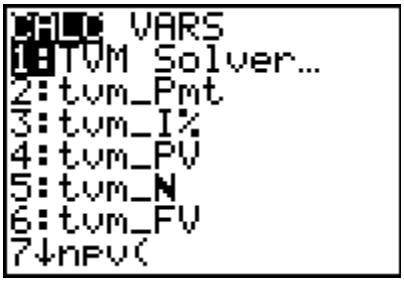
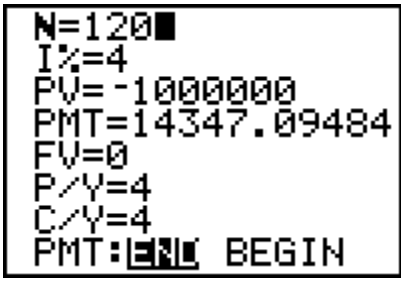
Texas Instruments Graphing Calculators have a built in app that may be used to compute quantities involved in compound interest, annuities, and amortization. For the examples below, we'll utilize the screens from a TI-84. To use the app properly, we need to understand the terms used in the app and the signs used on the numbers. We'll do this by carrying out some of the examples from Sections 5.2 and 5.3. To use the app, called TVM Solver, follow the steps below.

1. Press [ON] to turn on the calculator if it is not already on. 2. Press [APPS] to access the installed applications. 3. We want the Finance application. Press [ENTER] or [1] to start the Finance application.	
4. Press [ENTER] or [1] to start the TVM Solver.	
5. The screen in the TVM Solver shows several variables which may be changed by pressing the arrow keys to move to the line of the variable. Then the number on that line cam be edited.	

The values in the TVM Solver are quantities involved in compound interest and annuities.

- N is the number of periods in the term.
- I% is the annual interest rate written as a percent (not as a decimal). This means 4 percent is 4, not 0.04.

- PV is the present value.
- PMT is the payment.
- FV is the future value.
- P/Y is the number of payments per year.
- C/Y is the number of times interest is compounded in a year.
- PMT: END BEGIN indicates whether the payment is made at the end or the beginning of the period.

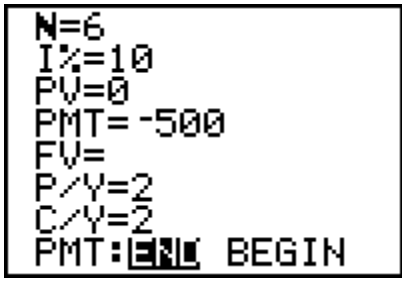
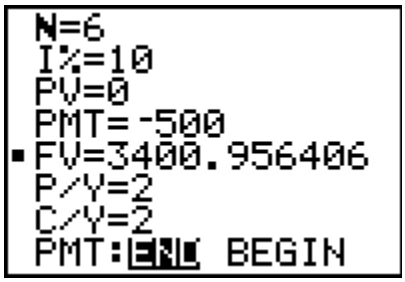
The TVM Solver has some interesting assumptions regarding the signs of the present value PV and the payment PMT. Amounts that are deposited like payments into an annuity or a deposit made into an account are negative. Amounts that you receive from an account, like the future value of a deposit, are positive.

Find the Future Value of the Annuity

An investor deposits $\$500$ in a simple annuity at the end of each six-month payment period. This annuity earns 10% per year, compounded semiannually.

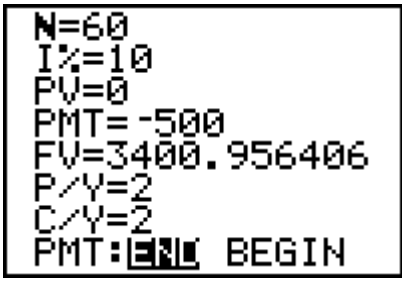
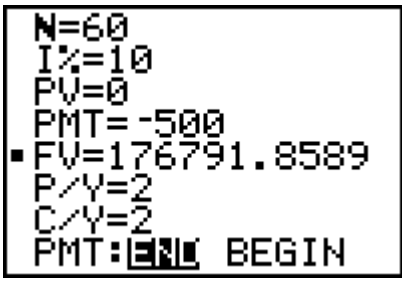
a. Find the future value if payments are made for three years.

Solution

1. Put the entries into the TVM Solver shown on the right. Any value can be in place of FV since that is what the Solver will find and put in that position. 2. Move the cursor to the FV line using the arrow keys. The value on this line is irrelevant since it will be calculated in the next step.	
3. To solve for the future value, press ALPHA ENTER. Notice that the word SOLVE is printed in green above the ENTER button to help you remember this combination. The future value will be placed on that line. You will also see a small black square to the left of FV to indicate that the value was calculated. The future value of the annuity is $\$3400.96$.	

b. Find the future value if payments are made for 30 years.

