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Examiners' report

CORE MATHS B (MEI)

H869

For first teaching in 2016

H869/02 Summer 2022 series

Version 1

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Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

Paper 2 series overview

This paper was well answered. Most candidates clearly understood the topics in the specification that were being tested and also related well to the various contexts that were used in the questions. There were only a few for whom this was not the case.

Half of the marks on this paper are based on a pre-release data set. The responses indicated that most candidates were familiar with this. It had clearly been used as teaching material as intended.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• they were well prepared which helped them to score most of the marks on all the questions • there were a lot of single mark questions requiring comment-type responses; on the whole they obtained these marks, showing an understanding of the underlying ideas.	• they usually scored the early marks on most or all of the questions. However, they often made mistakes on the subsequent calculations • their responses to the comment-type questions often showed a lack of engagement either with the topic or with the context • in many cases their scripts suggested a lack of serious preparation.

Section A overview

There were three questions in Section A.

Question 1 was on data handling in a context taken from everyday life. Although almost all candidates got the first few parts, many had difficulty interpreting the more demanding final part.

Question 2 was on the Normal distribution. The context was the heights of trees in a forest. It was well answered but part (c), on the area under part of the curve, was found less easy than the rest.

Question 3 was on a hypothesis test using Spearman's rank correlation coefficient. The variables were the number of steps taken in a day and the length of sleep the subsequent night. There were many correct responses.

Question 1 (a)

1 Jane is hoping to open a charity shop to support a local animal shelter. She will need more people to help with the work but before trying to recruit anyone she feels she needs more information.

She asks the 12 other people in her yoga group to fill in the questionnaire in **Fig. 1.1** anonymously.

Helping animals

For each question please circle one response

A **Are you in favour of work to support animals?**

1 Not at all 2 A little 3 On the whole 4 Strongly 5 Very strongly

B **Would you welcome a new charity shop on the high street raising money for animal welfare?**

1 Not at all 2 Prefer not 3 On the whole 4 Overall, yes 5 A great idea

C **Would you be prepared to donate your unwanted possessions to an animal charity shop?**

1 Never 2 Occasionally 3 Sometimes 4 Often 5 Always

D **How many hours a week would you be prepared to spend helping in an animal charity shop?**

1 None 2 One to Two 3 Three to Five 4 Six to Ten 5 Over Ten

Fig. 1.1

(a) Choose the term in the answer space which describes Jane's sample best. **[1]**

1(a)	**Circle one of the following terms**					
	Cluster	Opportunity	Quota	Self-selected	Simple random	Stratified

The correct response was Opportunity but only a minority of candidates got it right. All the other options were chosen.

Question 1 (b)

1 continued

Jane records the scores of 1, 2, 3, 4 or 5 in the table in **Fig. 1.2**. She treats them as numerical scores.

Question \ Score	1	2	3	4	5
A	5	0	1	2	4
B	6	0	0	3	3
C	4	1	0	4	3
D	6	0	1	2	2

Fig. 1.2

(b) Complete the table in **Fig. 1.3** in the answer space. **[1]**

1(b)

Score	1	2	3	4	5
Frequency			2		

Fig. 1.3

Almost all candidates got this right.

Question 1 (c)

(c) Show that one person did not answer all the questions. **[1]**

Almost all candidates got this response right too.

Question 1 (d)

1 (d) Choose the term in the answer space which describes the distribution of the scores best. **[1]**

1(d)	**Circle one of the following terms**				
	Positively skewed	Negatively skewed	Uniform	Normal	Bimodal

The correct response was "Bimodal" but many candidates answered, "Positively skewed".

Question 1 (e) (i)

(e) (i) Find the mean score per person per question answered, giving your answer to **2** decimal places. **[3]**

Only the highest performing candidates answered this part correctly. Many others did not appreciate that a weighted mean was required.

