Write your name here

Surname	Other Names

AS/A Level Mathematics

Non Linear Regression

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

• Use **black** ink or ball-point pen.
• If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
• **Fill in the boxes** at the top of this page with your name.
• Answer **all** questions and ensure that your answers to parts of questions are clearly labelled..
• Answer the questions in the spaces provided
– there may be more space than you need.
• You should show sufficient working to make your methods clear.
Answers without working may not gain full credit.
• Answers should be given to three significant figures unless otherwise stated.

Information

• The marks for **each** question are shown in brackets
– use this as a guide as to how much time to spend on each question.

Advice

• Read each question carefully before you start to answer it.
• Try to answer every question.
• Check your answers if you have time at the end.

1 Two variables x and y are related by the formula $y = ax^b$ where a and b are constants.

Show that this relationship can be written in the form $\log y = \log a + b \log x$

(Total for question 1 is 3 marks)

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2 The temperature of water (w°C) in a kettle t minutes after it was boiled is recorded in the table below

t	1	3	6	9	11	15	20
w	92	76	65	50	46	33	25

The data is coded using the changes of variable $x = t$ and $y = \log_{10} w$

The regression line of x on y is found to be $y = 1.99 - 0.031x$

(a) Given that the data can be modelled by an equation in the form $w = ab^t$ where a and b are constants. Find the values of a and b to 3 significant figures. **(3)**

(b) Give an interpretation of the constant a in this equation. **(1)**

(c) Explain why this model is not reliable for calculating the temperature after 1 hour. **(1)**

(Total for question 2 is 5 marks)

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3 The variables x and y are recorded and the results are shown in the table below

x	1	2	3	4	5	6	7	8	9	10
y	429	754	871	1119	2478	2653	3050	3279	5470	7439

The data is coded using the changes of variable $r = x$ and $s = \log_{10} y$

(a) The product moment correlation coefficient for the coded data is 0.98
Comment on r for this model and therefore justify the use of a model in the form $y = ab^x$ here a and b are constants **(3)**

The regression line of r on s is found to be $s = 2.60 + 0.127r$

(b) Find the values of a and b, give your answers to 3 significant figures **(3)**

(Total for question 3 is 6 marks)