273.26	\$452.00	\$6.78	\$458.78
April	\$458.78	\$250.00	\$103.85	\$312.63	\$4.69	\$317.32
May	\$317.32	\$200.00	\$24.95	\$142.27	\$2.13	\$144.40
June	\$144.40	\$100.00	\$98.00	\$142.40	\$2.14	\$144.54

$$\begin{aligned}\text{b) Total credit charges} &= \$6.90 + \$4.86 + \$6.78 + \$4.69 + \$2.13 + \$2.14 \\ &= \$27.50\end{aligned}$$

$$7 + 5 + 7 + 5 + 2 + 2 = 28$$

For the six-month period, the total interest charged was \$27.50.

Holders of bank credit cards can buy goods and obtain cash advances up to the credit limit for which they have been approved. Monthly statements showing all transactions that have been charged to the credit card account are sent to the cardholder.

With many of these credit cards, there are no interest charges on purchases if the balance is paid by the due date. If the balance is not paid in full by the due date, then interest charges appear on the next statement. The interest is calculated using simple interest for the number of days from the date that a purchase was posted to the account up to, but not including, the current statement date.

Interest is always charged on cash advances from the date on which the cash was advanced. To pay off the full amount you owe, you can phone the bank and ask for your payout balance that day. By paying that amount on the same day, you will stop any further interest being accumulated.

Example 3 Calculating Interest on a Bank Credit Card

Bjork received the following bank credit card statement on October 23. Interest is charged at a daily rate of 0.0504% on any unpaid balance and on cash advances from the date of posting up to, but not including, the statement date. The minimum payment is 5% of the new balance, to the nearest dollar.

- a) Calculate the interest charge.
- b) Calculate the total purchases.
- c) Calculate the new balance.
- d) Calculate the minimum payment due.
- e) If Bjork pays \$200 on November 10 and decides to pay off the outstanding balance on November 15, how much will she have to pay?

Card Number	Previous Statement	This Statement	Payment Due By
102304506	SEP 18	OCT 18	NOV 10
Posting Date	Description	Amount	
SEP 25	Dave's Discs, Edmonton, AB	53.29	
OCT 10	Payment received - Thank you	100.00	
OCT 15	Martine's, Edmonton, AB	85.99	

Previous Balance	+	Interest	+	Purchases/ Debits	-	Payments/ Credits	→	New Balance
203.54								

Solution

- a) Interest on previous balance:

$$I = Prt$$

$$= \$203.54 \times 0.000504 \times 30$$
$$= \$3.08$$

$$200 \times 0.0005 \times 30 = 3$$

There are 30 days from the previous statement date up to, but not including, this statement date.

- Interest on purchase posted on September 25:

$$I = Prt$$

$$= \$53.29 \times 0.000504 \times 23$$
$$= \$0.62$$

$$50 \times 0.0005 \times 20 = 0.5$$

There are 23 days from Sep 25 up to, but not including, Oct 18.

- Interest on purchase posted on October 15:

$$I = Prt$$

$$= \$85.99 \times 0.000504 \times 3$$
$$= \$0.13$$

$$100 \times 0.0005 \times 3 = 0.15$$

There are 3 days from Oct 15 up to, but not including, Oct 18.

$$\text{Total interest} = \$3.08 + \$0.62 + \$0.13$$
$$= \$3.83$$

The interest charge is \$3.83.

b) Total purchases = \$53.29 + \$85.99

$$= \$139.28$$

The total of Bjork's purchases is \$139.28.

c) New balance = previous balance + interest + purchases - payments

$$= \$203.54 + \$3.83 + \$139.28 - \$100.00$$
$$= \$246.65$$

$$200 + 140 - 100 = 240$$

Bjork's new balance is \$246.65.

d) Minimum payment = 5% of new balance

$$= 0.05 \times \$246.65$$
$$= \$12.33$$

$$0.05 \times 240 = 12$$

Bjork's minimum payment is \$12, to the nearest dollar.

-) The outstanding balance from the statement dated October 18 is \$246.65. The number of days from October 18 up to, but not including, November 10 is 22.

$I = Prt$

$$= \$246.65 \times 0.000504 \times 22$$

$$= \$2.73$$

$$250 \times 0.0005 \times 20 = 2.5$$

Balance on November 10 = outstanding balance + interest - payment

$$= \$246.65 + \$2.73 - \$200.00$$

$$= \$49.38$$

Estimate

$$250 - 200 = 50$$

From November 10 up to, but not including, November 15 is 5 days.

$I = Prt$

$$= \$49.38 \times 0.000504 \times 5$$

$$= \$0.12$$

$$50 \times 0.0005 \times 5 = 0.125$$

Balance on November 15 = \$49.38 + \$0.12

$$= \$49.50$$

To pay off her outstanding balance on November 15, Bjork will have to pay \$49.50.

Practice

Round answers to 2 decimal places, where necessary.

1. Michel bought a bicycle for \$329, including taxes. He agreed to pay 12 monthly instalments of \$31.26.

- How much did Michel pay for the bicycle?
- What was the finance charge?

2. Anik would like to buy a guitar that costs \$2200, including taxes. She has \$500 for a down payment, and the store allows her to pay off the balance in 24 monthly payments of \$80.

- What amount is to be financed?
- How much is the finance charge?
- How much will the guitar cost Anik?

The credit charge on a department store's charge card is 1.4% per month. Calculate the credit charge for one month for each of the following balances.

- \$682.00
- \$302.87
- \$59.45
- \$732.49

The credit charge on a gasoline company's charge card is 1.5% per month. Find the credit charge and the new balance for each customer.

	Balance Due	+	Credit Charge	→	New Balance
7.	\$392.00				
8.	\$63.45				
9.	\$48.25				
10.	\$82.51				

One bank credit card charges daily interest at 0.045%. Find the interest charge for each transaction for the number of days indicated.

- \$328.14 for 30 days
- \$86.10 for 21 days
- \$605.88 for 14 days
- \$425.63 for 31 days
- \$1204.58 for 10 days

Fern uses a credit card that charges daily interest at 0.042%. She has an unpaid balance from the previous month, and her current statement date is April 15. Find the interest charge for each of the following items.

- purchase for \$75.00, posted on April 1
- purchase for \$129.99, posted on March 28
- cash advance of \$100.00, on April 12
- purchase of \$672.25, posted on April 5
- the previous balance of \$238.52

Find the new balance for each credit card statement.

