



Name: _____ () Class: _____ Date: _____

MA303.2.2 – Experimental Data

At the end of this unit, you should be able to

- use linear law to draw straight line graphs using experimental data
- solve for unknown parameters
- identify and correct outliers in experimental data

In experiments, recordings or measurements of any variable usually results in inaccurate data collection. For data points which lie roughly on a straight line, we can quite easily predict the relationship between the variables by determining the equation of the straight line.

E1. In an experiment it is known that y varies directly as x^2 , and when measurements of y are taken with values of x , the recordings are shown below:

x	0.5	1.0	1.5	2.0	2.5	3
y	2.0	8.0	12.0	32.0	50.0	72.0

Since y varies directly as x^2 , a straight line will be revealed if y is plotted against x^2 . Thus we can create a new row of data showing the values of x^2 :

x	0.5	1.0	1.5	2.0	2.5	3
y	2.0	8.0	12.0	32.0	50.0	72.0
x^2	0.25	1.00	2.25	4.00	6.25	9.00

And by plotting the values of y against the values of x^2 correspondingly, a straight line can be drawn such that it passes through 5 out of the 6 points. The point that does not lie on the straight line is known as an **outlier** (see next page).

Hence, there is an incorrect reading or measurement in the experiment, which happens when $x = 1.5$, and the incorrect reading is $y = 12.0$. What should be the correct reading? By reading the point on the straight line where $x = 1.5$, we can see that y should be 18.0 and not 12.0.

Can the equation between x and y be found? The following steps are to be done:

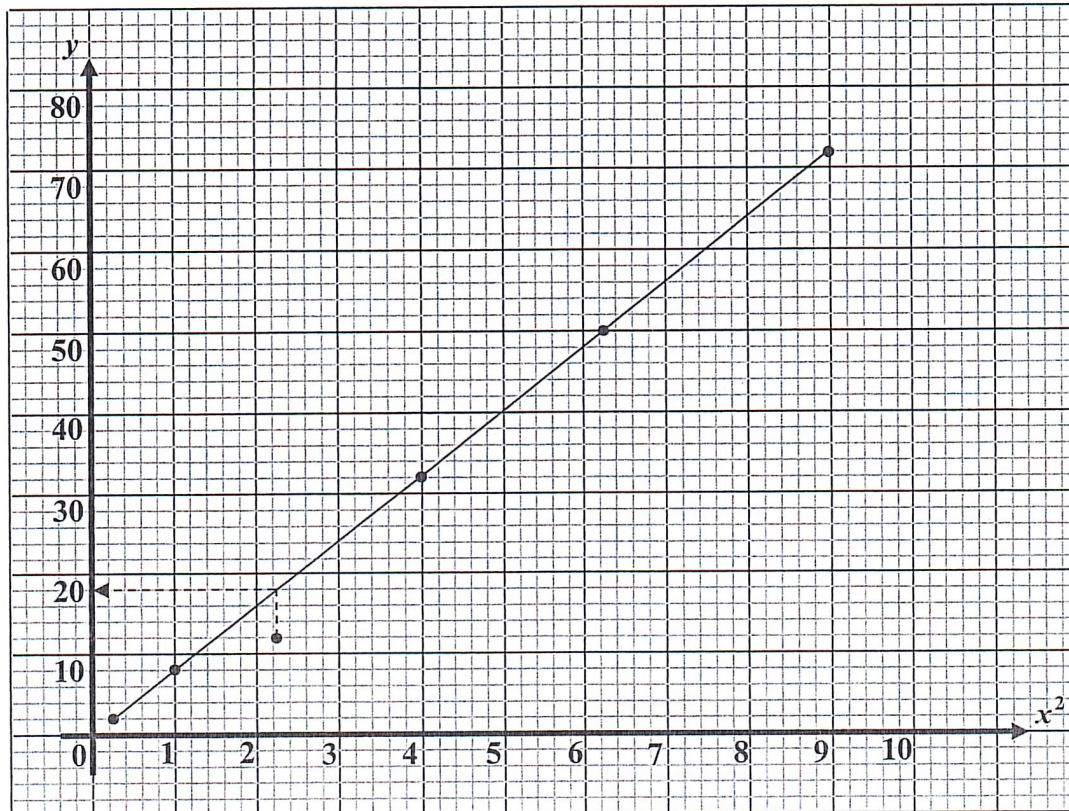
Step 1: Let $Y = y$ and $X = x^2$ to represent the vertical and horizontal axes respectively.

