Compound Interest Calculations

The HP-12C Compound Interest calculations use the **[n]**, **[i]**, **[PV]**, **[PMT]** and **[FV]** keyboard keys.

These keys correspond to the so called "Financial Registers" and represent the variables in the well known "Time Value of Money" equation.

$$PV + (1 + S \cdot i) \cdot PMT \cdot [\, 1 - (1 + i)^{-n}\,] \div i \; + FV \cdot (1 + i)^{-n} = 0$$

Variable	Description
[n]	Number of compounding periods or the total number of payments.
[i]	Interest rate per compounding period in percent ($i' = i \div 100$).
[PV]	Present value amount.
[PMT]	Payment amount.
[FV]	Future value amount.
S	Payment mode: for "BEG" mode is equal to 1, for "END" mode is equal to 0.

Any of the **[n]**, **[i]**, **[PV]**, **[PMT]** or **[FV]** variables can be calculated if the other four are known. If any other key is pressed before one of these keys, the displayed number is stored in the corresponding variable. Otherwise, the variable will be calculated.

Cash Flow Sign Convention:
The values entered in the **[PV]**, **[PMT]** or **[FV]** registers must have the proper sign. Positive numbers correspond to money received (**Cash-In**). Negative numbers correspond to money paid (**Cash-Out**).

Payment Mode:
The results of calculations involving payments made at the beginning of a loan period ("in advance") are different from those where payments are made at the end of a loan period ("in arrears"). To specify the proper payment mode press:

[g][END] :   to set the PMT at the end of each compounding period or,
[g][BEG] :   to set the PMT at the beginning of each compounding period.

The "**BEGIN**" or "**END**" status indicator in the display shows the current payment mode.

Number of Periods [n] & Interest Rate [i]:
In compound interest problems, the number entered in **[n]** corresponds to the total number of compounding periods where payments are made. **[n]** is normally given in years or months, but can be any other time unit. Nevertheless, the interest rate entered into **[i]**, must be expressed in terms of the same time unit. For example, if **[n]** is in quarters, **[i]** should be the interest rate per quarter.

If the number of periods is given in years, the interest rate is given as annual rate (usually called nominal rate). If there are 12 compounding periods per year (monthly payments), then two convenient shortcut functions can be used to store the monthly values:

[g][12x]: Multiplies the displayed number by 12 and store the result in **[n]**. For example, 4 years is stored as 48 compounding periods (months).

[g][12÷]: Divides the displayed number by 12 and store the result in **[i]**. For example a nominal rate of 7.25% is stored as 0.60% per month.

Also, to recover the values stored in "**n**" and " **i** " in a year basis press:

[RCL] [g][12x]: To recall and display the value stored in **[n]** divided by 12.

[RCL] [g][12÷]: To recall and display the number stored in **[i]** multiplied by 12.

Compounding Periods Calculation [n]

To calculate the number of periods, follow this pattern:

1)	Press **[f] clear [FIN]** to clear all the financial registers to 0.
2)	Enter the periodic interest rate in percent, using **[i]** or **[g] [12÷]**.
3)	Enter at least two of the other three variables (PV, PMT or FV) using **[PV]** , **[PMT]** and **[FV]** (Remember the Sign Convention).
4)	If **PMT** was entered, press **[g] [END]** or **[g] [BEG]** to set the PMT mode.
5)	Press **[n]** to calculate the number of payments or compounding periods. If the calculated value of n has a fractional portion greater than 0.005 the value of "n" is rounded up to the next higher integer.

Example (RPN mode): Calculating [n]

You borrow $25,000.00 at an interest rate of 6.7% per year. How many $500.00 monthly payments are needed to pay the loan in full?

Keystrokes	Description
clear [FIN] [g] [END]	Clear the Financial Registers and set payment mode to END.
Type "6.7" **[g] [12÷]**	Stores the monthly interest rate percent. **Result = 0.56**
Type "25000" **[PV]**	Type the loan amount and store it in "**PV**" (Cash-In).
Type "500" **[CHS] [PMT]**	Type the periodic payment and store it in "**PMT**" (Cash-Out).
[n]	Calculate the number of payments required. **Result = 59.00**
[RCL] [g] [12x]	Recall "**n**" in years. **Result = 4.92**
Type "59" **[n] [FV]**	The value of "**n**" may have been rounded up. To determine whether or not that is the case calculate the future value of 59 equal payments. Type "59" as an integer in "n", then "FV". **Result = 103.32 The positive value means that 59 equal payments of $500.00 results in an overpayment of $103.32.**
[RCL] [PMT] [+]	The last payment equals the normal payment minus the overpayment. **Result = -396.68** ("**PMT**" is negative, so the positive overpayment is added to get the last payment amount)