	Previous Balance	Interest	Purchases	Payments	New Balance
21.	182.10	2.89	49.50	120.00	
22.	350.00	1.58	35.00	200.00	
23.	493.72	9.78	247.50	250.00	
24.	505.00	12.13	120.00	500.00	
25.	582.47	10.24	88.00	27.00	

Applications and Problem Solving

26. Instalment buying Justin bought a computer system for \$3699, including taxes. He made a down payment of 15% of the price and paid the balance in monthly instalments of \$99 over 3 years.

- How much was his down payment?
- How much was the finance charge?
- How much did he actually pay for the computer system?

27. Which method of financing a purchase will cost less? Explain.

A: a small down payment, plus equal payments spread over 6 months

B: a large down payment, plus equal payments spread over 12 months

28. Department store credit The table shows Derek's department-store charge card account summary for a four-month period. Monthly credit charges are 1.25% of the balance due. Copy and complete the table to find the new balance at the end of January.

Month	Previous Balance	- Payment Made	+ Purchases Charged	→ Balance Due	+ Credit Charge	→ New Balance
October	\$138.53	\$100.00	\$223.85			
November		\$150.00	\$158.37			
December		\$150.00	\$418.44			
January		\$300.00	\$42.10			

29. Bank credit card Paula received her bank credit card statement on September 12. Interest is charged at a daily rate of 0.0479% on any unpaid balance and on cash advances from the date of posting up to, but not including, the statement date. The minimum payment required is 3% of the previous month's balance, to the nearest dollar.

- Calculate the interest charge.
- Calculate the total purchases.
- Calculate the new balance.
- Calculate the minimum payment due.

e) If Paula made the minimum payment on the due date, how much would she have to pay to pay off her outstanding balance on November 5?

Card Number	Previous Statement	This Statement	Payment Due By
102304506	AUG 09	SEP 09	SEP 30
Posting Date	Description	Amount	
AUG 12	Rainbow Creek, Vancouver, BC	75.00	
AUG 13	Chateau Jaune, Victoria, BC	208.00	
AUG 30	Payment - Thank you	600.00	
SEP 08	Cash Advance	200.00	
Previous Balance	Interest	Purchases/Debits	Payments/Credits
203.54			

30. Some stores advertise, "No payments until one year from now." Jamie is considering buying a racing bicycle, retailing at \$1350, including taxes. His options are to take a bank loan for 2 years at 11% per annum, compounded semi-annually, or to take the store's offer of no payments until one year from now, and then to pay 12 monthly payments of \$135.

- Describe the advantages and disadvantages of each option.
- What assumptions did you make?

31. Explain when it makes sense to make a payment between due dates on a bank credit card and when it does not.

32. List the advantages and disadvantages of buying on credit.

9.6 Housing Costs

A **mortgage** is an agreement between a money lender and a borrower to purchase property. The security for the mortgage is the property being bought. The **mortgagor** is the person borrowing the money, and the **mortgagee** is the person or business lending the money. A mortgage is usually repaid in equal periodic payments that include the principal and the interest. To **amortize** a mortgage means to repay the mortgage over a given period of time in equal periodic payments. The period of time is known as the **amortization period**. The term of a mortgage is the length of time that the mortgage agreement is in effect.



Explore: Use a Table

The table shows monthly mortgage payments for different interest rates. Each monthly payment is a blend of principal and interest.

Monthly payment for each \$1000 of Mortgage Debt				
Interest Rate (%)	Amortization Period			
	10 years	15 years	20 years	25 years
6	\$11.07	\$8.40	\$7.12	\$6.40
6.25	\$11.19	\$8.53	\$7.26	\$6.55
6.5	\$11.31	\$8.66	\$7.41	\$6.70
6.75	\$11.43	\$8.80	\$7.55	\$6.85
7	\$11.56	\$8.93	\$7.69	\$7.00
7.25	\$11.68	\$9.07	\$7.84	\$7.16
7.5	\$11.81	\$9.21	\$7.99	\$7.32
7.75	\$11.94	\$9.34	\$8.13	\$7.47
8	\$12.06	\$9.48	\$8.28	\$7.63

Suppose you need a mortgage of \$120 000, and the current interest rate is 7% for a term of 5 years. How much will your mortgage payments be each month if your mortgage is amortized over a period of

- a) 15 years? b) 25 years?

Inquire

- If you have a \$100 000 mortgage, amortized over 25 years, and your monthly payments are \$670, what rate of interest are you paying?
- How much more would your monthly payments be if the \$100 000 mortgage was amortized over 20 years instead of 25 years?
- Hedda needs an \$80 000 mortgage. She is considering two options.
Option A: a 3-year term at 6.25% amortized over 20 years
Option B: a 5-year term at 6.75% amortized over 25 years
Which option has the lower monthly payments?
- Even though the monthly payments are higher, why might a person choose a shorter amortization period?

The amount of money you have as a down payment helps determine the kind of mortgage for which you qualify. If you have a down payment of at least 25% of the price of the house, you may qualify for a conventional mortgage.

When you approach a lending institution for a mortgage, your income and expenses will be analyzed to determine whether you can afford the mortgage payments.

Banks use computers to determine the monthly mortgage payments. You may use the Amortization Table found on page 590 or a graphing calculator to do this. Because of the rounding involved, some discrepancies occur in the amounts. The graphing calculator result is more accurate.

Example 1 Calculating Monthly Mortgage Payments

Felix bought a house for \$175 000. He paid down 25% of the price of the house and arranged a 5-year mortgage at 6.75% per annum, amortized over 25 years, on the balance of the price.

- How much was Felix's down payment?
- How much was his monthly mortgage payment?

Solution

a) Price of house = \$175 000

Down payment = 25% of \$175 000
= \$43 750

$$\frac{1}{4} \times 180\,000 = 45\,000$$

Felix's down payment was \$43 750.

b) Balance to be financed = price of the house – down payment
= \$175 000 – \$43 750
= \$131 250

$$175\,000 - 45\,000 = 130\,000$$

Method 1: Using a Table

From the table, the monthly payment for each \$1000 of mortgage debt at 6.75%, amortized over 25 years, is \$6.85.

\$131 250 = 131.25 × \$1000

Monthly mortgage payment = \$6.85 × 131.25
= \$899.06

$$7 \times 130 = 910$$

Felix's monthly mortgage payment was \$899.06.