Question 1 (e) (ii)

(ii) Give one reason why this figure is not helpful to Jane. **[1]**

The intention of this question was to make the point that the mean of a bimodal distribution may be far away from most of the data. However, most candidates' responses related to the actual context and these were of course accepted if reasonable.

Question 2 (a) (i)

2 A large number of seeds of a forest tree are planted. Many years later, the heights of a sample of the now mature trees are reported to have mean 40 feet and standard deviation 8 feet.

(a) (i) Convert the mean and standard deviation of these heights into metres.
[1 foot = 30.5 cm to 3 s.f.] **[2]**

This question on change of units was well answered but a few candidates omitted the new units.

Question 2 (a) (ii)

(ii) It is suggested that the mean and standard deviation reported are only approximate.

Give a reason to support this view. **[1]**

Most candidates gave reasonable responses to this question, either commenting on the obvious rounding of the given figures, or on the difficulty of measuring the heights of trees or on the likely inaccuracy of sample data.

Question 2 (b)

In a larger study it is found that the heights of the mature trees grown under usual conditions are Normally distributed with mean 12 m and standard deviation 2 m. This distribution is shown in **Fig. 2.1** in the answer space for part **(b)**.

(b) Number the scale on the horizontal axis in **Fig. 2.1**. **[2]**

2(b)

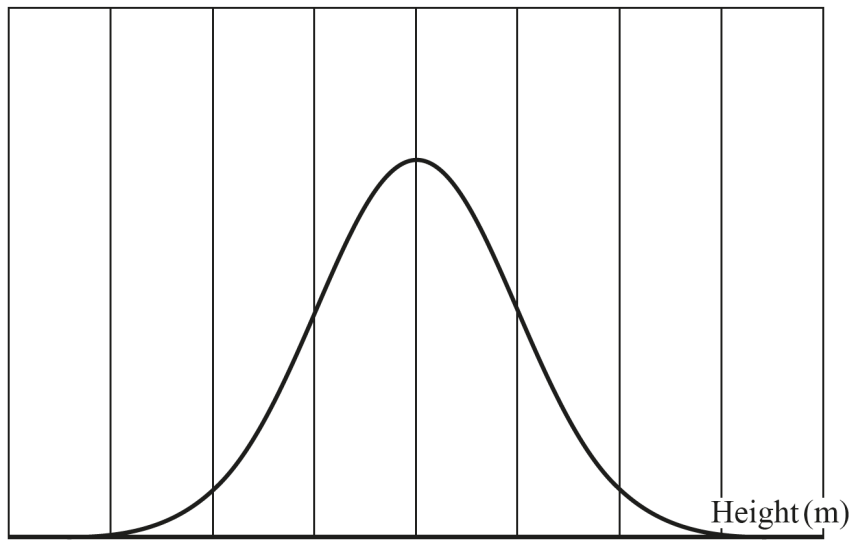


Fig. 2.1

Most candidates got this right with a central value of 12m and 2m intervals above and below it.

Question 2 (c)

(c) Find the percentage of mature trees that are over 10 m tall. **[3]**

While more successful candidates answered this succinctly, there were many rather confused responses often because the area to be found was not clearly defined by the candidate. Some candidates used their knowledge of areas associated with the Normal distribution (e.g. 68% within 1 standard deviation of the mean), others obtained figures from the formula booklet; either was acceptable.

Exemplar 1

2(c)

1 standard deviation

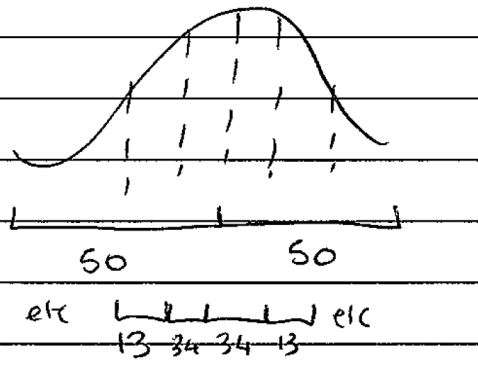
Using data sheet

or Z

$1^{sd} = 0.8413$

0.8413×100

$= 84.13\%$



$= 34 + 50 = \approx 84$

The response in Exemplar 1 actually shows two ways in which this part question could be correctly answered; either was acceptable.

