

Excel has several built in functions for working with compound interest and annuities. To use these functions, we'll start with a standard Excel worksheet.

	A	B	C
1		Given	Calculated
2	Number of Periods		
3	Annual Interest Rate (%)		
4	Payment (\$)		
5	Present Value (\$)		
6	Future Value (\$)		
7	Periods per Year		
8			

This worksheet contains the variables used throughout Chapter 5. Values given in a problem will be entered in column B. Values calculated by Excel will be entered in column C. We will also assume that amounts paid out are negative and amounts received are positive.

In Section 5.3, we'll modify the worksheet shown above. This will allow us to use Excel to calculate the different amounts in the annuity formula,

$$FV = PV(1+i)^n \pm PMT \left[\frac{(1+i)^n - 1}{i} \right]$$

This is done using two functions in Excel, the FV (future value) function and the PV (present value) function. Unlike compound interest problems, annuities have a regular payment into or out of the account. In Excel, amounts that you pay out are considered negative numbers and amount you receive are positive amounts.

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.

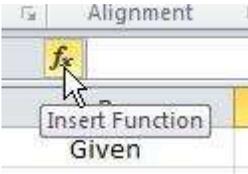
a. Find the future value if payments are made for three years.

Solution Since the investor is paying \$500 into the annuity, the payment must be entered as a negative number in Excel.

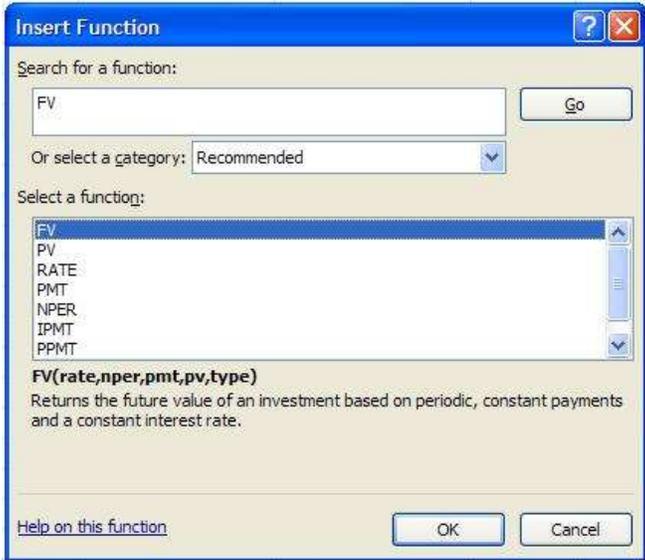
1. Start from the basic worksheet and enter the values shown below.

	A	B	C
1		Given	Calculated
2	Number of Periods	6	
3	Annual Interest Rate (%)	10%	
4	Payment (\$)	-500	
5	Present Value (\$)	0	
6	Future Value (\$)		
7	Periods per Year	2	
8			

