

GRADE 12 APPLIED WORKBOOK

UNIT B

PERSONAL FINANCE

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A clearly communicated answer

- is easily identified in the response space
Box it, label it, state in plain words even
- includes the parameters in the equation, and “y =”, “sin”, “ln”, or “x”, as applicable
ie: show proper formula, not just chicken scratch
- includes the units of measure, where applicable
- includes labels, units, and scales for the axes on graphs
- is expressed as an exact value or is appropriately rounded

Directing Words

Some questions may include directing words such as explain, state, and calculate. These words are explained below.

The word	The question is asking for...
identify/choose	the appropriate answer(s) from a given list of choices
state	a word, sentence, or number, without an explanation
describe/explain	words or symbols, diagrams, charts or graphs, or other methods that clearly show what you are thinking
justify/support	an explanation, information, or evidence that shows why your method, idea, or answer is correct

sketch/illustrate

a reasonably neat picture or diagram (not necessarily to scale) that shows or explains an idea, concept, or method

calculate/determine

a mathematical formula, an algebraic equation, or a numerical calculation to solve a problem

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Show work! So you know how you got the answer.
Round decimal answers to nearest 0.01 unless otherwise indicated or sensible

SIMPLE AND COMPOUND INTEREST

1-1. Eileen invests the \$2000 that she gets back from her income tax into a savings account with an interest rate of 1.5% for 12 years. Find the interest earned on her investment.

1-2. Parry invests \$600 in a savings account for ten years. He receives \$180 in interest. What is the interest rate in his account?

1-3. Joshua places \$2400 in a mutual fund with an interest rate of 5%. When he withdraws the money, he notices it earned \$2880 in interest. For how many years did Josh invest the money?

1-4. Using the Rule of 72, how many years would it take for investments to double at each of the following rates:

- a) 4% b) 7.2% c) $1\frac{1}{2}\%$

1-5. Ray invests \$800 in a savings account that earns 4.5% interest compounded semi-annually. Using the Rule of 72, find the length of time required to double Ray's investment.

1-6. Wanda invests \$15 000 in a savings account that guarantees an interest rate of 6%. She wants to have \$60 000 saved when she retires to use towards the purchase of a cottage. How long must she invest the money for?

1-7. Chris puts \$2000 in an account that accumulates 4% interest, compounded quarterly. How much money does he have after three years?

1-8. Barb has \$360 in a money maker account with 10% interest, compounded semi-annually.

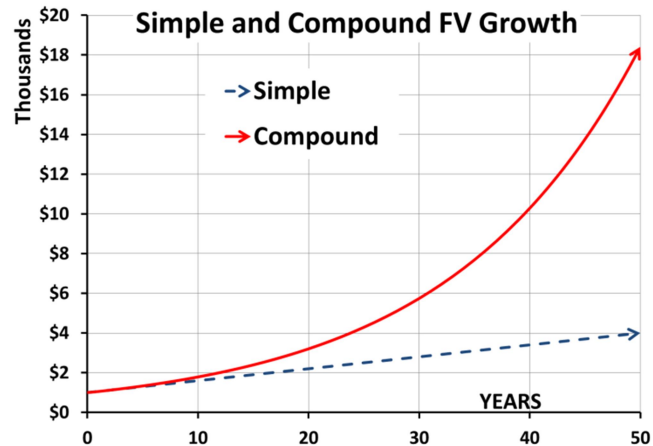
- a) How much money does she have after 8 years?
- b) How much interest does she earn?

1-9. When Dennis turns 18, his parents give him money that they invested for him when he was born. They invested the money in a savings account that had an interest rate of 7.2% compounded monthly. If they give him \$9101.31, how much did they initially invest?

1-10. Sabeena makes two \$1000 investments when she turns 18. One is in a simple interest savings account with an interest rate of 6% (shown in dashed line). The other is in a compound interest savings account with an interest rate of 6%, compounded annually (shown in solid curve)

a) Ten years into investing, estimate the difference between the investments.

b) Thirty years into investing, estimate the difference between the investments.