Method 2: Using a Graphing Calculator

Number of payment periods = 25 × 12

Annual interest rate, % = 6.75

Present value, \$ = 131250

Payment, \$: to be found

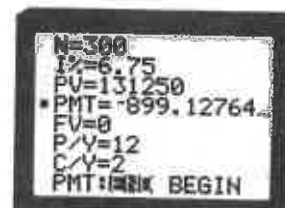
Future value, \$ = 0

Payments per year = 12

Compounding periods per year = 2

The payment is -\$899.13, so Felix must pay \$899.13 as his monthly mortgage payment.

By Canadian law, the interest rate on mortgages is compounded semi-annually, so the C/Y value entered must be 2.



Another expense involved in owning a house is **property tax**. Property tax is levied by municipalities on real estate. The money collected is used to pay for the services provided by the municipality. These services include schools, libraries, garbage pickup, police and fire protection, and road maintenance.

The rate at which property tax is calculated is called the **mill rate** and is determined each year by the municipality when it sets its budget. The mill rate is the amount of tax levied annually for each \$1000 of assessed value of the property. The mill rates for residential properties, apartment buildings, and commercial properties may be different.

A **mill** is a monetary denomination of one tenth of a cent, or one thousandth of a dollar.

A mill rate of 3.5 mills taxes a property at $\frac{35}{1000}$ of a dollar for each dollar of assessed property value, or \$35 for each \$1000 of assessed value.

$$\text{Property tax} = \frac{\text{assessed value}}{1000} \times \text{mill rate}$$

Example 2 Calculating Property Taxes

The assessed value of a house is \$129 550. If the residential mill rate is 22.375, what is the annual property tax on the house?

Solution

$$\begin{aligned} \text{Annual property tax} &= \frac{\text{assessed value}}{1000} \times \text{mill rate} \\ &= \frac{\$129\,550}{1000} \times 22.375 \\ &= \$2898.68 \end{aligned}$$

Estimate

$$20 \times 130 = 2600$$

The annual property tax on the house is \$2898.68.

When you own a house, your **monthly housing costs** are the monthly mortgage payment plus the monthly property tax.

Example 3 Calculating Housing Costs

Catherine has just renewed the mortgage on her house. She arranged a 5-year \$95 000 mortgage at 7.25% per annum, amortized over 20 years. Her house has an assessed value of \$165 000, and the residential mill rate in her municipality is 12.5970. Find her monthly housing costs.

Solution

From the Amortization Table on page 590, the monthly payment for each \$1000 of mortgage at 7.25% per annum, amortized over 20 years, is \$7.84.

$$\begin{aligned} \text{Monthly mortgage payment} &= \frac{\text{mortgage amount}}{1000} \times \$7.84 \\ &= \frac{95\,000}{1000} \times \$7.84 \\ &= \$744.80 \end{aligned}$$

Estimate

$$100 \times 7.8 = 780$$

$$\begin{aligned} \text{Annual property tax} &= \frac{\text{assessed value}}{1000} \times \text{mill rate} \\ &= \frac{\$165\,000}{1000} \times 12.5970 \\ &= \$2078.51 \end{aligned}$$

Estimate

$$170 \times 12 = 2040$$

$$\begin{aligned} \text{Monthly property tax} &= \frac{\$2078.51}{12} \\ &= \$173.21 \end{aligned}$$

$$\begin{aligned} \text{Monthly housing costs} &= \text{monthly mortgage payment} + \text{monthly property tax} \\ &= \$744.80 + \$173.21 \\ &= \$918.01 \end{aligned}$$

Catherine's monthly housing costs are \$918.01.

Practice

Where necessary, use the Amortization Table on page 590 to determine monthly payment for each \$1000 of mortgage debt. Round answers to 2 decimal places, where necessary.

Calculate the amount of each down payment.

1. 25% down on a price of \$200 000
2. 5% down on a price of \$147 500
3. 5% down on a price of \$99 900
4. 12.5% down on a price of \$165 000

Calculate the monthly mortgage payment for a mortgage of \$125 500, with each of the following rates and amortization periods.

5. 6.25% per annum, amortized over 25 years
6. 8% per annum, amortized over 10 years
7. 7.25% per annum, amortized over 15 years
8. 9.75% per annum, amortized over 20 years

Find the monthly payment for each mortgage.

	Principal (\$)	Interest Rate (%)	Amortization Period
9.	90 000	8	20 years
10.	150 000	7.25	25 years
11.	146 000	6.5	15 years
12.	283 500	8.5	10 years
13.	312 474	6.75	25 years

The residential mill rate for a town is 32.0665.

Calculate the annual property tax for each assessed value.

- | | |
|---------------|---------------|
| 14. \$79 000 | 15. \$152 800 |
| 16. \$235 000 | 17. \$255 000 |
| 18. \$426 500 | 19. \$65 300 |

The mill rate for commercial properties in a city is 42.0061. What is the annual property tax for properties with each assessed value?

- | | |
|------------------|------------------|
| 20. \$4 235 000 | 21. \$954 000 |
| 22. \$27 500 000 | 23. \$820 000 |
| 24. \$1 532 000 | 25. \$10 550 000 |

Applications and Problem Solving

26. A \$100 000 mortgage loan is taken at 6.5% per annum, amortized over 25 years.

- a) What is the monthly payment of the loan?
- b) Assuming that the interest rate remains the same over the amortization period of the loan, what is the total amount paid for the loan?
- c) What is the total interest paid for the loan?

27. Sarah would like to buy a condominium priced at \$199 900. She has saved \$55 000 for a down payment and has been offered a 3-year mortgage on the balance at 7.5% per annum, amortized over 20 years.

- a) What is the amount to be financed?
- b) What would her monthly mortgage payment be?

28. Hector wants to buy a bungalow priced at \$175 000. His down payment is 28% of the selling price.

- a) What amount of mortgage does Hector need to finance?
- b) If he takes a 5-year mortgage at 7% per annum, amortized over 25 years, what is the monthly payment?
- c) If the interest rate remains the same over the amortization period, what will be the total cost of the bungalow?
- d) How much interest will Hector pay in total?

29. The assessed value of an office building is \$742 000. If the commercial mill rate is 26.2118, what is the annual property tax for that building?

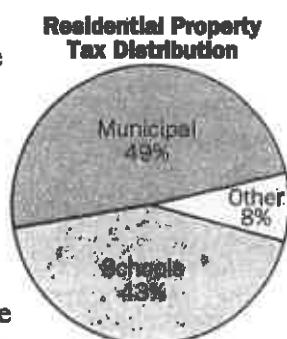
30. **Education funding** One year the combined residential mill rate for the City of Edmonton was 15.1888. This mill rate was the sum of the school mill rate of 7.1084 and the municipal mill rate of 8.0804. A house in Edmonton had an assessed value of \$107 850.