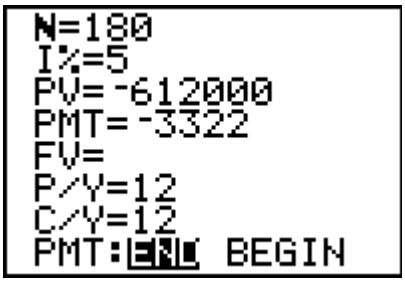
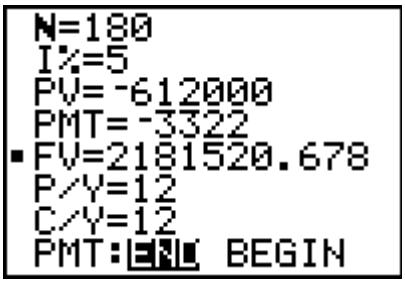
Solution Thirty years of semiannual payments corresponds to $n = 60$. We need to make this change in the TVM Solver, and solve for FV again.

4. Use the arrow keys to move the cursor to the top line. Change the value to 60. 5. Move the cursor back to the FV line.	
6. Press ALPHA ENTER to calculate the future value. The future value of the annuity is $176,791.86.	

Find the Future Value of a Retirement Account

An employee's retirement account currently has a balance of $612,000. Suppose the employee contributes $3322 at the end of each month. If the account earns a return of 5% compounded monthly, what will the future value of the account in 15 years?

Solution We need to enter the proper values into the TVM Solver. Since payments are made monthly over 15 years, there are $15 \cdot 12$ or 180 periods.

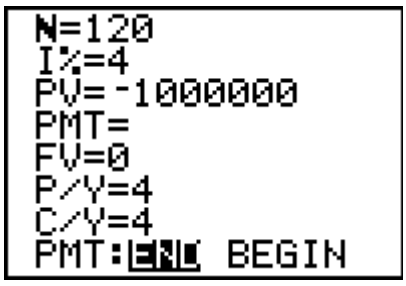
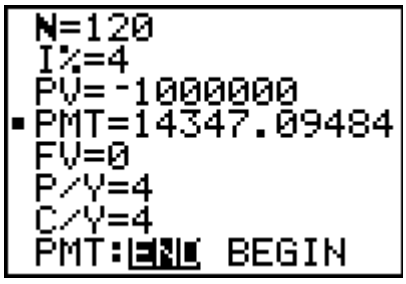
1. Use the arrow keys to move the cursor to the top line. Change the value to 180. 2. Move the cursor back to the FV line. The value on this line is irrelevant since it will be calculated in the next step.	
3. Press ALPHA ENTER to calculate the future value. The sum of future value for the compounded amount and the future value of the ordinary annuity is $2,181,520.68.	

Find the Payment from an Annuity

A savvy investor has accumulated $\$1{,}000{,}000$ in an ordinary annuity. The annuity earns 4% interest compounded quarterly. She wishes to receive payments from the annuity each quarter for the next 30 years.

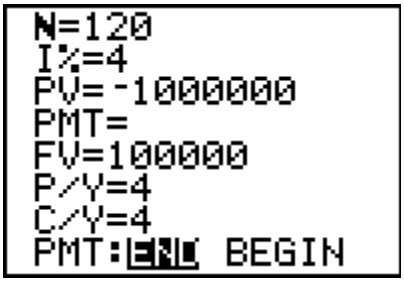
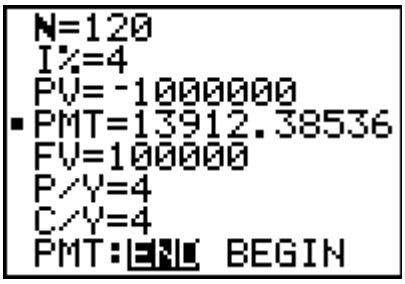
a. If the annuity will end up with no money in 30 years, what payment should she receive?

Solution The investor has already put $1,000,000 into the annuity, so the present value is entered as a negative number. We want to draw the annuity down to a future value of $0.

1. Enter the values on the right into the TVM Solver. 2. Move the cursor back to the PMT line. The value on this line is irrelevant since it will be calculated in the next step.	
3. Press ALPHA ENTER to calculate the payment. The calculated value is positive. This indicates that payments of $\$14{,}347.09$ will be received from the annuity.	

b. The investor wishes to leave a balance in the annuity to leave to her heirs. If the annuity is to end contain $\$100{,}000$ in 30 years, what payment should she receive?

Solution In this case, we do not want the annuity to be reduced to $0. Instead, we want the annuity to contain $100,000 in 120 periods.