Step 2: The equation of the straight line can be found by taking two points that **lie on the line**. In this case since 5 of the 6 points lie on the line itself, by choosing (1, 8) and (9, 72) the equation is given by

$$\frac{Y - 8}{X - 1} = \frac{72 - 8}{9 - 1} \Rightarrow Y - 8 = 8(X - 1) \Rightarrow Y = 8X$$

Step 3: By replacing back $Y = y$ and $X = x^2$ we can easily see that the equation linking x and y is given by

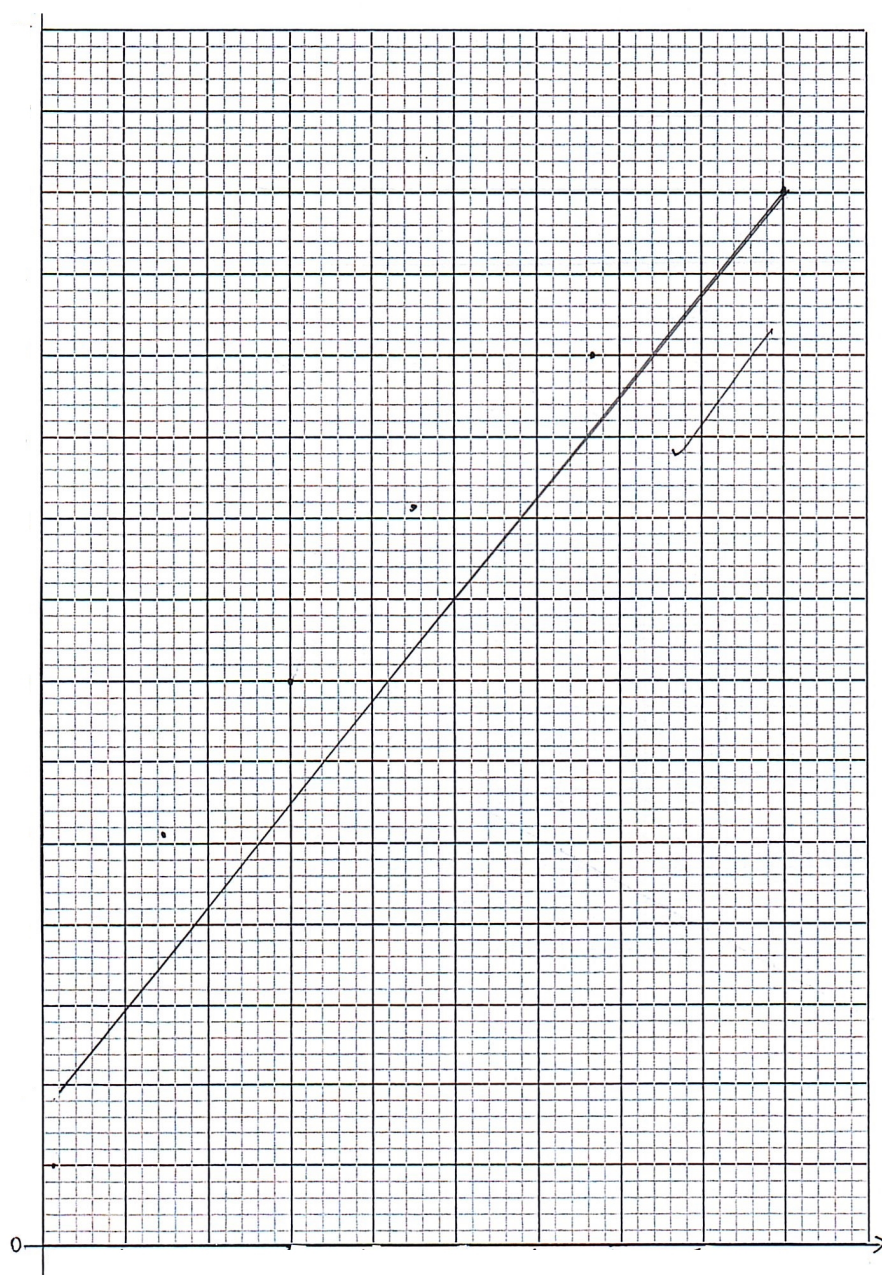
$$y = 8x^2.$$



E2. The table below shows the experimental values of two quantities x and t in which they are related by the equation $x = at^2 - bt$, where a and b are real constants.