- a) What was the annual property tax for that house?
- b) How much of the annual property tax did the schools receive?

31. One year, the residential mill rate for the City of North Vancouver was 6.545 15. If the home owner lived in the property, a grant of \$470 was given to those under 65 years of age, and a grant of \$745 was given to those 65 years of age and over. Winnie owns and lives in a single family home that was assessed that year at \$275 600. If Winnie was 42 years old that year, what was her annual property tax?

32. One year, the residential mill rate for the City of North Vancouver was 6.545 15. The circle graph shows how the residential property taxes were distributed. If the assessed value of a single family dwelling was \$354 000, how much of the annual property tax went to

- the municipality?
- schools?



33. Mala just renewed the \$125 862 mortgage on her house for a one-year term at 6.5%, amortized over 15 years. Her house has an assessed value of \$185 000, and the residential mill rate is 8.3015. Find her monthly housing costs.

34. Property conversion Jarvis owned a single family dwelling assessed at \$224 000. He decided convert his property into business premises, consisting of a bakery and a cafe. The converted property was reassessed at \$350 000. That year, the residential mill rate was 5.447 12 and the business mill rate was 17.220 05. By how much did Jarvis's property tax increase that year?

35. Mae needs to renew her mortgage. The principal will be \$84 525, and she is considering whether to take a one-year term at 6.25% per annum or a three-year term at 6.75% per annum. In each case, the amortization period is 25 years.

- How much less will she need to budget for monthly mortgage payments over the first year if she chooses the one-year term?

- Suggest reasons why she might choose the three-year term mortgage instead.

36. Working backward What is the mill rate for condominiums, if a condominium assessed at \$144 500 receives an annual property tax bill for \$962.35? Round your answer to 4 decimal places.

37. The consumer has many options to consider when planning to buy a home. Find out about the following types of mortgages: open, closed, variable-rate, high-ratio, and government-assisted. Write a few sentences describing the advantages and disadvantages of the different types.

38. Abdul bought a small farm for \$112 000. He paid 25% down and obtained a 7-year mortgage for the balance at 8.5% per annum, amortized over 10 years.

- If the interest rate remained the same for the 10 years, how much did he pay for the farm altogether?
- If Abdul had been able to negotiate 0.25% off the mortgage rate, how much would he have saved over the 10 years?
- If he had been able to increase his down payment by \$10 000, how much would he have saved over the 10 years?

39. Equity

- What does the term *equity* mean?

- How can home-owners increase the equity in their home?

- How could the equity in a home decrease?

40. a) Use your research skills to find the mill rate for each type of property in your municipality. Choose one local example of each type of property and find its assessed value. (The assessed value of properties is public information and may be available in your public library or from local municipal offices.)

b) Calculate the annual property tax on each of your choices.

NUMBER POWER

A winning lottery number was 832. Over 80 but under 100 people picked the winning number and shared a jackpot of \$658 000. How many people shared the jackpot, and how much did each person get, if they each got a whole number of dollars?

Review

- 9.1** 1. Gerri is paid \$8.50/h for regular hours and time-and-a-half for hours in excess of 40 h per week. What is her gross income if she works 47.5 h one week?
2. Kurt is a waiter and earns \$7.95/h. He averages \$40 in tips for each 5-h shift that he works. One weekend he works 3 shifts. What is his gross income?
3. Gordon is a computer salesperson who is paid on a graduated commission basis. He earns 7% on the first \$2000 of sales, 10% on the next \$4000 of sales, and 15% on sales in excess of \$6000. What is his gross income for a month in which he has \$24 000 in sales?
4. Hedda picks apples on her uncle's farm each fall. For each kilogram of apples she picks, she is paid \$0.10. How much does she earn for a weekend when she picks 908 kg?
- 9.2** Use the Federal Tax Table on page 534 to find the federal tax for each of the following annual taxable incomes.
- \$20 873.00
 - \$15 095.46
 - \$31 507.33
 - \$27 482.93
- Find the amount of provincial tax payable by each employee.
9. MaeTze lives in Jasper, Alberta, and her basic federal tax is \$2548.52.
10. Ben lives in Port Alberni, British Columbia, and his basic federal tax is \$1976.84.
11. Natalya lives in Brandon, Manitoba, and her basic federal tax is \$3010.55.
12. Laura works in Regina and earns an annual salary of \$42 900. Her personal tax credit is \$6456, and each month she has \$50 deducted for a disability insurance plan and \$200 for her RRSP.
- Calculate her annual deductions for CPP and EI.
 - Determine her total income tax.
 - Find Laura's net annual income.
- 9.3** 13. Find the amount of a \$5000 Canada Savings Bond after 3 years, with interest at 4.5% per annum, compounded annually.
14. Find the interest charged on a loan of \$2000 for 2 years, with interest at 7.25% per annum, compounded quarterly.
15. Marie invested \$2500 in an RRSP for a two-year term at a guaranteed interest rate of 6.4% per annum, compounded quarterly.
- Calculate the value of her investment at the end of the two-year term.
 - How much interest did she earn on this investment?
16. Jean opened a savings account with \$1000. Six months later, and at six-month intervals after that, he made a total of five deposits of \$300 into the account. The account paid interest at 3.75% per annum, compounded semi-annually.
- What amount was in the account at the end of the third year?
 - How much interest had Jean's account earned?
- 9.4** 17. If interest is compounded monthly at 4.5% per annum, what is the effective annual interest rate?
18. For an investment of \$2000, which is the better option?
- Option A: interest compounded quarterly at 6% per annum
- Option B: interest compounded semi-annually at 5.5% per annum
19. Is it better to invest your savings at $5\frac{1}{4}\%$ per annum, compounded semi-annually, or at 5% per annum, compounded daily? Explain.
- 9.5** 20. An exercise machine sells for \$289, including taxes. The store offers an instalment plan of \$50 down and six monthly payments of \$41.83.
- What is the instalment plan price?
 - What is the finance charge?
- The credit charge on a retail store's charge card is 1.5% per month. Find the credit charge and the new balance for each of the following customers.