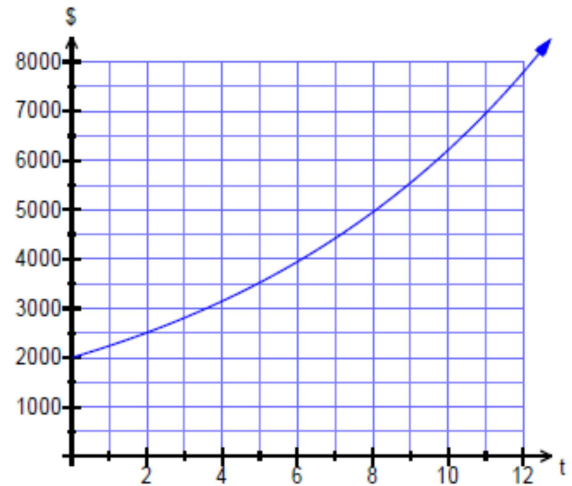


c) Estimate the amount in both accounts after 50 years.

d) Divide the amounts you found in c) and then complete the statement below.

"After 50 years, there is _____ times more money in the compound interest account than in the savings account"

1-11. Theresa receives a report on her investment from her financial institution. The report contains a graph displaying the value of her investment over time (measured in years) – as shown.



What type of interest does Theresa's investment have? How do you know?

1-12. Describe a situation in which it would be advantageous to have simple interest. Explain your answer.

APPLICATIONS OF COMPOUND INTEREST

2-1. Abby invests \$750 in a GIC that gives an interest rate of 4.8%, compounded daily. How much will she have in six years?

2-2. Brian invests a sum of money when he is 18. When he is 30, he withdraws the money and has \$5000. If the interest rate of his account was 3.2%, compounded semi-annually, find the amount he invested.

2-3. Crystal deposits \$880 into an account that compounds interest quarterly. After 42 months, she has \$1050. What was the interest rate of her account?

2-4. David puts \$21 000 in a high-interest savings account. The account has an interest rate of 7.2%, compounded annually. When he takes it out, he has \$31 870.44. How long did he invest his money?

2-5. Elizabeth wants to get the most money she can out of her investments. As a result, after investing \$1500 in a savings account for 4 years at an interest rate of 4.2%, compounded weekly, she moves her money to a GIC that she invests in for another 6 years. The GIC offers an interest rate of 5.5%, compounded monthly. How much money will she have at the end of the 10 years?

2-6. Felix invested \$2200 into a variable rate savings account. During the first year, his investment earned 4%. During the second year, the investment earned 5.5%. During the third year, the investment earned 4.8%. If all interest rates are compounded quarterly, find how much money Felix has at the end of three years.

2-7. Gina is weighing her options and isn't sure if she should invest \$2000 or \$3000 into a savings account for her child. She wants to invest the money for 18 years in an educational savings account that has a 3.8% interest rate, compounded monthly.

- a) How much money does each option give her?
- b) How much more money will Gina's child have in their education savings account if \$3000 is invested?

2-8. Leonard wants to invest some money. The bank he deals with offers him a 3.8% interest rate, compounded quarterly, for his \$5000 investment. The other bank in town offers him a 4.9% interest rate, compounded quarterly. Leonard wants to withdraw the money after 15 years. Using a graph and mathematic reasoning, convince Leonard why he should invest in the other bank, assuming all other factors are equal.

2-9. Madison's mom invests \$500 when she is born. She can invest it in a simple interest savings account with an interest rate of 4% or a savings account with an interest rate of 4%, compounded annually. Graph both types of interest over 18 years on the same set of axes and comment on which account would be best to invest in.

ANNUITIES

3-1. Josh invests \$50 weekly for 6 years in his savings account that has a 2.8% interest rate, compounded weekly. How much money will he have after 6 years?

