Chapter Review Problems

Unit 8.1 Computing simple interest and maturity value

For Problems 1–7, consider a loan of Sterling George. Sterling borrowed $10,000 on October 1, 2005, for 1 year at 8% interest.

1. What is the principal amount? $10,000
2. What is the term? 1 year
3. What is the maturity date? October 1, 2006
4. What is the dollar amount of interest? $800
   \[ I = PRT = 10,000 \times 8\% \times 1 = 800 \]
5. What is the maturity value? $10,800
   \[ M = P + I = 10,000 + 800 = 10,800 \]
6. If Sterling borrowed the money for only 8 months, what is the total amount he will owe?
   \[ I = PRT = 10,000 \times 8\% \times \frac{8}{12} = 533.33 \]
   \[ M = P + I = 10,000 + 533.33 = 10,533.33 \]
7. If Sterling borrowed the money for 14 months, what is the total amount he will owe?
   \[ I = PRT = 10,000 \times 8\% \times \frac{14}{12} = 933.33 \]
   \[ M = P + I = 10,000 + 933.33 = 10,933.33 \]
8. In the simple interest formula \( I = PRT \), \( I \) stands for the interest rate. (T or F) False.
   \( I \) stands for the dollar amount of interest; \( R \) stands for interest rate.
9. In the simple interest formula \( I = PRT \), \( T \) stands for time, in months. (T or F) False.
   \( T \) stands for time, in years.

For Problems 10–12, calculate the number of days for which interest should be charged.

<table>
<thead>
<tr>
<th>Date of loan</th>
<th>Date of payment</th>
<th>Number of days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. 11, 2006</td>
<td>Oct. 28, 2006</td>
<td>290 days</td>
</tr>
<tr>
<td>July 13, 2006</td>
<td>Feb. 21, 2007</td>
<td>223 days</td>
</tr>
<tr>
<td>Dec. 18, 2007</td>
<td>Mar. 23, 2008 (leap year)</td>
<td>96 days</td>
</tr>
</tbody>
</table>

10. Oct. 28 → Day 301
    Jan. 11 → Day - 11
    290

11. Number of days left in first year: 365 - 194 (day number for July 13) = 171
    Number of days in next year: Feb. 21 → + 52
    223

12. Number of days left in first year: 365 - 352 (day number for Dec. 18) = 13
    Number of days in next year: Mar. 23 → 82 + 1 (for leap year) = + 83
    96

For Problems 13–15, calculate the maturity date.

<table>
<thead>
<tr>
<th>Date of loan</th>
<th>Term</th>
<th>Maturity date</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 15, 2006</td>
<td>60 days</td>
<td>135 + 60 = 195 → July 14</td>
</tr>
<tr>
<td>Aug. 2, 2006</td>
<td>180 days</td>
<td>214 + 180 = 394; 394 - 365 = 29 → Jan. 29</td>
</tr>
<tr>
<td>Jan. 18, 2008</td>
<td>90 days</td>
<td>18 + 90 = 108 → Apr. 17 (leap year)</td>
</tr>
</tbody>
</table>

For Problems 16 and 17, we will calculate interest on a 13% 90-day $15,000 loan.

16. Calculate interest, assuming the lender uses a 360-day year.
   \[ I = PRT = 15,000 \times 13\% \times \frac{90}{360} = 487.50 \]

17. Calculate interest, assuming the lender uses a 365-day year.
   \[ I = PRT = 15,000 \times 13\% \times \frac{90}{365} = 480.82 \]
18. The Truth in Lending Act sets the maximum interest rate lenders can charge. (T or F)  **False**

19. The Truth in Lending Act applies to all loans. (T or F)  **False** the law does not apply to business loans, loans over $25,000 (unless they are secured by real estate), most public utility fees, and student loan programs.

20. In calculating an APR for Truth in Lending purposes, lenders are required to use a 365-day year. (T or F)  **True**

For Problems 21–24, consider a loan of Mary Patterson. Mary borrowed $25,000 at 11.5% interest for 120 days. The lender uses a 365-day year.

