

CANDIDATE
NAME

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9709/61

May/June 2023

1 hour 15 minutes

You will need: List of formulae (MF19)

- 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.

- 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 **12** pages. Any blank pages are indicated.

2

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- 1** In a certain country, 20 540 adults out of a population of 6 012 300 have a degree in medicine.
- (a)** Use an approximating distribution to calculate the probability that, in a random sample of 1000 adults in this country, there will be fewer than 4 adults who have a degree in medicine. [4]

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- (b)** Justify the approximating distribution used in part (a). [2]

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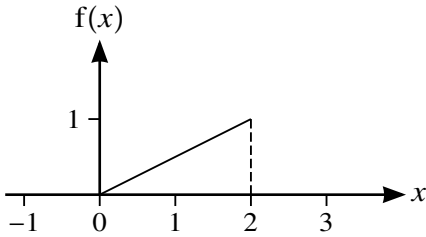
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2 (a)



The graph of the function f is a straight line segment from $(0, 0)$ to $(2, 1)$.

Show that f could be a probability density function. [2]

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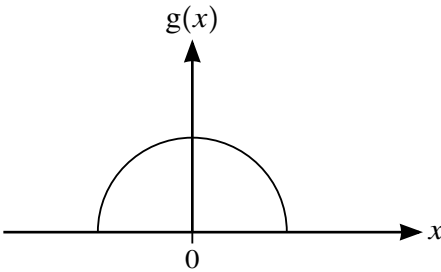
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(b)



The graph of the function g is a semicircle, centre $(0, 0)$, entirely above the x -axis.

Given that g is a probability density function, find the radius of the semicircle. [2]

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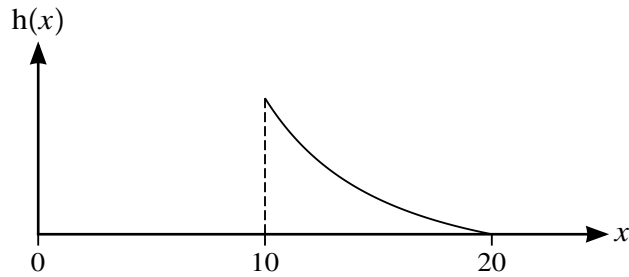
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(c)



The time, X minutes, taken by a large number of students to complete a test has probability density function h , as shown in the diagram.

- (i) Without calculation, use the diagram to explain how you can tell that the median time is less than 15 minutes. [1]

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It is now given that

$$h(x) = \begin{cases} \frac{40}{x^2} - \frac{1}{10} & 10 \leq x \leq 20, \\ 0 & \text{otherwise.} \end{cases}$$

- (ii) Find the mean time. [3]

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[illegible]

4 A certain train journey takes place every day throughout the year. The time taken, in minutes, for the journey is normally distributed with variance 11.2.

- (a) The mean time for a random sample of n of these journeys was found. A 94% confidence interval for the population mean time was calculated and was found to have a width of 1.4076 minutes, correct to 4 decimal places.

Find the value of n . [3]

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- (b) A passenger noted the times for 50 randomly chosen journeys in January, February and March.

Give a reason why this sample is unsuitable for use in finding a confidence interval for the population mean time. [1]

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- (c) A researcher took 4 random samples and a 94% confidence interval for the population mean was found from each sample.

Find the probability that exactly 3 of these confidence intervals contain the true value of the population mean. [2]

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5 Large packets of rice are packed in cartons, each containing 20 randomly chosen packets. The masses of these packets are normally distributed with mean 1010 g and standard deviation 3.4 g. The masses of the cartons, when empty, are independently normally distributed with mean 50 g and standard deviation 2.0 g.

(a) Find the variance of the masses of full cartons. [2]

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Small packets of rice are packed in boxes. The total masses of full boxes are normally distributed with mean 6730 g and standard deviation 15.0 g. The masses of the boxes and cartons are distributed independently of each other.

(b) Find the probability that the mass of a randomly chosen full carton is more than three times the mass of a randomly chosen full box. [5]

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6 A sample of 5 randomly selected values of a variable X is as follows:

1 2 6 1 a

where $a > 0$.

Given that an unbiased estimate of the variance of X calculated from this sample is $\frac{11}{2}$, find the value of a . [3]

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(c) State what is meant by a Type I error in this context. [1]

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(d) During the 4 randomly chosen weeks there are a total of 3 accidents.
State the conclusion that the manager should reach. Give a reason for your answer. [2]

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(e) Assuming that the mean remains 1.9 accidents per week, use a suitable approximation to calculate the probability that there will be more than 100 accidents during a 52-week period. [4]

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[illegible]

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