

# Chapter Review Problems

Tip: After doing a problem in “begin” mode, don’t forget to switch your calculator back to “end” mode.

## Unit 10.1: Finding future value

1. Tammy Brown is 31 and deposits \$2,000 at the end of each year into an individual retirement account (IRA). If the account earns 11% compounded annually, how much will Tammy have when she retires 34 years later?

N	i	PV	PMT	FV
34	11		-2,000	613,674.87

2. Jack Green spends \$135 a month on cigarettes and is considering the advantages of kicking the habit. If Jack just turned 19 and deposits the \$135 at the end of each month into a savings plan earning 8% compounded monthly, how much will he have in his savings plan at age 70, after his final deposit?

N	i	PV	PMT	FV
$51 \times 12 = 612$	$8 \div 12 \approx 0.67$		-135	1,161,338.43

3. You deposit \$500 today into a savings plan and deposit an additional \$100 each quarter (starting in 3 months) for 35 years. If you earn 5.5% compounded quarterly, what will your balance be in 35 years?

N	i	PV	PMT	FV
$35 \times 4 = 140$	$5.5 \div 4 \approx 1.38$	-500	-100	45,316.26

4. 170 years ago, your great-great-great-great grandfather lost \$42 playing poker at a fur-trading post in Wyoming. If he had not been tempted to get into the poker game and instead had deposited the \$42 in a savings account earning 4% compounded annually, how much would be in the account today?

N	i	PV	PMT	FV
170	4	-42		33,030.64

5. Calculate the account balance for \$500 left on deposit for 267 days earning 5.25% compounded daily.

N	i	PV	PMT	FV
267	$5.25 \div 365 \approx 0.01$	-500		519.57

6. Jed Redmond just turned 22. He decides to empty the change out of his pocket each day—averaging a dollar a day—and set it aside. Then, at the end of each year, Jed will deposit the money in a savings plan earning 7.75% compounded annually. How much will Jed have when he turns 65, after his final deposit?

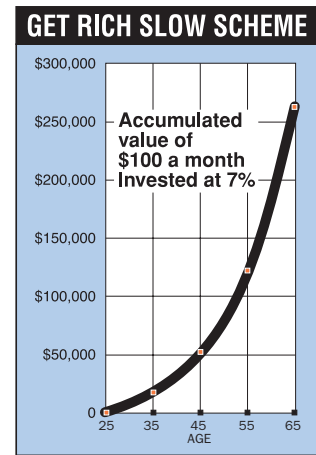
N	i	PV	PMT	FV
43	7.75		-365	111,953.59

7. The average growth rate for stocks over the last 75 years is reported to be about 11%, compounded annually. If your grandmother had invested \$500 in the stock market 75 years ago and received the 11% return, what would her investment be worth today?

N	i	PV	PMT	FV
75	11	-500		1,253,699.39

8. Refer to a business magazine article, shown to the right. Assuming that interest is compounded monthly and deposits are made at the end of each month, calculate the *precise* savings plan balance you will have at ages 35, 45, 55, and 65.

N	i	PV	PMT	FV
$10 \times 12 = 120$	$7 \div 12 \approx 0.58$		-100	17,308.48
$20 \times 12 = 240$	↑		↑	52,092.67
$30 \times 12 = 360$	↑		↑	121,997.10
$40 \times 12 = 480$	↑		↑	262,481.34



## Unit 10.2 Sinking funds

Problems 9–11 deal with a promise Beth received from her Uncle Ted. He promises to give her \$50,000 on her 30th birthday,  $6\frac{1}{2}$  years from now. Uncle Ted can earn 8.5% compounded quarterly on his money.

9. What amount could Uncle Ted deposit today in a savings plan so that the plan would have the required \$50,000 in  $6\frac{1}{2}$  years?

N	i	PV	PMT	FV
$6.5 \times 4 = 26$	$8.5 \div 4 \approx 2.13$	-28,942.51		50,000

10. If, instead, Uncle Ted elects to make quarterly deposits into the plan (starting in 3 months), what is the required quarterly deposit?

