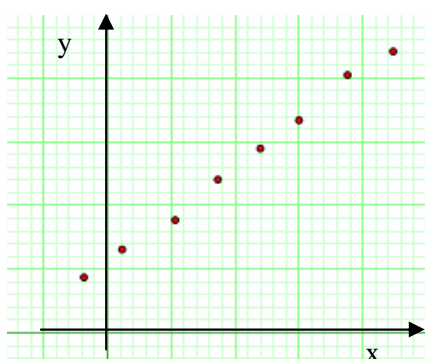
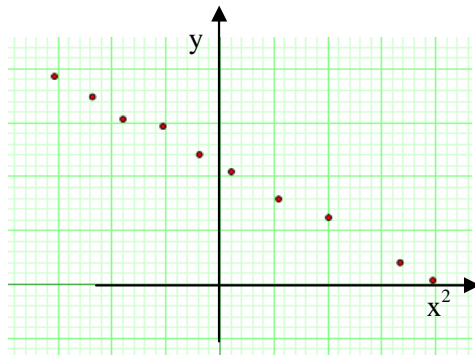
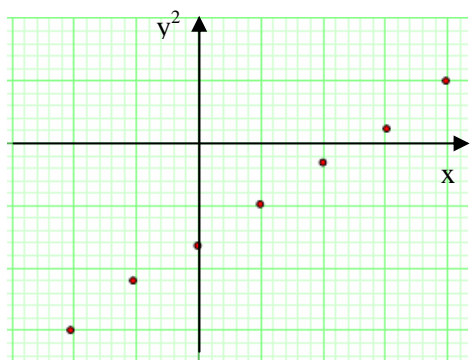
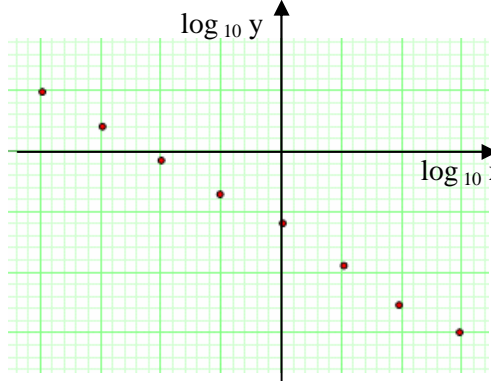
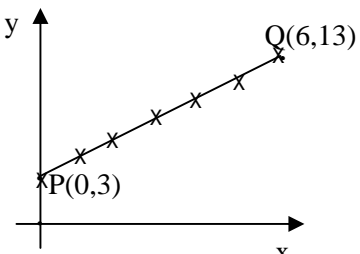
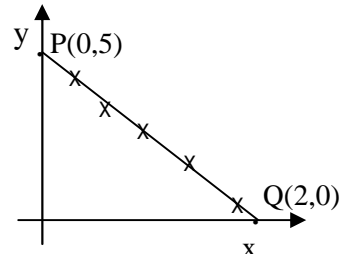


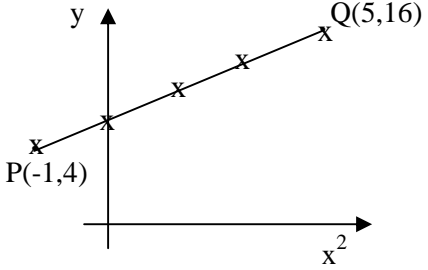
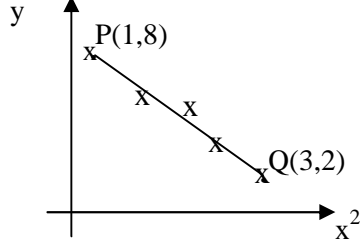
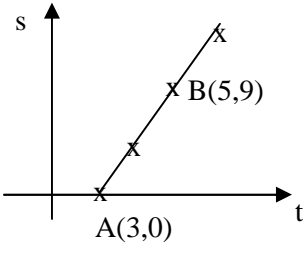
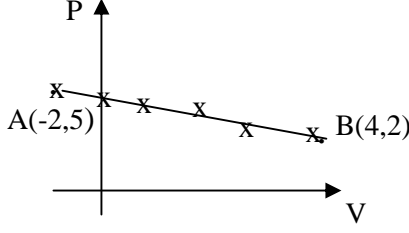
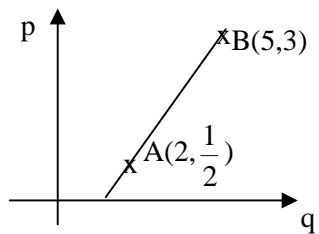
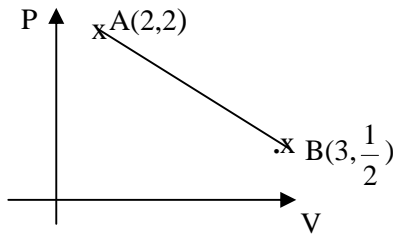
LINEAR LAW

