OXFORD
INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

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Candidate signature _____

I declare this is my own work.

INTERNATIONAL A-LEVEL
MATHEMATICS

(9660/MA04) Unit S2 Statistics

Time allowed: 1 hour 30 minutes

Materials
- For this paper you must have the Oxford International AQA Booklet of Formulae and Statistical Tables (enclosed).
- You may use a graphic calculator.

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.

Advice
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- Show all necessary working; otherwise marks may be lost.

Answer **all** questions in the spaces provided.

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1 (a) Explain what is meant by a statistic.

[2 marks]

1 (b) Explain what is meant by the critical region of a test statistic.

[2 marks]

4

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2 The time T minutes between babies being born in a hospital can be modelled by an exponential distribution with mean 10 minutes.

2 (a) Find $\mathrm{P}(T < 5)$

Give your answer to four significant figures.

[3 marks]

Answer _____

2 (b) Find $\mathrm{P}(8 < T < 14)$

Give your answer to four significant figures.

[2 marks]

Answer _____

5

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3 The continuous random variable X has probability density function defined by

$$f(x) = \begin{cases} \dfrac{4}{(2x+1)^2} & 0 \le x \le a \\ 0 & \text{otherwise} \end{cases}$$

where a is a constant.

3 (a) Show that $a = 0.5$

[4 marks]

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3 (b) Find $P(0.2 < X < 0.4)$

[3 marks]

Answer _____

7

Turn over for the next question

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4 The time, X, that a fully charged laptop battery can be used before it needs to be recharged has a mean of 16 hours.

Following complaints that a recent batch of fully charged laptop batteries have a shorter time before needing recharging, a random sample of 200 laptop batteries was taken.

The results were

$$\sum x = 3\,100 \quad \text{and} \quad \sum x^2 = 50\,300$$

Test whether the mean time has decreased, using the 1% level of significance.

[10 marks]

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10

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5 (a) State three properties of a normal distribution.

[3 marks]

Property 1 _____

Property 2 _____

Property 3 _____

5 (b) The duration of an appointment with a dentist at a dental surgery has a normal distribution with mean 14 minutes and standard deviation 1.2 minutes.

5 (b) (i) Find the probability that the duration of an appointment with the dentist is greater than 17 minutes, giving your answer to four decimal places.

[3 marks]

Answer _____

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5 (b) (ii) A random sample of 50 appointments to the dental surgery is taken.

Find the probability that the sample mean duration of an appointment with the dentist is less than 13.8 minutes, giving your answer to three decimal places.

[4 marks]

Answer _____

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5 (b) (iii) Sana's journey time from the dental surgery to her home has a normal distribution with mean 30 minutes and standard deviation 4 minutes.

The journey time from the dental surgery to her home is independent of the duration of an appointment.

Find the probability that the total time of Sana's appointment and her journey home is less than 35 minutes, giving your answer to four decimal places.

[4 marks]

Answer _____

14

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6 The total number of breakdowns of the boats owned by a transport company can be modelled by a Poisson distribution with parameter 4 breakdowns per week.

6 (a) Find the probability that the total number of boat breakdowns in a week is 3 giving your answer to three significant figures.

[2 marks]

Answer _____

6 (b) The total number of breakdowns of buses owned by the same transport company can be modelled by a Poisson distribution with parameter 2.5 breakdowns per week.

Breakdowns of boats are independent of breakdowns of buses.

The transport company hires a new maintenance company to work on its boats and buses.

Several months later there was a total of 7 breakdowns of boats and buses during a 2-week period.

The maintenance company claims that there has been a reduction in the total number of breakdowns per week of boats and buses.

Test the maintenance company's claim, using the 5% level of significance.

[8 marks]

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10

Turn over ►

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7 According to a television channel, 3% of its viewers watch the channel's local news programme at least once a month.

7 (a) A random sample of 100 viewers is taken.

Using a Poisson approximation, estimate the probability that less than 4 viewers watched the local news programme at least once during the last month, giving your answer to three significant figures.

[4 marks]

Answer _____

7 (b) A random sample of 20 viewers is taken and 3 of the viewers watched the local news programme at least once during the last month.

The television channel claims that the proportion of its viewers that watch the local news programme at least once a month has changed.

7 (b) (i) Carry out a hypothesis test to investigate the television channel's claim, using the 5% level of significance and **no distributional approximations**.

[6 marks]

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7 (b) (ii) Describe, in the context of the test in **part (b)(i)**, a Type I error.

[2 marks]

7 (b) (iii) The test in **part (b)(i)** is repeated with a different random sample of 20 viewers.

Find the probability of making a Type I error.

[3 marks]

Answer

15

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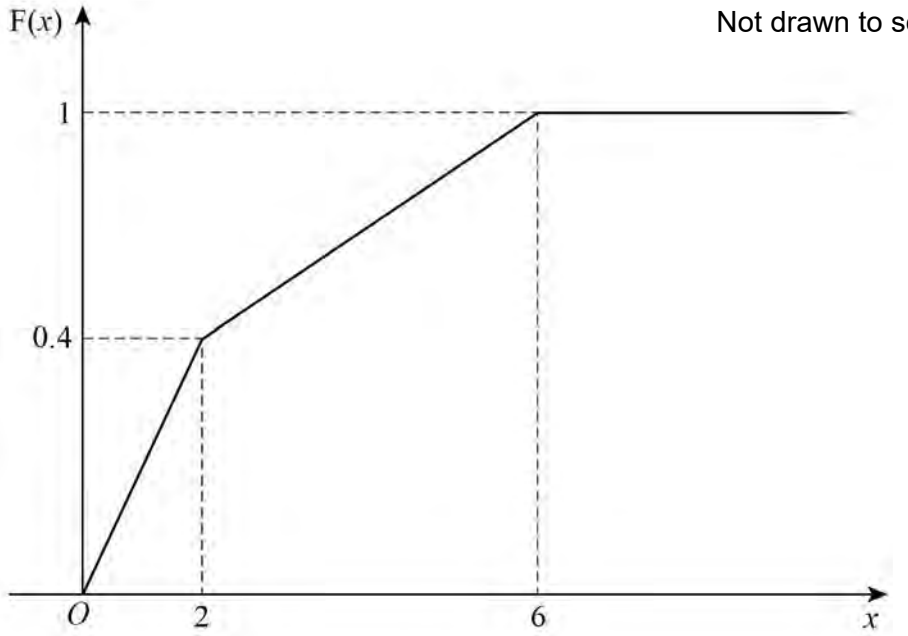
8 The continuous random variable X has cumulative distribution function $\mathrm{F}(x)$ as shown in the graph.



8 (a) Use the graph above to find $\mathrm{F}(x)$

[5 marks]

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Answer

8 (b) Find the probability density function f(x)

[3 marks]

Answer

Question 8 continues on the next page

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8 (c) Find $\mathrm{Var}\left(X^3\right)$ giving your answer to three significant figures.

[7 marks]

Answer _____

15

END OF QUESTIONS

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