N	i	PV	PMT	FV
↑	↑	0	-1,460.36	↑

11. If, instead, Uncle Ted elects to deposit \$10,000 today, what additional quarterly deposit is required?

N	i	PV	PMT	FV
↑	↑	-10,000	-955.78	↑

12. Kristi just turned 28 and can save \$180 per month, starting in 1 month. If Kristi can earn 8% compounded monthly, what age will she be when she accumulates \$1,000,000?

N	i	PV	PMT	FV
547.60 months	$8 \div 12 \approx 0.67$		-180	1,000,000

Kristi's age now 28.00  
 Years left to accumulate \$1,000,000:  $547.60 \text{ months} \div 12$  +45.63  
 Kristi's age when she has \$1,000,000 73.63 (73 years old)

13. While your dentist is filling a cavity in one of your teeth, he is talking with his dental assistant about the new dental equipment he wants to buy in  $2\frac{1}{2}$  years for \$35,000. He wonders how much he will need to set aside at the end of each month to accumulate the \$35,000. You get his attention and tell him that if he will quit drilling for a minute you will calculate the amount for him. What is the amount, assuming he can earn 11% compounded monthly?

N	i	PV	PMT	FV
$2.5 \times 12 = 30$	$11 \div 12 \approx 0.92$		-1,018.90	35,000

14. You want to start a retail clothing business and estimate it will take \$15,000 to get started. If you can save \$250 each month, starting today, and your savings will earn 8% compounded monthly, in how many months can you start your business?

N	i	PV	PMT	FV
<b>50.35 months</b>	$8 \div 12 \approx 0.67$		-250 Begin*	15,000

\*Note: Don't forget to put back in "end" mode.

For Problems 15–17, help an auto manufacturer make some calculations on some bonds. The company issues \$86,500,000 of 10.5% 20-year bonds to upgrade its assembly line. Terms of the bond require annual interest payments to bondholders plus annual deposits to a sinking fund for retirement of the bonds when they mature.

15. How much interest must the corporation pay to the bondholders each year?

$$I = PRT = \$86,500,000 \times 10.5\% \times 1 = \mathbf{\$9,082,500}$$

16. Assuming the corporation can earn 11.5% compounded annually on its sinking fund, how much must it deposit into the fund at the end of each year?

N	i	PV	PMT	FV
20	11.5		<b>-1,271,963.81</b>	86,500,000

17. What is the total amount the corporation needs each year to meet its obligations on the bonds?

Annual interest payments	\$ 9,082,500.00
Annual sinking fund deposit	<u>+ 1,271,963.81</u>
Total needed each year	<b>\$10,354,463.81</b>

### Unit 10.3 Annuities

For Problems 18–21, pretend you receive an inheritance of \$500,000 and deposit it in a savings account that earns 6.75% compounded monthly.

18. If you want to live off the interest without withdrawing any of the principal, what amount can you withdraw each month?

$$I = PRT = \$500,000 \times 6.75\% \times \frac{1}{12} = \mathbf{\$2,812.50}$$

19. If you withdraw \$2,500 at the end of each month, what will the balance be in 25 years?

N	i	PV	PMT	FV
$25 \times 12 = 300$	$6.75 \div 12 \approx 0.56$	-500,000	2,500	<b>743,358.22</b>

20. If you withdraw \$3,500 at the end of each month, how long before the balance is exhausted?

N	i	PV	PMT	FV
$290.14 \div 12$ $\approx 24.18$ yrs	↑	↑	3,500	0

21. If you want the plan to last 35 years, how much can you withdraw at the end of each month?

N	i	PV	PMT	FV
$35 \times 12 = 420$	↑	↑	<b>3,107.08</b>	0

22. A wealthy citizen sets up a trust for scholarships at a local community college. The gift is for \$1,000,000, and the money is distributed at the beginning of each year over the next 200 years. If the trust earns 7.5% compounded annually, how much is available for scholarships each year?

N	i	PV	PMT	FV
200	7.5	-1,000,000	<b>69,767.48 Begin*</b>	0

\*Note: Don't forget to put back in "end" mode.

## Unit 10.4 Rate considerations

23. Refer to the advertisement shown below. Confirm the annual yield (APY). Use an arbitrary \$100 deposit.

**A GREAT LOOKING  
FIGURE IN JUST  
6 MONTHS**

Figures on our 6-Month CDs  
are turning the heads of Utah savers!