1.1 Draw the line of best fit

<p>1</p> 	<p>2</p> 
<p>3</p> 	<p>4</p> 

1.2 Write the equation for the line of best fit of the following graphs.

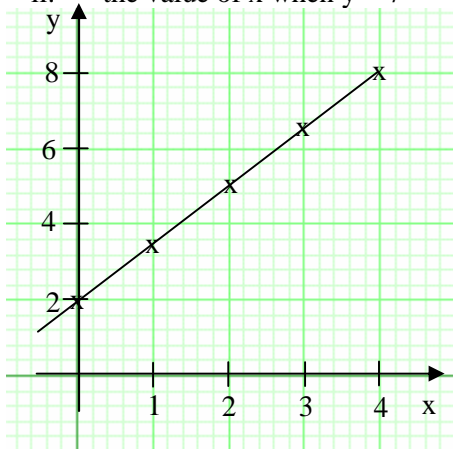
<p>1</p>  <p>$[y = \frac{5}{3}x + 3]$</p>	<p>2</p>  <p>$[y = -\frac{5}{2}x + 5]$</p>
-----------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------

3	 <p>$[y=2x^2+6]$</p>	4	 <p>$[y=-3x^2+11]$</p>
5	 <p>$[s=\frac{9}{2}t-\frac{27}{2}]$</p>	6	 <p>$[P=-\frac{1}{2}v+4]$</p>
7	 <p>$[p=\frac{5}{6}q-\frac{7}{6}]$</p>	8	 <p>$[p=-\frac{3}{2}v+5]$</p>

1.3 Determine the values of variables from lines of best fit

1 The diagram below shows a line of best fit. From the graph, find

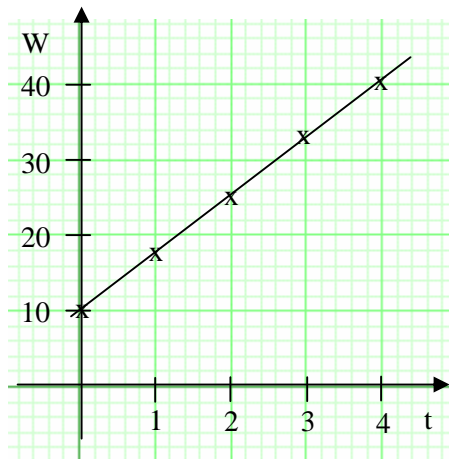
- i. the value of y when $x = 0.5$
- ii. the value of x when $y = 7$



[2.8, 3.3]

2 The diagram below shows a line of best fit. From the graph, find

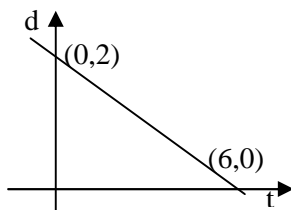
- i. the value of t when $w = 38$
- ii. the value of w when $t = 1.6$



[3.6,22]

3 The diagram below shows a line of best fit obtained by plotting the graph of d against t . The line intersects the vertical and the horizontal axes at points $(0,2)$ and $(6,0)$ respectively. Find

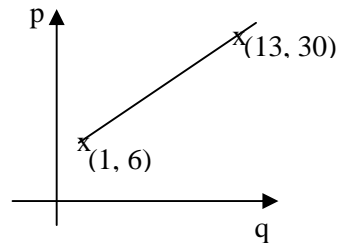
- i. the equation of best fit
- ii. the value of t when $d=3$
- iii. the value of d when $t=4$



$[d = -\frac{1}{3}t + 2, -3, \frac{2}{3}]$

4 Two variables, p and q are known to be linearly related as shown by the line of best fit in the diagram below. The line passes through points $(1.6, 6)$ and $(13.6, 30)$. Determine