3-2. Rhonda needs to have \$2500 in three and a half years. What monthly investment will she have to make if her bank offers a 4.8% interest rate, compounded monthly?

3-3. Danny deposits \$100 monthly in a retirement fund. His bank offers an interest rate of 5.2%, compounded monthly. If he plans on retiring in 11 years, find:

- a) How much his investment will be worth when he is ready to retire.
- b) How much interest his investment earns over the 11 years.

3-4. Rebecca wants to save up for a trip to see her family in Scotland. She estimates she'll need \$2000 for the flight and spending money. The bank offers her a 6.4% interest rate, compounded quarterly. If she wants to go on the trip in 18 months, find:

- a) The amount she needs to invest each quarter.
- b) How much interest her investment will earn.

3-5. Evan has \$3,500 in his savings account but he wants to add more to save up for a boat. He is able to deposit \$225 monthly. The bank offers him a 2.4% interest rate. He estimates he wants to buy the boat in four years.

- a) How much will he have saved for the boat after 4 years?
- b) How much interest does his investment make?

3-6. Stephanie currently has \$500 saved. She wants to save up for a trip to see her favourite musician perform. She estimates the trip will cost \$1,500. Her bank offers her a 6.6% interest rate, compounded weekly. The concert is in 60 weeks.

- a) How much does she have to invest weekly to have enough for the trip?
- b) How much interest does her investment make?

3-7. When Shane started his career, he wanted to invest his money for retirement. His bank provided an interest rate of 3.9%, compounded annually. Anna started her career at the same time as Shane, and she wanted to invest her money, too. Her bank provided an interest rate of 5.1%, compounded annually. They both worked for 36 years, and each deposited \$1,000 a year during their careers.

- a) Find the value of Shane's and Anna's investments.
- b) Who has more invested? How much more do they have?
- c) Graph, [using technology], the value of both their investments versus time on the same set of axes. [Give a reasonable sketch here of what the graph looks like]

3-8. Ten years ago, Lanny started investing. He had two choices: invest \$500 monthly or \$125 weekly. His bank offered an interest rate of 4.95%.

a) Find the present value of both options.

b) Which option would make Lanny the most money? How much more interest does it make him?

3-9. Marnie invests \$175 monthly in a savings account. During the past two years, her bank offered her a 3.75% interest rate, compounded monthly.

Marnie is investing in a new account with a 4.3% interest rate. If she continue to make \$175 monthly deposits, how much money will she have 4 years from now?

3-10. Two brothers, Mike and Ralph, have different approaches to investing. Mike invests \$100 a month over 20 years in a savings account that has an interest rate of 5%, compounded monthly. Ralph doesn't invest any money during the first ten years that Mike does. Mike finally convinces Ralph to invest money, though, and he invests \$250 a month for the next 10 years.

- a) How much money did Mike invest?
- b) How much money is Mike's investment worth?
- c) How much interest did Mike's investment make?
- d) How much money did Ralph invest?
- e) How much money is Ralph's investment worth?
- f) How much interest did Ralph's investment make?
- g) Graph, [using technology], both investments versus time on the same set of axes. [provide a sketch of the graph here]
- h) Who was the smarter investor? Justify your answer mathematically.

PRESENT VALUE OF AN ANNUITY

4-1. Theoren wants to invest a sum of money so that he can withdraw \$1000 every quarter for the next 10 years. His bank offers an interest rate of 5.45%, compounded quarterly. How much must he invest in the annuity? How much interest will the annuity earn Theoren?

4-2. Rose is trying to find the financial institution that will provide her the best rate of return on money she wishes to invest in an annuity. Credit Union A offers an interest rate of 5%, compounded bi-weekly. Credit Union B offers an interest rate of 5.4%, compounded quarterly. She has \$35,000 to invest, and wants to receive the money over a 10-year period

- a) What will her bi-weekly payment be with Credit Union A?
- b) What will her quarterly payment be with Credit Union B?
- c) Which credit union will give her more money over the 10 years?
- d) Which factor is more important for Rose to make her choice: the interest rate or the compounding frequency?

