



## hp calculators

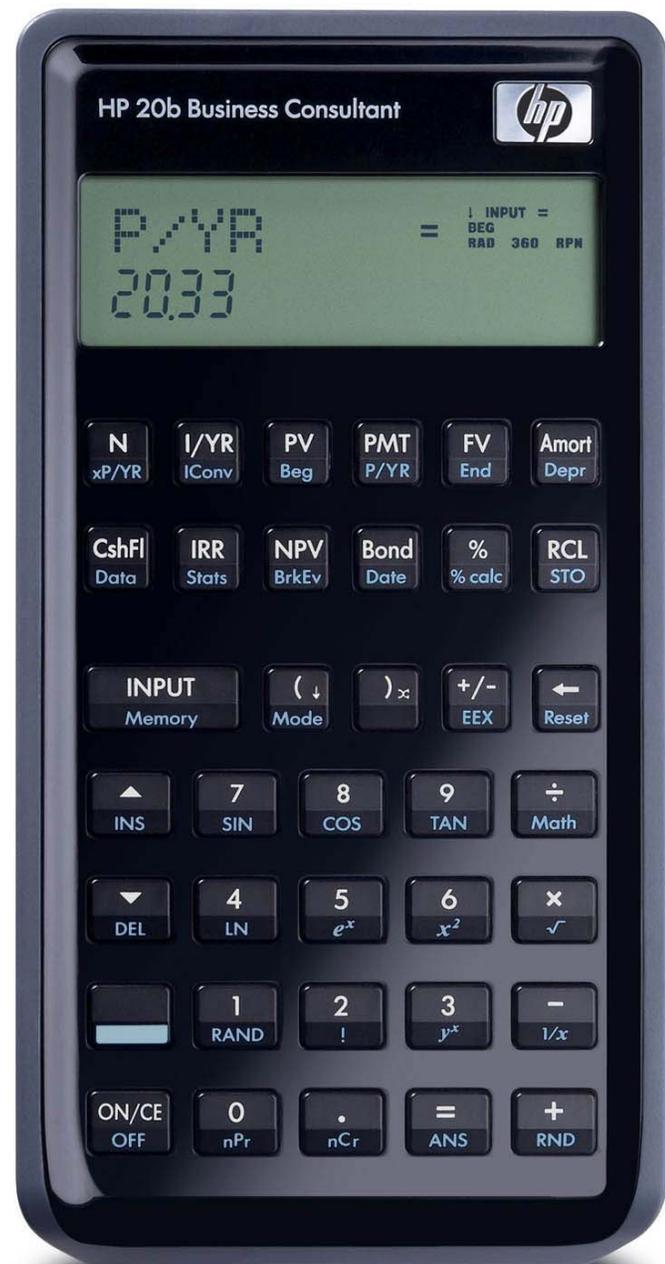
### HP 20b Loan Amortizations

The time value of money application

Amortization

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### The time value of money application

The time value of money application built into the HP 20b is used to solve compound interest problems and annuities that involve regular, uniform payments. Compound interest problems require the input of 3 of these 4 values:

$\boxed{N}$   $\boxed{I/YR}$   $\boxed{PV}$   $\boxed{FV}$ . Annuity problems require the input of 4 of these 5 values:  $\boxed{N}$   $\boxed{I/YR}$   $\boxed{PV}$   $\boxed{PMT}$   $\boxed{FV}$ . Once these values have been entered in any order, the unknown value can be computed by pressing the key for the unknown value. These keys and their shifted functions, are described in the table below.