2. Click in cell C6 where the result of the calculation will go. Select the function button just above the worksheet.

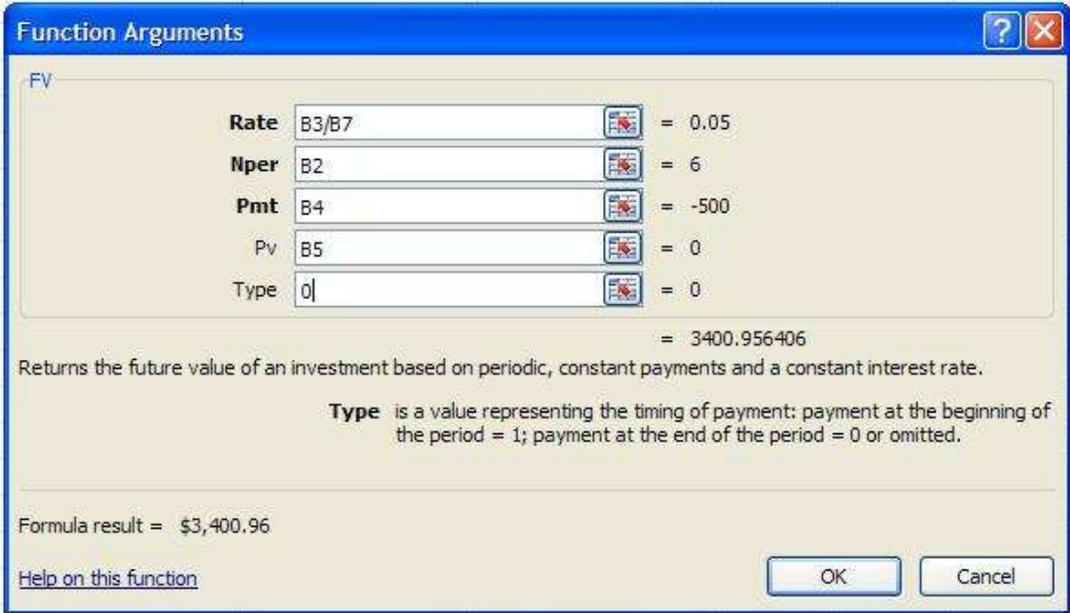


From the box that appears, search for the FV function and select Go. Once the FV function shows in the Select a function area, select it and click on OK.



This starts the FV wizard where you can supply the arguments to the function.

- 3. Enter the arguments into the wizard.
 - Rate is the rate per compounding period so divide the value in B3 by the number of compounding periods per year in B7.
 - Nper is the number of compounding periods in B2.
 - Pmt is the payment in B4.
 - Pv is the present value in B5.
 - Type indicates whether the annuity is an ordinary annuity (0) or an annuity due (1).



4. Press Enter on the keyboard to calculate the future value.

C6		f_x	=FV(B3/B7,B2,B4,B5,0)
	A	B	C
1		Given	Calculated
2	Number of Periods	6	
3	Annual Interest Rate (%)	10%	
4	Payment (\$)	-500	
5	Present Value (\$)	0	
6	Future Value (\$)		\$3,400.96
7	Periods per Year	2	

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 FV function, and solve for future value again.

C6		f_x	=FV(B3/B7,B2,B4,B5,0)
	A	B	C
1		Given	Calculated
2	Number of Periods	60	
3	Annual Interest Rate (%)	10%	
4	Payment (\$)	-500	
5	Present Value (\$)	0	
6	Future Value (\$)		\$176,791.86
7	Periods per Year	2	

Find the Future Value of a Retirement Account

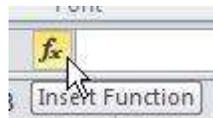
An employee's retirement account currently has a balance of \$612,000. Suppose the employee contributes \$3322 at the end of each month. If the account earns a return of 5% compounded monthly, what will the future value of the account in 15 years?

Solution The payments are made monthly over 15 years so there are $15 \cdot 12$ or 180 periods. The employee has already paid \$612,000 into the account. Additionally, the employee is paying \$3322 into the account each month. Since the amounts are paid out, they are both entered as negative numbers.

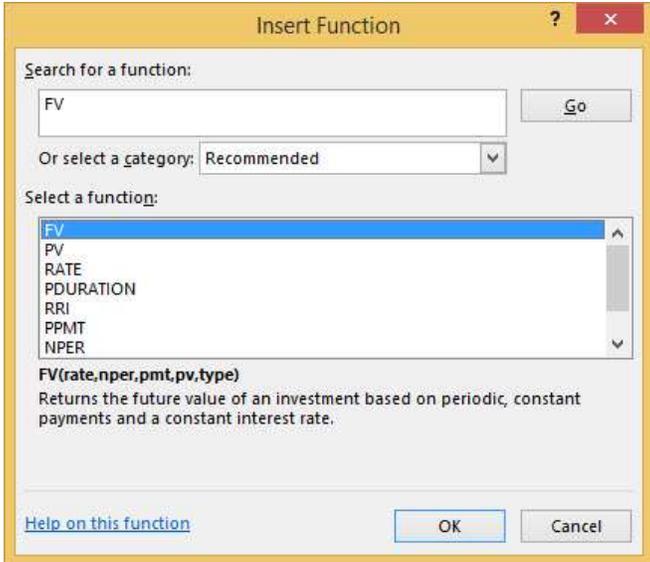
- Starting from the basic Excel sheet, enter the amounts shown below.

