



hp calculators

HP 9s Memory Calculations

The Memory Keys

Practice Using the Memory to Solve Problems



The memory keys

The HP 9s provides a special register, the memory (M), in which a number can be stored. If this number is different than zero then the M annunciator is lit. The contents of the memory can be recalled and be used in any calculation except in Statistics mode. The memory will save you having to write down results, and also many keystrokes when performing chain calculations, repetitive evaluations, etc. On the HP 9s the memory keys are called as follows:

- ◆ The Store key: $X \rightarrow M$ ($\overline{X \rightarrow M}$) stores the displayed number in memory. Note that this is *not* an exchange operation: the previous contents of the memory is lost, and the number in the display is not altered. No pending calculation is affected.
- ◆ The Recall key: MR (\overline{MR}) recalls the contents of the memory. The memory is not altered and pending calculations are not cancelled.
- ◆ The Sum key: M+ ($\overline{M+}$) adds the displayed number to the contents of the memory. It does an implicit ENTER first: the calculation in progress is performed and the result is displayed and added to the memory.

To clear the memory (that is, to turn off the M annunciator) simply store 0 in it by pressing $0 \overline{X \rightarrow M}$ or $\overline{ON/C} \overline{X \rightarrow M}$.

Practice using the memory to solve problems

Example 1: Calculate $1.46 + 12 - 7.5 + 67 + 987 + 6 - 89$ using the $\overline{M+}$ key.

Solution: First of all, clear the memory: $0 \overline{X \rightarrow M}$. We can add all these numbers as follows:

$\overline{1} \overline{.}$ $\overline{4}$ $\overline{6}$ $\overline{M+}$ $\overline{1}$ $\overline{2}$ $\overline{M+}$ $\overline{7}$ $\overline{.}$ $\overline{5}$ $\overline{+/-}$ $\overline{M+}$ $\overline{6}$ $\overline{7}$ $\overline{M+}$ $\overline{9}$ $\overline{8}$ $\overline{7}$ $\overline{M+}$ $\overline{6}$ $\overline{M+}$ $\overline{8}$ $\overline{9}$ $\overline{+/-}$ $\overline{M+}$

Press \overline{MR} to display the answer.

Answer: 976.96

You may find it more convenient to use the usual way, that is: $\overline{1} \overline{.}$ $\overline{4}$ $\overline{6}$ $\overline{+}$ $\overline{1}$ $\overline{2}$ $\overline{-}$... $\overline{-}$ $\overline{8}$ $\overline{9}$ \overline{ENTER} which is actually shorter, but consider this:

Example 2: Calculate the following operations, and find the sum of the first, second and fourth results:

$$35 \times \ln 5, \quad -2 \times 8^5, \quad \sqrt[3]{34} \quad \text{and} \quad \frac{31}{13^{-3.5}}$$

Solution: The $\overline{M+}$ key allows us to select the numbers to be added. Clear the memory ($\overline{ON/C} \overline{X \rightarrow M}$) and press:

$\overline{3}$ $\overline{5}$ $\overline{\times}$ $\overline{5}$ $\overline{\ln}$ \overline{ENTER} $\overline{M+}$
 $\overline{2}$ $\overline{+/-}$ $\overline{\times}$ $\overline{8}$ $\overline{x^y}$ $\overline{5}$ \overline{ENTER} $\overline{M+}$
 $\overline{3}$ $\overline{4}$ $\overline{2ndF}$ $\overline{\sqrt[3]{\square}}$ \overline{ENTER}
 $\overline{3}$ $\overline{1}$ $\overline{\div}$ $\overline{1}$ $\overline{3}$ $\overline{x^y}$ $\overline{3}$ $\overline{\cdot}$ $\overline{5}$ $\overline{+/-}$ \overline{ENTER} $\overline{M+}$

Press \overline{MR} to display the sum.

Answers: Rounded to two decimal places, the results are 56.33, -65536, 3.24 and 245563.28, respectively. The sum requested is 180083.61

Example 3: Calculate $\frac{(3.1267 + 34^2)^{-3.1267}}{3.1267 + \ln\sqrt{3.1267}}$

Solution: Since 3.1267 appears four times in this expression, we will store it in memory:

$\boxed{3} \boxed{\cdot} \boxed{1} \boxed{2} \boxed{6} \boxed{7} \boxed{X-M}$

which will save us quite a few keystrokes:

$\boxed{+} \boxed{3} \boxed{4} \boxed{x^2} \boxed{\text{ENTER}} \boxed{x^y} \boxed{\text{MR}} \boxed{+/-} \boxed{\div} \boxed{(} \boxed{\text{MR}} \boxed{+} \boxed{\sqrt{}} \boxed{\ln} \boxed{\text{ENTER}}$

Note that the sequence $\boxed{\text{MR}} \boxed{+} \boxed{\sqrt{}}$ is equivalent to $\boxed{\text{MR}} \boxed{+} \boxed{\text{MR}} \boxed{\sqrt{}}$.