**Table 1** The HP 20b Time Value of Money Keys

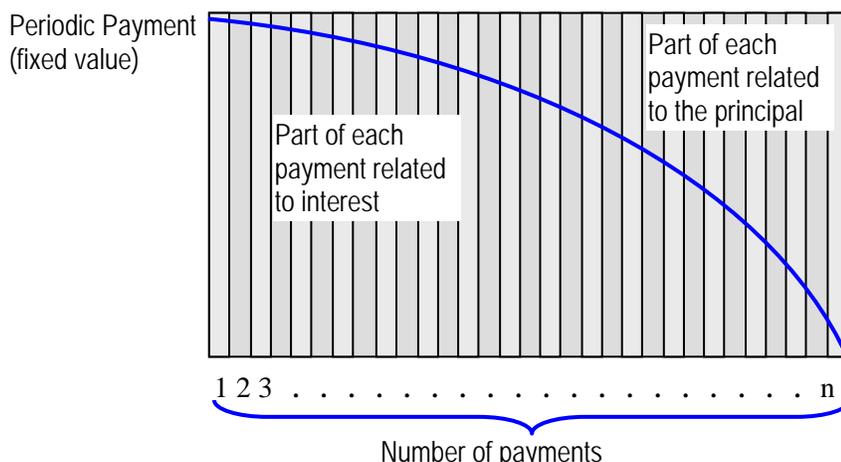
Keys	Description
$\boxed{N}$	Stores or calculates the number of payments or compounding periods N.
$\boxed{\text{ON}} \boxed{xP/YR}$	Multiplies a value by the number of payments per year and stores as N.
$\boxed{I/YR}$	Stores or calculates the nominal, annual interest rate.
$\boxed{PV}$	Stores or calculates the present value (PV). To a lender or borrower, PV is the amount of a loan; to an investor, PV is the initial investment. PV always occurs at the beginning of the first period.
$\boxed{PMT}$	Stores or calculates the amount of each periodic payment (PMT).
$\boxed{\text{ON}} \boxed{P/YR}$	Stores the number of payments or compounding periods per year.
$\boxed{FV}$	Stores or calculates the future value (FV), a final cash flow. FV always occurs at the end of the last compounding period.
$\boxed{\text{ON}} \boxed{\text{Beg}}$	Sets Begin mode (Beg). Payments occur at the beginning of each compounding period.
$\boxed{\text{ON}} \boxed{\text{End}}$	Sets End mode (End). Payments occur at the end of each compounding period.

The time value of money application operates on the convention that money invested is considered positive and money withdrawn is considered negative. In a compound interest problem, for example, if a positive value is input for the  $\boxed{PV}$ , then a computed  $\boxed{FV}$  will be displayed as a negative number. In an annuity problem, of the three monetary variables, at least one must be of a different sign than the other two. For example, if the  $\boxed{PV}$  and  $\boxed{PMT}$  are positive, then the  $\boxed{FV}$  will be negative. If the  $\boxed{PMT}$  and  $\boxed{FV}$  are both negative, then the  $\boxed{PV}$  must be positive, etc. An analysis of the monetary situation should indicate which values are being invested and which values are being withdrawn. This will determine which are entered as positive values and which are entered as negative values.

Interest rates are always entered as the number is written in front of the percent sign, i.e., 5% is entered as a 5 rather than as 0.05. The stated annual nominal interest rate is always entered into  $\boxed{I/YR}$ , as shown in the examples.

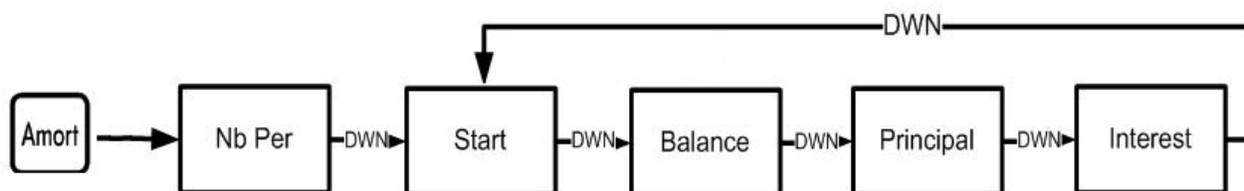
### Amortization

The word 'amortization' comes from a Latin word meaning "about to die". When a loan earning interest has regular, fixed payments, it is said that the loan is being paid off or amortized. Although the debt is reduced by the same periodic payments, different parts of each payment are applied against the principal and against the interest. The interest is deducted from each payment and the remaining amount is used to reduce the debt. The figure below illustrates this process.



### Amortization on the HP 20b

The HP 20b can amortize loans using the **Amort** key. This process uses values entered into the TVM registers, as described above. The map of this menu is presented below. To move from one item in the menu to the next, press the down arrow key **▼**. This key is abbreviated DWN in the map below. Below this map is a table explaining each of the entries in the amort menu in more detail. To clear the amortization menu while in the menu, press **Reset** **INPUT**. To exit the menu, press **ON/CE**.



### Amortization Menu Items

Menu Item/Key	Description
<b>Amort</b>	Opens the Amortization menu starting with <i>Nb Period</i> .
<i>Nb Period</i>	Number of periods to group together in the amortization calculation. The default value is the number of payments per year defined by the <b>P/YR</b> key. Input only.
<i>Start</i>	Period on which to start amortization. Default is 1. If you want to amortize for the 2 <sup>nd</sup> year with 12 payments per year, enter 13 (the second year starts at the 13 <sup>th</sup> payment with 12 payments per year). Output only.
<i>Balance</i>	The loan balance at the end of the assigned amortized period. Output only.
<i>Principal</i>	Amount of the loan payment applied to the principal at the end of the amortized period. Output only.
<i>Interest</i>	Amount of the loan payment applied to the interest at the end of the amortized period. Output only.

