HP 39 RPN Version 1

Files: HP39RPN0.000

INTRODUCTION

Have you ever wondered about RPN (Reverse Polish Notation)? RPN is a classic way of making calculations, which reduced many keystrokes in calculations. Plus, it allowed you to see results every step of the way. Think of it on how you would work on problems as if you did the calculation by hand. This program puts your HP 39gs (or 39g+) in RPN mode. In this version, you have an equivalent to an HP 35/45 in your hand, able to do powerful and basic calculations within seconds.

Disclaimer: This should work on HP 40gs models as well, but please don't quote me own because I don't own one. I am also not an employee of HP.

About HP 35

Hewlett Packard released the HP 35 in the early 1970s. It was one of the first handheld, scientific calculators to hit the market. At a price of about $300, you can easily calculate arithmetic calculations, along with logarithms and trigonometric calculations. The version gives you the equivalent to an HP 35, plus a few other functions. The HP 35 ran on RPN entry, as well as many Hewlett Packard calculators did. Some examples include the celebrated 1970s programmable calculators HP 65 and HP 41, as well as their best selling financial calculator, HP 12C. Today, the RPN models include the HP 12C Platinum, HP 33S, and HP 50g. (all have an algebraic mode)

Note: since this is programmed in "HP Basic", the way numbers are entered are slightly modified. I will show you how.

How RPN Works

Picture four boxes stacked vertically. This stack of boxes, oddly enough, is called the stack.

t Stack
z Stack
y Stack
x Stack

In the classic HP calculators (HP 35, HP 45, HP 12C for example), you will only see the contents of the x Stack. In HP 39 RPN, you will always see all four stacks. You normally will be working with the contents of the x Stack.

One argument commands, like sin and cos, take action only of the contents of the x stack. Two argument commands, like addition and multiplication, take the contents of the x and y stacks, leaving the answer in the x stack. The z and t stacks are primarily used for memory contents, and holding places for immediate results.

As we go through the calculations, you will see the stack in action. It is a good idea to follow through each example the first time.

KEY CONVENTIONS

Key presses are represented as [SIN], [1], etc.

Commands after the [SHIFT] key are in italics, for example [SHIFT] *PROGRAM*.

Numbers are keyed as normal: 1, 2, etc…

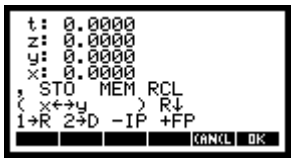
In keystroke sequences, I will use the following:

Keystroke Sequence	Resulting Screen

I try to be consistent with the HP 39g+/39gs User's Manual.

RUNNING HP39RPN

Press [SHIFT] *PROGRAM*.		
Find "HP 39 PRN" and press RUN.		



The HP 39PRN Screen

LEAVING HP 39RPN

Press the [ON] key at any time to exit the program.

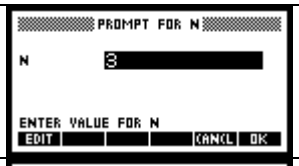
VARIBLES USED IN HP 39RPN

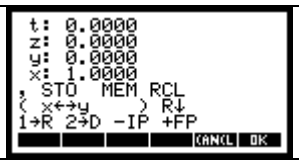
Real: A (for the key entry), N (for the number entered)
List: L0 (stack and memory)

I try to use the least amount of variables as possible.

ENTERING NUMBERS

Enter a real number:

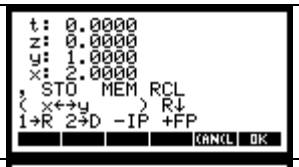
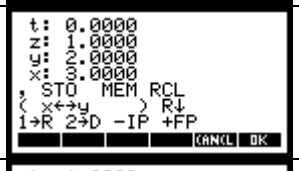
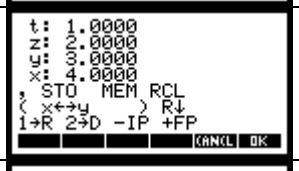
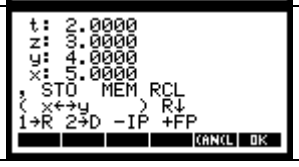
1. Press [ENTER]		
2. Enter the number		

3. Press [ENTER]		

NOTE: The first “ENTER” is unique to HP 39RPN.

