Cambridge International A Level

**Cambridge International Examinations**
Cambridge International Advanced Level

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*0419852400*

**MATHEMATICS** **9709/73**

Paper 7 Probability & Statistics 2 **(S2)** **May/June 2018**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name in the spaces at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions in the space provided. If additional space is required, you should use the lined page at the end of this booklet. The question number(s) must be clearly shown.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 50.

This document consists of **12** printed pages.


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**1** A random variable $X$ has the distribution $B(75, 0.03)$.

**(i)** Use the Poisson approximation to the binomial distribution to calculate $P(X < 3)$. [3]

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**(ii)** Justify the use of the Poisson approximation. [1]

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**2** Amy has to choose a random sample from the 265 students in her year at college. She numbers the students from 1 to 265 and then uses random numbers generated by her calculator. The first two random numbers produced by her calculator are 0.213 165 448 and 0.073 165 196.

**(i)** Use these figures to find the numbers of the first four students in her sample. [2]

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There were 25 students in Amy's sample. She asked each of them how much money, $\$x$, they earned in a week, on average. Her results are summarised below.

$$n = 25 \qquad \Sigma x = 510 \qquad \Sigma x^2 = 13\,225$$

**(ii)** Find unbiased estimates of the population mean and variance. [3]

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**(iii)** Explain briefly what is meant by 'population' in this question. [1]

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**3** A researcher wishes to estimate the proportion, $p$, of houses in London Road that have only one occupant. He takes a random sample of 64 houses in London Road and finds that 8 houses in the sample have only one occupant. Using this sample, he calculates that an approximate $\alpha\%$ confidence interval for $p$ has width 0.130. Find $\alpha$ correct to the nearest integer. [5]

**4** The numbers, $M$ and $F$, of male and female students who leave a particular school each year to study engineering have means 3.1 and 0.8 respectively.

**(i)** State, in context, one condition required for $M$ to have a Poisson distribution. [1]

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Assume that $M$ and $F$ can be modelled by independent Poisson distributions.

**(ii)** Find the probability that the total number of students who leave to study engineering in a particular year is more than 3. [3]

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**(iii)** Given that the total number of students who leave to study engineering in a particular year is more than 3, find the probability that no female students leave to study engineering in that year. [3]

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**5** The time taken for a particular train journey is normally distributed. In the past, the time had mean 2.4 hours and standard deviation 0.3 hours. A new timetable is introduced and on 30 randomly chosen occasions the time for this journey is measured. The mean time for these 30 occasions is found to be 2.3 hours.

**(i)** Stating any assumption(s), test, at the 5% significance level, whether the mean time for this journey has changed. [6]

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**(ii)** A similar test at the 5% significance level was carried out using the times from another randomly chosen 30 occasions.

**(a)** State the probability of a Type I error. [1]

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**(b)** State what is meant by a Type II error in this context. [1]

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**6** The times, in minutes, taken to complete the two parts of a task are normally distributed with means 4.5 and 2.3 respectively and standard deviations 1.1 and 0.7 respectively.

**(i)** Find the probability that the total time taken for the task is less than 8.5 minutes. [4]

**(ii)** Find the probability that the time taken for the first part of the task is more than twice the time taken for the second part. [5]

**7** A random variable $X$ has probability density function defined by

$$\mathrm{f}(x) = \begin{cases} k\left(\dfrac{1}{x^2} + \dfrac{1}{x^3}\right) & 1 \leqslant x \leqslant 2, \\ 0 & \text{otherwise,} \end{cases}$$

where $k$ is a constant.

**(i)** Show that $k = \frac{8}{7}$. [3]

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**(ii)** Find $\mathrm{E}(X)$. [3]

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**(iii)** Three values of $X$ are chosen at random. Find the probability that one of these values is less than 1.5 and the other two are greater than 1.5. [5]

## Additional Page

If you use the following lined page to complete the answer(s) to any question(s), the question number(s) must be clearly shown.

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