	A	B	C
1		Given	Calculated
2	Number of Periods	180	
3	Annual Interest Rate (%)	5%	
4	Payment (\$)	-3322	
5	Present Value (\$)	-612000	
6	Future Value (\$)		
7	Periods per Year	12	

- Since we want to calculate the future value, click in cell C6. Now click on the function button just above the worksheet.

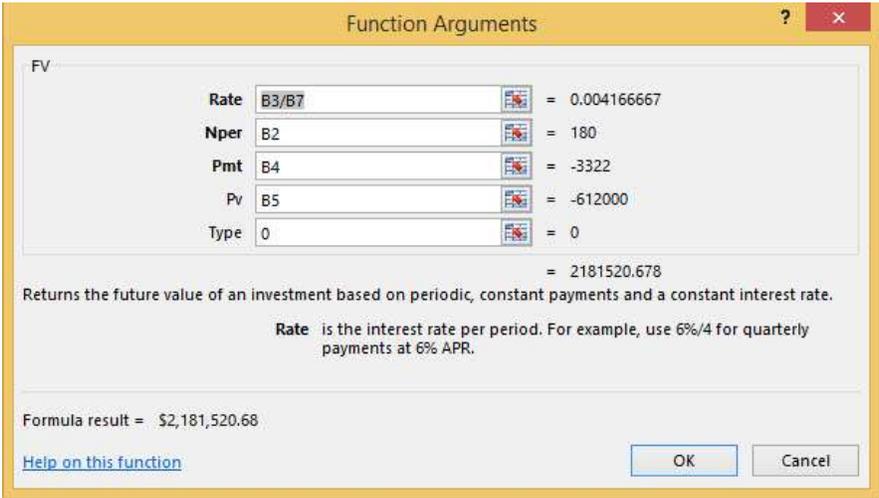


- From the box that appears, search for the FV function and select Go. Once the FV function shows in the Select a function area, select it and click on OK.



This starts the FV wizard where you can supply the arguments to the function.

- 4. The Function Argument box for the Financial Wizard will appear, Enter the values shown below.



(01)

- 5. Click OK to paste the function into the cell.
- 6. The value is calculated and placed in cell C6.

fx		=FV(B3/B7,B2,-3322,-612000,0)	
B		C	
Given		Calculated	
180			
5%			
-3322			
-612000			
		\$2,181,520.68	
12			

7.

If you examine the contents of the cell, you can see how the FV function works:

FV(interest rate per period, number of periods, payment, present value, payment timing)

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.

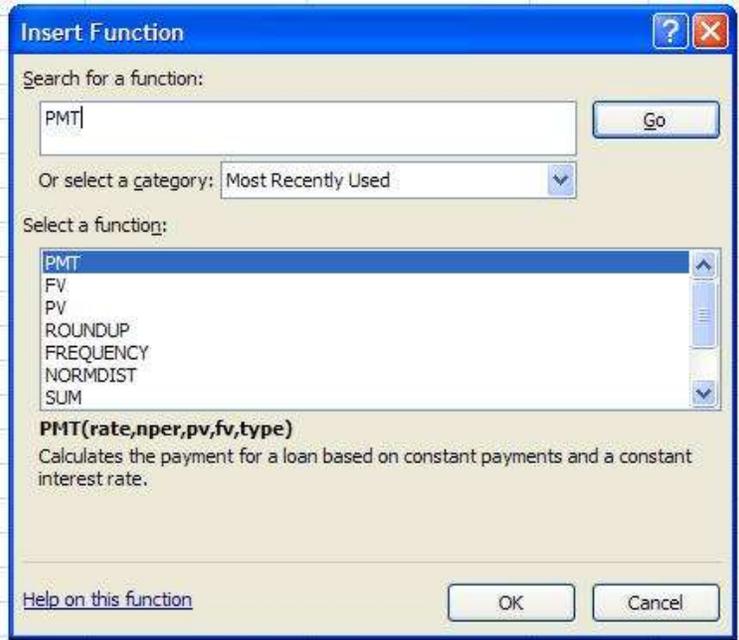
- a. If the annuity will end up with no money in 30 years, what payment should she receive?