The number is place on the x-stack. This also “pushes” everything else “up”. So whatever was in the y stack now is in the z stack, whatever was in the z stack now lives in the t stack. The contents of the t stack is lost. This is what HP calls *stack lift*.

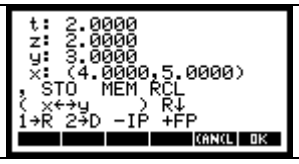
To illustrate, lets continue from the last example, enter the numbers 1 through 5 on to the stack.

[ENTER] 2 [ENTER]		
[ENTER] 3 [ENTER]		
[ENTER] 4 [ENTER]		
[ENTER] 5 [ENTER]		

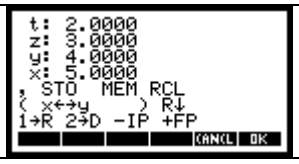
Notice how the 1 goes “bye bye”.

MAKING NUMBERS COMPLEX

HP 39RPN will not allow you to enter complex numbers directly. However, you can enter complex numbers onto the stack by first entering the real part first, then its imaginary part. Press [X,T,θ] key to form the complex number (y stack, x stack) [y stack + i * x stack]

[X, T, θ]		

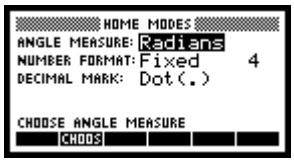
You can separate complex numbers into its real and imaginary parts by pressing [SHIFT] *EEX*.

[SHIFT] *EEX*		

As you can see, HP 39 assigns certain functions to some of the keys. You have a handy dandy reference guide on the screen to tell you most of the remapped keys.

SETTING MODES

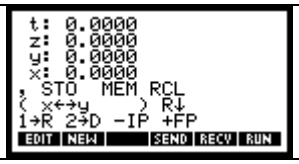
In the version, you must set modes before running HP 39 RPN, because you will not be able to change them while the program is running. In all the examples, I have the following modes:



STACK MANIPULATIONS

CLEARING THE STACK

You can easily clear the stack by pressing [SHIFT] *CLEAR*.

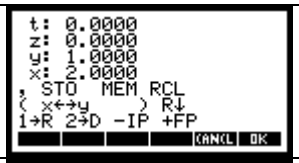
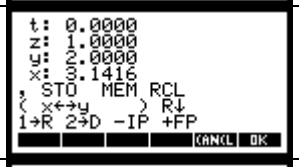
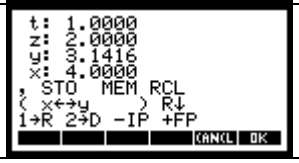
[SHIFT] *CLEAR*		

You will always start with a clear stack and memory every time you run HP 39PRN.

ROLL AND SWAP

To illustrate how these stack manipulations work, we are going to first fill the stack with what else, numbers!

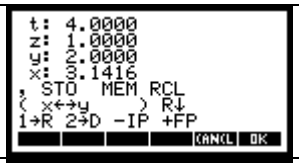
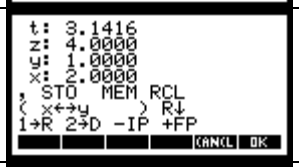
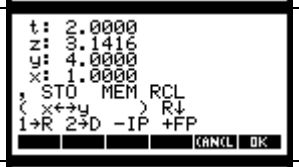
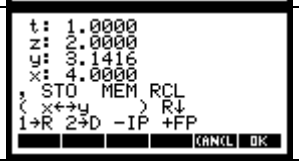
Enter 1, 2, π, and 4.