	Balance Owing	+	Credit Charge	→	New Balance
21.	\$598.25				
22.	\$108.50				
23.	\$926.78				
24.	\$1055.30				

25. Brad uses a credit card that charges daily interest at 0.045%. He has an unpaid balance from the previous month, and his current statement is dated November 14. Find the interest charge for each of the following items.

- a) \$38.00 posted on October 28
- b) \$100.00 posted on November 2
- c) \$250.75 posted on November 8

26. Mark bought a house for \$86 000. He paid 25% down and obtained a 3-year mortgage for the balance at 6.75%, amortized over 25 years. What is his monthly mortgage payment? Refer to the Amortization Table on page 590.

27. Reka and Joe need to renew their mortgage. The principal will be \$103 088, and they are considering a two-year term at 6% or a five-year term at 7%. The new mortgage will be amortized over 20 years. How much less will they need to budget for monthly mortgage payments if they choose the two-year term?

28. The assessed value of a house is \$150 000. If the residential mill rate is 15.775, what is the annual property tax on the house?

29. Rita is sharing an apartment with her sister. Rita's net monthly income is \$1749. At present, her monthly expenses are as follows.

Item	Amount	Item	Amount
Rent	\$450	Food	\$175
Car Loan	\$250	Car Repairs	\$50
Gas	\$75	Parking	\$15
Telephone	\$12.40	Cable	\$17.50
Clothing	\$250	Recreation	\$300
Personal Care	\$45		

Any money Rita has left over, she saves. Rita would like to move out on her own. The rent on the apartment she would like is \$750. Her telephone costs would be \$35, and cable TV would be \$30. She would like to save \$75 per month.

- a) Construct a budget statement for her present situation.
- b) Suggest some adjustments to her current budget so that she could afford to move.

Exploring Math

Perfect, Abundant, Deficient, and Amicable Numbers

A perfect number is a counting number that is equal to the sum of all its proper divisors. A proper divisor of a number is less than the number itself.

The proper divisors of 6 are 1, 2, and 3.
 $1 + 2 + 3 = 6$, so 6 is a perfect number.

An abundant number is a counting number the sum of whose proper divisors is greater than the number itself.

The proper divisors of 18 are 1, 2, 3, 6, and 9.
 $1 + 2 + 3 + 6 + 9 = 21$, so 18 is an abundant number.

A deficient number is a counting number the sum of whose proper divisors is less than the number itself.

The proper divisors of 10 are 1, 2, and 5.
 $1 + 2 + 5 = 8$, so 10 is a deficient number.

For two amicable numbers or friendly numbers, the sum of the proper divisors of one number equals the other number.

Identify the following numbers as perfect, abundant, or deficient.

- | | |
|---------|---------|
| 1. 32 | 2. 52 |
| 3. 28 | 4. 58 |
| 5. 56 | 6. 50 |
| 7. 250 | 8. 112 |
| 9. 496 | 10. 264 |
| 11. 525 | 12. 804 |

13. Show that 220 and 284 are amicable numbers.

14. Show that 1184 and 1210 are amicable numbers.

15. Can two perfect numbers be amicable? Explain.

Chapter Check

1. Copy and complete the table. The employer pays time-and-a-half for hours worked in excess of regular hours each week.

	Regular	Overtime	Total
a)	\$15.00	35	7
b)	\$7.50	40	12
c)	\$12.90	37.5	0
d)	\$24.00	40	10

2. Marion is paid \$350 per week, plus 20% commission on sales in excess of \$2000. One week, she had \$6750 in sales. What was her gross income that week?
3. Bernie charges \$3.00 per page for inputting data into a computer. What is his gross income if he inputs 103 pages one week?
4. Tosha lives in British Columbia and earns a monthly salary of \$3000. Her personal tax credit is \$6456, and she has \$300 deducted from her pay each month for her RRSP.
- Find her monthly CPP contribution.
 - Find her monthly EI premium.
 - Calculate her total annual income tax.
5. Find the interest earned on an investment of \$1500 at 5.5% per annum, compounded annually, for four years.
6. Interest is charged at 4.5% per annum, compounded monthly. What is the total amount owing on a loan of \$2000 after six months?
7. What is the effective annual interest rate charged on a loan, if the nominal rate is 9% per annum and interest is compounded semi-annually?
8. **Instalment buying** Mario bought an electronic keyboard that had a retail price of \$429.31, including taxes. He made a down payment of 15% and paid off the balance in 18 monthly instalments of \$25.21.
- What was the instalment price?
 - What was the finance charge?
 - By what percent is the instalment price greater than the retail price?

9. **RRSP** Steve is 20 years old and hopes to retire when he is 55. He invests \$6000 in an RRSP. If this investment earns interest at an average rate of 11% per annum, compounded semi-annually, what is its value in 35 years time?

10. **Credit card** Maggie uses a credit card that charges daily interest at 0.046%. She has an unpaid balance from the previous month, and the date of her current statement is May 04. Find the interest charge for each of the following items.

- purchase for \$89.00 posted on April 10
- cash advance of \$150.00 on April 15
- purchase for \$132.96 posted on April 18
- previous balance of \$320.45

11. **Property tax** A cottage has an assessed value of \$95 000. If the mill rate for recreational property is 12.045, how much is the annual property tax on the cottage?

12. **Housing costs** Davon has a \$115 000 mortgage at 7.5%, amortized over 25 years. His house has an assessed value of \$162 000, and the residential mill rate in his municipality is 32.593. How much should he budget each month for his housing costs?

13. Meera has just started a new job as an engineer for a large oil company. Her gross monthly income is \$4818.21. Her deductions each month are CPP \$87.92, EI \$95.88, income tax \$1168.95, professional dues \$57.00, RPP \$484.48, health insurance \$57.72.

- Calculate Meera's net income per month.
- Meera plans her budget by listing her predicted monthly expenses.

Item	Amount	Item	Amount
Rent	\$500	Car Loan Payment	\$350
Cable TV	\$35	Student Loan	\$400
Phone	\$45	Food	\$250
Clothing	\$250	Car Operating Costs	\$150
Hair Care	\$100		

How much does Meera have left after she deducts these amounts?

- Meera decides to budget the balance as follows: 25% savings, 60% recreation and miscellaneous, and 15% to pay off her car loan faster. Draw a circle graph to display her entire spending budget.

