Further modelling of non-linear data

Year 11 General Maths
Units 1 and 2

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Learning Objectives

By the end of the lesson I would hope that you have an understanding and be able to apply to questions the following concepts:

- Use the knowledge from previous lessons to turn non-linear graphs into linear graphs
- Understand how to linearise:
  - Squared graphs
  - Reciprocal graphs
  - Logarithmic graphs

Recap

In the previous lessons we have looked at how we can transform data using the CAS to help us find equations to help us predict values which we might not have had before.

We might be asked to do this without the use of a CAS. So, let's looks at some examples where we can do this using pencil and paper methods.

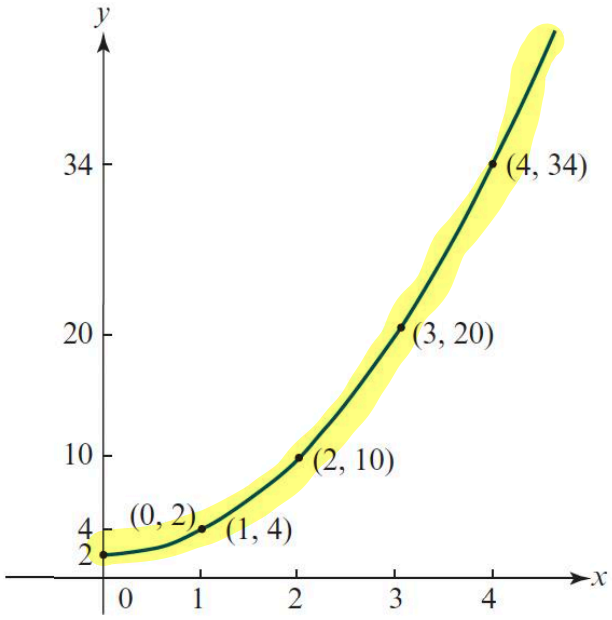
Example 1

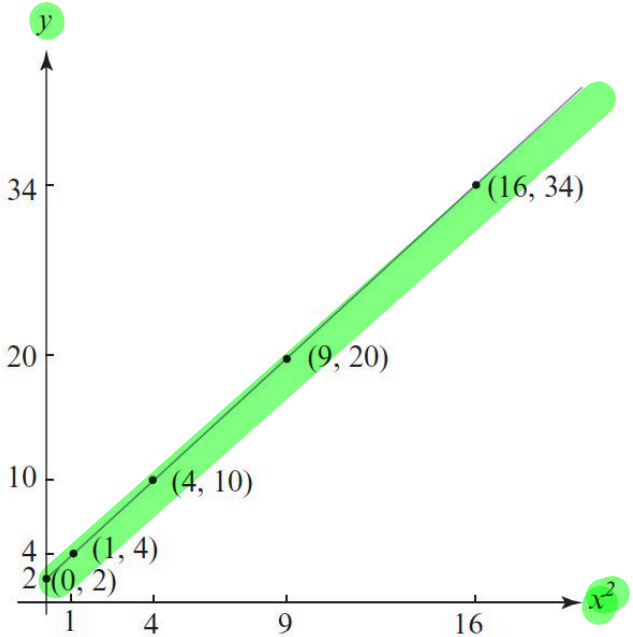
The data in the given table has undergone an x^2 transformation, and the graph of both the original data and the transformed data is shown. Find a rule connecting the variables x and y.

x	0	1	2	3	4
x^2	0	1	4	9	16
y	2	4	10	20	34

$y = mx + c$

$y = 2x^2 + 2$





Example 1

The most important graph is the one of the straight line. We can use our year 9 knowledge of straight lines to find the equation of the original graph.