[ENTER] 1 [ENTER] [ENTER] 2 [ENTER]		
[SHFIT] π (The constant π is entered automatically)		
[ENTER] 4 [ENTER]		

ROLLING THE STACK

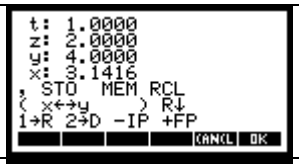
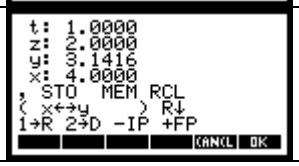
Like a rolodex, you can review the stack by pressing [ )] (right parenthesis). The contents are rolled downward, one stack at time. The contents of the x stack will be “rolled” to the t stack.

Continuing form the last example:

[ )]		
[ )]		
[ )]		
[ )]		

SWAPPING x STACK and y STACK

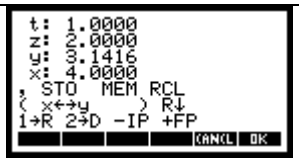
Remember the EXC key on most basic calculators? The swap command is sort of like that. The swap command switches the contents of the x and y stacks. This comes in handy. Press [( ] (left parenthesis) to swap the x and y stacks. The contents of the z and t stacks remain intact.

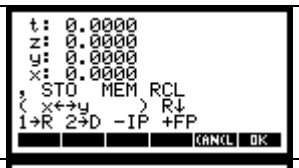
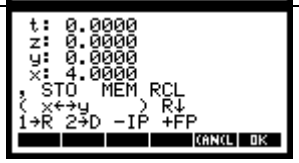
[( ]		
[( ]		

MEMORY

Use the [,] (comma) and the [SHIFT] *MEMORY* keys to store and recall from the contents of memory. In this version, the HP 39RPN has one memory register.

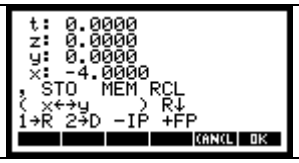
Example: Let's store 4 into memory, clear the stack, and recall what is in memory.

[,] (to store the contents of the x stack into memory)	 (Nothing really happens to the display)

[SHIFT] *CLEAR*	
[SHIFT] *MEMORY*	 The contents of the memory are placed on the x stack.

CHANGING THE SIGN OF the x STACK

CHS (Change Sign) just changes the sign of the x stack.

[(-)]	

ARITHMETIC

When you process an arithmetic function, the result will appear in the x stack. Everything else gets shifted down one stack. Whatever is in the t stack gets copied into the z stack. This is what HP calls *stack drop*.

You will not need to clear the stack before a new calculation.

In this example, I will start with a fresh, cleared stack.

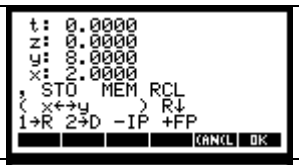
Example: Do the following four calculations:

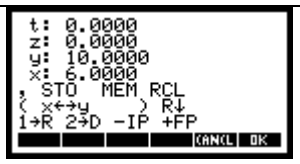
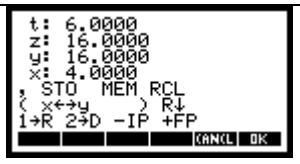
$8 + 2$

$8 - 2$

8×2

$8 \div 2$

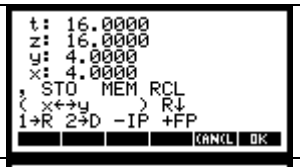
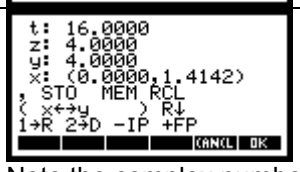
[ENTER] 8 [ENTER] [ENTER] 2 [ENTER]	
[+]	 Obviously, $8 + 2 = 10$

[ENTER] 8 [ENTER] [ENTER] 2 [ENTER] [-]	 t: 0.0000 z: 0.0000 y: 10.0000 x: 6.0000 , STO MEM RCL (x↔y) R↓ 1→R 2→D -IP +FP CANCL OK $8-2=6$
[ENTER] 8 [ENTER] [ENTER] 2 [ENTER] [X]	 t: 0.0000 z: 10.0000 y: 6.0000 x: 16.0000 , STO MEM RCL (x↔y) R↓ 1→R 2→D -IP +FP CANCL OK $8\times 2=16$
[ENTER] 8 [ENTER] [ENTER] 2 [ENTER] [÷]	 t: 6.0000 z: 16.0000 y: 16.0000 x: 4.0000 , STO MEM RCL (x↔y) R↓ 1→R 2→D -IP +FP CANCL OK $8\div 2=4$ Notice the stack.