Chapter 9

Personal Finance p. 523

1. US Civil War 2. World War I 3. The Great Depression 4. World War II 5. a) 30% b) 30% c) 40%

Getting Started pp. 524–525

1 Comparing Unit Prices 1. a) the price of a specified unit of a product b) olive oil: \$0.0144/mL, \$0.0120/mL; tomato ketchup: \$0.0053/mL, \$0.0036/mL; orange juice: \$0.0020/mL, \$0.0017/mL; bleach: \$0.0014/mL, \$0.0009/mL c) Answers may vary. 2. olive oil: 500 mL; tomato ketchup: 1.25 L; orange juice: 1.89 L; bleach: 1.8 L 3. a) The larger size has a lower unit price. b) Answers may vary.

4. Answers may vary. The person may not need the larger size, or may not have enough storage space.

2 Buying at a Supermarket 1. bagels: Foodmart; oranges: EconoFoods; detergent: EconoFoods; cream cheese: Foodmart 2. Answers may vary. You assume quality is the same, and in products such as bagels and oranges, you assume size is the same. 3. Answers may vary. quality 4. Answers may vary. quality, location, selection

3 Warm Up Estimates may vary for 1.–7. 1. \$39 2. \$93 3. \$4 4. \$26 5. \$360 6. \$1.10 7. \$630 8. \$22.40 9. \$327.82 10. \$4.563 11. \$84.60 12. \$448 13. \$15 620 14. \$23.65 15. \$425.21 16. 0.3, 30% 17. 0.25, 25% 18. 0.5, 50% 19. 0.17, 17% 20. 0.8, 80% 21. 0.32, 32% 22. 0.55, 55% 23. 1.25, 125% 24. 0.75 25. 0.07 26. 0.045 27. 0.0275 28. 1.25 29. 0.005 Estimates may vary for 30.–37. 30. 60 31. 2400 32. \$500 33. \$3 34. \$1 35. \$5200 36. \$800 37. \$17 38. \$4852.80 39. \$234 40. \$690 41. \$36 42. \$0.44 43. \$0.27 44. \$3 out of \$10 45. \$8 out of \$40 46. \$18 out of \$192

Mental Math

1. \$8.75 2. \$0.25 3. \$0.60 4. \$0.48 5. \$48 6. \$130 7. \$1.50 8. \$60 9. \$15 10. \$0.18 11. 5.5% 12. 16% 13. 13% 14. 5% 15. 0.1% 16. 1% 17. 0.5% 18. 0.25%

Multiplying Numbers That Differ by 10 and End in 5

1. 375 2. 2475 3. 9975 4. 16 875 5. 357 500 6. 637 500 7. 15.75 8. 80.75 9. The numbers are $10x + 5$ and $10x - 5$. Their product is $(10x + 5)(10x - 5) = 100x^2 - 25$. 10. a) Drop the 5 from the larger, and add to the smaller, multiply and subtract 75. b) The numbers are $10x - 5$ and $10(x + 1) + 5$. Their product is $100x^2 + 100x - 75$, or $100x(x + 1) - 75$.

Investigating Math p. 526

1 Converting Currencies 1. a) drachma, krona, krone, peseta b) 196 078 drachma; 5200 krona; 4331 krone; 96 154 peseta 2. \$524.35 3. \$38.142.50 4. a) \$63 792.50 b) 243 390 francs 5. \$152.57 6. No. The exchange rate may change in four years.

7. a) 38 462 bolivar; 65 pesos b) 6 pesos

2 Buying and Selling 1. The bank pays less if you are selling than they charge if you are buying. This is how they make money. 2. 71% represents a Canadian dollar worth US71¢. 132% represents a US dollar worth \$1.32 Canadian. 3. a) increased b) decreased

Section 9.1 pp. 530–531

Practice 1. 15 2. 9 3. 22.5 4. 28.5 5. 5.25 6. 18.75 7. a) \$3640 b) \$840 c) \$24/h 8. \$495 9. \$560 10. \$384 11. \$521.25 12. \$814.13 13. \$5570 14. \$1960.10 15. \$360 16. a) the 40-h week b) \$52 17. \$2211 18. \$15 600 19. \$1239.75

Applications and Problem Solving 20. \$42 21. \$524.10 22. \$422.50 23. \$588 24. \$3038.50 25. a) piecework b) \$470 c) tips 26. 15% 27. a) He would earn \$87 more for Option B. b) Answers may vary. Option A: pays less, but Anton can improve his keyboarding; Option B: pays more, but no room for improvement 28. a) \$2195, \$2187.53, \$2330.72, \$2339.76 29. a) A: \$2625; B: \$3000; C: \$3125 c) \$15 000

8. \$41.11

Section 9.2 pp. 536–537

Practice 1. 52 2. 12 3. 26 4. 24 5. \$37.09 6. \$16.60 7. \$63.21 8. \$55.08 9. \$11.53 10. \$40.67 11. \$11.02 12. \$29.75 13. \$58.73 14. \$43.88 15. \$18.47 16. \$37.87 17. \$4556 18. \$3111.85 19. \$5692.78 20. \$9874.10 21. \$14 457.90 22. \$1647.33 23. \$1421.66 24. \$2551.83 25. \$1507.95 26. \$904.34 27. CPP: \$1068.80; EI: \$1053; taxable income: \$39 294; basic federal tax: \$6095.11 28. CPP: \$844.80; EI: \$807.30; taxable income: \$29 900; basic federal tax: \$3332.51

Applications and Problem Solving 29. a) CPP: \$896; EI: \$850.50 b) \$6219.38 30. a) CPP: \$1068.80; EI: \$1053 b) \$11 861.03 c) \$31 881.17 31. \$35 389.06 32. \$27 485.41 33. a) \$2980 b) \$26 881.28 34. a) the employer's earnings b) Answers may vary. c) Answers may vary. 35. a) \$582.75 b) Answers may vary. 36. Net claim code is a category on which the amount of tax deduction is based. b) Codes are based on the personal tax credit an employee expects to have. 37. Answers may vary. 38. Answers may vary.