- i. the equation of best fit
- ii. the value of q when $p= 15$
- iii. the value of p when $q = 5$



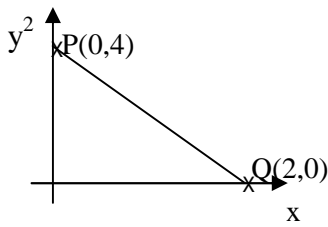
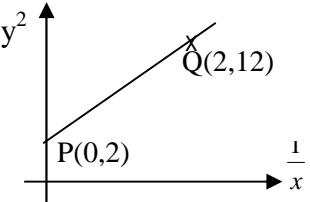
$[p=2q+4, 5.5, 14]$

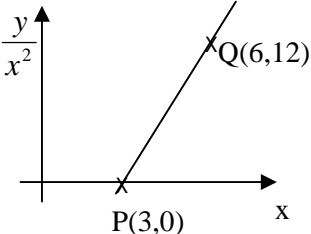
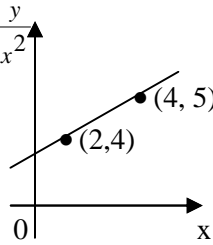
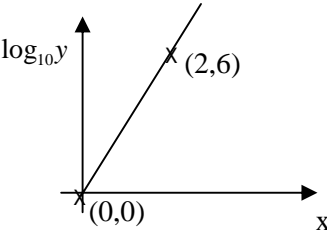
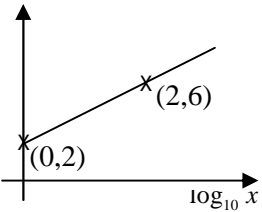
2.1 Reduce non linear relations to linear form

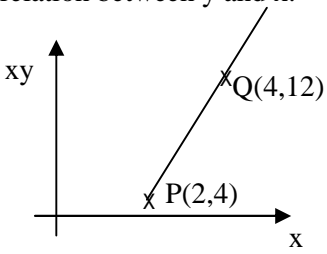
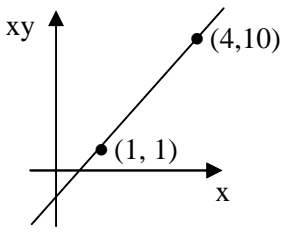
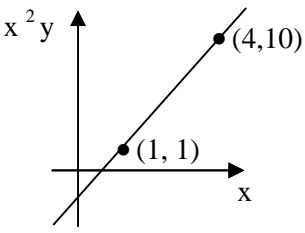
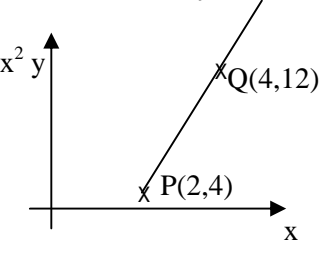
Reduce each of the equations to the form $Y=mX+C$ where a and b are constants.

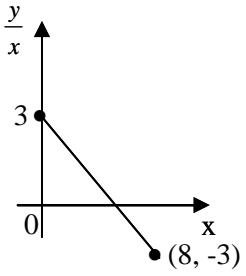
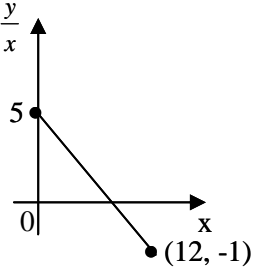
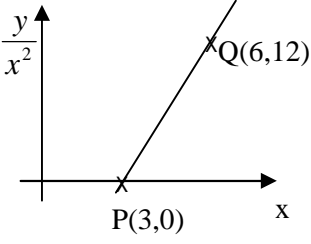
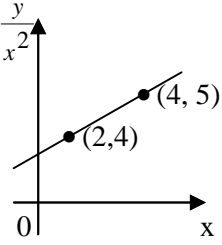
	Non-linear equation	Linear equation	Y	X	m	C
1	$y = a x^2 + b x$					B
2	$y = a x^3 + b x^2$	$\frac{y}{x^2} = a x + b$				
3	$y = \frac{a}{x} + b$		y			
4	$y = \frac{a}{x} + b x$					A
5	$x y = \frac{a}{x} + b x$			$\frac{1}{x^2}$		
6	$x + b y = a x y$		$\frac{1}{y}$			
7	$y = \frac{5}{x} - 3 x$					5
8	$y = \frac{a(b-x)}{x^2}$		xy			
9	$y = a b^x$				$\log_{10} b$	
10	$y = a x^b$					$\log_{10} a$
11	$y = a^2 x^b$				b	
12	$PV=a$		P			