ANNUAL RATE: 5.75%  
ANNUAL YIELD: 5.83%\*

\*Annual yield assumes principal and interest remain on deposit  
for 1 year at rate shown, with interest compounded semiannually.  
Substantial penalty for early withdrawal.

24. Refer to the advertisement shown below. Confirm the annual yield (APY).

**Compounded Daily**

**4.55%**    **4.65%**  
Annual Rate    Annual Yield

**12 Month Certificate**

23.

N	i	PV	PMT	FV
2	$5.75 \div 2 \approx 2.88$	-100		<b>105.83</b>
1	<b>5.83</b>	↑		↑

24.

N	i	PV	PMT	FV
365	$4.55 \div 365 \approx 0.01$	-100		<b>104.65</b>
1	<b>4.65</b>	↑		↑

25. One way of measuring inflation is through the use of the consumer price index (CPI), which tracks the cost of a “basket of goods” (food, housing, medical care, fuel, etc.). The base year of the current index is 1983, when the basket of goods cost \$100. The CPI was 9.9 in 1913 (meaning the same basket of goods cost \$9.90), 29.6 in 1960, and 170.8 in the year 2000. Calculate the average annual rate of inflation for the following periods: (a) 1913 to 1960, (b) 1960 to 1983, (c) 1983 to 2000, and (d) 1913 to 2000.

N	i	PV	PMT	FV
47	<b>2.36</b>	-9.9		29.6
23	<b>5.44</b>	-29.6		100
17	<b>3.20</b>	-100		170.8
87	<b>3.33</b>	-9.9		↑

26. Your annual salary 12 years ago was \$15,600; it is now \$23,000. If the inflation rate over the last 12 years has averaged 3.5% per year, has your salary kept up with inflation?

N	i	PV	PMT	FV
12	<b>3.29</b>	-15,600		23,000

**No; your salary has increased 3.29% per year, which is less than the average annual inflation rate.**

27. Tuition at a local college is currently \$2,550 per year. You want your newborn daughter to attend when she turns 18. If tuition rates are expected to increase at an annual rate of 4.5%, what will the annual tuition be at the college 18 years from now?

N	i	PV	PMT	FV
18	4.5	-2,550		<b>5,631.62</b>

## Challenge problems

28. The elephant population in a certain region is decreasing 5% per year. If there are currently 3,200 elephants in the region, what is the projected elephant population 20 years from now?

N	i	PV	PMT	FV
20	-5	-3,200		<b>1,147 elephants</b>

29. A few prices for the years 1943 and 2000 are shown. Which item has the greatest average annual rate of increase?

Item	1943	2000
Gallon milk	\$0.62	\$2.89
New auto (average)	\$900	\$17,500
New home	\$3,600	\$142,000
Household income	\$2,041	\$35,500

N	i	PV	PMT	FV
57	<b>2.74</b>	-0.62		2.89
↑	<b>5.34</b>	-900		17,500
↑	<b>6.66</b>	-3,600		142,000
↑	<b>5.14</b>	-2,041		35,500

For Problems 30–33, consider Social Security and Medicare payroll deductions. As of the writing of this text, the federal government requires employees to pay tax of 7.65% on the first \$80,400 earned each year plus 1.45% of the remainder. Employers must contribute a matching amount. Assume that an employee earns \$45,000 each year during a 40-year working career.

30. Based on these rates, what is the amount withheld from the employee's pay each year?

$$\$45,000 \times 7.65\% = \mathbf{\$3,442.50}$$

31. What is the total amount contributed by the employee and employer to the fund each year?

$$\$3,442.50 \text{ (employee share)} + \$3,442.50 \text{ (employer share)} = \mathbf{\$6,885.00}$$

32. The money is remitted to the government quarterly. What is the quarterly deposit?  $\$6,885 \div 4 = \mathbf{\$1,721.25}$

33. Assuming that the deposits were made to a savings plan at the end of each quarter (instead of with the IRS), earning 7% compounded quarterly, how much would the employee have in the savings plan at the end of a 40-year working career?

N	i	PV	PMT	FV
$40 \times 4 = 160$	$7 \div 4 = 1.75$		-1,721.25	<b>1,480,390.69</b>

34. You win a contest in which you have the choice of receiving \$25,000 today or receiving \$3,500 a year (starting today) for 10 years. If you can earn 7.5% compounded annually, which choice should you make, and why?

