

# HP35s / HP12c Programs

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## Revision History

Revision Date	Description
May 25, 2016	Revised <i>Modular Exponentiation</i> program by using DSE function instead of direct variable count.

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**Part I**

**HP35s**

## 0.1 Modular Exponentiation

### Description

This program calculates the modulus of a number raised to a large power. The formula looks like this:

$$\text{modexp} = n^p \bmod m$$

### Usage

GTO A001     $n$  R/S             $p$  R/S             $m$  R/S

### Program Listing

A001	LBL A	start of program
A002	STO N	store number to be raised to the power P
A003	STOP	wait for user R/S
A004	STO P	store exponent
A005	STOP	wait for user R/S
A006	STO M	store modulus
A007	1	initialize product ...
A008	STO R	... and save in memory
A009	RCL N	recall base ...
A010	RCL R	recall product ...
A011	×	... and multiply the two
A012	RCL M	recall the modulus ...
A013	RMDR	... and apply it
A014	STO R	save the new product
A015	DSE P	decrement exponent ...
A016	GTO A009	... and loop back if not finished.
A017	RCL R	pull the product from memory
A018	RTN	we are done!

### Example

In the following example we calculate  $5^{101} \bmod 31$  using the following steps:

GTO A001	0.00000	go to start of program
5 R/S	5.00000	the “base”
101 R/S	101.00000	the “exponent”
31 R/S	25.00000	the “modulus” and result

### Comments

The HP35s is not known for its lightning speed. The above example will take about 12 seconds to run.

## 0.2 atan2

### Description

This program calculates  $\text{atan2}(\frac{y}{x})$ . Result is in the range  $-180^\circ$  to  $+180^\circ$ .

### Usage

GTO Z001      $x$  R/S              $y$  R/S

### Program Listing

Z001	LBL Z	Start of program.
Z002	STO X	Store $x$ in X.
Z003	STOP	Wait for user R/S.
Z004	STO Y	Store $y$ in Y.
Z005	RCL Y	Recall Y. Note: this is also the entry point for subroutine.
Z006	RCL X	Recall X.
Z007	$\div$	Take ratio of rise over run ( $\frac{y}{x}$ ).
Z008	ATAN	Calculate $\arctan(\frac{y}{x})$ .
Z009	STO R	Save as an interim result in R.
Z010	RCL X	Test sign of X.
Z011	$x > 0?$	Is $x$ positive?
Z012	GTO Z027	If so then go to end of program.
Z013	RCL Y	Recall Y ...
Z014	SGN	Calculate its sign ...
Z015	45	
Z016	$\times$	then multiply it by $45^\circ$ .
Z017	RCL X	Get X value.
Z018	$x = 0?$	Is it equal to zero?
Z019	RTN	If so then return the value of the stack ( $\pm 45^\circ$ )
Z020	180	Setup offset depending on sign of $y$ .
Z021	STO -R	Initially subtract $180^\circ$ — we do this at a minimum.
Z022	RCL Y	Get Y value.
Z023	$x < 0?$	Is it negative?
Z024	GTO Z027	If yes, then we are done since we already subtracted $180^\circ$ .
Z025	360	If $y$ is positive then we have to add $360^\circ$ ...
Z026	STO +R	... for a total addition of $180^\circ$ .
Z027	RCL R	Get the angle.
Z028	RTN	Return to calling function.

## Example

In the following example we calculate  $\text{atan2}(\frac{+1.5}{-1.0})$  using the following steps:

GTO Z001	0.00000	Go to start of program.
1.5	1.5	Your value for $x$ .
R/S	1.50000	
-1.0	-1.0	Your value for $y$ .
R/S	-33.69007	The resulting angle.

## Comments

Users have to be careful about a couple of things:

1. Angles are calculated in *degrees*. Confirm calculator setting before using this function.
2. User is responsible for ensuring that  $x$  and  $y$  are **never** both zero.