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.

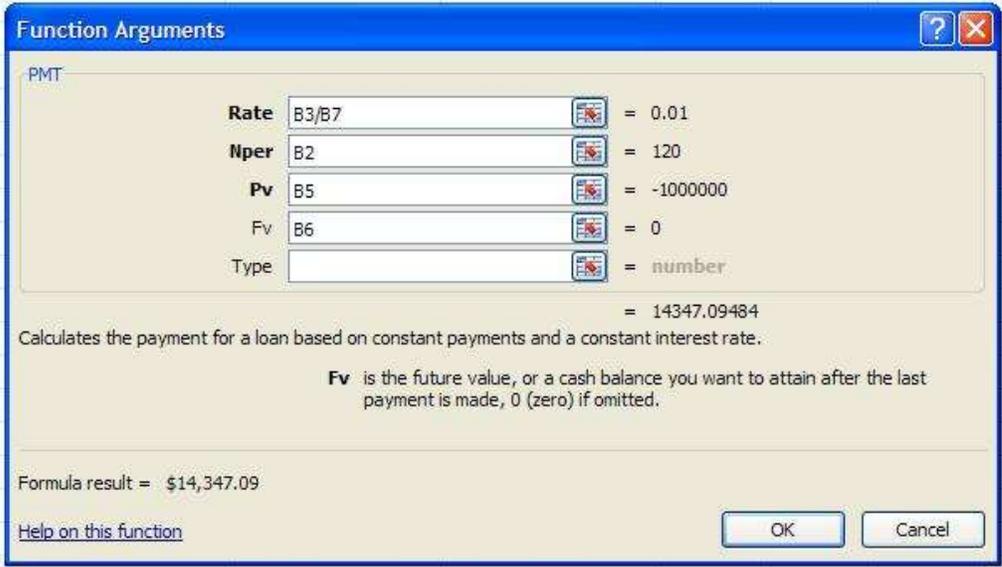
1. xxxx

	A	B	C
1		Given	Calculated
2	Number of Periods	120	
3	Annual Interest Rate (%)	4%	
4	Payment (\$)		
5	Present Value (\$)	-1000000	
6	Future Value (\$)	0	
7	Periods per Year	4	

2. xxxx



3. xxxx

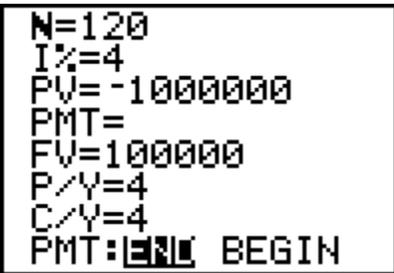
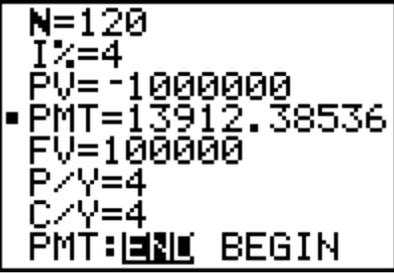


4. xxxx

fx	
=PMT(B3/B7,B2,B5,B6)	
B	C
Given	Calculated
120	
4%	
	\$14,347.09
-1000000	
0	
4	

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?