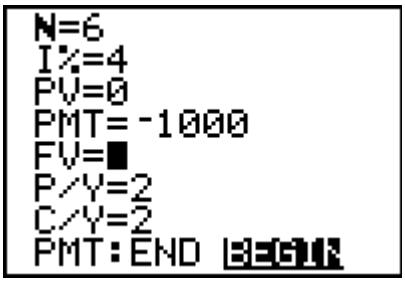
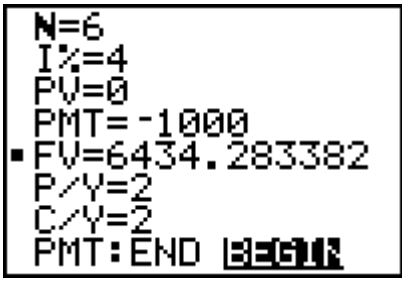
4. Use the arrow keys to move the cursor to the FV line. Change the value to 100,000. 5. Move the cursor back to the PMT line. The value on this line is irrelevant since it will be calculated in the next step.	
6. Press [ALPHA][ENTER] to calculate the payment. The payment is positive. This means $13,912.38 will be received from the annuity each quarter.	

Find the Future Value of an Annuity Due

An investor deposits $1000 in a simple annuity at the beginning of each six-month payment period. This annuity earns 4% per year, compounded semiannually. Find the future value if payments are made for three years.

Solution In this example, the payments are made at the beginning of each period. Payments are made every six months so there are $3 \cdot 2$ periods over the term of the annuity.

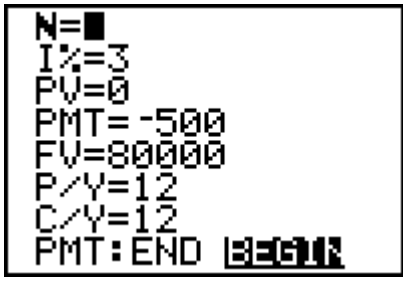
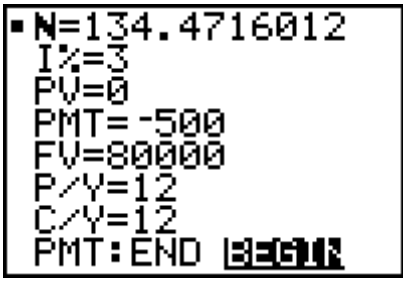
<table>
<tr>
<td>1. Enter the values as shown on the right. Make sure you highlight BEGIN on the bottom line. Do this by moving the cursor to BEGIN and press [ENTER].

2. Move the cursor to the FV line. The value on this line is irrelevant since it will be calculated in the next step.</td>
<td> 
</td>
</tr>
<tr>
<td>3. Press [ALPHA][ENTER] to calculate the future value. The payments lead to a future value of $6434.28.</td>
<td> 
</td>
</tr>
</table>

How Long Will It Take To Accumulate Some Amount?

The parents of a newborn child anticipate that they will need $80,000 for the child's college education. They plan to deposit $500 in an account at the beginning of each month in an account that earns 3% interest compounded monthly. How long will it take them to reach their goal?

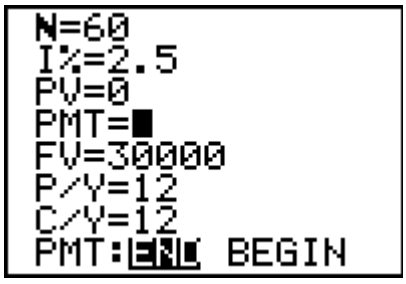
Solution In this annuity due, payments are negative since they are being made to the annuity. In the future, the accumulated amount will be withdrawn from the annuity so the future value is positive.

1. Enter the values shown to the right. 2. Move the cursor back to the N line. The value on this line is irrelevant since it will be calculated in the next step.	
3. Press ALPHA ENTER to calculate the number of payments. It will take approximately 135 periods (in this case months) to accumulate to $80,000.	

Find The Payment Needed To Accumulate a Fixed Amount

A new car buyer wishes to buy a vehicle with cash in five years. To do this, she wishes to deposit some amount at the end of each month in an account earning 2.5% interest compounded monthly. If she wishes to accumulate $30,000, what should the payments be?

Solution The account will receive payments for $5 \cdot 12$ periods. The payments are made at the end of each period.

1. Enter the values shown on the right. Make sure END is highlighted in the bottom line. 2. Move the cursor back to the PMT line. The value on this line is irrelevant since it will be calculated in the next step.	
3. Press ALPHA ENTER to calculate the payment. A payment of about $469.93 insures the account will contain $30,000 in five years.