Periodic Interest Rate Calculation [i]

To calculate the interest rate **[i]**, follow this pattern:

1)	Press **[f] clear [FIN]** to clear all the financial registers to 0.
2)	Enter the number of payments or periods, using **[n]** or **[g] [12x]**.
3)	Enter at least two of the other three variables (PV, PMT or FV) using **[PV]** , **[PMT]** and **[FV]** (Remember the Sign Convention).
4)	If **PMT** was entered, press **[g] [END]** or **[g] [BEG]** to set the PMT mode.
5)	Press **[i]** to calculate the periodic interest rate in percent.

Example: Calculating [i]

What annual interest rate must be earned to accumulate $10,000 in 8 years on an investment of $6,000 with quarterly compounding?

Keystrokes	Description
clear [FIN] **[g] [END]**	Clear the Financial Registers and set payment mode to END.
In **RPN** mode: Type "8" **[ENTER]** "4" **[x] [n]** In **ALG** mode: Type "8" **[x]** "4" **[n]**	Type the number of years, multiply by "4" quarters per year and press "n" to store the total number of quarters. **Result = 32.00**
Type "6000" **[CHS]** **[PV]**	Type the loan amount, change sign and press "**PV**" (Cash-Out).
Type "10000" **[FV]**	Type the periodic payment and store it in "**FV**" (Cash-In).
[i]	Calculate the quarterly interest rate percent. **Result = 1.61**
In **RPN**: Type "4" **[x]** In **ALG**: **[x]** "4" **[=]**	Calculate the annual interest rate percent. **Result = 6.44**

Present Value Calculation [PV]

To calculate the present value **[PV]**, follow this pattern:

1)	Press **[f] clear [FIN]** to clear all the financial registers to 0.
2)	Enter the number of payments or periods, using **[n]** or **[g] [12x]**.
3)	Enter the periodic interest rate in percent, using **[i]** or **[g] [12÷]**.
4)	Enter "PMT" or "FV" or both using **[PMT]** and **[FV]** (Remember the Sign Convention).
5)	If **PMT** was entered, press **[g] [END]** or **[g] [BEG]** to set the PMT mode.
6)	Press **[PV]** to calculate the present value.

Example: Calculating [PV]

An investor is considering purchasing a rental property with a 5 year net cash flow of $1,230 per month.   It is expected that the property can be sold for $10,000 at the end of the fifth year.   What is the property worth now if the investor wants an over all return of 15% per year?

Keystrokes	Description
clear [FIN] **[g] [END]**	Clear the Financial Registers and set payment mode to END.
Type "5" **[g] [12x]**	Store the number of periodic payments. **Result = 60.00**
Type "15" **[g] [12x÷]**	Store the monthly interest rate percent. **Result = 1.25**
Type "1230" **[PMT]**	Type the monthly payments and store it in "**PMT**" (Cash-In).
Type "10000" **[FV]**	Type the selling price and store it in "**FV**" (Cash-In).
[PV]	Calculate the present value. **Result = -56,448.22** (Cash-Out)

Periodic Payment Calculation [PMT]

To calculate the periodic payment **[PMT]**, follow this pattern:

1)	Press **[f] clear [FIN]** to clear all the financial registers to 0.
2)	Enter the number of payments or periods, using **[n]** or **[g] [12x]**.
3)	Enter the periodic interest rate in percent, using **[i]** or **[g] [12÷]**.
4)	Enter "PV" or "FV" or both using **[PV]** and **[FV]** (Remember the Sign Convention).
5)	Press **[g] [END]** or **[g] [BEG]** to set the PMT mode.
6)	Press **[PMT]** to calculate the periodic payment value.

Example: Calculating PMT

What is the monthly payment on a 25-year, $89,560 mortgage at 5.25% annual interest, compounded monthly?