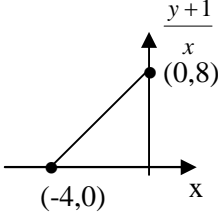
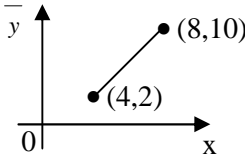
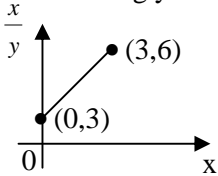
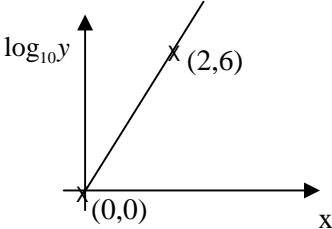
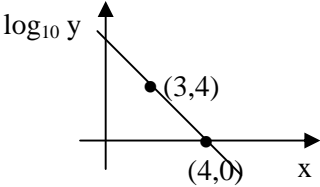
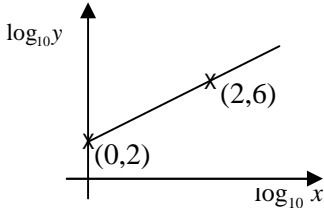
2.2 Determine values of constants of non-linear relations given lines of best fit

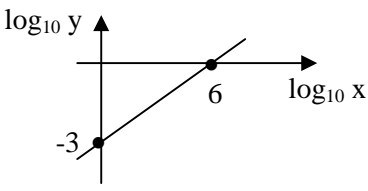
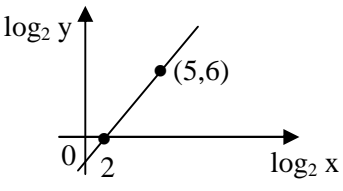
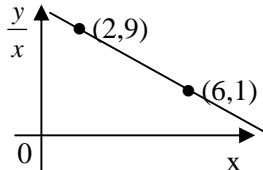
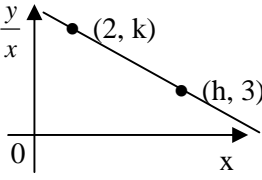
1	<p>The diagram below shows the line of best fit for the graph of y^2 against x. Determine the non-linear equation connecting y and x.</p>  <p>[$y^2 = -2x + 4$]</p>	2	<p>The diagram below shows the line of best fit for the graph of y^2 against $\frac{1}{x}$. Determine the non-linear equation connecting y and x.</p>  <p>[$y^2 = 5\left(\frac{1}{x}\right) + 2$]</p>
---	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

3	<p>The diagram below shows the line of best fit for the graph of $\frac{y}{x^2}$ against x. Determine the non-linear equation connecting y and x.</p>  <p style="text-align: center;">$\frac{y}{x^2}$</p> <p style="text-align: center;">x</p> <p style="text-align: center;">P(3,0) Q(6,12)</p> <p>$[\frac{y}{x^2} = 4x - 12]$</p>	4	<p>The diagram below shows the line of best fit for the graph of $\frac{y}{x^2}$ against x. Determine the non-linear equation connecting y and x.</p>  <p style="text-align: center;">$\frac{y}{x^2}$</p> <p style="text-align: center;">x</p> <p style="text-align: center;">(2,4) (4,5)</p> <p style="text-align: center;">0</p> <p>$[\frac{y}{x^2} = \frac{1}{2}x + 3]$</p>
5	<p>The diagram below shows the line of best fit for the graph of $\log_{10} y$ against x. Determine the non-linear equation connecting y and x.</p>  <p style="text-align: center;">$\log_{10} y$</p> <p style="text-align: center;">x</p> <p style="text-align: center;">(0,0) (2,6)</p> <p>$[\log_{10} y = 3x]$</p>	6	<p>The diagram below shows the line of best fit for the graph of $\log_{10} y$ against $\log_{10} x$. Determine the non-linear equation connecting y and x.</p>  <p style="text-align: center;">$\log_{10} y$</p> <p style="text-align: center;">$\log_{10} x$</p> <p style="text-align: center;">(0,2) (2,6)</p> <p>$[\log_{10} y = 2 \log_{10} x + 2]$</p>