21. How much interest will Mary owe on the maturity date?  
\[ I = PRT = 25,000 \times 0.115 \times \frac{120}{365} = 945.21 \]

22. Assume Mary pays the loan off early, in 89 days. How much interest will she owe?  
\[ I = PRT = 25,000 \times 0.115 \times \frac{89}{365} = 701.03 \]

23. Assume Mary has some extra cash and instead pays $8,000 on day 24 (24 days after getting the loan), then the balance on day 89 (89 days after getting the loan). Fill in the blanks.

<table>
<thead>
<tr>
<th>Day number</th>
<th>Total payment</th>
<th>Interest</th>
<th>Principal</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>25,000.00</td>
</tr>
<tr>
<td>24</td>
<td>$8,000.00</td>
<td>$189.04</td>
<td>$7,810.96</td>
<td>$17,189.04</td>
</tr>
<tr>
<td>89</td>
<td>$17,541.06</td>
<td>$352.02</td>
<td>$17,189.04</td>
<td>$0.00</td>
</tr>
<tr>
<td>Totals</td>
<td>$25,541.06</td>
<td>$541.06</td>
<td>$25,000.00</td>
<td>—</td>
</tr>
</tbody>
</table>

**Procedure for payment on day 24**  
1. \[ I = PRT = 25,000 \times 0.115 \times \frac{24}{365} = 189.04 \]  
2. Principal = $8,000.00 - $189.04 = $7,810.96  
3. Balance = $25,000.00 - $7,810.96 = $17,189.04

**Procedure for payment on day 89**  
1. \[ I = PRT = 17,189.04 \times 0.115 \times \frac{65}{365} = 352.02 \] (89 days - 24 days = 65 days)  
2. Principal = $17,189.04 (previous balance)  
3. Total payment = $352.02 + $17,189.04 = $17,541.06

24. How much interest does Mary pay under each situation: Problem 21, Problem 22, and Problem 23.  
   - Problem 21: $945.21  
   - Problem 22: $701.03  
   - Problem 23: $541.06

Unit 8.2  Solving for principal, rate, and time

For problems in this unit, if the answer is a percent, express the answer to the nearest hundredth of a percent.

25. From memory, or by modifying the formula \[ I = PRT \], write a formula designed to solve for (a) \( P \), (b) \( R \), and (c) \( T \).

\[ P = \frac{I}{RT} \quad R = \frac{I}{PT} \quad T = \frac{I}{PR} \]

For Problems 26–29, find the missing value.

<table>
<thead>
<tr>
<th>I</th>
<th>P</th>
<th>R</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.</td>
<td>$320.83</td>
<td>$5,000</td>
<td>11%</td>
</tr>
<tr>
<td>27.</td>
<td>$63.75</td>
<td>$4,500</td>
<td>8.5%</td>
</tr>
<tr>
<td>28.</td>
<td>2,964.75</td>
<td>$35,400</td>
<td>16.75%</td>
</tr>
<tr>
<td>29.</td>
<td>$275</td>
<td>$2,000</td>
<td>11%</td>
</tr>
</tbody>
</table>

30. You open a checking account. You are paid 3% interest on the average balance but are charged a $7 monthly charge. Assuming that interest is paid monthly (regardless of the number of days in the month), calculate the average daily balance you must maintain to offset the $7 monthly charge.

\[ P = \frac{I}{RT} = \frac{\frac{7}{3%} \times \frac{1}{12}}{0.03 \times 1 + \frac{1}{12}} = \frac{7}{0.0025} = 2,800 \]

**Check answer:**  \[ I = PRT = 2,800 \times 3\% \times \frac{1}{12} = 7.00 \]
31. You decide to pay off a 9% $3,000 loan early. The bank tells you that you owe $111.70 interest. Assuming that the bank uses a 365-day year, for how many days are you being charged interest?

\[
T = \frac{I}{PR} = \frac{111.70}{3,000 \times 9\%} = \frac{111.70}{270} = .4137037
\]

365 days \times .4137037 = 151 days

Check answer: \[I = PRT = 3,000 \times 9\% \times \frac{151}{365} = 111.70\]

32. You borrow $200 from your aunt and agree to repay her $225 ($200 principal + $25 interest) in 18 months. What interest rate are you paying?

\[
R = \frac{I}{PT} = \frac{25}{200 \times \frac{18}{12}} = \frac{25}{300} = .0833 = 8.33\%
\]

33. You get a 180-day $5,000 consumer loan at 9%. You are required to pay a $100 setup fee at the time you get the loan. What is your APR?