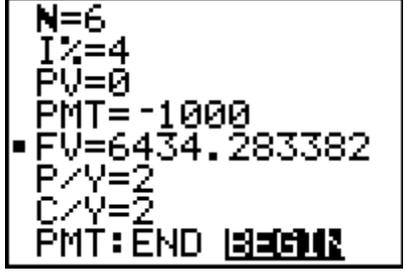
Solution In this case, we do not want the annuity to be reduced to \$0. Instead, we want the annuity to contain \$100,000 in 120 periods.

<p>1. Use the arrow keys to move the cursor to the FV line. Change the value to 100,000.</p> <p>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.</p>	
<p>3. Press [ALPHA][ENTER] to calculate the payment. The payment is positive. This means \$13,912.38 will be received from the annuity each quarter.</p>	

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.

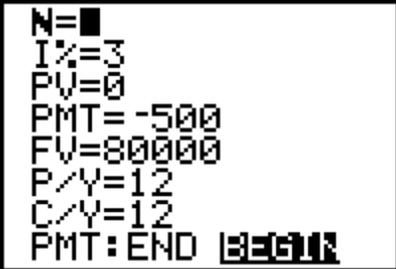
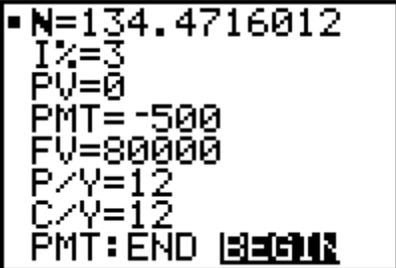
Solution In this example, the payments are made at the beginning of each period. Payments are made every six months so there are 3·2 periods over the term of the annuity.

<p>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.</p> <p>2. Move the cursor to the FV line. The value on this line is irrelevant since it will be calculated in the next step.</p>	
<p>3. Press ALPHAENTER to calculate the future value. The payments lead to a future value of \$6434.28.</p>	

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?

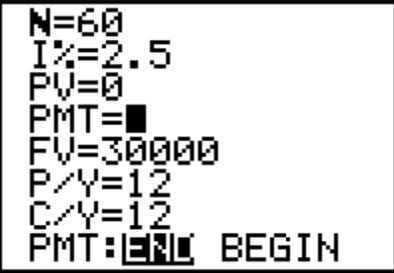
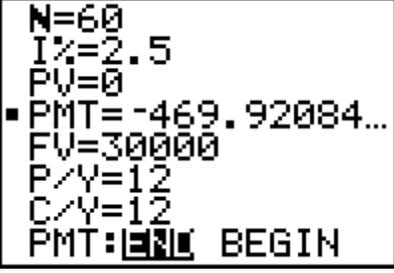
Solution In this annuity due, payments are negative since they are being made to the annuity. In the future, the accumulated amount will be withdrawn from the annuity so the future value is positive.

<ol style="list-style-type: none"> 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. 	
<ol style="list-style-type: none"> 3. Press ALPHAENTER 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 5·12 periods. The payments are made at the end of each period.

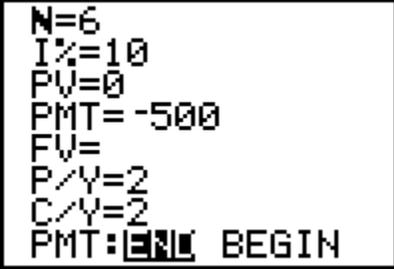
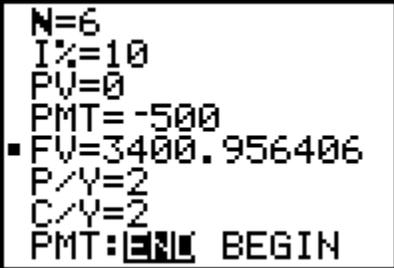
<p>1. Enter the values shown on the right. Make sure END is highlighted in the bottom line.</p> <p>2. Move the cursor back to the PMT line. The value on this line is irrelevant since it will be calculated in the next step.</p>	
<p>3. Press [ALPHA][ENTER] to calculate the payment. A payment of about \$469.93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

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.