Question 2 (d)

In one particular plantation 254 seeds grew into young trees. They were then thinned out. The smallest 50% of the young trees were cut down.

Many years later all the surviving trees were measured. The distribution of their mature heights is shown in the frequency chart in **Fig. 2.2**.

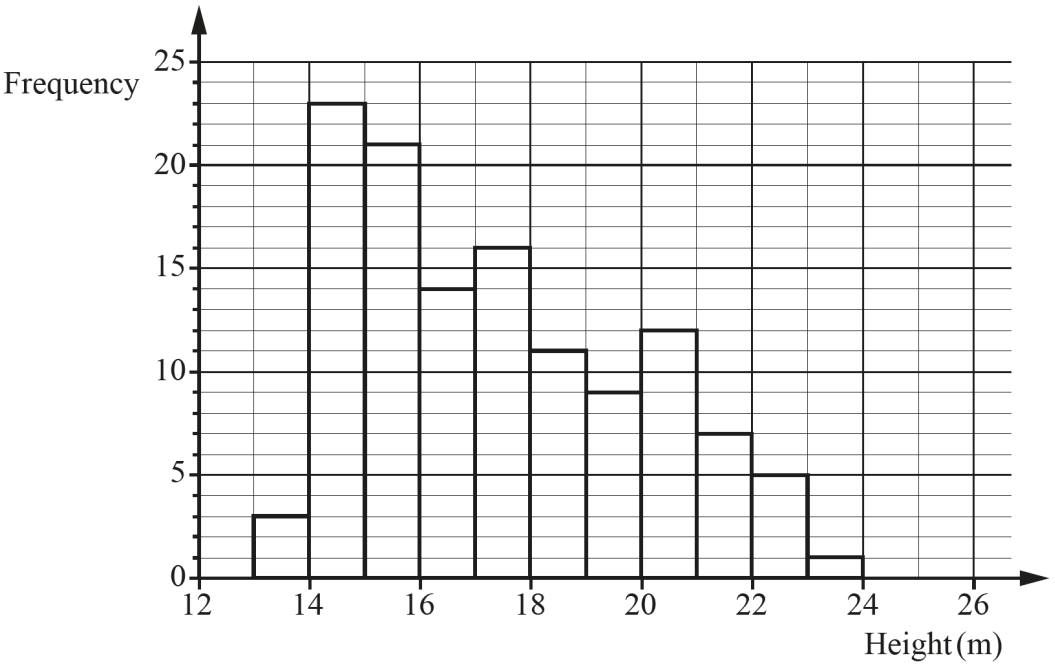


Fig. 2.2

(d) How many of the trees that were not cut down when the thinning took place had subsequently died? **[2]**

This question was very well answered, even by candidates who had not completed the previous part successfully.

Question 2 (e)

(e) Comment on the distribution of the heights of the mature trees. **[1]**

Most candidates said the distribution was skewed but many said it was negative instead of positive. Some wrote a description of it, for example that the frequency decreased with increasing height, and this was accepted if correct.

Question 3 (a)

3 A shop sells devices for counting the number of steps you take each day. **Fig. 3.1** shows their own special notice for advertising them.

Statistically Proved

Taking more steps in the day makes you sleep longer at night

Fig. 3.1

A customer challenges this and asks the shop for details of the proof.
Fig. 3.2 shows the shop manager's written reply.

For a week I recorded the number of steps I took each day and how long I slept for that night. That gave me my theory. Look at my figures.

Day	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*	*Sun*
Steps	6459	6871	7762	6967	12678	12511	12413
Sleep (hours)	6.4	6.8	7.4	5.9	7.7	8.1	7.3

So I used my data to do a proper hypothesis test using the Spearman coefficient. It showed there is a significant correlation. You can see I have proved statistically that taking more steps makes you sleep longer at night.