4-3) Robyn wishes to invest \$165 000 in an annuity that will pay him monthly over the next 15 years. The interest rate is 3.8%, compounded monthly.

- a) What will Robyn's monthly payment be?
- b) How much interest does Robyn's investment earn in the third year?
- c) When the investment value dips below \$100 000, Robyn wishes to stop withdrawing money from the annuity and build the account value back up to \$165 000. After how long will he do this?

4-4) Parvati buys a digital camera that costs \$648. She finances the camera under a "Do Not Pay for 6 months" promotion that carries a \$79 finance charge. What effective interest rate (compounded monthly) is Parvati paying if she pays the camera off in 6 months?

4-5) Rudy buys a snow blower by agreeing to make payments. The \$1300 snow blower will require Rudy to make monthly payments of \$129/month for 12 months.

- a) How much interest does Rudy pay?
- b) What is the effective interest rate that Rudy pays (compounded monthly)?

4-6) Samantha takes out a \$5000 loan to do some home renovations. She is going to repay the loan with monthly payments over 5 years. Her bank charges her 7.99% interest.

- a) What is her monthly payment?
- b) How much interest does she pay in her first year paying the loan back?
- c) How much interest does Samantha pay over the life of the loan?
- d) If she is able to double her monthly payment, how much sooner can she pay the loan off?

4-7) Rupert takes out a \$30,000 loan. He is investigating the effect of choosing different compounding periods. His financial institution offers him a 19.8% interest rate. If he wants to pay the loan back in 6 years, how much interest can he save himself if he pays the loan off weekly vs. semi-annually?

4-8) Desseraay wants to buy herself a used vehicle. She can afford monthly payments of up to \$275. Her bank offers her an interest rate of 5.5%, compounded monthly. If she wants a 4 year car loan, how much can she afford to spend on a vehicle? Graph the value of the loan over a 4-year period.

4-9) Colin wishes to buy a trailer for \$22 000. The bank offers him a 9.75% interest rate, compounded monthly. He wants to consider a loan with a repayment schedule between 3 and 6 years.

He can afford monthly payments at or under \$500 and wants to pay the trailer off as soon as possible.

- a) How many years should his loan be? What is the monthly payment?
- b) How much interest is paid over the life of the loan?

4-10) Mandy has \$25 000 to invest in an annuity. Her bank offers her 5.8% interest, compounded monthly.

- a) How many months could she withdraw \$150/month?
- b) How many months could she withdraw \$300/month?
- c) Which option gives her more money over the life of the annuity? Explain mathematically.

REVIEW

5-1. Using the Rule of 72, how many years would it take for an investment to double at a compound interest rate of 5.4%?

5-2. Simple Interest and Compound Interest graphs:

- a) Draw an example of a simple interest investment versus time graph.
- b) Draw an example of a compound interest investment versus time graph.
- c) How are they the same? How are they different? Explain your answers.

5-3. Danielle invests \$4000 in a simple interest savings account that earns \$1100 interest in 66 months. What interest rate does Danielle's account have?

5-4. Mark invests his birthday money in a savings account that has 4.8% interest, compounded monthly. After 4 years, he has \$1650.98.

- a) How much did he initially invest?
- b) How much interest did his investment make?

5-5. Wanda and Barb invest some money at the same time when they graduate high school. Wanda invests \$10,000 and Barb invests \$20 000. They both invest in a savings account that has an interest rate of 6%, compounded annually.

- a) Graph their investments over 40 years on the same set of axes.
- b) How much more money does Barb have after 40 years?
- c) Using your answer in b, what does this tell you about investing?

5-6. Travis withdraws his investment after 12 years. He initially invested \$5000 into an account that compounds interest weekly. He has \$9385.07 when he takes his money out. What was the interest rate for his investment?

