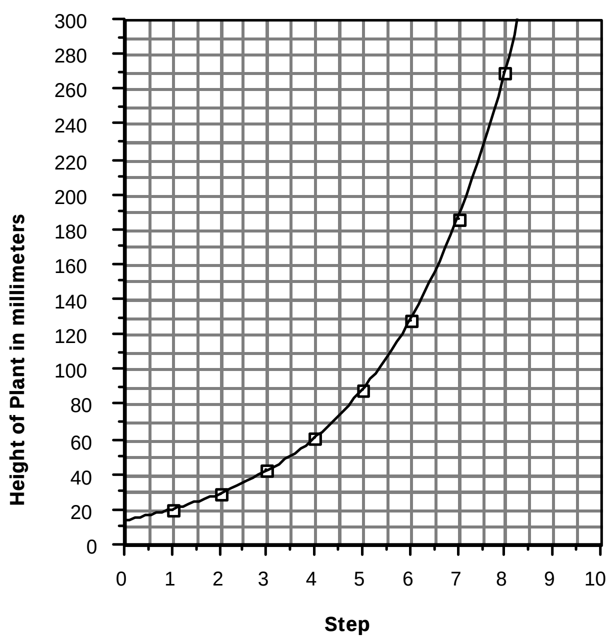
Activity II Continuously Changing Growth - Solutions

Solution: 1

a.

Step	1	2	3	4	5	6	7	8
Height of Plant (mm)	20	29	42.1	61.0	88.5	128.3	186.0	267.7

b.



c. New stem length = Old stem length + 0.45 x Old stem length

$$N = L + 0.45L$$

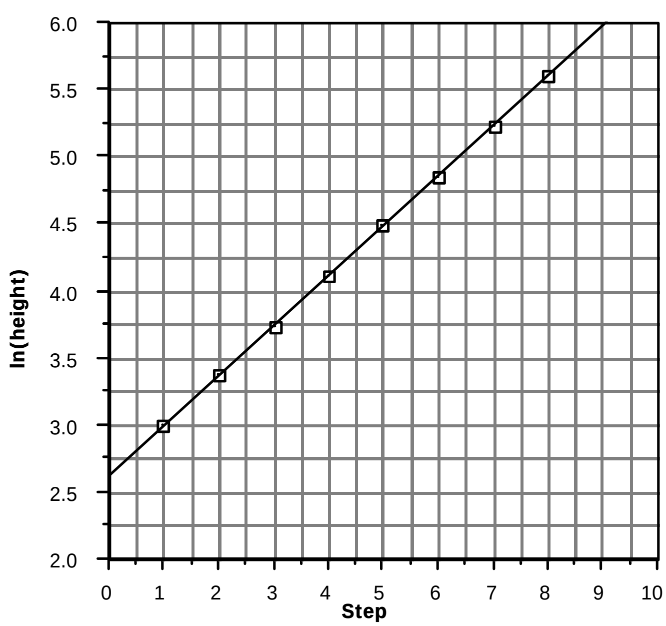
Solution: 2

It is clear that the equation is not linear since the graph does not represent a straight line. You know how to determine the equation of a straight line, so the approach is to transform the data in some way to make the plot of the transformed data linear. Use a function on the independent variable, the dependent variable or both in attempt to create a graph which is linear.
Example:

Apply the natural logarithm function to the dependent variable values.
Amend the table to include the natural logarithm of all the heights.

Step	1	2	3	4	5	6	7	8
Height of Plant (mm)	20	29	42.1	61.0	88.5	128.3	186.0	267.7
ln(height)	2.995	3.367	3.74	4.11	4.483	4.854	5.226	5.59

Plot of the natural logarithm of the height against step number.



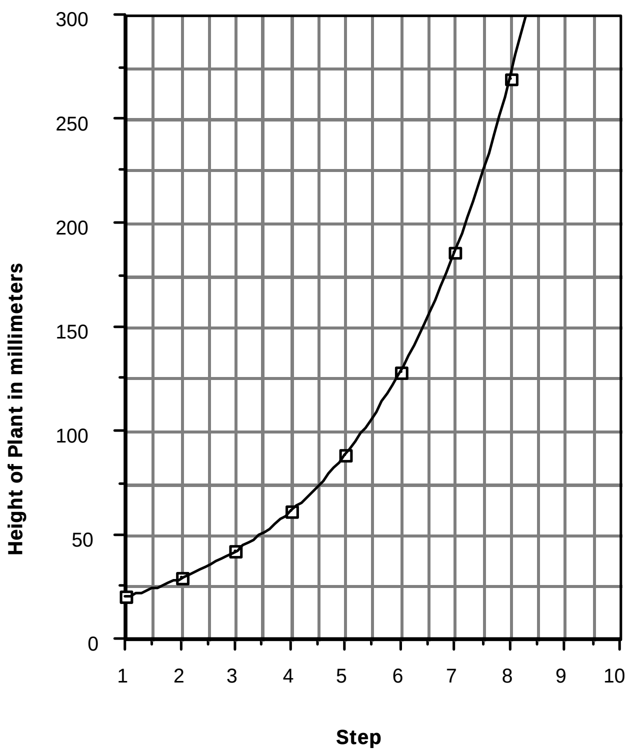
This new graph appears linear.
Determine the equation of the graph of the transformed data.

$$\ln(\text{height}) = .37\text{Step number} + 2.63$$

The inverse of the logarithmic function is the exponential function. To write the equation as a function in h, do the following steps.
Raise both sides of the equation to an exponential power and simplify using the laws of exponents.

$$e^{\ln(h)} = e^{(0.37s + 2.63)}$$
$$h = e^{(0.37s + 2.63)}$$
$$h = e^{0.37s} \times e^{2.63}$$
$$h = e^{2.63} \times e^{0.37s}$$
$$h = 13.9\,(1.45)^{s}$$

$h = 13.9\,(1.45)^{s}$ is the equation of the function representing the growth of this imaginary plant.
Graphing $h = 13.9\,(1.45)^{s}$ on the graph of the original data yields the following.



Conclusion: The growth of the imaginary plant can be described as having a rate of change which can be expressed as a constant with a variable exponent. This change in rate is called exponential and this kind of growth is called exponential growth.