SQUARES AND SQUARE ROOT

To take the square of the x stack, press [x^2]. To take the square root, press [SHFT] √.

Take the square of 4 and the square root of –2.

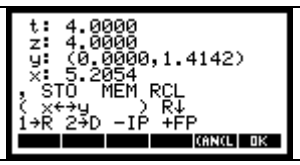
[ENTER] 4 [ENTER] [x^2]	 t: 16.0000 z: 16.0000 y: 4.0000 x: 4.0000 , STO MEM RCL (x↔y) R↓ 1→R 2→D -IP +FP CANCL OK
[ENTER] [(-)] 2 [ENTER] [SHIFT] √	 t: 16.0000 z: 4.0000 y: 4.0000 x: (0.0000,1.4142) , STO MEM RCL (x↔y) R↓ 1→R 2→D -IP +FP CANCL OK Note the complex number is displayed. The program will not give an error message. $\sqrt{-2}=i\sqrt{2}\approx 1.4142i$

POWERS AND ROOTS

Here is how power and root functions work on the HP 39RPN

POWERS: y stack $^{\text{x stack}}$;
ROOTS: $\sqrt[\text{x stack}]{}$(y stack)

Calculate the following: (continuing the example)
$2^{2.34}$ and $\sqrt[3]{178}$

[ENTER] 2 [ENTER] (base) [ENTER] 2.38 [ENTER] (exponent) [X^Y]	 t: 4.0000 z: 4.0000 y: (0.0000,1.4142) x: 5.2054 , STO MEM RCL (x↔y) R↓ 1→R 2→D -IP +FP CANCL OK

	$2^{2.38} \approx 5.2.054$
[ENTER] 3 [ENTER] (root exponent) [ENTER] 178 [ENTER] (base) [SHIFT] $\sqrt[n]{}$	 $\sqrt[3]{178} \approx 1.0062$

You can easily do more complex calculations with HP 39 RPN. Just think of how you would tackle the problem as if you were doing it by hand.

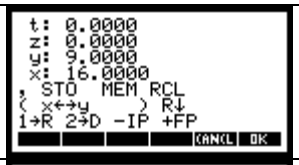
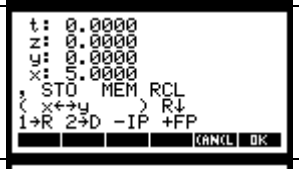
Start by going inside the parenthesis first, and then work your way to the outside. We will illustrate this with a few examples.

The keystroke sequences will show only one way to tackle these problems in RPN. Can you find others?

In the following four problems, I am starting with a clean stack. Recall, you clear the stack by pressing [SHIFT] *CLEAR*. This is not required, though.

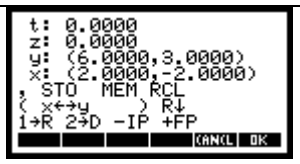
Problem 1:

$$(\sqrt{3^2 + 4^2}) \times 5^3 = 625$$

[ENTER] 3 [ENTER] [x^2] [ENTER] 4 [ENTER] [x^2]		
[+] [SHIFT] $\sqrt{}$		
[ENTER] 5 [ENTER] [ENTER] 3 [ENTER] [X^Y]		
[X]		

Problem 2:

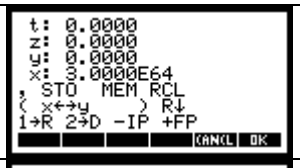
$$\frac{6+3i}{2-2i} \times \frac{4-4.5i}{\pi} \approx 4.1778 + 1.7905i$$

