

Please check the examination details below before entering your candidate information

Candidate surname

Other names

**Pearson Edexcel  
Level 3 GCE**

Centre Number

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Candidate Number

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**Thursday 16 May 2019**

Afternoon

Paper Reference **8FM0-23**

**Further Mathematics**

**Advanced Subsidiary**

**Further Mathematics options**

**23: Further Statistics 1**

**(Part of options B, E, F and G)**

**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.
- 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 40. There are 4 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 leisure club offers a choice of one of three activities to its 150 members on a Tuesday evening. The manager believes that there may be an association between the choice of activity and the age of the member and collected the following data.

Activity Age $a$ years	Badminton	Bowls	Snooker
$a < 20$	9	3	3
$20 \leq a < 40$	10	10	14
$40 \leq a < 50$	16	15	5
$50 \leq a < 60$	15	13	11
$a \geq 60$	4	19	3

- (a) Write down suitable hypotheses for a test of the manager's belief.

(1)

The manager calculated expected frequencies to use in the test.

- (b) Calculate the expected frequency of members aged 60 or over who choose snooker, used by the manager.

(1)

- (c) Explain why there are 6 degrees of freedom used in this test.

(2)

The test statistic used to test the manager's belief is 19.583

- (d) Using a 5% level of significance, complete the test of the manager's belief.

(2)

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3. Andreia's secretary makes random errors in his work at an average rate of 1.7 errors every 100 words.
- (a) Find the probability that the secretary makes fewer than 2 errors in the next 100-word piece of work.

(2)

Andreia asks the secretary to produce a 250-word article for a magazine.

- (b) Find the probability that there are exactly 5 errors in this article.

(2)

Andreia offers the secretary a choice of one of two bonus schemes, based on a random sample of 40 pieces of work each consisting of 100 words.

In scheme **A** the secretary will receive the bonus if more than 10 of the 40 pieces of work contain no errors.

In scheme **B** the bonus is awarded if the total number of errors in all 40 pieces of work is fewer than 56

- (c) Showing your calculations clearly, explain which bonus scheme you would advise the secretary to choose.

(5)

Following the bonus scheme, Andreia randomly selects a single 500-word piece of work from the secretary to test if there is any evidence that the secretary's rate of errors has decreased.

- (d) Stating your hypotheses clearly and using a 5% level of significance, find the critical region for this test.

(4)

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**Question 3 continued**

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**(Total for Question 3 is 13 marks)**



4. The discrete random variable  $X$  has probability distribution

$x$	-3	-1	1	2	4
$P(X = x)$	$q$	$\frac{7}{30}$	$\frac{7}{30}$	$q$	$r$

where  $q$  and  $r$  are probabilities.

(a) Write down, in terms of  $q$ ,  $P(X \leq 0)$  (1)

(b) Show that  $E(X^2) = \frac{7}{15} + 13q + 16r$  (2)

Given that  $E(X^3) = E(X^2) + E(6X)$

(c) find the value of  $q$  and the value of  $r$  (7)

(d) Hence find  $P(X^3 > X^2 + 6X)$  (4)



**Question 4 continued**

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