Keystrokes	Description
clear [FIN]	Clear the Financial Registers.
Type "25" **[g] [12x]**	Store the number of periodic payments. **Result = 300.00**
Type "5.25" **[g] [12÷]**	Store the monthly interest rate percent. **Result = 0.44**
Type "89560" **[PV]**	Type the monthly payments and store it in "**PV**" (Cash-In).
[g] [END]	Set the payment mode to END.
[PMT]	Calculate the periodic payment. **Result = -536.69** (Cash-Out)

FV Future Value Calculation

To calculate the future value FV , follow this pattern:

1)	Press **[f] clear [FIN]** to clear all the financial registers to 0.
2)	Enter the number of payments or periods, using **[n]** or **[g] [12x]**.
3)	Enter the periodic interest rate in percent, using **[i]** or **[g] [12÷]**.
4)	Enter "PV" or "PMT" or both using **[PV]** and **[PMT]** (Remember the Sign Convention).
5)	If **PMT** was entered, press **[g] [END]** or **[g] [BEG]** to set the PMT mode.
6)	Press **[FV]** to calculate the future value amount.

Example: Calculating FV

A savings account offers a nominal rate of 4%. If you open that account with an initial deposit of $2,000.00 and each month after that you deposit an additional $300, what is the balance of the account after 5 years?

Keystrokes	Description
clear [FIN]	Clear the Financial Registers.
Type "5" **[g] [12x]**	Store the number of periodic payments. **Result = 60.00**
Type "4" **[g] [12÷]**	Store the monthly interest rate percent. **Result = 0.33**
Type "2000" **[PV]**	Type the present value and store it in "**PV**" (Cash-Out).
[g] [END]	Set the payment mode to END.
Type "300" **[PMT]**	Type the monthly payments and store it in "**PMT**" (Cash-Out).
[FV]	Calculate the future value. **Result = 22,331.69** (Cash-In)

Odd-Period Calculations

Interest can begin to accrue prior to the beginning of the first regular payment period. This results in a first period longer than the regular payment period (sometimes called an "odd first period"). For simplicity, the calculator always considers the first period as equal to the remaining periods. If interest starts before the first payment period begins, the "odd period" is the time from the date interest begins accruing and the date the first payment period starts.

To calculate **[n]**, **[i]**, **[PV]**, **[PMT]** or **[FV]** for odd period cases, simply enter a non integer **[n]**. In this way, the integer part of **[n]** specifies the number of full payment periods, and the fractional part specifies the "odd period" as a fraction of a full period. Therefore, the "odd period" can't be greater than one full period.

The calculation for the "odd period" may be performed using either simple or compound interest. To use compound interest calculation for the "odd period" press **[STO] [EXX]** (the status indicator "**C**" appears in the display to indicate the calculator is in compound interest mode).

Example : "Odd-Period" Calculation (RPN mode)

A 36 month loan for $4,500.00 accrues interest at 5% per year, and payments are due at the end of each month starting with the payment due March 31, 2004. Interest begins accruing on February 15, 2004. Thus, the first regular period begins on March 1, 2004. Calculate the monthly payment, with the odd days counted on the basis of a 30-day month and compound interest used for the "odd period".

Keystrokes	Description
clear [FIN]	Clears the Financial Registers.
[g] [M.DY]	Set Month-Day-Year format.
[g] [END]	Sets the payment mode to END.
[STO] [EXX]	Set the odd period interest calculation to compound. The status indicator "**C**" should be in the display.

Keystrokes	Description
Type "2.152004" [ENTER] "3.012004"	Type the date Interest begins, press "ENTER" and type the date of the beginning of the first period.
[g] [ΔDYS]	Calculate the actual number of Odd-period days. **Result = 15**
[X⇌Y]	Show the number of Odd-period days on the basis of the 30/360 calendar. **Result = 16**
In RPN: Type "30" [÷] In ALG: Type [÷] "30" [=]	Divide by 30 days to calculate the fractional part of the number of periods. **Result = 0.53**
In RPN: Type "36" [+] [n] In ALG: Type [+] "36" [n]	Add the 36 regular months to the fractional part and press "**n**". **Result = 36.53**
Type "5" [g] [12÷]	Store the monthly interest rate percent. **Result = 0.42**
Type "4500" [PV]	Type the amount of the loan and press "**PV**" (Cash-In).
[PMT]	Calculate the monthly payment. **Result = -135.17** (Cash-Out).

The RLM's 12C calculators includes a "Non-Integer N° Periods" in the "Settings" tool. When this setting is set to "ON", the Odd Period calculation is not taken into account, and the "n" value, fractional or not, is directly used in the TVM equation.