5-7. Lindsey invests \$300 a month in an education fund for her son starting when he is 1 month old. When her son turns 18, she gives him the money to go to school. If the fund had an interest rate of 4% compounded monthly, how much money will he receive?

5-8. Joey needs to have \$4000 in a year and a half to buy a car. How much must he invest weekly into a savings account that has a weekly compounding interest rate of 5.85%?

5-9. Garrett has \$12 000 saved. He wants to save up for a truck that costs \$40 000.

- a) How much does he have to invest quarterly to buy the truck in 3 years if his savings account has an interest rate of 5.45%, compounded quarterly?
- b) How much interest does his investment earn?

5-10. Whitney has \$200 000 invested in an account that gives her a 3.8% interest rate, compounded monthly.

- a) If she wants to receive monthly payments from the account for the next 35 years, how much does she receive each month?
- b) How much interest does her investment make?

5-11. Jeremy has \$30 000 invested and wants to take out annual payments for the next 25 years. His account has an interest rate of 5.99%, compounded annually.

- a) Graph Jeremy's investment over the 25 years.
- b) After how many years is there less than \$10 000 invested?
- c) How much interest does the investment earn?

5-12. Alexis and her brother Dave both invest \$3000 in separate savings accounts. Alexis' has an interest rate of 2.9%, compounded monthly, and Dave's has an interest rate of 6.3%, compounded monthly. They both add \$100/month to their investments.

- a) Whose investment do you expect to have a higher value? Explain your answer.
- b) How long does it take for the more valuable investment to be worth twice as much as the other investment?

5-13. Cathy purchases a bicycle that costs \$479. The store offers her a "Do Not Pay For a Year" promotion. If the finance charge for the offer is \$129, what is Cathy's effective interest rate if she pays the bicycle off in 12 months?

5-14. Gordon buys office equipment that costs \$1800. The store he's purchasing the equipment from allows him to pay \$125/month over 2 years to pay for the equipment.

- a) How much interest does Gordon pay?
- b) What is Gordon's effective interest rate over the 2 years?

5-15. Mandy finances her new television. The cost of the TV is \$2000. She plans to pay it off in three years. The interest rate on the loan is 29%, compounded monthly.

- a) What is her monthly payment?
- b) How much interest will she pay?
- c) Graph the loan over the three years.

5-16. Caitlan wants to buy some new furniture that costs \$6000. She wants to make weekly payments on the furniture but can't afford more than \$70/week. The store will charge her an interest rate of 19%, compounded weekly. She can pay off the furniture in 1, 2 or 3 three years. If she wants to pay off the furniture as soon as possible, how long should her loan be?

5-17. Gary buys a car that costs \$24 000. The interest rate on the loan is 17% over 6 years. Gary wants to explore the differences in compounding periods.

- a) If Gary chooses to make annual payments, what is his annual payment?
- b) How much total interest does Gary pay by making annual payments?
- c) If Gary chooses to make weekly payments, what is his weekly payment?
- d) How much total interest does Gary pay by making weekly payments?
- e) Which choice is better for Gary if he wants to minimize his interest paid?

