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Candidate surname					Other names				
Centre Number					Candidate Number				
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**Pearson Edexcel Level 3 GCE**

**Monday 18 October 2021 – Afternoon**

Paper reference	<b>9MA0/31</b>
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**Mathematics**

**Advanced**

**PAPER 31: Statistics**

**You must have:**  
Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

**Candidates may use any calculator allowed by Pearson regulations. 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, centre number and candidate number.
- 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.
- Values from statistical tables should be quoted in full. If a calculator is used instead of tables the value should be given to an equivalent degree of accuracy.
- Inexact answers should be given to three significant figures unless otherwise stated.

### Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- The total mark for this part of the examination is 50. There are 6 questions.
- 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.

Turn over ►

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1. (a) State one disadvantage of using quota sampling compared with simple random sampling.

(1)

In a university 8% of students are members of the university dance club.

A random sample of 36 students is taken from the university.

The random variable  $X$  represents the number of these students who are members of the dance club.

- (b) Using a suitable model for  $X$ , find

(i)  $P(X = 4)$

(ii)  $P(X \geq 7)$

(3)

Only 40% of the university dance club members can dance the tango.

- (c) Find the probability that a student is a member of the university dance club and can dance the tango.

(1)

A random sample of 50 students is taken from the university.

- (d) Find the probability that fewer than 3 of these students are members of the university dance club and can dance the tango.

(2)



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Question 1 continued.

Lined area for writing the answer to Question 1.

(Total for Question 1 is 7 marks)



2. Marc took a random sample of 16 students from a school and for each student recorded

- the number of letters,  $x$ , in their last name
- the number of letters,  $y$ , in their first name

His results are shown in the scatter diagram on the next page.

(a) Describe the correlation between  $x$  and  $y$ .

(1)

Marc suggests that parents with long last names tend to give their children shorter first names.

(b) Using the scatter diagram comment on Marc's suggestion, giving a reason for your answer.

(1)

The results from Marc's random sample of 16 observations are given in the table below.

$x$	3	6	8	7	5	3	11	3	4	5	4	9	7	10	6	6
$y$	7	7	4	4	6	8	5	5	8	4	7	4	5	5	6	3

(c) Use your calculator to find the product moment correlation coefficient between  $x$  and  $y$  for these data.

(1)

(d) Test whether or not there is evidence of a negative correlation between the number of letters in the last name and the number of letters in the first name.

You should

- state your hypotheses clearly
- use a 5% level of significance

(3)

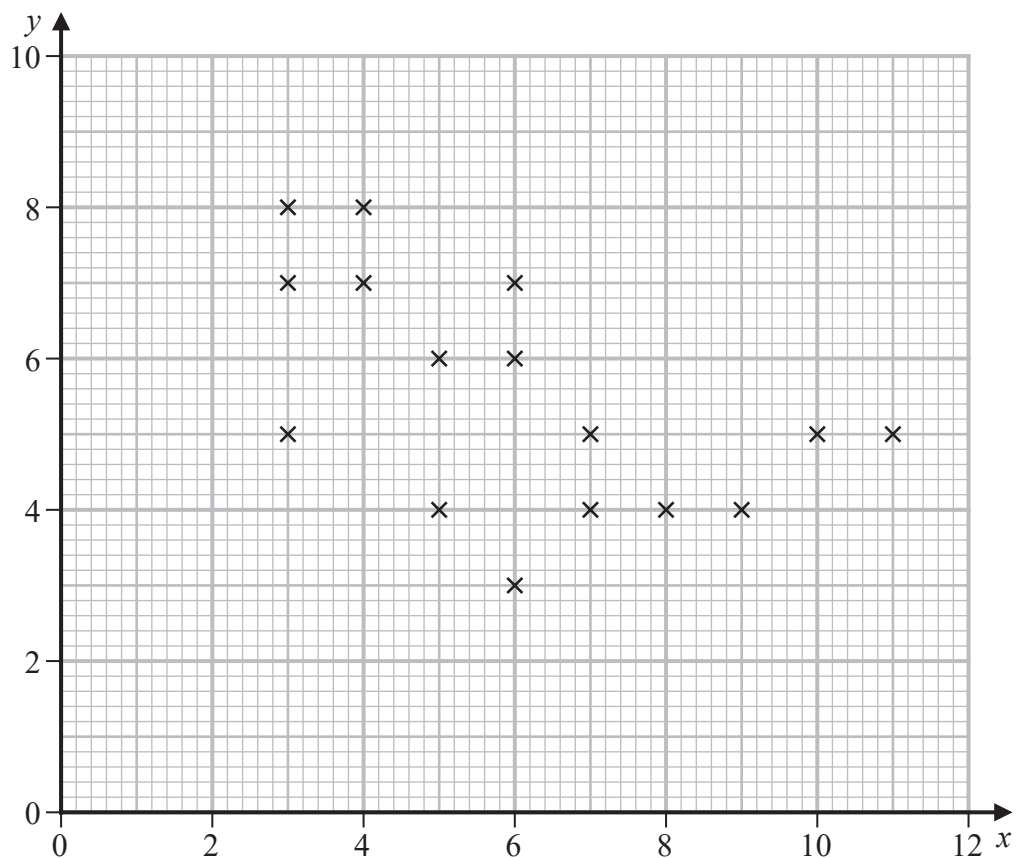


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Question 2 continued.