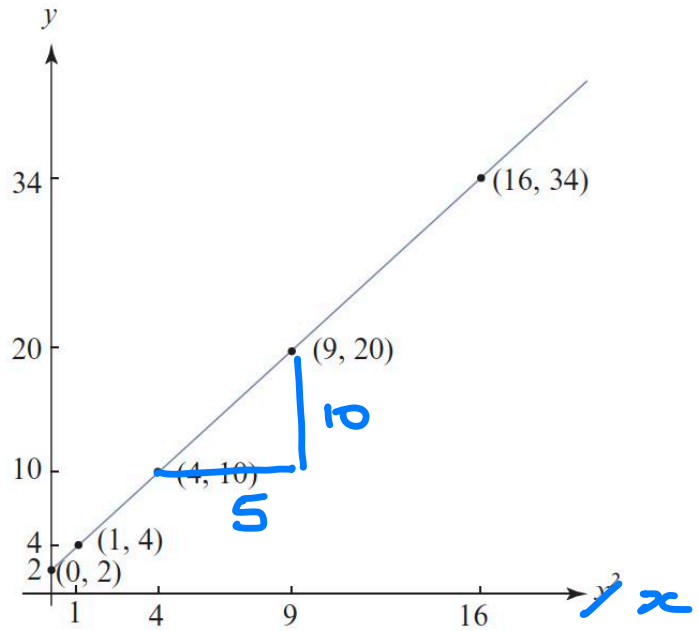
$$y = mx + c$$

$$m = \frac{\text{rise}}{\text{run}} = \frac{10}{5} = 2$$

$$y = 2x + c$$

$(0, 2)$ $\quad 2 = 2 \cdot 0 + c$

$$c = 2$$



$$y = 2x + 2$$

$$y = 2 \cdot x^2 + 2$$

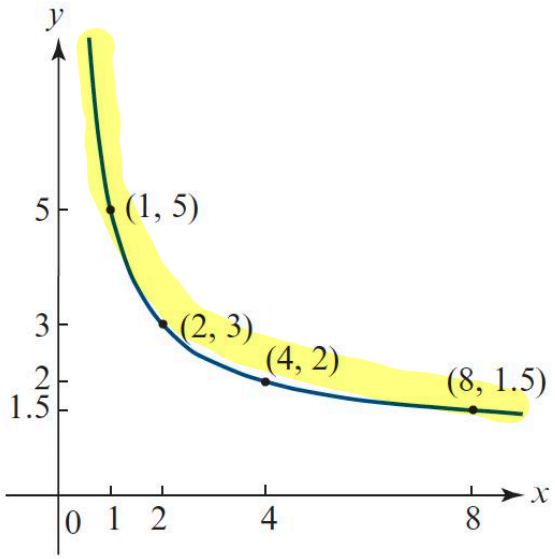
Example 2

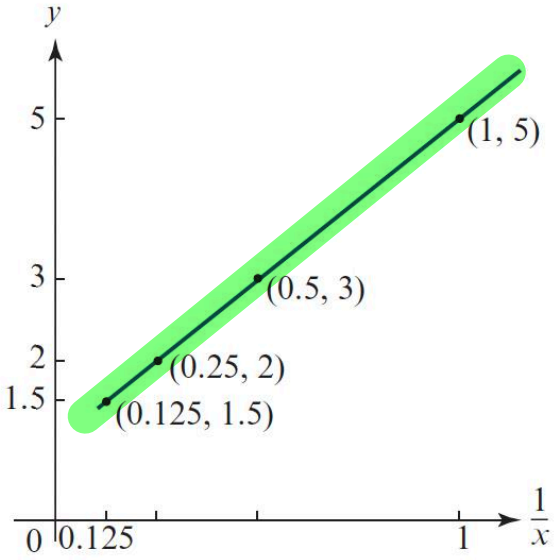
The data in the given table has undergone a $\frac{1}{x}$ transformation, and the graph of both the original data and the transformed data is shown. Find a rule connecting the variables x and y.

x	1	2	4	8
$\frac{1}{x}$	1	0.5	0.25	0.125
y	5	3	2	1.5

$\frac{1}{1}$ $\frac{1}{2}$ $\frac{1}{4}$ $\frac{1}{8}$

$y = \frac{4}{x} + 1$



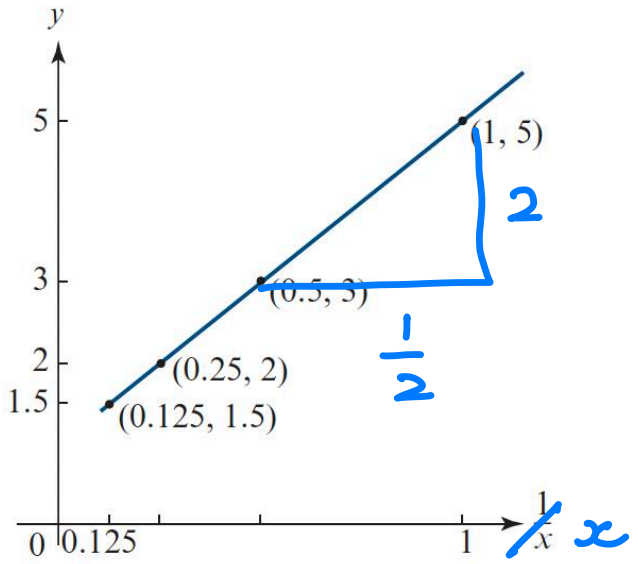


Example 2

Again, the straight-line graph is going to be the one which is the most useful.