Fig. 3.2

The customer decides to check the shop manager's test.

(a) Write down the null hypothesis and the alternative hypothesis for a 1-tail test using Spearman's rank correlation coefficient. **[2]**

This was not well answered. The correct responses were:

H_0: There is no association between the steps taken and hours of sleep

H_1: There is a positive association

Misconception

Answering Question 3(a), many candidates missed the word "positive" from H_1 . Many others, instead of giving precise statements, wrote too much. On this occasion some leniency was shown in the marking but that may not be the case in the future.

Question 3 (b)

(b) Complete the table in the answer space and calculate the value of r_s. **[4]**

3(b)

Day	Steps	Steps rank, x	Sleep	Sleep rank, y	$d = x - y$	d^2
Mon	6459		6.4			
Tue	6871	6	6.8	5	1	1
Wed	7762	4	7.4	3	1	1
Thu	6967		5.9			
Fri	12678	1	7.7	2	–1	1
Sat	12511	2	8.1	1	1	1
Sun	12413	3	7.3	4	–1	1
				$\sum$		

Spearman's coefficient, $r_s =$

Many candidates got this part fully right. Where there were mistakes, they were mostly numerical errors or omissions.

Question 3 (c)

(c) Carry out the test, using a 5% significance level, and state the conclusion. **[3]**

There were many correct responses to this part. A common mistake was to use the tables for the pmcc when finding the critical value, obtaining 0.6694 instead of 0.7143.

Question 3 (d)

(d) Make **two** criticisms of the manager's reply to the customer in **Fig. 3.2**. **[2]**

There were many good responses to this part. The commonest were that the manager only used himself as a subject and that the data only covered one week. Marks were not given for non-statistical criticisms, such as that the manager was rude.

Section B overview

The three questions in Section B were all based on the pre-release data. It was clear that the vast majority of candidates were familiar with it and could find any data items they were asked for.

Question 4 (a)

4 **(a)** Write down the Population of the Seychelles, its Birth rate per thousand population and its Annual population growth (%). **[1]**

Virtually all candidates found the correct figures.

Question 4 (b) (i)

(b) **(i)** Find how many babies are born in a year in the Seychelles. **[1]**

Most candidates obtained the right response. The commonest mistake was to be a factor of 10 out as a result of not dealing with the birth rate being given as a percentage per thousand of the population.

Question 4 (b) (ii)

(ii) Find by how many people the population of the Seychelles increases over a year. **[2]**

This question too was answered correctly by many candidates.

Question 4 (c)

(c) The death rate for the Seychelles is 7.1 per thousand population.

Show that there is a net immigration of about 100 people per year into the Seychelles. **[3]**

Most candidates obtained the correct number of deaths per year, but several then did not combine the various elements they had already obtained to estimate the number of immigrants. However there were plenty of right responses from candidates who had thought through the question.

Question 5 (a) (i)

5 Some countries are described as "young", meaning that a high proportion of the people who live there are young. Similarly countries where a high proportion of the population are not young can be described as "old".

(a) (i) Write down the median ages of France, Japan, the United States and Zambia. **[1]**

Virtually all candidates answered this correctly.

Question 5 (a) (ii)

(ii) Place the four countries in order of median age, from youngest to oldest. **[1]**