Principal (P) for APR purposes is the amount of money you have use of: $5,000 - $100 fee = $4,900

Interest (I) for APR purposes is total finance charges:

\[
I = PRT = 5,000 \times 9\% \times \frac{180}{365} = 221.92
\]

Set-up fee + 100.00

Total finance charges $321.92

\[
R = \frac{I}{PT} = \frac{321.92}{4,900 \times \frac{180}{365}} = \frac{321.92}{2,416.44} = .1332 = 13.32\%
\]

34. You get a $3,500 loan for 90 days. Interest of 13% is charged, using a 360-day year. What is the APR?

\[
I = PRT = 3,500 \times 13\% \times \frac{90}{360} = 113.75
\]

\[
R = \frac{I}{PT} = \frac{113.75}{3,500 \times \frac{90}{360}} = \frac{113.75}{863.01} = .1318 = 13.18\%
\]

\[\text{Even though interest is calculated using a 360-day year, an APR always uses a 365-day year}\]

35. You get a loan using the discount method. You sign a note, agreeing to repay the lender $2,000 in 60 days. Assuming a discount rate of 15%, determine the APR.

\[
D = MRT = 2,000 \times 15\% \times \frac{60}{360} = 50
\]

\[\text{Remember, the discount method uses a 360-day year to calculate interest}\]

Proceeds = M - D = $2,000 - $50 = $1,950 (this is money you have use of)

\[
R = \frac{I}{PT} = \frac{50}{1,950 \times \frac{60}{360}} = \frac{50}{320.55} = .1560 = 15.60\%
\]

\[\text{Even though interest is calculated using a 360-day year, an APR always uses a 365-day year}\]

Unit 8.3 Compound interest

For Problems 36–38, calculate the periodic rate.

36. 8% compounded semiannually: \(\frac{8}{2} = 4\%\)

37. 7% compounded quarterly \(\frac{7}{4} = 1.75\%\)

38. 7.5% compounded monthly \(\frac{7.5}{12} = .625\%\)

39. Jessica Gutierrez loans a friend $700 at 5% simple interest for 3 years. What is the maturity value?

\[
I = PRT = 700 \times 5\% \times 3 = 105
\]

\[
M = P + I = 700 + 105 = 805
\]
40. Glenna Gardner deposits $700 in a savings account. The money is left on deposit for 3 years earning 5% compounded annually. Calculate the account balance at the end of 3 years.

\[ R = \frac{I}{P} = \frac{98}{700} = 0.14 \approx 14\% \]

\[ PT = 2,352 \times \frac{3}{65} = 128.88 \]

\[ \approx 76.04\% \]

\[ \text{Balance} = 700.00 \times (1 + 0.05)^3 = 810.34 \]

<table>
<thead>
<tr>
<th>Year</th>
<th>Interest</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>—</td>
<td>$700.00</td>
</tr>
<tr>
<td>1</td>
<td>$700 \times 5% = 35.00</td>
<td>$735.00</td>
</tr>
<tr>
<td>2</td>
<td>$735 \times 5% = 36.75</td>
<td>$771.75</td>
</tr>
<tr>
<td>3</td>
<td>$771.75 \times 5% = 38.59</td>
<td>$810.34</td>
</tr>
</tbody>
</table>

41. George Lavin deposits $700 in a savings account. The money is left on deposit for 3 years earning 5% compounded semiannually. Calculate the account balance at the end of 3 years. Do not round intermediate results, but write amounts to the nearest penny.

\[ R = \frac{I}{P} = \frac{18.39}{700} = 0.0262 \approx 2.62\% \]

\[ PT = 128.88 \times \frac{3}{65} = 64.44 \]

\[ \approx 2.62\% \]

\[ \text{Balance} = 700.00 \times (1 + 0.05)^3 = 811.79 \]

