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I declare this is my own work.

# INTERNATIONAL A-LEVEL MATHEMATICS

(9660/MA04) Unit S2 Statistics

Tuesday 19 January 2021 07:00 GMT 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 graphical 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.

## 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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
<b>TOTAL</b>	



J A N 2 1 M A O 4 O 1

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

- 1** The means and variances of the independent continuous random variables  $X_1$ ,  $X_2$  and  $X_3$  are given in the table below where  $f$ ,  $g$  and  $h$  are constants.

	Mean	Variance
$X_1$	$f$	$g$
$X_2$	$h$	$g$
$X_3$	$g$	2

- 1 (a)** Find in terms of  $f$ ,  $g$  and  $h$

**1 (a) (i)**  $E(3X_1 + 2X_2 - X_3)$

**[1 mark]**

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Answer \_\_\_\_\_

**1 (a) (ii)**  $\text{Var}(4X_1 - 3X_2)$

**[1 mark]**

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Answer \_\_\_\_\_



$$E(3X_2) = E(X_1)$$

$$E\left(\sum_{n=1}^3 X_n\right) = 7.1$$

$$\text{Var}\left(\sum_{n=1}^3 X_n\right) = 9$$

**[4 marks]**

[illegible]
$$f = \underline{\hspace{2cm}} \qquad g = \underline{\hspace{2cm}} \qquad h = \underline{\hspace{2cm}}$$

6

**[7 marks]**

[illegible]

**2 (b) (i)** Find the probability of making a Type I error in this test.

**[1 mark]**

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Answer \_\_\_\_\_

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

**[1 mark]**

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9

**Turn over for the next question**

**Turn over ►**



- 3** The continuous random variable  $T$  has a cumulative distribution function  $F(t)$  defined by

$$F(t) = \begin{cases} 0 & t < 4 \\ kt^2 - \frac{1}{3} & 4 \leq t \leq 8 \\ 1 & t > 8 \end{cases}$$

where  $k$  is a constant.

- 3 (a)** Find the value of  $k$

**[2 marks]**

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Answer \_\_\_\_\_

- 3 (b)** The probability density function of  $T$  is  $f(t)$

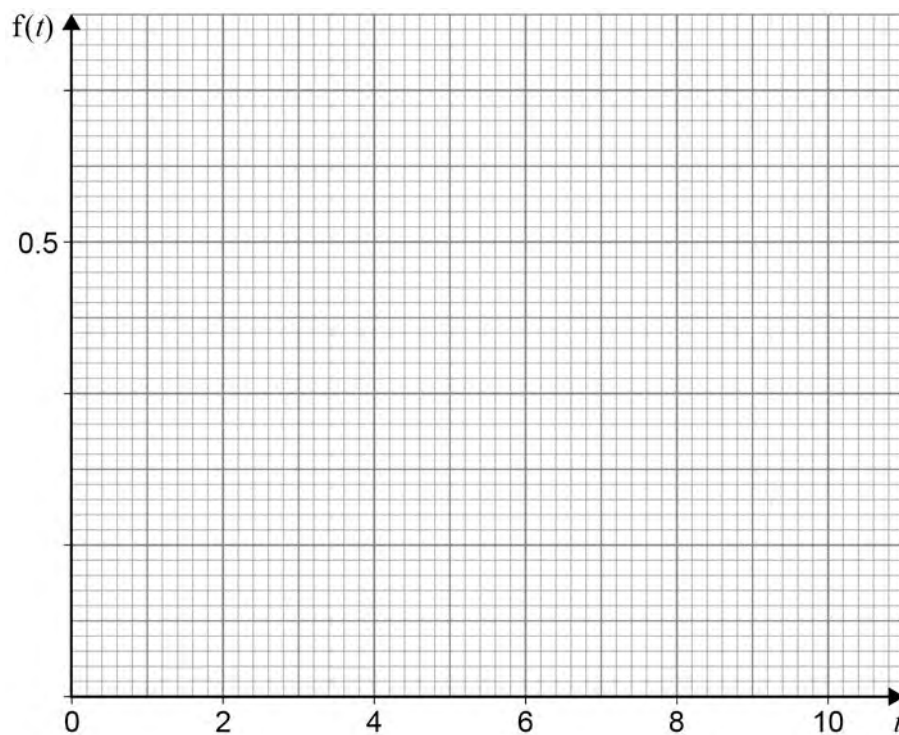
Draw the graph of  $f(t)$  for  $0 \leq t \leq 10$

**[3 marks]**

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A weed treatment prevents weeds growing for a mean of 70 days in areas to which it is applied.

$$\sum x = 7060 \quad \text{and} \quad \sum x^2 = 499\,000$$

**[10 marks]**

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10

- 5 (a)** For a Poisson distribution with  $\lambda = 4$  it is given that

$$P(X = 7) = kP(X = 5)$$

Find the exact value of  $k$

**[3 marks]**

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Answer \_\_\_\_\_

- 5 (b)** When active, a Venus flytrap plant captures flies.  
The leaves of different plants are either red or green.  
The number of flies captured per day by a **red** plant is modelled by a Poisson distribution with mean 2

- 5 (b) (i)** Find the probability of a red plant capturing less than 3 flies on 1 day.  
Give your answer to four significant figures.

**[2 marks]**

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Answer \_\_\_\_\_

- 5 (b) (ii)** Find the probability of a red plant capturing more than 8 and fewer than 17 flies over 7 days.