7	<p>The diagram below shows the line of best fit for the graph of xy against x. Determine the relation between y and x.</p>  <p>The graph shows a coordinate system with a vertical axis labeled xy and a horizontal axis labeled x. A straight line is drawn through two points: $P(2,4)$ and $Q(4,12)$. The line has a positive slope and is labeled as the line of best fit.</p> <p>[$y = 4 - \frac{4}{x}$]</p>	8	<p>The diagram below shows the straight line graph of xy against x. Express y in terms of x.</p>  <p>The graph shows a coordinate system with a vertical axis labeled xy and a horizontal axis labeled x. A straight line is drawn through two points: $(1,1)$ and $(4,10)$.</p> <p>[$y = 3 - \frac{2}{x}$]</p>
9	<p>The diagram below shows the straight line graph of x^2y against x. Express y in terms of x.</p>  <p>The graph shows a coordinate system with a vertical axis labeled x^2y and a horizontal axis labeled x. A straight line is drawn through two points: $(1,1)$ and $(4,10)$.</p> <p>[$y = \frac{3}{x} - \frac{2}{x^2}$]</p>	10	<p>The diagram below shows the line of best fit for the graph of x^2y against x. Determine the relation between y and x.</p>  <p>The graph shows a coordinate system with a vertical axis labeled x^2y and a horizontal axis labeled x. A straight line is drawn through two points: $P(2,4)$ and $Q(4,12)$. The line has a positive slope and is labeled as the line of best fit.</p> <p>[$y = \frac{4}{x} - \frac{4}{x^2}$]</p>

11	<p>The diagram below shows the line when $\frac{y}{x}$ against x is drawn. Express y as a function of x.</p>  <p>The graph shows a Cartesian coordinate system with the vertical axis labeled $\frac{y}{x}$ and the horizontal axis labeled x. The origin is marked with 0. A straight line is plotted, passing through the y-axis at the point (0, 3) and through the point (8, -3).</p> <p>[$y = -\frac{3}{4}x^2 + 3x$]</p>	12	<p>The diagram below shows the line when $\frac{y}{x}$ against x is drawn. Express y as a function of x.</p>  <p>The graph shows a Cartesian coordinate system with the vertical axis labeled $\frac{y}{x}$ and the horizontal axis labeled x. The origin is marked with 0. A straight line is plotted, passing through the y-axis at the point (0, 5) and through the point (12, -1).</p> <p>[$y = -\frac{1}{2}x^2 + 5x$]</p>
13	<p>The diagram below shows the line of best fit for the graph of $\frac{y}{x^2}$ against x. Determine the relation between y and x.</p>  <p>The graph shows a Cartesian coordinate system with the vertical axis labeled $\frac{y}{x^2}$ and the horizontal axis labeled x. A line of best fit is drawn through two points: P(3, 0) on the x-axis and Q(6, 12).</p> <p>[$y = 4x^3 - 12x^2$]</p>	14	<p>The diagram below shows the line when $\frac{y}{x^2}$ against x is drawn. Express y as a function of x.</p>  <p>The graph shows a Cartesian coordinate system with the vertical axis labeled $\frac{y}{x^2}$ and the horizontal axis labeled x. The origin is marked with 0. A straight line is plotted, passing through the points (2, 4) and (4, 5).</p> <p>[$y = \frac{1}{2}x^3 + 3x^2$]</p>

15	<p>The diagram below shows the line when $\frac{y+1}{x}$ against x is drawn. Express y in terms of x.</p>  <p>[$y=2x^2+8x-1$]</p>	<p>The diagram below shows the line when $\frac{1}{y}$ against x is drawn. Determine the non-linear equation connecting y and x</p>  <p>[$y = \frac{1}{2x-6}$]</p>
17	<p>The diagram below shows the line when $\frac{x}{y}$ against x is drawn. Determine the non-linear equation connecting y and x</p>  <p>[$y = \frac{x}{x+3}$]</p>	<p>The diagram below shows the line of best fit for the graph of $\log_{10} y$ against x. Determine the relation between y and x.</p>  <p>[$y = 10^{3x}$]</p>
19	<p>The diagram below shows part the graph of $\log_{10} y$ against x. Form the equation that connecting y and x.</p>  <p>[$y = 10^{-4x+16}$]</p>	<p>The diagram below shows the line of best fit for the graph of $\log_{10} y$ against $\log_{10} x$. Determine the relation between y and x.</p>  <p>[$y= 100x^2$]</p>