[ENTER] 6 [ENTER] [ENTER] 3 [ENTER] [X,T,θ] [ENTER] 2 [ENTER] [ENTER] [(-)] 2 [ENTER] [X,T,θ]		
[÷]		
[ENTER] 4 [ENTER] [ENTER] [(-)] 4.5 [ENTER] [X,T,θ]		
[X] [SHIFT] π [÷]		

Problem 3:

$$\sqrt[44]{(3x10^{64})(2x10^{32})} \approx 158.3082$$

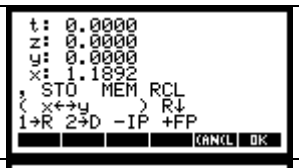
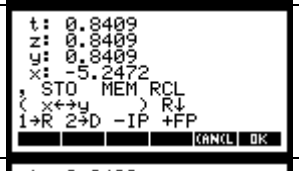
Note: When you are prompted to enter numbers, you can use [SHIFT] *EEX* as normal, in order to enter powers of 10.

[ENTER] 3 [SHIFT] *EEX* 64 [ENTER]		
[ENTER] 2 [SHIFT] *EEX* 32 [ENTER] [X]		
[ENTER] 44 [ENTER] [SHIFT] $\sqrt[n]{}$		

Problem 4:

$$\sqrt[4]{2} + \left(\frac{\frac{-2.4}{\sqrt[4]{2}}}{4.3-1.7} \right) \times \left(\frac{1}{\sqrt[4]{2}} \right) \approx -3.2231$$

In this problem, we will use the MEMORY and SWAP keys to aid us in calculation. Remember that this is only one approach.

[ENTER] 2 [ENTER] [ENTER] 4 [ENTER] [SHIFT] $\sqrt[n]{}$ [÷] [,]		
[ENTER] 1 [ENTER] [( ] [÷]		
[SHIFT] *MEMORY* [ENTER] 4.3 [ENTER] [ENTER] 1.7 [ENTER] [-] [÷]		
[ENTER] [(-)] 2.4 [ENTER] [( ] [÷]		
[X]		
[SHIFT] *MEMORY* [+]		

OTHER FUNCTIONS INCLUDED IN HP 39PRN

Numeric Functions

TO DO	PRESS
Find the natural logarithm (base e) of x	[LN]
Find the exponential of x	[SHIFT] e^x
Find the common logarithm (base 10) of x	[LOG]
Find the antilogarithm of x	[SHIFT] 10^x
Find the factorial of x (x!)	[SHIFT] *!* (X Key)
Find the reciprocal of x (1/x)	[SHIFT] x^{-1} (÷ Key)
Find the absolute value of x	[SHIFT] *ABS* (Left Parenthesis Key)
Find the argument of x	[SHIFT] *ARG* (Right Parenthesis Key)
Find the integer part of x	[SHIFT] ∠ (- Key)
Find the fractional part of x	[SHIFT] ∑ (+ Key)

Start with a clear stack and calculate the following:

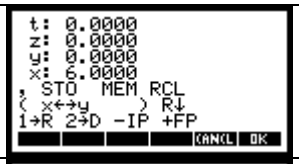
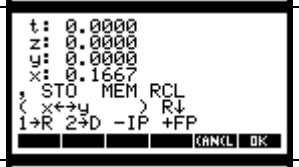
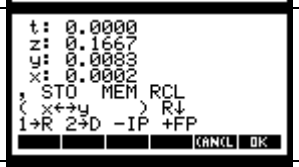
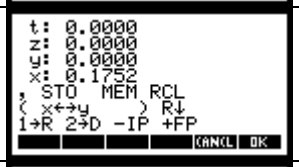
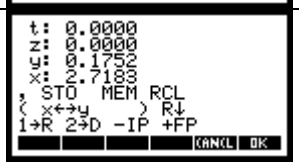
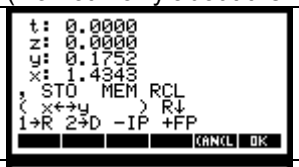
$$\frac{1}{3!}+\frac{1}{5!}+\frac{1}{7!}\approx .1752$$

$$10^{(\ln e+\log e)}\approx 27.1828$$

$$\Gamma(\pi)\approx 2.288$$

Also, find the fractional and integer parts of π.