Give your answer to four significant figures.

**[3 marks]**

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Answer \_\_\_\_\_





- 5 (c)** The number of flies captured per day by a **green** plant is also modelled by a Poisson distribution, but with mean 5

Dave owns one red plant and one green plant. He records the total number of flies captured by his two plants each day for 64 days.

The data recorded by Dave is shown below.

Number of flies captured	1	2	3	4	5	6	7	8	9	10	11	12
Frequency	1	3	3	6	6	7	9	9	8	7	3	2

- 5 (c) (i)** Use this data to find unbiased estimates of the mean and variance of the distribution of the total number of flies captured by his two plants each day.

Give your answers to three significant figures.

**[3 marks]**

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Mean \_\_\_\_\_ Variance \_\_\_\_\_

- 5 (c) (ii)** Dave claims that the number of flies captured by the two plants are independent of each other.

Using your answer in **part (c)(i)**, make **two** statements that support Dave's claim.

**[2 marks]**

Statement 1 \_\_\_\_\_

Statement 2 \_\_\_\_\_



- 6** A vehicle breakdown recovery service records the time taken,  $T$  minutes, between telephone calls requesting vehicle recovery.

It is assumed that  $T$  has an exponential distribution with  $\lambda = 0.2$

- 6 (a)** Find the variance for the time between telephone calls.

**[1 mark]**

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Answer \_\_\_\_\_

- 6 (b)** Katherine answers the telephone calls requesting vehicle recovery.  
She begins work at 8.00 am

Find the probability that Katherine receives a telephone call before 8.15 am  
Give your answer to three significant figures.

**[2 marks]**

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Answer \_\_\_\_\_



Find the probability that she does not receive a telephone call before 8.30 am  
Give your answer to three significant figures.

[illegible]

Give your answer to three significant figures.

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8

$$f(x) = \begin{cases} \frac{1}{60}(10x + x^3) & 1 \leq x \leq 3 \\ 0 & \text{otherwise} \end{cases}$$

**[3 marks]**

[illegible]

Answer \_\_\_\_\_

3



**[7 marks]**

[illegible]

7



$$P(X < 200) = P(X > 170)$$

**[2 marks]**

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**[2 marks]**

[illegible]

Answer \_\_\_\_\_

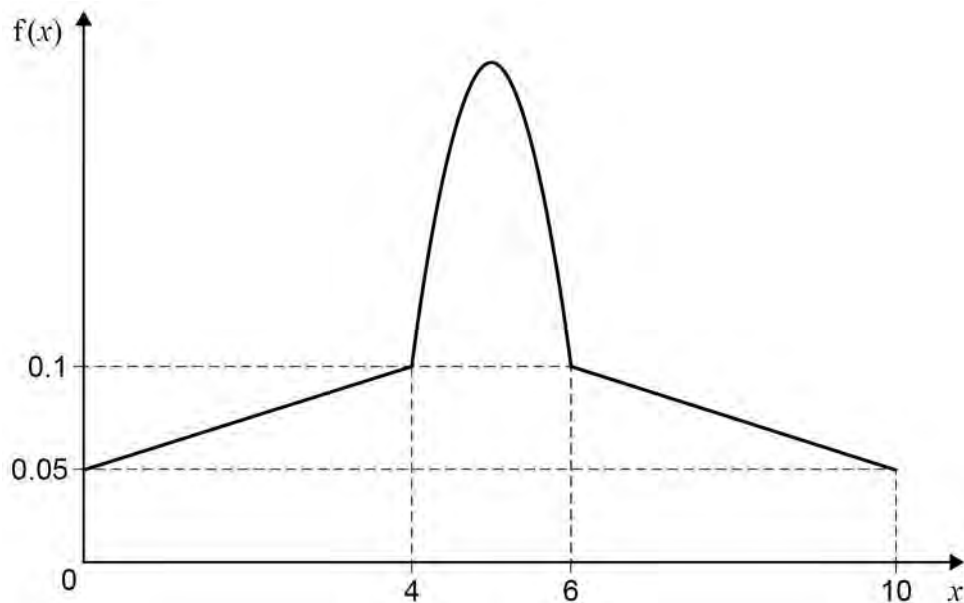


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10

The continuous random variable  $X$  is defined by the probability density function  $f(x)$  and the graph shown below where  $a$ ,  $q$ ,  $n$  and  $b$  are constants.

$$f(x) = \begin{cases} ax + 0.05 & 0 \leq x \leq 4 \\ q - n(x-5)^2 & 4 < x \leq 6 \\ bx + 0.175 & 6 < x \leq 10 \\ 0 & \text{otherwise} \end{cases}$$



The graph is symmetrical

10 (a) State the median of  $X$

[1 mark]

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Answer 

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10 (b) Find the value of  $a$  and the value of  $b$

[3 marks]

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$$a = \underline{\hspace{2cm}}$$

$$b = \underline{\hspace{2cm}}$$

**10 (c)** Find the value of  $n$  and the value of  $q$

**[5 marks]**

$$n = \underline{\hspace{2cm}}$$

$$q = \underline{\hspace{2cm}}$$

**10 (d)** Find  $P(0 < X < 4.5)$

**[2 marks]**

Answer  $\underline{\hspace{2cm}}$

**END OF QUESTIONS**



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