TABLES

MONTHLY LOAN PAYMENT TABLE FOR A LOAN OF \$1,000

Annual Rate	1 Year Monthly	2 Years Monthly	3 Years Monthly	4 Years Monthly	5 Years Monthly	10 Years Monthly	15 Years Monthly	20 Years Monthly	25 Years Monthly
2%	\$84.24	\$42.54	\$28.64	\$21.70	\$17.53	\$9.20	\$6.44	\$5.06	\$4.24
3%	\$84.69	\$42.98	\$29.08	\$22.13	\$17.97	\$9.66	\$6.91	\$5.55	\$4.74
4%	\$85.15	\$43.42	\$29.52	\$22.58	\$18.42	\$10.12	\$7.40	\$6.06	\$5.28
5%	\$85.61	\$43.87	\$29.97	\$23.03	\$18.87	\$10.61	\$7.91	\$6.60	\$5.85
6%	\$86.07	\$44.32	\$30.42	\$23.49	\$19.33	\$11.10	\$8.44	\$7.16	\$6.44
7%	\$86.53	\$44.77	\$30.88	\$23.95	\$19.80	\$11.61	\$8.99	\$7.75	\$7.07
8%	\$86.99	\$45.23	\$31.34	\$24.41	\$20.28	\$12.13	\$9.56	\$8.36	\$7.72
9%	\$87.45	\$45.68	\$31.80	\$24.89	\$20.76	\$12.67	\$10.14	\$9.00	\$8.39
10%	\$87.92	\$46.14	\$32.27	\$25.36	\$21.25	\$13.22	\$10.75	\$9.65	\$9.09
12%	\$88.85	\$47.07	\$33.21	\$26.33	\$22.24	\$14.35	\$12.00	\$11.01	\$10.53
14%	\$89.79	\$48.01	\$34.18	\$27.33	\$23.27	\$15.53	\$13.32	\$12.44	\$12.04
16%	\$90.73	\$48.96	\$35.16	\$28.34	\$24.32	\$16.75	\$14.69	\$13.91	\$13.59
18%	\$91.68	\$49.92	\$36.15	\$29.37	\$25.39	\$18.02	\$16.10	\$15.43	\$15.17
20%	\$92.63	\$50.90	\$37.16	\$30.43	\$26.49	\$19.33	\$17.56	\$16.99	\$16.78
25%	\$95.04	\$53.37	\$39.76	\$33.16	\$29.35	\$22.75	\$21.36	\$20.98	\$20.88
30%	\$97.49	\$55.91	\$42.45	\$36.01	\$32.35	\$26.36	\$25.30	\$25.07	\$25.02
35%	\$99.96	\$58.52	\$45.24	\$38.97	\$35.49	\$30.12	\$29.33	\$29.20	\$29.17

EXAMPLES of loan payments

Example A. You borrow \$120,000 for 10 years at 14% Annual Rate. Your monthly payments are \$13.22 for each thousand you borrow. So your monthly payment on \$120,000 is 120 times as much or \$1,586.40 per month. So your loan is paid off after 120 payments of \$1,586.40 so a total of \$190,368 in payments. So your \$120K loan cost you \$190K.

Example B. You borrow \$200,000 for 25 years at 6% Annual Rate to buy a house. Your monthly payments are \$6.44 *for each* thousand you borrow. So your monthly payment on \$200,000 is 200 times as much or \$1,288 per month. So your loan is paid off after 300 payments of \$1,288 so a total of \$386,400 in payments. So your \$200K house cost you \$386K over 25 years. Of course, hopefully you will be able to sell it for at least \$350K, so it really only cost you \$36K to live in a house for 25 years. Mind you now you need another place to live... but the kids are gone so you can get a smaller place!

Interpolation of Payment. If you want interest rates such 6.5% or 7.75% a linear interpolation should be sufficiently accurate. For example 6.5% would be halfway between \$6.44 and \$7.07, so $(6.44 + 7.07) / 2 =$ **\$6.755** per thousand per month for a 6.5% interest rate

ANSWERS (full solutions, with steps, are on the Merlin Black Board distance learning website)
 (some of these are best solved using a computer spreadsheet.)

1-1. $I = \$360$
1-2. $r = 3\%$
1-3. $t = 24$ years
1-4. a. 18 years b. 10 years c. 48 years
1-5. 16 years
1-6. 24 years (two doublings!)
1-7. $A = \$2,253.65$
1-8. a. $A = \$785.83$ b. $I = \$425.83$
1-9. $P = \$2500$
1-10. a. about \$200 b. nearly \$3,000 c. \$4,000 , \$18,400 d. 4.85 times
1-11. Compound interest (not a linear function)
1-12. If you owe money!
2-1. $FV = \$1000.30$
2-2. $PV = -\$3416.02$
2-3. 5.08% gets us closest to \$1050.
2-4. \$31 870.44.