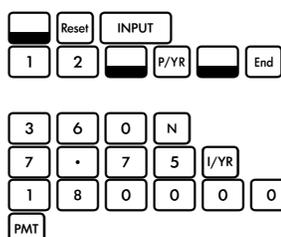
## HP 20b Loan Amortizations

Note that the menu map indicates that pressing  when the computed amortized interest is displayed takes you back to the next period's ending balance. This means that you can continue to press  and go through the entire loan amortization. The HP 20b will continue to loop through the display of these three computed amortization values for you.

### Practice amortizing loans

**Example 1:** Calculate the first year of the annual amortization schedule for a 30-year, \$180,000 mortgage at 7.75%, compounded monthly. Compute the monthly payment first.

**Solution:** By default, the HP 20b will amortize an entire year's worth of payments unless told otherwise by the user. Later examples indicate how to set the parameters for other time periods, including individual payment amortization.



(Note that you do not need to do this if you are already in END mode with 12 as the number of periods per year.)

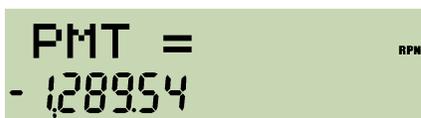


Figure 1

Now begin the loan amortization by pressing the amortization key.



Figure 2

Since we wish to amortize an entire year's worth of payments, press .



Figure 3

Since we wish to start with the first payment, press .

The HP 20b displays the remaining loan balance at the end of these 12 periods, which is \$178,420.18.



Figure 4

Press  to display the amount of principal repaid during these periods, which is \$-1,579.82.

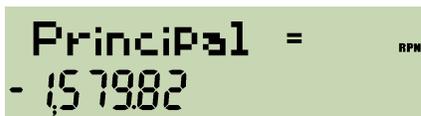


Figure 5

Press  again to display the amount of interest paid during these periods, which is \$-13,894.66.



Figure 6

Answer: After one year, the loan balance is \$178,420.18. The amount of principal paid so far is \$1,579.82 and \$13,894.66 interest has been paid.

Example 2: With all data from the previous example still available in the calculator's memory, calculate the second year of the annual amortization of the same mortgage.

Solution: Simply press  and the HP 20b will loop back through the amortization menu to the Start position, allowing you to choose where you wish to continue the amortization.



Figure 7

Since we wish to begin with the next month (the first month of the second year), press  and the HP 20b displays the remaining loan balance at the end of these 12 periods, which is \$176,713.49.



Figure 8

Press  to display the amount of principal repaid during these periods, which is \$-1,706.69.



Figure 9

Press  again to display the amount of interest paid during these periods, which is \$-13,894.66.



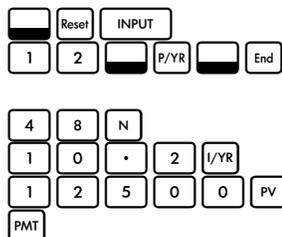
Figure 10

Answer: After two years, the loan balance is \$176,713.49. The amount of principal repaid is \$1,706.69 and the amount of interest paid is \$13,767.79.

HP 20b Loan Amortizations

**Example 3:** Amortize the 10<sup>th</sup> payment of a 4-year car loan. The loan amount is \$12,500 and the interest rate is 10.2%, compounded monthly. Assume monthly payments starting in one month.

**Solution:**



(Note that you do not need to do this if you are already in END mode with 12 as the number of periods per year.)



Figure 11

Now begin the loan amortization by pressing the amortization key.



Figure 12

Since we wish to amortize a single payment ONLY, press [1] [INPUT].



Figure 13

Now press [v]. Since we wish to amortize the 10th payment, press [1] [0] [INPUT].



Figure 14

Now press [v]. The HP 20b displays the remaining loan balance after the 10<sup>th</sup> payment, which is \$10,297.26.



Figure 15

Press [v] to display the amount of principal repaid from this 10<sup>th</sup> payment, which is \$-228.76.



Figure 16

Press  again to display the amount of interest paid from this 10<sup>th</sup> payment, which is \$-89.47.



Figure 17

Answer: After ten payments, the remaining loan balance is \$10,297.26. From the 10<sup>th</sup> payment, the amount of principal to be repaid is \$228.76 and \$89.47 interest.

Example 4: With all data from the previous example still available in the calculator memory, amortize the 22<sup>nd</sup> payment.

Solution:



Figure 18



Figure 19



Figure 20

Answer: After twenty-two payments, the loan balance is \$7,395.66. From the 22<sup>nd</sup> payment, the amount paid toward principal is \$253.21 and \$65.02 interest.