Section 9.3 pp. 542–543

Practice 1. 4% 2. 2% 3. 0.667% 4. 0.022% 5. 6
6. 8 7. 5 8. 48 9. 6 10. 6 11. 31 12. 61 13. 1.5%; 12
14. 3%; 12 15. 6%; 10 16. 0.5%; 12 17. 0.016%; 30
18. \$2604.52 19. \$2389.66 20. \$3077.25
21. \$2029.81 22. \$97.42 23. \$34.85 24. \$59.18
25. \$2.78 26. \$3738.55 27. \$2089.36 28. \$2813.77
Applications and Problem Solving 29. \$2567.36
30. \$20 805.70 31. \$1210.54 32. \$13 589.85
33. a) Option C b) \$2.18 34. a) \$2122.35 b) \$122.35
35. a) \$108, \$116, \$124, \$132, \$140, \$148, \$156,
\$164, \$172, \$180, \$188, \$196; \$108.24, \$117.17,
\$126.82, \$137.28, \$148.59, \$160.84, \$174.10,
\$188.45, \$203.99, \$220.80, \$239.01, \$258.71 c) Yes.
There is only one y -value for each x -value. d) Simple
interest gives a straight line. The amount of interest
is the slope, and it does not change. Compound
interest gives a curve. Since the interest is increasing,
the slope is increasing. 36. \$3653.45 37. about
18 years

Technology pp. 544–545

1 No Payments Made 1. \$5378.54 2. 5.25 years
3. 7.86% 4. 7% compounded annually
2 Monthly Payments Made 1. Yes. \$3139.27 must
still be paid. 2. –\$8261; The annuity has run out.
3. 6.87% 4. \$462.32 5. a) \$306 837.52 b) 10.84%
c) \$329.52 d) Yes. The earlier you start, the more
interest you earn.

Technology p. 546

1 Annuity Remaining 1. Answers may vary.
2. \$4254.52 3. after 3 years 4. a) \$34 371.59
b) \$56 394.89 c) \$18 938.81
2 Annuity Payments 1. a) \$701.33 b) \$424.94
c) \$1267.43 d) \$113.55

Section 9.4 pp. 549–550

Practice 1. 8.16% 2. 8.24% 3. 8.30% 4. 12.55%
5. 6.09% 6. 8.57% 7. 5.06% 8. 7.71% 9. 5.97%
10. 4.33%
Applications and Problem Solving 11. 5.25%
compounded semi-annually; \$1.92 12. a) A
b) A: 8.77%; B: 8.30% 13. the bank loan 14. 7.12%
15. a) The annual rate is the daily rate times 365.
b) 1.53% c) 20.03% 16. 19.56% 17. a) Option A:
7.02%; Option B: 7.2% b) Answers may vary. She
may think the interest rate will go down. 18. a) 12%,
12.36%, 12.49%, 12.55%, 12.62%, 12.68%, 12.72%,
12.73% c) 12.75% d) 12.75% 19. a) 7.71% b) 10.67%
c) 9.65% d) 6.40% 20. 6.4%

Section 9.5 pp. 555–556

Practice 1. a) \$375.12 b) \$46.12 2. a) \$1700 b) \$220
c) \$2420 3. \$9.55 4. \$4.24 5. \$0.83 6. \$10.25
7. \$5.88; \$397.88 8. \$0.95; \$64.40 9. \$0.72; \$48.97
10. \$1.24; \$83.75 11. \$4.43 12. \$0.81 13. \$3.82
14. \$5.94 15. \$5.42 16. \$0.44 17. \$0.98 18. \$0.13
19. \$2.82 20. \$3.11 21. \$114.40 22. \$217.69
23. \$500.94 24. \$437.75 25. \$601.71
Applications and Problem Solving 26. a) \$554.85
b) \$419.85 c) \$4118.85 27. Answers may vary.
28. \$298.51 29. a) \$7.01 b) \$483 c) \$93.55 d) \$3
e) \$93.07 30. a) The store's offer is less expensive.
b) Answers may vary.

Section 9.6 pp. 560–561

Practice 1. \$50 000 2. \$7375 3. \$4995 4. \$20 625
5. \$822.03 6. \$1513.53 7. \$1138.29 8. \$1174.68
9. \$745.20 10. \$1074.00 11. \$1264.36 12. \$3492.72
13. \$2140.45 14. \$2533.25 15. \$4899.76
16. \$7535.63 17. \$8176.96 18. \$13 676.36
19. \$2093.94 20. \$177 895.83 21. \$40 073.82
22. \$1 155 167.75 23. \$34 445 24. \$64 353.35
25. \$443 164.36
Applications and Problem Solving 26. a) \$669.82
b) \$200 946 c) \$100 946 27. a) \$144 900 b) \$1157.17
28. a) \$126 000 b) \$882.52 c) \$313 756 d) \$138 756
29. \$19 449.16 30. a) \$1638.11 b) \$766.64
31. \$1333.84 32. a) \$1135.32 b) \$996.30 33. \$1218.41
34. \$4806.86 35. a) \$307.42 b) Answers may vary.
36. 6.6599 37. a) \$152 188 b) \$1293.60 c) \$4784

Section 9.7 pp. 565–566

Practice 1. education/reading 2. gifts 3. shelter
4. utilities 5. personal care 6. food 7. entertainment
8. gifts 9. food 10. clothing or personal care
11. charitable donations 12. personal care 13. home
furnishings 14. clothing 15. balanced 16. surplus of
6.5% 17. deficit 18. surplus of 7.6% 19. \$48.50
20. b) \$780
Applications and Problem Solving 21. a) \$675
22. a) Hydro: \$76.92, \$25.64; Gas: \$80.75, \$26.92;
Food: \$410.17, \$136.72; TV: \$22, \$7.33; Phone: \$35,
\$11.67 c) \$510.83 24. a) 34.8%, 18.6%, 9.3%, 7.1%,
7.0%, 23.2% c) –\$26.41, +\$37.50, –\$61.69, +\$5.60,
\$0, +\$45

Investigating Math pp. 567–569

1 Understanding a Bank Statement 1. a) \$1807
b) Debit is an amount subtracted from an account,
and credit is an amount added to an account.
2. a) Direct debit is the use of your bank card in a
store or a bill payment taken directly from your
account; instant teller withdrawal is the withdrawal of

money from a bank machine. 3. It was cashed first.
 4. Yes, if the bank allows overdrafts. 5. Option A
2 Reconciling a Bank Statement with a Personal Transaction Record 1. Answers may vary.
 2. Answers may vary. 3. a) The error was writing \$88.95 instead of \$88.59 for cheque 003.