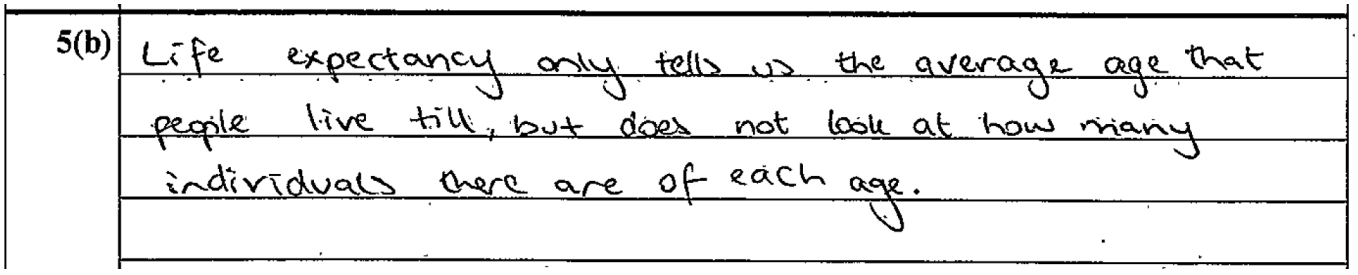
Virtually all candidates also answered this correctly.

Question 5 (b)

(b) Explain briefly why the median age is a better measure of how young or old a country is than the life expectancy. **[1]**

Most candidates knew what they wanted to say in response to this part, but not all found it easy to express themselves. There were some rather long responses but if one contained sensible points this was not of course held against the candidate and the mark was given.

Exemplar 2



A good statement as to why the median is a better measure of a country's age than life expectancy.

Question 5 (c)

Rishi is interested in the differences between typical median ages in different continents or regions.

He uses the command =AVERAGE(... : ...) to find the mean values of the median ages.

(c) Fill in the blank spaces in the command needed to find the mean of the median ages for the countries in Africa. **[1]**

Most candidates answered this spreadsheet question correctly. However, there were some candidates who left it blank. There is the possibility this was because they were unfamiliar with spreadsheets, even though their use is in the specification.

Question 5 (d)

Rishi uses the spreadsheet to draw the bar chart in **Fig. 5.1** below showing the mean values of the median ages for each continent or region.

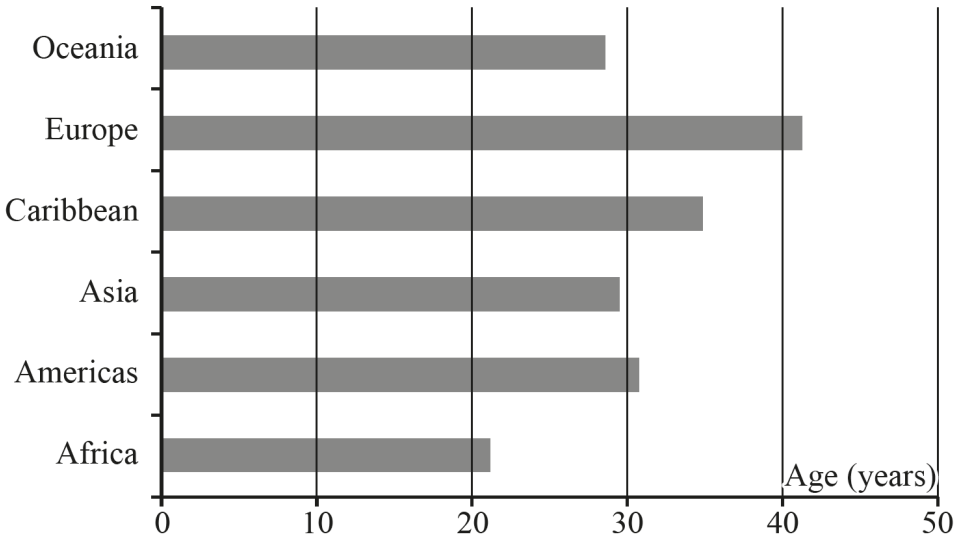


Fig. 5.1

He also uses the spreadsheet to calculate the standard deviations of the median ages for the different continents. The continent with the lowest standard deviation is Europe with 3.8 years and the continent with the highest is Asia with 6.6 years.

(d) For Africa the mean is 21.2 years and the standard deviation is 5.3 years.

Use these figures to identify the median ages of countries that can be considered outliers for Africa.

Identify **3** countries that are outliers for Africa, justifying your answer. **[2]**

This question was not well answered.