<p>21 The diagram below shows part the graph of $\log_{10} y$ against $\log_{10} x$. Form the equation that connecting y and x.</p>  <p>[$y = \frac{\sqrt{x}}{1000}$]</p>	<p>22 The diagram below shows part the graph of $\log_2 y$ against $\log_2 x$. Determine the relation between y and x.</p>  <p>[$y = \frac{x^2}{16}$]</p>
<p>23 <i>SPM 2003 Paper 1 Q10</i> x and y are related by the equation $y = px^2 + qx$, where p and q are constants. A straight line is obtained by plotting $\frac{y}{x}$ against x, as shown in the diagram below.</p>  <p>Calculate the values of p and q. [4 marks]</p> <p>[$p = -2, q = 13$]</p>	<p>24 <i>SPM 2004 Paper 1 Q13</i> Diagram below shows a straight line graph of $\frac{y}{x}$ against x</p>  <p>Given that $y = 6x - x^2$, calculate the value of k and h [3 marks]</p> <p>[$h = 3, k = 4$]</p>

<p>25 <i>SPM 2005 Paper 1 Question 13</i> The variables x and y are related by the equation $y=kx^4$, where k is a constant.</p> <p>(a) Convert the equation $y=kx^4$ to linear form.</p> <p>(b) Diagram below shows the straight line obtained by plotting $\log_{10}y$ against $\log_{10}x$</p> <p>Find the value of</p> <p>(i) $\log_{10} k$</p> <p>(ii) h [4 marks]</p> <p>[3, 11]</p>	<p>26 The diagram below shows a straight line graph $\log_{10} y$ against x. The variables x and y are related by the equation $y= ab^x$, where a and b are constants. Find the values of</p> <p>(i) a</p> <p>(ii) b</p> <p>[10,100]</p>
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

- 2.3 Obtain information from
- (i) lines of best fit
 - (ii) equations of lines of best fit.

1. Use graph paper to answer this question.

The table below records the values of an experiment for two variables x and y which are related by

$y = px^2 + \frac{q}{x}$ where p and q are constants.

x	0.8	1	1.3	1.4	1.5	1.7
y	108.75	79	45.38	36.5	26.67	8.19

(a) Plot xy against x^3 using scale 2 cm represents 1 unit in x -axis and 2 cm represents 10 units for y -axis.

Hence, draw the line of best fit

[5marks]

(b) From the graph, estimate the value of

(i) p and q

(ii) x when $y = \frac{45}{x}$

[5marks]

[Answer: $p = -16.67$, $q = 95$, $x = 1.458$]

2. Use graph paper to answer this question.

The table below records the values of an experiment for two variables x and y which are related by $\frac{y}{x} = \frac{p}{x} + kx$ where p and k are constants.

x	3	5	6	7	8	9
y	4.7	4.0	3.6	3.0	2.5	1.8

(a) Plot the graph y against x^2 [4 marks]

(b) use the graph to estimate the values of

- (i) p
- (ii) k .

(iii) x which satisfy the simultaneous equation $\frac{y}{x} = \frac{p}{x} + kx$ and $y = 2$ [6 marks]

[answer: $p=5, k= -0.04, x= 8.60 - 8.75$]

3. Use graph paper to answer this question.

The table below records the values of an experiment for two variables x and y which are related by $Y=pq^x$ where p and q are constants.

x	3	4	5	6	7
y	5	10	20	40	80

(a) Plot the graph $\log_{10} y$ against x [4 marks]

(b) Use the graph to estimate the values of

- (i) p
- (ii) q .
- (iii) y when $x=4.8$

[6 marks]

[answer: 1.995, 0.6166, 17.38]

4. SPM 2003 Paper 2 Question 7

Use graph paper to answer this question.