Connecting Math and Transportation pp. 570–571

1 Which Car to Buy 1. freight and dealer preparation, taxes, licence, possibly dealer options
 4. “Black book” value is the average retail price of the given model, with stated options, in good condition.
2 Financing a Car Purchase 1. a) \$1880 b) \$493
 c) the bank
3 Operating Costs 1. fixed: depreciation, insurance, licence; variable: gas, maintenance 3. \$20 480

Review pp. 572–573

1. \$435.63 2. \$239.25 3. \$3240 4. \$90.80
 5. \$3548.41 6. \$2566.23 7. \$5528.81 8. \$4672.10
 9. \$1159.58 10. \$998.30 11. \$1565.49
 12. a) CPP: \$1068.80; EI: \$1053 b) \$9613.01
 c) \$28 165.19 13. \$5705.83 14. \$309.08
 15. a) \$2838.51 b) \$338.51 16. a) \$2704.43 b) \$204.43

17. 4.59% 18. Option A 19. $5\frac{1}{4}\%$ compounded semi-annually 20. a) \$300.98 b) \$11.98 21. \$8.97; \$607.22 22. \$1.63; \$110.13 23. \$13.90; \$940.68
 24. \$15.83; \$1071.13 25. a) \$0.29 b) \$0.54 c) \$0.68
 26. \$441.86 27. \$58.89 28. \$2366.25

Exploring Math 1. deficient 2. deficient 3. perfect
 4. deficient 5. abundant 6. deficient 7. deficient
 8. abundant 9. perfect 10. abundant 11. deficient
 12. abundant 13. sum of proper factors of 220: 284;
 sum of proper factors of 284: 220 14. sum of proper factors of 1184: 1210; sum of proper factors of 1210: 1184 15. No. Since the proper factors of any perfect number add to the number itself, they cannot add to any other number.

Chapter Check p. 574

1. a) \$682.50 b) \$435 c) \$483.75 d) \$1347.50 2. \$1300
 3. \$309 4. a) \$86.67 b) \$81 c) \$6503.62 5. \$358.24
 6. \$2045.42 7. 9.2% 8. a) \$518.18 b) \$88.87 c) 20.7%
 9. \$254 579.50 10. a) \$0.98 b) \$1.31 c) \$0.98 d) \$4.42
 11. \$1144.28 12. \$1281.30 13. a) \$2866.26 b) \$786.26

Using the Strategies p. 575

1. 10 3. no 4. 18 5. 785 m 7. $x = 2y - z$ 8. $D = 1$,
 $E = 4$, $F = 8$ 9. 441, 1444 10. -25 11. 343
 12. a) 219, 438, 657 b) 327, 654, 981 and 273, 546, 819
Data Bank 1. a) increase b) 55+ years

Cumulative Review, Chapters 1–9 pp. 576–579

1. one solution; $(-2, 2)$ 2. no solution 3. one solution;
 $(-4, -4)$ 4. infinitely many solutions 5. $(2, -1)$
 6. $(-\frac{1}{2}, 2)$ 7. $(-1, 0)$ 8. $(2, 1)$ 9. $(2, -1)$ 10. $(-3, 2)$

11. $(-2, 0)$ 12. $(1, -3)$ 13. $(2, -\frac{1}{2})$ 14. $(2, -2)$
 15. $(3, 2, 1)$ 16. $(-1, 1, 0)$ 17. length: 563 km,
 breadth: 257 km 18. bachelor: 48; 1-bedroom: 60;
 2-bedroom: 60 19. $p < -7$ 20. $h > 3$ 21. $f \geq 4$
 22. $n \leq 12$ 23. $g \leq 2$ 24. $y > -12$ 25. $x \leq 12$ 26. $m > 11$
 27. $d < \frac{7}{3}$ 28. $(1, 6), (-5, 1), (-2, -2)$ 41. a) $5x + 8y \leq 40$

b) $x \geq 0, y \geq 0$ 42. a) down b) $(0, 0)$ c) $x = 0$
 d) D: all real numbers, R: $y \leq 0$ e) maximum: 0
 43. a) up b) $(0, 5)$ c) $x = 0$ d) D: all real numbers, R:
 $y \geq 5$ e) minimum: 5 44. a) down b) $(1, -3)$ c) $x = 1$
 d) D: all real numbers, R: $y \leq -3$ e) maximum: -3
 45. a) up b) $(5, 0)$ c) $x = 5$ d) D: all real numbers, R:
 $y \geq 0$ e) minimum: 0 46. a) up b) $(-3, -4)$ c) $x = -3$
 d) D: all real numbers, R: $y \geq -4$ e) minimum: -4
 47. a) down b) $(-7, 2)$ c) $x = -7$ d) D: all real numbers,
 R: $y \leq 2$ e) maximum: 2 48. $y = 4x^2 + 3$

49. $y = -(x + 2)^2 - 3$ 50. $y = \frac{1}{2}(x + 2)^2 + 5$
 51. $y = (x + 3)^2 - 3$ 52. $(5, -13)$ 53. $(-4, 15)$ 54. $(3, -3)$
 55. $(1, 1)$ 56. a) 8 m b) 10 m c) 1 m d) 1.7 m e) 20.7 m
 57. a) 200 m by 200 m b) 40 000 m² 58. -4, 3 59. 3, 5

60. -1, 9 61. -2, $\frac{1}{3}$ 62. ± 11 63. $\frac{-9 \pm \sqrt{69}}{2}$

64. $\frac{5 \pm \sqrt{33}}{4}$ 65. -1, -2 66. $-\frac{1}{5}, -1$ 67. $\pm \frac{1}{\sqrt{3}}$

68. no real roots 69. real, equal 70. 1, 2 71. -7.14,
 0.14 72. $3x^2 + 13x - 10 = 0$ 73. $k < \frac{25}{8}$

74. $(2p - 1)(p + 1)(p - 1)$ 75. 3, ± 1 76. $-\frac{1}{2}, 1, 2$

77. Yes. 180 cm by 90 cm 78. 0.75 m

79. a) $(f + g)(x) = 4x^2 + 2x - 12$

b) $(f - g)(x) = 4x^2 - 2x - 6$

c) $(fg)(x) = 8x^3 - 12x^2 - 18x + 27$

d) $\left(\frac{f}{g}\right)(x) = 2x + 3, x \neq \frac{3}{2}$

e) $f(x) + 3g(x) = 4x^2 + 6x - 18$

f) $(gg)(x) + f(x) = 8x^2 - 12x$

80. a) $(f \circ g)(x) = \sqrt{5x + 3}, (g \circ f)(x) = 5\sqrt{x + 3}$

b) f: D: $x \geq -3$, R: $y \geq 0$; g: D: all real numbers,

R: all real numbers; $f \circ g$: D: $x \geq -\frac{3}{5}$, R: $y \geq 0$;