Answer: $7.105079822 \cdot 10^{-11}$

Example 4: Evaluate $3x^3 - 4x^2 + 5$ when $x = 2.0012$ and -3.2012

Solution: Since the x values contain several digits, we can save many keystrokes if we substitute $\boxed{\text{MR}}$ for the x value. Let's store the first value:

$\boxed{2} \boxed{\cdot} \boxed{0} \boxed{0} \boxed{1} \boxed{2} \boxed{X-M}$. To save a few more keystrokes, we'll use Horner's method to evaluate the polynomial, i.e. writing it as: $((3x - 4)x + 5)$

$\boxed{3} \boxed{x} \boxed{\text{MR}} \boxed{-} \boxed{4} \boxed{\text{ENTER}} \boxed{x} \boxed{\text{MR}} \boxed{x^2} \boxed{+} \boxed{5} \boxed{\text{ENTER}}$ (*)

To evaluate the polynomial at $x = -3.2012$, simply store this value in the memory:

$\boxed{3} \boxed{\cdot} \boxed{2} \boxed{0} \boxed{1} \boxed{2} \boxed{+/-} \boxed{X-M}$

and press the sequence (*) again, exactly as written above.

Answers: Rounding to four decimal digits, the answers are 13.0240 and -134.4054, respectively.

Example 5: The following iterative method is a well-known way of calculating square roots:

$$x_{k+1} = \frac{x_k + \frac{a}{x_k}}{2}$$

where $k = 0, 1, 2, \dots$ and $x_0 > 0$. It can be easily proved ($2x = x + a/x$) that $\lim_{k \rightarrow \infty} x_k = \sqrt{a}$.

Calculate $\sqrt{2}$ using this method.

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Solution: First of all, store an initial value—which must be greater than zero—in memory, say 1: $\boxed{1} \text{ (X-M)}$. Then, the following sequence of keystrokes must be repeated until the result does not change (remember that the number of displayed decimal digits can be set by the (2ndF) FIX key):

$a \text{ (}\div\text{) (MR) (M+) (MR) (}\div\text{) (2) (ENTER) (X-M)}$

In this case a (i.e. the argument of the square root function) is $\boxed{2}$. Four iterations will suffice:

$\boxed{2} \text{ (}\div\text{) (MR) (M+) (MR) (}\div\text{) (2) (ENTER) (X-M)}$ (returns 1.5)
 $\boxed{2} \text{ (}\div\text{) (MR) (M+) (MR) (}\div\text{) (2) (ENTER) (X-M)}$ (returns 1.41666667)
 $\boxed{2} \text{ (}\div\text{) (MR) (M+) (MR) (}\div\text{) (2) (ENTER) (X-M)}$ (returns 1.414215686)
 $\boxed{2} \text{ (}\div\text{) (MR) (M+) (MR) (}\div\text{) (2) (ENTER) (X-M)}$ (returns 1.414213562)
 $\boxed{2} \text{ (}\div\text{) (MR) (M+) (MR) (}\div\text{) (2) (ENTER) (X-M)}$ (returns 1.414213562)

Answer: $\sqrt{2} = 1.414213562$ to ten significant digits.

Example 6: Verify that $1.3407 + \frac{1}{1.3407 + \frac{1}{1.3407 + \dots}} = \frac{1.3407 + \sqrt{1.3407^2 + 4}}{2}$

Solution: Continued fractions can be easily evaluated on the HP 9s. Since we are working with four decimal digits, let's set FIX 4: $\text{(2ndF) FIX} \text{ (4)}$, and then store 1.3407 in the memory:

$\boxed{1} \text{ (.) (3) (4) (0) (7) (X-M)}$

Now repeat the following sequence until the result does not change:

$\text{(2ndF) } x^{-1} \text{ (+) (MR) (ENTER)}$

Results are 2.0866, 1.8200, 1.8902, 1.8698, 1.8755, 1.8739, 1.8744, 1.8742, 1.8743, 1.8742, 1.8742. Therefore, the fraction seems to converge to the number 1.8742. Let's now evaluate the right-hand expression:

$\text{(MR) (}x^2\text{) (+) (4) (ENTER) (}\sqrt{\text{)} (+) (MR) (ENTER) (}\div\text{) (2) (ENTER)}$

Answer: Both sides of the equation evaluate to 1.8742. (Remember to press $\text{(2ndF) FIX} \text{ (.)}$ to restore the default display format).