2-5. Elizabeth has \$2466.11 after 10 years

2-6. After 3 years, Felix has \$2536.03.

2-7. a. $FV = \$5938.95$ b. difference = \$1979.65

2-8. He will earn ~ \$1500 more by going with the bank that has the interest rate of 4.9%

2-9. The compound interest investment is worth more

3-1. $FV = \$16\,982.00$

3-2. $PMT = \$54.78$

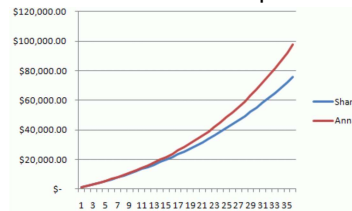
3-3. a. Danny's investment is worth \$17 760.44..
b. the interest earned is \$4560.44

3-4. a. $PMT = \$320.25$ b. \$78.50

3-5. a. \$15 175.81 b. \$875.81

3-6. a. $PMT = \$15.42$ b. \$74.80

3-7. a. Shane's investment is worth \$76 006.10, Anna's investment is worth \$97 916.44
b. Anna has \$21 910.34 more invested.



3-8. a. monthly $FV = \$77\,433.80$ b. weekly: $FV = \$84\,055.11$ c. difference: \$1621.31

3-9. a. \$4354.45 b. \$14 317.93

3-10. a. \$24 000 b. \$41 103.37 c. \$17 103.37 d. \$30 000 e. FV = \$38 820.57 f. \$8820.57 g. graph h. Mike was the smarter investor
4-1. Invest \$30 680.43, Interest \$9319.57
4-2. a. \$171.19 b. \$1138.16 c. Bank B will give Rose more money over 10 years d. The interest rate is the more important factor
4-3. a. \$1204.01. b. \$5469.99 c. At the end of the 7th year
4-4. 23.23%
4-5. a. \$248 b. 17.59%
4-6. a. \$101.36 b. \$368.91 c. \$1081.48 d. 32.97 months earlier!
4-7. a. \$22 576.25 - \$21 318.88 = \$1257.37
4-8. \$11 824.66
4-9. a. Years to Pay Out = 3 Payment = \$707.30 (too high) So, Colin's loan should be 5 years @ \$464.73/month b. Colin pays \$5884 in interest
4-10. a. 339.63 months b. 106.91 months c. So the \$150 withdrawals will give you more money but over a longer time; \$18 874.25 more to withdraw if you go with \$150 withdrawals.
5-1. 13.33333 years

5-2. We can see that the compound interest graph increases faster
5-3. $r = 5\%$
5-4. a. $PV = \$1363.09$ b. $\$287.89$
5-5. a. graph b. Wanda: A $\$102\,857.18$; Barb: A $\$205\,714.36$ c. Invest early
5-6. 5.25%
5-7. $FV = \$94\,677.73$
5-8. $FV = \$4000$
5-9. a. $PMT = \$2000.10$ (quarterly) b. $\$3998.80$
5-10. a. $\$861.72$ b. $\$161\,921.32$
5-11. a. graph b. the investment go below $\$10\,000$ at the end of the 20th year c. $\$28\,614.30$
5-12. a. Dave's investment will be worth more because his interest rate is higher. b. 30.92 years. (using a spreadsheet)
5-13. 24.09%
5-14. a. $\$1200$ b. 25.81%
5-15. a. Monthly Payment is $\$83.81$ b. $\$1017.21$ c.
5-16. Caitlan should finance the furniture over 2 years.
5-17. a. Annual Payment is $\$6686.76$ b. Total Interest is $\$16\,120.53$ c. Weekly Payment is $\$122.83$ d. Total Interest is $\$14\,321.57$ e. he should make weekly payments