<table>
<thead>
<tr>
<th>Time</th>
<th>Interest</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>—</td>
<td>$700.00</td>
</tr>
<tr>
<td>6 months</td>
<td>$700 \times 2.5% = 17.50</td>
<td>$717.50</td>
</tr>
<tr>
<td>12 months</td>
<td>$717.50 \times 2.5% = 17.94</td>
<td>$735.44</td>
</tr>
<tr>
<td>18 months</td>
<td>$735.44 \times 2.5% = 18.39</td>
<td>$753.82</td>
</tr>
<tr>
<td>24 months</td>
<td>$753.82 \times 2.5% = 18.85</td>
<td>$772.67</td>
</tr>
<tr>
<td>30 months</td>
<td>$772.67 \times 2.5% = 19.32</td>
<td>$791.99</td>
</tr>
<tr>
<td>36 months</td>
<td>$791.99 \times 2.5% = 19.80</td>
<td>$811.79</td>
</tr>
</tbody>
</table>

*Note: Without rounding intermediate results, $735.4375 + $18.3859375 = $753.8234375

42. Refer to Problems 39–41. Who ended up with the most money, and why? George Lavin (Problem 41) ended up with the most. The more often interest is compounded, the more interest is earned.

Challenge problems

43. Bob Green purchased merchandise from a supplier and failed to pay the invoice amount ($285) by the last day of the credit period (August 23). Calculate the total amount Bob must pay on October 16 if the supplier charges 18% interest on past-due accounts.

Number of days: Oct. 16 → Day 289
Aug. 23 → Day 235

\[ I = PRT = 285 \times 18\% \times \frac{54}{365} = 7.59 \]

\[ M = P + I = 285 + 7.59 = 292.59 \]

44. Alyce Lee, a sporting goods retailer, purchased ski clothing from a supplier for $2,450. The seller offers a 4% discount if the invoice is paid within 10 days; if not paid within 10 days, the full amount must be paid within 30 days of the invoice date. Use the formula \( R = \frac{I}{PT} \) to find the annual rate Alyce, in effect, is paying the supplier if she fails to pay the invoice at the end of the discount period. Hint: Alyce is, in effect, borrowing the net amount (amount after deducting the discount) for 20 days and must pay the difference as interest.

Invoice amount $2,450
Discount: $2,450 \times 4\% = 98
Net amount due $2,352

If Alyce fails to pay the invoice within the discount period she is, in effect, borrowing $2,352 for 20 days and paying an extra $98 as interest, so:

\[ R = \frac{I}{PT} = \frac{98}{2,352 \times \frac{20}{365}} = \frac{98}{128.88} = 0.7604 = 76.04\% \]
For Problems 45–48, do some calculations for delinquent property taxes.

45. You fail to pay your annual property taxes on the November 30, 2006, due date. If the tax was $845.23 and you are charged simple interest at 12%, calculate the amount of interest you must pay if you make payment on May 4, 2007.

   Number of days left in first year: 365 - 334 (day number for Nov. 30) = 31
   Number of days in next year: May 4  →  + 124
                           155

   \[
   I = PRT = \frac{845.23 \times 12\% \times 155}{365} = $43.07
   \]

46. In addition to the 12% simple interest, you are charged a one-time 6% penalty for failing to pay the tax on time. What is the one-time penalty?

   $845.23 \times 6\% = $50.71

47. What is the total amount you must pay on May 4, 2007?

   $845.23 + 43.07 interest + 50.71 penalty = $939.01

48. Calculate your APR (including the 6% penalty).

   \[
   R = \frac{I}{PT} = \frac{43.07 + 50.71}{845.23 \times 155} = \frac{93.78}{358.93} = .2613 = 26.13\%
   \]

49. The ad to the right states that $1,000 left on deposit for 5 years earning 8.75% compounded semiannually would result in the same balance as $1,000 earning 10.69% simple interest. Determine if the ad is correct. First, find the maturity value using 10.69% simple interest. Then, find the ending balance for 8.75% compounded semiannually.