N	i	PV	PMT	FV
10	7.5	-25,000	0	<b>51,525.79</b>
↑	↑	0	-3,500 Begin*	<b>53,228.42</b>

\*Note: Don't forget to put back in "end" mode.

**Take \$3,500 per year.** \$25,000 today would grow to \$51,525.79 in 10 years, while \$3,500 per year (starting today) would grow to \$53,228.42.

35. At the end of each month for 3 years, you deposit \$200 into a savings plan. You then make no further deposits but leave the money in the plan for another 5 years. If the plan earns 8.5% compounded monthly, what will the balance be at the end of the 8-year period?

N	i	PV	PMT	FV
$3 \times 12 = 36$	$8.5 \div 12 \approx 0.71$		-200	<b>8,168.53</b>
$5 \times 12 = 60$	↑	-8,168.53	0	<b>12,475.80</b>

For Problems 36 and 37, consider a savings plan for your retirement. You can earn 6.5% compounded monthly.

36. You plan on retiring in exactly 32 years and want to be able to withdraw \$2,500 at the end of each month during 20 years of retirement. What amount must be on deposit at the beginning of the 20-year retirement period in order to withdraw \$2,500 each month for 20 years?

N	i	PV	PMT	FV
$20 \times 12 = 240$	$6.5 \div 12 \approx 0.54$	<b>-335,312.51</b>	2,500	0

37. How much must you deposit at the end of each month for the next 32 years to accumulate the required sum of Problem 36?

N	i	PV	PMT	FV
$32 \times 12 = 384$	↑	0	<b>-260.97</b>	335,312.51

38. If gasoline prices have increased over the past 30 years from 25.9 cents per gallon to \$1.599 per gallon, what is the average annual rate of increase?

N	i	PV	PMT	FV
30	<b>6.26</b>	-0.259*		1.599

\* Note: 25.9 cents, written in terms of dollars, is \$0.259

39. The Dow Jones Industrial Average (DJIA) is an index that monitors changes in the stock market. On April 13, 1920, the DJIA was 104.61; on April 13, 1960, the DJIA was 626.50; and on April 13, 2000, the DJIA was 10,923.55. Calculate the average annual increase in the index from (a) April 13, 1920, to April 13, 1960; (b) April 13, 1960, to April 13, 2000; and (c) April 13, 1920, to April 13, 2000.

N	i	PV	PMT	FV
40	<b>4.58</b>	-104.61		626.50
↑	<b>7.41</b>	-626.50		10,923.55
80	<b>5.98</b>	-104.61		↑

40. You are thinking about buying one of two bonds. The first pays 8.35% compounded semiannually; the second pays 8.5% compounded annually. Which provides the greater return?

The second bond pays 8.5% compounded annually, resulting in an APY of the same 8.5%. Let's find the APY for the first bond, using an arbitrary \$100 investment:

N	i	PV	PMT	FV
2	$8.35 \div 2 \approx 4.18$	-100		<b>108.52</b>
1	<b>8.52</b>	↑		↑

The APY for the first bond is 8.52%, greater than the 8.5% provided by the second bond.


41. Refer to the news article below. What interest rate must the annuity earn? Assume that the \$25,000 payments are received at the beginning of each year.

## Murray's 500th Nets \$500,000

THE ASSOCIATED PRESS

BALTIMORE — Nearly a week of hype ended with the sale of a scuffed-up baseball. But this wasn't any baseball. Hit by Baltimore Orioles star Eddie Murray for his 500th home run, it sold for \$500,000.

Dan Jones, a salesman from Towson, got the ball on Sept. 6, when Murray joined Willie Mays and Hank Aaron as the only players to reach 3,000 hits and 500 home runs. Jones will receive \$25,000 a year for 20 years, totaling \$500,000. But the buyer, Michael Lasky, is paying only \$280,000 in the deal. Lasky is putting the \$280,000 in an annuity. With interest, Jones is able to receive the total of \$500,000.



Roberto Borea/The Associated Press

Michael Lasky shows off the \$500,000 baseball.

