

Please check the examination details below before entering your candidate information

Candidate surname	Other names
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Pearson Edexcel
International
Advanced Level

Centre Number

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Candidate Number

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Thursday 21 January 2021

Morning (Time: 1 hour 30 minutes)	Paper Reference WST03/01
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Mathematics
International Advanced Subsidiary/Advanced Level
Statistics S3

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

Total Marks

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Candidates may use any calculator permitted 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 the 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.
- There are 6 questions in this question paper. The total mark for this paper is 75.
- 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.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Turn over ►

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3. The students in a group of schools can choose a club to join. There are 4 clubs available: Music, Art, Sports and Computers. The director collected information about the number of students in each club, using a random sample of 88 students from across the schools. The results are given in Table 1 below.

	Music	Art	Sports	Computers
No. of students	14	28	27	19

Table 1

The director uses a chi-squared test to determine whether or not the students are uniformly distributed across the 4 clubs.

- (a) (i) Find the expected frequencies he should use.

Given that the test statistic he calculated was 6.09 (to 3 significant figures)

- (ii) use a 5% level of significance to complete the test. You should state the degrees of freedom and the critical value used.

(4)

The director wishes to examine the situation in more detail and takes a second random sample of 88 students. The director assumes that within each school, students select their clubs independently. The students come from 3 schools and the distribution of the students from each school amongst the clubs is given in Table 2 below.

School \ Club	Music	Art	Sports	Computers
School A	3	10	9	8
School B	1	11	13	5
School C	11	6	7	4

Table 2

The director wishes to test for an association between a student's school and the club they choose.

- (b) State hypotheses suitable for such a test.

(1)

- (c) Calculate the expected frequency for School C and the Computers club.

(1)

The director calculates the test statistic to be 7.29 (to 3 significant figures) with 4 degrees of freedom.

- (d) Explain clearly why his test has 4 degrees of freedom.

(2)

- (e) Complete the test using a 5% level of significance and stating clearly your critical value.

(2)



Question 3 continued

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Q3

(Total 10 marks)



Question 4 continued

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Q4

(Total 14 marks)



5. Chrystal is studying the lengths of pine cones that have fallen from a tree. She believes that the length, X cm, of the pine cones can be modelled by a normal distribution with mean 6 cm and standard deviation 0.75 cm.

She collects a random sample of 80 pine cones and their lengths are recorded in the table below.

Length, x cm	$x < 5$	$5 \leq x < 5.5$	$5.5 \leq x < 6$	$6 \leq x < 6.5$	$x \geq 6.5$
Frequency	6	14	24	26	10

- (a) Stating your hypotheses clearly and using a 10% level of significance, test Chrystal's belief. Show your working clearly and state the expected frequencies, the test statistic and the critical value used. **(10)**

Chrystal's friend David asked for more information about the lengths of the 80 pine cones. Chrystal told him that

$$\sum x = 464 \quad \text{and} \quad \sum x^2 = 2722.59$$

- (b) Calculate unbiased estimates of the mean and variance of the lengths of the pine cones. **(3)**

David used the calculations from part (b) to test whether or not the lengths of the pine cones are normally distributed using Chrystal's sample. His test statistic was 3.50 (to 3 significant figures) and he did not pool any classes.

- (c) Using a 10% level of significance, complete David's test stating the critical value and the degrees of freedom used. **(3)**
- (d) Estimate, to 2 significant figures, the proportion of pine cones from the tree that are longer than 7 cm. **(2)**

Question 5 continued

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Q5

(Total 18 marks)