$y = mx + c$

$m = \frac{\text{rise}}{\text{run}} = \frac{2}{\frac{1}{2}} = 4$



$y = mx + c$

$y = 4x + c$

$y = 4x + 1$

$(1, 5)$ $\quad 5 = 4.1 + c$

$5 = 4 + c$

$c = 1$

$y = 4.\frac{1}{x} + 1$

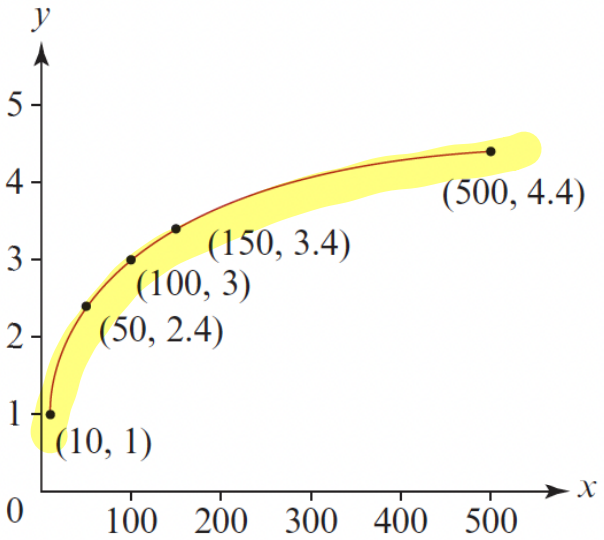
$y = \frac{4}{x} + 1$

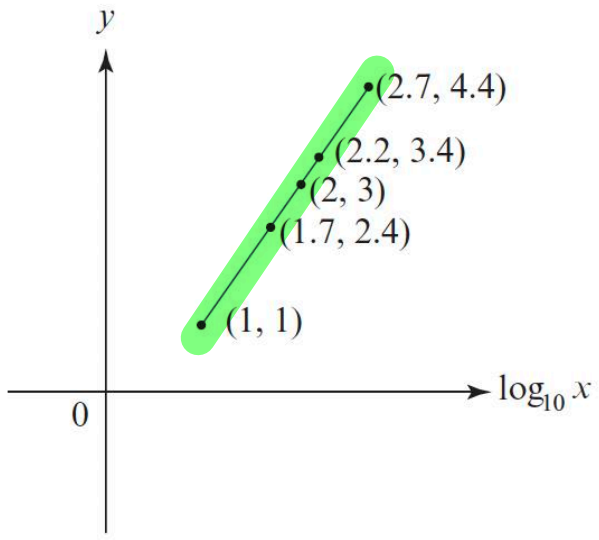
Example 3

The data in the given table has undergone a $\log_{10}(x)$ transformation, and the graph of the transformed data is shown. Find a rule connecting the variables x and y.

x	10	50	100	150	500
$\log_{10}(x)$	1	1.7	2	2.2	2.7
y	1	2.4	3	3.4	4.4

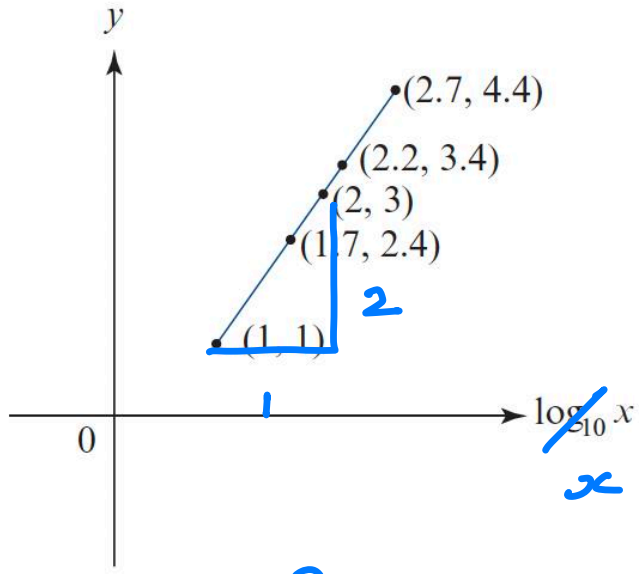
$y = 2\log_{10} x - 1$





Example 3

And, once more, the straight line is going to be the one we need to use.



$y = mx + c$

$m = \frac{\text{rise}}{\text{run}} = \frac{2}{1} = 2$

$y = 2x + c$

$(1, 1) \quad 1 = 2.1 + c$

$1 = 2 + c$

$c = -1$

$y = 2x - 1$

$y = 2.\log_{10} x - 1$

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By the end of the lesson, I would hope that you have an understanding and be able to apply to questions the following concepts:

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- Understand how to linearise:
    - Squared graphs
    - Reciprocal graphs
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Work to complete

The work I am asking to be completed for this topic is shown below.

This is the minimum work which should be completed. The more questions which are answered the better your chance of success in exams. Questions towards the end of the exercises and in the Chapter Review are the best practice you can do.

Questions to complete:
Exercise 9D:

Extension:

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