Math 1320: Graphing Logarithmic Functions

How do I graph a logarithmic function? Like any other graph that is plotted by hand, we want to start with a table of coordinates ($x-$ and $y-$ values). In order to capture the behavior of the graph, the more points we plot the better. I recommend plotting at least 6 points.

How do I evaluate logarithms?
Consider the three logarithmic equations below:

$f(x) = \log(x-1)$ $\quad$ $g(x) = \ln(2x)$ $\quad$ $h(x) = \log_3 x$

x	$f(x) = log\,(x-1)$
1	$log\,(1-1)$ =?
2	$log\,(2-1)$ =?
3	$log\,(3-1)$ =?
4	$log\,(4-1)$ =?
5	$log\,(5-1)$ =?
6	$log\,(6-1)$ =?

x	$g(x) = ln\,(2x)$
1	$ln\,(2 \cdot 1)$ =?
2	$ln\,(2 \cdot 2)$ =?
3	$ln\,(2 \cdot 3)$ =?
4	$ln\,(2 \cdot 4)$ =?
5	$ln\,(2 \cdot 5)$ =?
6	$ln\,(2 \cdot 6)$ =?

x	$h(x) = log_3(x)$
1	$log_3(1)$ =?
2	$log_3(2)$ =?
3	$log_3(3)$ =?
4	$log_3(4)$ =?
5	$log_3(5)$ =?
6	$log_3(6)$ =?

After plugging in the respective values for x, all that's left is to evaluate the logarithm. But how? Well, for $f(x)$ and $g(x)$, we may use the function buttons on our scientific calculators:

- For $f(x)$, when $x = 1$, in our calculator we use the following button sequence:
  LOG (1 - 1) ENTER
- For $g(x)$, when $x = 1$, in our calculator we use the following button sequence:
  LN (2 $\cdot$ 1) ENTER
- Continue the process for each value of x.

But we don't have a calculator button to evaluate a logarithm of base 3. We need a special property of logarithms to graph $h(x)$:

The Change-of-Base Property	
Common Logarithms	Natural Logarithms
$log_b M = \frac{log\,M}{log\,b}$	$log_b M = \frac{ln\,M}{ln\,b}$

Applying the change-of-base property, we can use a scientific calculator to evaluate $h(x)$ at each value of x.

Example 1. Graph the equation $h(x) = \log_3 x$.

I copied the table from above and added an extra column for applying the change-of-base property:

x	$h(x) = log_3(x)$	**Apply Change-of-Base Property**	**Coordinates**
1	$log_3(1)$ =?		
2	$log_3(2)$ =?		
3	$log_3(3)$ =?		
4	$log_3(4)$ =?		
5	$log_3(5)$ =?		
6	$log_3(6)$ =?		

Practice applying the change-of-base property to evaluate the logarithms. Use a scientific calculator and round your answer to two decimal places.

1. $\log_5 7$ [≈ 1.21]
2. $\log_9 4$ [≈ 0.63]
3. $\log_1 8$ [undefined]
4. $\log_{12} 1$ [0]