   10.69% simple interest
   \[
   I = PRT = $1,000 \times 10.69\% \times 5 = $534.50
   \]
   \[
   M = P + I = $1,000 + $534.50 = $1,534.50
   \]

   8.75% compounded semiannually (let's use calculators)
   Balance in 6 months: $1,000 + 4.375% = $1,043.75
   Balance in 12 months: + 4.375% = $1,089.41
   Balance in 18 months: + 4.375% = $1,137.08
   Balance in 24 months: + 4.375% = $1,186.82
   Balance in 30 months: + 4.375% = $1,238.75
   Balance in 36 months: + 4.375% = $1,292.94
   Balance in 42 months: + 4.375% = $1,349.51
   Balance in 48 months: + 4.375% = $1,408.55
   Balance in 54 months: + 4.375% = $1,470.17
   Balance in 60 months: + 4.375% = $1,534.49

   The ending balances are almost identical, showing that, for a 5-year period, 10.69% simple interest is equivalent to 8.75% compounded semiannually.

Practice Test

1. In the simple interest formula \( I = PRT \), \( I \) stands for the interest rate. (T or F)  **False.** \( I \) stands for the dollar amount of interest; \( R \) stands for interest rate.

2. Lynette Read borrowed $12,000 at 9.5% interest for 8 months. What is the maturity value?

   \[
   I = PRT = $12,000 \times 9.5\% \times \frac{8}{12} = $760
   \]
   \[
   M = P + I = $12,000 + $760 = $12,760
   \]

3. On June 22, 2005, Lo Nguyen borrowed some money for 120 days. What is the maturity date?

   June 22  →  Day 173 + 120 = 293  →  Oct. 20
4. Buck Tanner gets a 9% $1,500 loan on December 23, 2007, to do some holiday shopping. If Buck repays the money on April 10, 2008 (a leap year), how much interest does he owe? Assume the lender uses a 365-day year.

Number of days left in first year: 365 - 357 (day number for Dec. 23) = 8
Number of days in next year: Apr. 10 + 100 + 1 (for leap year) + 101 = 109

\[ I = PRT = $1,500 \times 9\% \times \frac{109}{365} = $40.32 \]

5. You borrow $15,000 for 90 days at 9% interest. The lender uses a 365-day year. You make a payment of $3,000 on day 22 (22 days after getting the loan). Calculate your balance after the $3,000 payment is applied.

\[ I = PRT = $15,000 \times 9\% \times \frac{22}{365} = $81.37 \]

Principal = $3,000.00 - $81.37 = $2,918.63
Balance = $15,000.00 - $2,918.63 = $12,081.37

6. You get a 7% 90-day $3,000 loan. The lender uses a 360-day year and charges you a $100 set-up fee at the time you get the loan. What is your APR?

Principal (P) for APR purposes is the amount of money you have use of: $3,000 - $100 fee = $2,900.
Interest (I) for APR purposes is total finance charges:

\[ I = PRT = $3,000 \times 7\% \times \frac{90}{360} = 52.50 \]

Set-up fee = +100.00
Total finance charges = $152.50

\[ R = \frac{I}{PT} = \frac{152.50}{2,900 \times \frac{90}{365}} = \frac{152.50}{771.57} = .2133 \approx 21.33\% \]

Even though interest is calculated using a 360-day year, an APR always uses a 365-day year

7. You get a loan using the discount method. You sign a note, agreeing to repay the lender $30,000 in 180 days. Assuming a discount rate of 13.5%, determine the APR.

\[ D = MRT = $30,000 \times 13.5\% \times \frac{180}{360} = $2,025 \]

Proceeds = M - D = $30,000 - $2,025 = $27,975 (this is amount you have use of)

\[ R = \frac{I}{PT} = \frac{2,025}{27,975 \times \frac{180}{365}} = \frac{2,025}{13,795.89} = .1468 \approx 14.68\% \]

8. Kyle Santini deposits $500 in a savings account. The money is left on deposit earning 6% compounded semiannually. Calculate the account balance at the end of 2 years.

\[ \begin{array}{c|c|c}
\hline
\text{Beginning} & \text{Interest} & \text{Balance} \\
\hline
& 0 & $500.00 \\
6 \text{ months} & $500.00 \times 3\% = $15.00 & $515.00 \\
12 \text{ months} & $515.00 \times 3\% = $15.45 & $530.45 \\
18 \text{ months} & $530.45 \times 3\% = $15.91 & $546.36 \\
24 \text{ months} & $546.36 \times 3\% = $16.39 & $562.75 \\
\hline
\end{array} \]