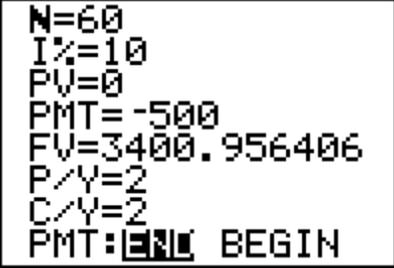
c. Find the future value if payments are made for three years.

Solution

<p>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.</p> <p>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.</p>	
<p>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.</p>	

d. 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.

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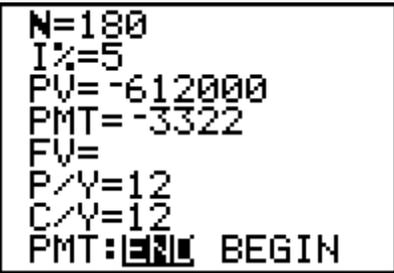
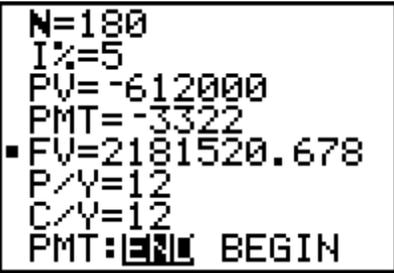
6. Press **[ALPHA][ENTER]** to calculate the future value. The future value of the annuity is \$176,791.86.

```
N=60  
I%=10  
PV=0  
PMT=-500  
▪ FV=176791.8589  
P/Y=2  
C/Y=2  
PMT:[END] BEGIN
```

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 beginning of each month. If the account earns a return of 5% compounded monthly, what will the future value of the account in 15 years?

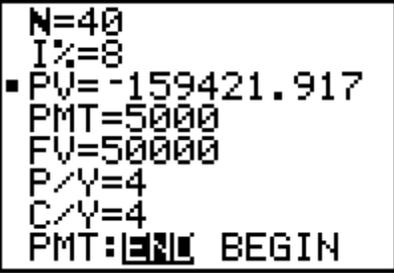
Solution We need to enter the proper values into the TVM Solver. Since payments are made monthly over 15 years, there are $15 \cdot 12$ or 180 periods.

<p>1. Use the arrow keys to move the cursor to the top line. Change the value to 180.</p> <p>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.</p>	
<p>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.</p>	

Find the Amount Needed to Establish a Trust Fund

A wealthy individual wishes to create a trust fund for his grandson so that he may withdraw \$5000 at the end of every quarter for ten years. At the end of ten years, the grandson will receive the rest of the trust which contains \$50,000. If the trust earns 8% interest compounded quarterly, how much should be put into the trust initially?

Solution

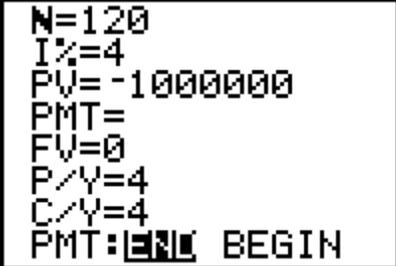
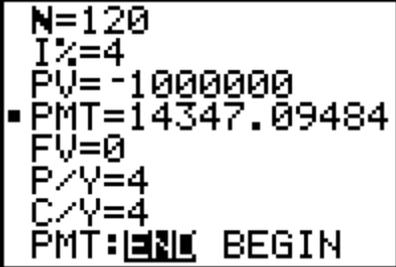
<p>4. Use the arrow keys to move the cursor to the top line. Change the value to 180.</p> <p>5. Move the cursor back to the FV line. The value on this line is irrelevant since it will be calculated in the next step.</p>	
<p>6. Press [ALPHA][ENTER] to calculate the future value. The sum of future value for the compounded amount and the future value of the ordinary annuity is \$2,181,520.68.</p>	

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.