Misconception

In answering Question 5(d), many candidates did not use the mean ± 2 standard deviations criterion; 1, 1.5 and 3 standard deviations were all seen.

Question 5 (e)

Rishi looks more carefully at the median ages for Africa. He wishes to compare them with those from the other continents.

He notices that the figures for Northern Africa and the island countries are quite different from those for the rest of Africa. He decides to treat all those countries as outliers and to remove them from his investigation.

This leaves only countries in mainland Southern Africa. For these 42 countries the mean is 19.2 and the standard deviation is 2.5.

(e) Give one reason in favour of removing all those countries and one reason against doing so. **[2]**

Most candidates gave a good reason for not removing the outliers but there were fewer responses that included a good reason for doing so.

Question 5 (f)

(f) There are several issues that the government of a young country may regard as problems. Use your general knowledge to state one of them briefly. **[1]**

This open-ended question produced a wide variety of responses. No credit was given for those, like "High crime rate", that were not related to a country being young.

Question 6 (a)

6 Casey is investigating the rate of population growth around the world.

She starts by cleaning the data, excluding countries where the growth rate figure looks unreliable. Then she places countries for each region or continent into three groups according to their annual growth rate: Negative (less than 0%), Low (between 0% and 1.5%) and Fast (over 1.5%).

Her results are shown in **Fig. 6.1**.

	Observed frequency, f_o			
	Negative	**Low**	**Fast**	**Total**
Africa	0	10	46	**56**
Americas	2	20	4	**26**
Asia	5	27	18	**50**
Caribbean	5	14	4	**23**
Europe	18	29	1	**48**
Oceania	6	14	4	**24**
Total	**36**	**114**	**77**	**227**

Fig. 6.1

Casey notices the differences between the regions and wonders if they are statistically significant. She decides to carry out a χ^2 test on the data.

(a) Select which one of the following statements is the null hypothesis. **[1]**

A The regions are all different.

B Most regions have a Low growth rate.

C The proportions of Negative, Low and Fast growth rates are independent of the region.

D There is a correlation between regions and annual growth rate.

E The proportions of Negative, Low and Fast growth rates depend on the region.

6(a)	**Circle one of the statements for the null hypothesis**				
	A	B	C	D	E

Many candidates chose the correct response, C.

Question 6 (b)

6 (b) Show that the Expected frequency of Negative growth rate for the Americas is less than 5. **[3]**

Most candidates got this right but some lost the final mark by failing to show their response was less than 5.

Question 6 (c)

Because the Expected frequency for this cell is so low, Casey decides to combine the figures for Negative and Low under a new heading of "Slow".

(c) Complete **Fig. 6.2** in the answer space. **[2]**

6(c)

	Observed frequency, f_o				Expected frequency, f_e		
	Slow	**Fast**	**Total**		**Slow**	**Fast**	**Total**
Africa	10	46	**56**		37.004 ...	18.995 ...	**56**
Americas							
Asia	32	18	**50**		33.039 ...	16.960 ...	**50**
Caribbean	19	4	**23**		15.198 ...	7.801 ...	**23**
Europe	47	1	**48**		31.718 ...	16.281 ...	**48**
Oceania	20	4	**24**		15.859 ...	8.140 ...	**24**
Total	**150**	**77**	**227**				

Fig. 6.2

This was well answered.

Question 6 (d) (i)

6 (d) (i) Complete the calculation of X^2 in the answer space. Give your working correct to **2** decimal places and your final answer to **1** decimal place. **[2]**

6(d)(i)

X^2	=	19.71	+	38.39	
	+	1.35	+	2.63	
	+	0.03	+	0.06	
	+	0.95	+	1.85	
	+	7.36	+	14.34	
	+	...	+	...	
			=	...	(1 dp)

This too was well answered.