Table below shows the value of two variables, x and y , obtained from an experiment. It is known that x and y are related by the equation $y = pk^{x^2}$, where p and k are constants

x	1.5	2.0	2.5	3.0	3.5	4.0
y	1.59	1.86	2.40	3.17	4.36	6.76

(a) Plot $\log_{10} y$ against x^2
Hence, draw the line of best fit. [5 marks]

(b) Use the graph in (a) to find the value of

- (i) p
- (ii) k

[5 marks]

[Answer: $p=1.259, k=1.109$]

5. SPM 2004 Paper 2 Question 7

Use graph paper to answer this question.

Table below shows the values of two variables, x and y , obtained from an experiment. Variables x and y are related by the equation $y = p k^x$, where p and k are constants.

x	2	4	6	8	10	12
y	3.16	5.50	5.50	16.22	28.84	46.77

- (a) Plot $\log_{10} y$ against x by using a scale of 2 cm to 2 units on the x -axis and 2 cm to 0.2 unit on the $\log_{10} y$ -axis.

Hence, draw the line of best fit

[4 marks]

- (b) Use your graph from (a) to find the value of

(i) p

(ii) k

[6 marks]

Answer : $p = 1.820, k = 1.309$

6. SPM 2005 Paper 2 Question 7

Use graph paper to answer this question.

Table below shows the values of two variables, x and y , obtained from experiment. The variables x and y are related by the equation $y = px + \frac{r}{px}$, where p and r are constants.

x	1.0	2.0	3.0	4.0	5.0	5.5
y	5.5	4.7	5.0	6.5	7.7	8.4

- (a) Plot xy against x^2 , by using a scale of 2 cm to 5 units on both axes. Hence, draw the line of best fit.

[5 marks]

- (b) Use the graph from (a) to find the value of

(i) p

(ii) r

[5 marks]

Answer : [$p = 1.37, r = 5.48$]

7. SPM 2006 Paper 2 Question 7

Use graph paper to answer this question.

Table below shows the values of two variables, x and y , obtained from an experiment. Variables x and y are related by the equation $y = pk^{x+1}$, where p and k are constants.

x	1	2	3	4	5	6
y	4.0	5.7	8.7	13.2	20.0	28.8

- (a) Plot $\log y$ against $(x+1)$, using a scale of 2 cm to 1 unit on the $(x+1)$ -axis and 2 cm to 0.2 unit on the $\log y$ -axis.

Hence, draw the line of best fit.

[5 marks]

- (b) Use your graph from (a) to find the values of

(i) p

(ii) k

[5 marks]

Answer for 2.1

	Non-linear equation	Linear equation	Y	X	m	C
1	$y = a x^2 + b x$	$\frac{y}{x} = ax + b$	$\frac{y}{x}$	x	a	b
2	$y = ax^3 + bx^2$	$\frac{y}{x^2} = ax + b$	$\frac{y}{x^2}$	x	a	b
3	$y = \frac{b}{x} + a$	$y = b\left(\frac{1}{x}\right) + a$	y	$\frac{1}{x}$	b	a
4	$y = \frac{b}{x} + ax$	$xy = b + ax^2$	xy	x^2	a	b
5	$xy = \frac{b}{x} + ax$	$y = b\left(\frac{1}{x^2}\right) + a$	y	$\frac{1}{x^2}$	b	a
6	$x + by = axy$	$\frac{1}{y} = -\frac{b}{x} + a$	$\frac{1}{y}$	$\frac{1}{x}$	-b	a
7	$y = \frac{5}{x} - 3x$	$xy = -3x^2 + 5$	xy	x^2	-3	5
8	$y = \frac{a(b-x)}{x^2}$	$xy = (ab)\frac{1}{x} - a$	xy	$\frac{1}{x}$	ab	-a
9	$y = ab^x$	$\log_{10} y = (\log_{10} b)x + \log_{10} a$	$\log_{10} y$	x	$\log_{10} b$	$\log_{10} a$
10	$y = ax^b$	$\log_{10} y = b(\log_{10} x) + \log_{10} a$	$\log_{10} y$	$\log_{10} x$	b	$\log_{10} a$
11	$y = a^2 x^b$	$\log_{10} y = b(\log_{10} x) + 2\log_{10} a$	$\log_{10} y$	$\log_{10} x$	b	$2\log_{10} a$
12	PV=a	$P = \frac{a}{V}$	P	$\frac{1}{V}$	a	0