N	i	PV	PMT	FV
20	7.18	-280,000	25,000 Begin*	

\*Note: Don't forget to put back in "end" mode.

42. Refer to the advertisement. Confirm the APY. Use an initial \$500 deposit.

*OUR THREE-YEAR CD\* Is on the Up and Up*

<b>6.0%</b> RATE FIRST YEAR	<b>7.0%</b> RATE SECOND YEAR	<b>8.0%</b> RATE THIRD YEAR
-----------------------------------	------------------------------------	-----------------------------------

**7.19%** ANNUAL PERCENTAGE YIELD

\*Based on quarterly compounding. Substantial penalty for early withdrawal. \$500 minimum balance.

N	i	PV	PMT	FV
4	$6 \div 4 = 1.50$	-500		530.68
4	$7 \div 4 = 1.75$	-530.68		568.82*
4	$8 \div 4 = 2$	-568.82		615.70
$3 \times 1 = 3$	7.19	-500		↑

\*Note: Assume that the unrounded year 1 ending balance (530.6817753 internal value) is transferred into the PV register as a negative value; if the rounded value (530.68) is entered in the PV register, the ending balance is slightly different (568.81). The same procedure should be used for year 3 (transfer the year 2 ending balance into PV as a negative value for year 3).

## Practice Test

1. You find an old savings account passbook in your attic. The last balance shown is \$576.82 as of 55 years ago. Calculate the current balance if the bank has been paying 4.75% compounded annually.

N	i	PV	PMT	FV
55	4.75	-576.82*		7,404.78

\*Note: We can enter the PV value as positive or negative. In this solution, the amount (\$576.82) is thought of as being deposited and, therefore, is entered as a negative value.

2. You deposit \$200 today into a savings plan and deposit an additional \$25 each month (starting in 1 month) for 22 years. If you earn 6.5% compounded monthly, what will your balance be in 22 years?

N	i	PV	PMT	FV
$22 \times 12 = 264$	$6.5 \div 12 \approx 0.54$	-200	-25	<b>15,429.16</b>

3. You want to accumulate \$100,000 in 18 years for your child's education, and you can earn 7.75% compounded monthly. What amount must you deposit each month if the first of your 216 deposits is made today?

N	i	PV	PMT	FV
$18 \times 12 = 216$	$7.75 \div 12 \approx 0.65$		<b>-212.70</b> Begin	100,000

4. Ben just turned 22. He wants to accumulate \$1,000,000. Ben starts a savings plan by depositing \$2,500. He then makes additional deposits of \$400 at the end of each quarter. If Ben's savings plan earns interest at 8% compounded quarterly, what age will Ben be when he has accumulated the \$1,000,000?

N	i	PV	PMT	FV
<b>192.60 quarters</b>	$8 \div 4 = 2$	-2,500	-400	1,000,000

Ben's age now 22.00  
 Years left to accumulate \$1,000,000: 192.60 quarters  $\div$  4 +48.15  
 Ben's age when he has \$1,000,000 70.15 **(70 years old)**

5. Your uncle dies and your 62-year old aunt receives \$250,000 life insurance proceeds. She needs monthly income and expects to live until she is 90 years old. If she invests the insurance money, earning 7.75% compounded monthly, how much can she withdraw at the end of each month for the next 28 years?

N	i	PV	PMT	FV
$28 \times 12 = 336$	$7.75 \div 12 \approx 0.65$	-250,000	<b>1,824.34</b>	0

6. Mitch Swanson wins \$100,000 on a game show. If he deposits the money in a savings plan earning 7.5% compounded monthly and makes withdrawals of \$1,000 at the end of each month, how long can Mitch make withdrawals until the plan is exhausted?

N	i	PV	PMT	FV
<b>157.42 months</b>	$7.5 \div 12 \approx 0.63$	-100,000	1,000	0

7. What is the APY (to the nearest hundredth of a percent) for 6% compounded quarterly?

N	i	PV	PMT	FV
4	$6 \div 4 = 1.5$	-100		<b>106.14</b>
1	<b>6.14</b>	↑		↑

8. If the average value of homes in your area has increased over the last 10 years from \$108,000 to \$165,000, what is the average annual rate of increase?

N	i	PV	PMT	FV
10	<b>4.33</b>	-108,000		165,000