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Question 2 continued.

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Question 2 continued.

Lined area for writing the answer to Question 2.

(Total for Question 2 is 6 marks)

3. Stav is studying the large data set for September 2015

He codes the variable Daily Mean Pressure,  $x$ , using the formula  $y = x - 1010$

The data for all 30 days from Hurn are summarised by

$$\sum y = 214 \quad \sum y^2 = 5912$$

- (a) State the units of the variable  $x$  (1)
- (b) Find the mean Daily Mean Pressure for these 30 days. (2)
- (c) Find the standard deviation of Daily Mean Pressure for these 30 days. (3)

Stav knows that, in the UK, winds circulate

- in a **clockwise** direction around a region of **high** pressure
- in an **anticlockwise** direction around a region of **low** pressure

The table gives the Daily Mean Pressure for 3 locations from the large data set on 26/09/2015

Location	Heathrow	Hurn	Leuchars
Daily Mean Pressure	1029	1028	1028
Cardinal Wind Direction			

The Cardinal Wind Directions for these 3 locations on 26/09/2015 were, in random order,

W      NE      E

You may assume that these 3 locations were under a single region of pressure.

- (d) Using your knowledge of the large data set, place each of these Cardinal Wind Directions in the correct location in the table. (2)
- Give a reason for your answer.

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Question 3 continued.

Lined area for writing the answer to Question 3.

(Total for Question 3 is 8 marks)



4. A large college produces three magazines.

One magazine is about green issues, one is about equality and one is about sports.

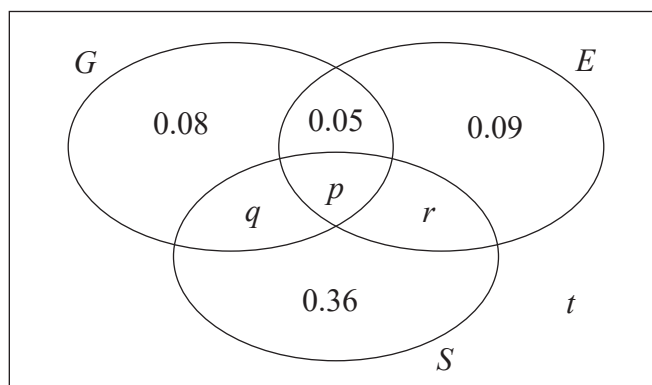
A student at the college is selected at random and the events  $G$ ,  $E$  and  $S$  are defined as follows

$G$  is the event that the student reads the magazine about green issues

$E$  is the event that the student reads the magazine about equality

$S$  is the event that the student reads the magazine about sports

The Venn diagram, where  $p$ ,  $q$ ,  $r$  and  $t$  are probabilities, gives the probability for each subset.



- (a) Find the proportion of students in the college who read exactly one of these magazines.

(1)

No students read all three magazines and  $P(G) = 0.25$

- (b) Find

(i) the value of  $p$

(ii) the value of  $q$

(3)

Given that  $P(S | E) = \frac{5}{12}$

- (c) find

(i) the value of  $r$

(ii) the value of  $t$

(4)

- (d) Determine whether or not the events  $(S \cap E')$  and  $G$  are independent. Show your working clearly.

(3)



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Question 4 continued.

Lined area for writing the answer to Question 4.



Question 4 continued.

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Question 4 continued.

(Total for Question 4 is 11 marks)





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Question 5 continued.

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6. The discrete random variable  $X$  has the following probability distribution

$x$	$a$	$b$	$c$
$P(X = x)$	$\log_{36} a$	$\log_{36} b$	$\log_{36} c$

where

- $a, b$  and  $c$  are distinct integers ( $a < b < c$ )
- all the probabilities are greater than zero

(a) Find

- the value of  $a$
- the value of  $b$
- the value of  $c$

Show your working clearly.

(5)

The independent random variables  $X_1$  and  $X_2$  each have the same distribution as  $X$

(b) Find  $P(X_1 = X_2)$

(2)



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Question 6 continued.

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(Total for Question 6 is 7 marks)

**TOTAL FOR STATISTICS IS 50 MARKS**

