Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

MATHEMATICS **9709/61**

Paper 6 Probability & Statistics 2 **May/June 2021**

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

[Turn over

1 Accidents at two factories occur randomly and independently. On average, the numbers of accidents per month are 3.1 at factory *A* and 1.7 at factory *B*.

Find the probability that the total number of accidents in the two factories during a 2-month period is more than 3. [4]

2 The time, in minutes, taken by students to complete a test has the distribution N(125, 36).

(a) Find the probability that the mean time taken to complete the test by a random sample of 40 students is less than 123 minutes. [3]

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(b) Explain whether it was necessary to use the Central Limit theorem in the solution to part **(a)**. [1]

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3 The graph of the probability density function of a random variable X is symmetrical about the line $x = 4$.

Given that $P(X < 5) = \frac{20}{27}$, find $P(3 < X < 5)$. [2]

4 100 randomly chosen adults each throw a ball once. The length, l metres, of each throw is recorded. The results are summarised below.

$$n = 100 \qquad \Sigma l = 3820 \qquad \Sigma l^2 = 182\,200$$

Calculate a 94% confidence interval for the population mean length of throws by adults. [6]

5 On average, 1 in 75 000 adults has a certain genetic disorder.

(a) Use a suitable approximating distribution to find the probability that, in a random sample of 10 000 people, at least 1 has the genetic disorder. [3]

(b) In a random sample of n people, where n is large, the probability that no-one has the genetic disorder is more than 0.9.

Find the largest possible value of n. [4]

6 The probability density function, f, of a random variable X is given by

$$f(x) = \begin{cases} k(6x - x^2) & 0 \leqslant x \leqslant 6, \\ 0 & \text{otherwise,} \end{cases}$$

where k is a constant.

State the value of $E(X)$ and show that $\text{Var}(X) = \frac{9}{5}$. [6]

7 The masses, in kilograms, of large and small sacks of flour have the distributions $N(55, 3^2)$ and $N(27, 2.5^2)$ respectively.

(a) Some sacks are loaded onto a boat. The maximum load of flour that the boat can carry safely is 340 kg.

Find the probability that the boat can carry safely 3 randomly chosen large sacks of flour and 6 randomly chosen small sacks of flour. [5]

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(b) Find the probability that the mass of a randomly chosen large sack of flour is greater than the total mass of two randomly chosen small sacks of flour. [5]

8 At a certain large school it was found that the proportion of students not wearing correct uniform was 0.15. The school sent a letter to parents asking them to ensure that their children wear the correct uniform. The school now wishes to test whether the proportion not wearing correct uniform has been reduced.

(a) It is suggested that a random sample of the students in Grade 12 should be used for the test.

Give a reason why this would not be an appropriate sample. [1]

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A suitable sample of 50 students is selected and the number not wearing correct uniform is noted. This figure is used to carry out a test at the 5% significance level.

(b) State suitable null and alternative hypotheses. [1]

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(c) Use a binomial distribution to find the probability of a Type I error. You must justify your answer fully. [5]

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(d) In fact 4 students out of the 50 are not wearing correct uniform.

State the conclusion of the test, explaining your answer. [2]

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(e) State, with a reason, which of the errors, Type I or Type II, may have been made. [2]

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Additional Page

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