t	1	2	3	4	5	6	7
x	1.0	6.1	15.2	27.8	45.6	66.1	90.5

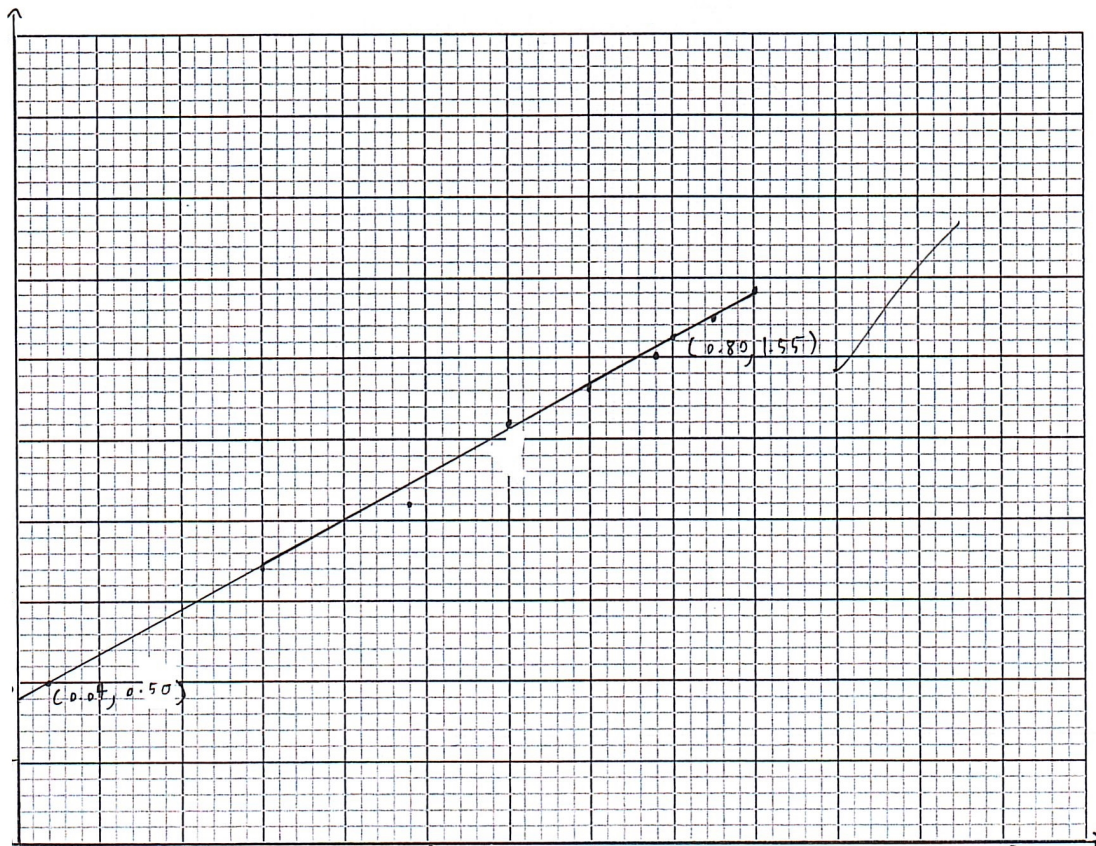
By drawing a straight line graph, estimate the constants a and b . Show your working clearly.



P1. It is given that $y = ax^b$ where a and b are real constant. An experiment was conducted to measure the quantities x and y and the following table is obtained.

x	2	3	4	5	6	7	8
y	6.5	12.5	19.3	26.7	35.3	44.1	54.4

By drawing a straight line graph, estimate to one decimal place, the values of a and b . Hence, estimate the value of y when $x = 5.6$



P2. The table below shows experimental readings of p for given values of q such that $pq = ap - q^2 + b\sqrt{q}$ where a and b are real constants. One of the readings is incorrect.

q	0	1	2	3	4	5	6
p	0	2.9	85.6	-23.5	-13.8	-12.2	-12.0

- (a) By using a scale of 4 cm to 1 unit on the vertical axis and 2 cm to 0.1 unit on the horizontal axis, draw a straight line graph of $\frac{pq + q^2}{p}$ against $\frac{\sqrt{q}}{p}$, and identify the incorrect reading.
- (b) Estimate the values of a and b , and hence estimate the correct reading from (a).