Note $\Gamma(x)=(x-1)!$
This is the gamma function.

[SHIFT] [ENTER] 3 [ENTER] [SHIFT] !		
[SHIFT] x^{-1}		
[ENTER] 5 [ENTER] [SHIFT] ! [SHIFT] x^{-1} [ENTER] 7 [ENTER] [SHIFT] ! [SHIFT] x^{-1}		
[+] [+] (Part 1 complete)		
[ENTER] 1 [ENTER] [SHIFT] e^x [,]	 (Do not worry about the .1752 now.)	
[LN] [SHIFT] *MEMORY* [LOG] [+]		
[SHIFT] 10^x (Part 2 is complete)		
[SHIFT] π [ENTER] 1 [ENTER] [-] [SHIFT] *!* (Part 3 is complete)		

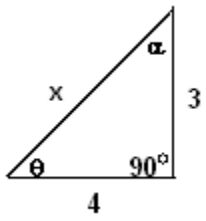
[SHIFT] π [SHIFT] ∑ (fractional part of π)		
[SHIFT] π [SHIFT] ∠ (integer part of π)		

Angle Functions

TO DO	PRESS
Change x from radians to degrees.	[SHIFT] *PROGRAM* (1 Key)
Change x from radians to degrees	[SHIFT] *SYNTAX* (2 Key)
Sine of x	[SIN]
Cosine of x	[COS]
Tangent of x	[TAN]
Arcsine of x	[SHIFT] *ASIN*
Arccosine of x	[SHIFT] *ACOS*
Arctangent of x	[SHIFT] *ATAN*

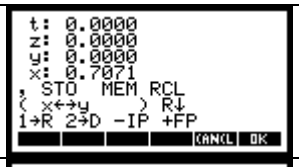
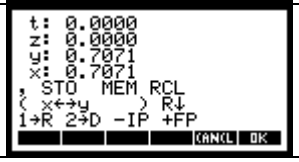
Now, recall that my calculator is set to Radians mode, with answers fixed to four decimal places. To change modes, you must exit HP 39 RPN and change modes before re-running the program. I hope to correct this on the next version. So, my next batch of examples is done in Radian mode.

1. Show that $\sin(\pi/4) = \sin 45^\circ$
2. Find the arccosine of .75 in both radians and degrees.
3. From the triangle, find the following:



Find the length of the side x, and angles α and θ.

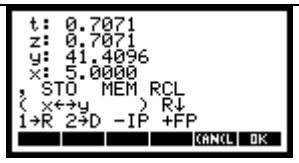
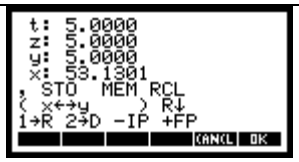
Problem 1

[SHIFT] *π* [ENTER] 4 [ENTER] [÷] [SIN]		
[ENTER] 45 [ENTER] [SHIFT] *PROGRAM* [SIN]		

Problem 2

[ENTER] .75 [ENTER] [SHIFT] *ACOS* [SHIFT] *SYNTAX*	 The arccosine of .75 is about .7227 radians and approximately 41.4096 degrees

Problem 3 (One way to tackle the problem)

Find x by using the Pythagoras Theorem. [ENTER] 3 [ENTER] x^2 [ENTER] 4 [ENTER] x^2 [+] [SHIFT] √	 x = 5
Next, find θ by using tan θ = ¾. [ENTER] 3 [ENTER] [ENTER] 4 [ENTER] [÷] [SHIFT[*ATAN* [SHIFT] *SYNTAX*	 $\theta \approx 36.8699^\circ$
Finally, use the fact that α° = 180° - θ° to find α. [ENTER] 180 [ENTER] [( ] [-] [ENTER] 90 [ENTER] [-]	 $\alpha \approx 53.1301^\circ$

Questions?

Send comments and questions to ews773@hotmail.com

Thank you.

Resources:

HP 42S RPN Scientific Calculator Owner's Manual (1988)
HP 39gs Graphing Calculator User's Guide (2006)