Question 6 (d) (ii)

(ii) State which element makes the smallest contribution to the value of X^2. **[1]**

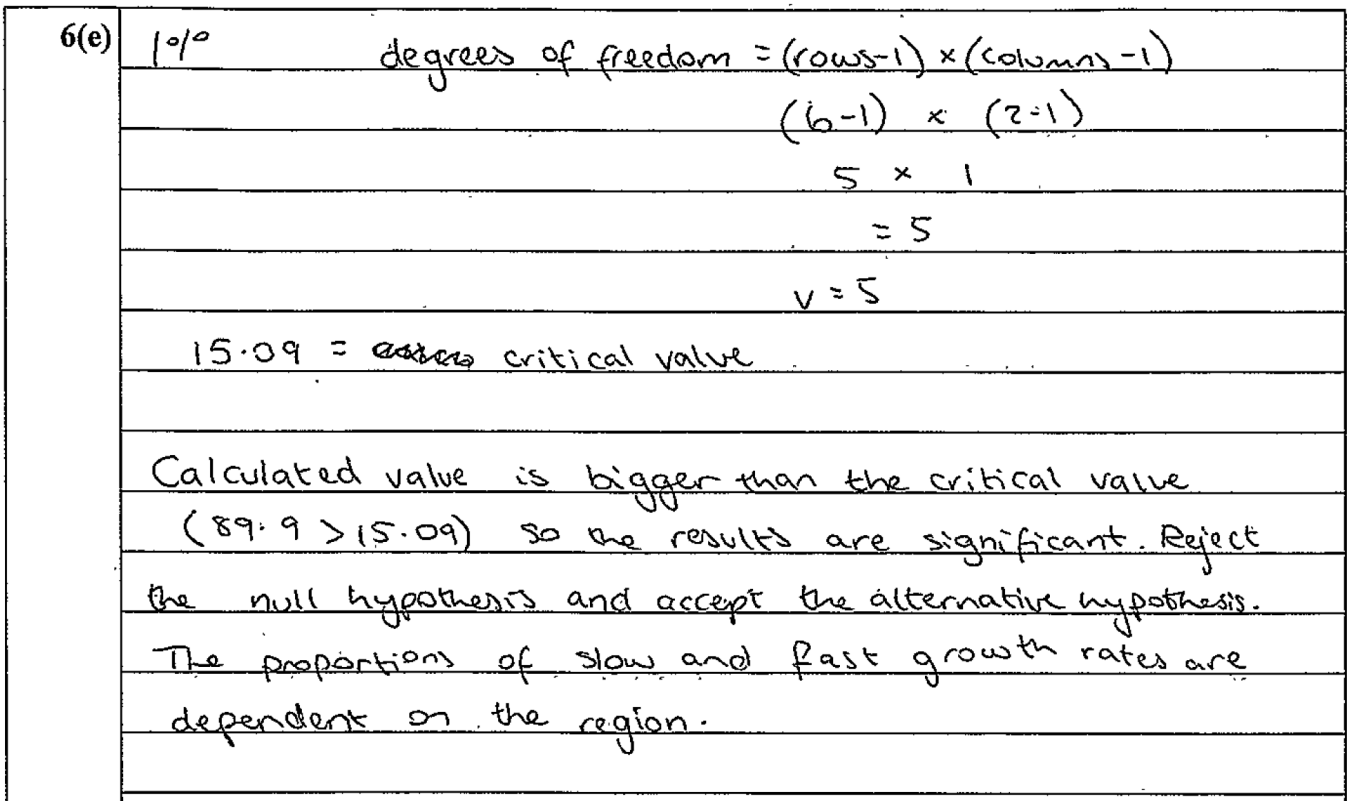
Most candidates wrote either "Asia low" or "0.03" and either was acceptable. However there were those who did not identify the element uniquely, for example giving responses like "Asia" or "0.03 and 0.06", and they were not given the mark.

Question 6 (e)

(e) Carry out the test at the 1% significance level and state the conclusion. **[5]**

This question was well answered by many candidates. The final mark was only available for perfect responses and all 5 marks were often given.

Exemplar 3



A good example of a fully correct final part to Question 6.

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