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

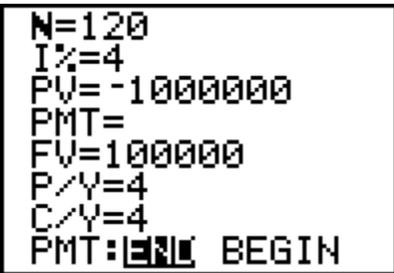
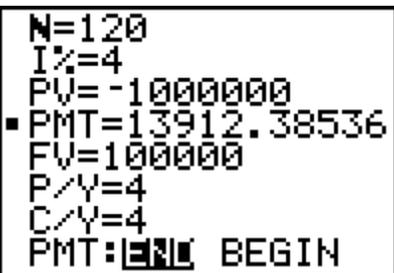
Solution

<p>7. Use the arrow keys to move the cursor to the top line. Change the value to 180.</p> <p>8. Move the cursor back to the FV line. The value on this line is irrelevant since it will be calculated in the next step.</p>	
<p>9. 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.</p>	

The quarterly payment is \$14,347.09.

- d. 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?

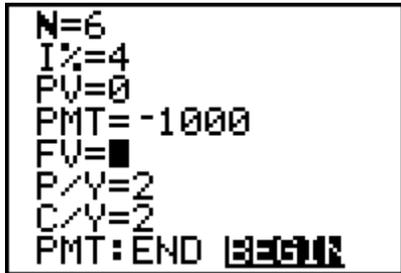
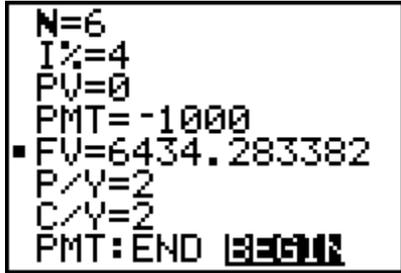
Solution

<p>10. Use the arrow keys to move the cursor to the top line. Change the value to 180.</p> <p>11. Move the cursor back to the FV line. The value on this line is irrelevant since it will be calculated in the next step.</p>	
<p>12. 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.</p>	

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.

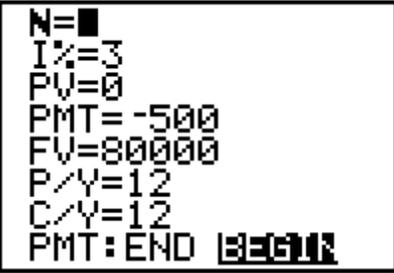
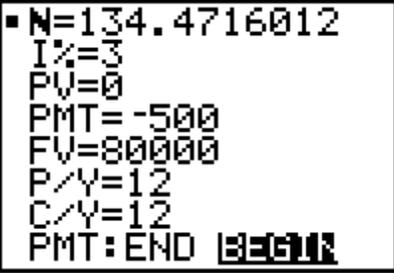
Solution

<p>13. Use the arrow keys to move the cursor to the top line. Change the value to 180.</p> <p>14. Move the cursor back to the FV line. The value on this line is irrelevant since it will be calculated in the next step.</p>	
<p>15. 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.</p>	

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?

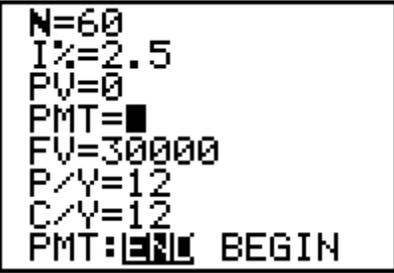
Solution

<p>16. Use the arrow keys to move the cursor to the top line. Change the value to 180.</p> <p>17. Move the cursor back to the FV line. The value on this line is irrelevant since it will be calculated in the next step.</p>	
<p>18. 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.</p>	

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

<p>19. Use the arrow keys to move the cursor to the top line. Change the value to 180.</p> <p>20. Move the cursor back to the FV line. The value on this line is irrelevant since it will be calculated in the next step.</p>	
<p>21. 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.</p>	