OCR
RECOGNISING ACHIEVEMENT

Thursday 31 May 2012 – Morning

A2 GCE MATHEMATICS

4734 Probability & Statistics 3

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4734
- List of Formulae (MF1)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found in the centre of the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question or is clearly appropriate.

INFORMATION FOR CANDIDATES

This information is the same on the Printed Answer Book and the Question Paper.

- The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
- **You are reminded of the need for clear presentation in your answers.**
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

1 A machine fills packets of flour whose nominal weights are 500 g. Each of a random sample of 100 packets was weighed and 14 packets weighed less than 500 g. The population proportion of packets that weigh less than 500 g is denoted by p.

(i) Calculate an approximate 95% confidence interval for p. **[4]**

(ii) The weights of the packets, in grams, are normally distributed with mean μ and variance 50. Assuming that p=0.14, calculate the value of μ. **[3]**

2 Four pairs of randomly chosen twins were each given identical puzzles to solve. The times taken (in seconds) are shown in the following table.

Twin pair	1	2	3	4
Time for first-born	46	38	44	49
Time for second-born	40	41	37	46

Stating any necessary assumption, test at the 10% significance level whether there is a difference between the population mean times of first-born and second-born twins. **[9]**

3 A charity raises money by sending letters asking for donations. Because of recent poor responses, the charity's fund-raiser, Anna, decides to alter the letter's appearance and designs two possible alternatives, one colourful and the other plain. She believes that the colourful letter will be more successful. Anna sends 60 colourful letters and 40 plain letters to 100 people randomly chosen from the charity's database. There were 39 positive responses to the colourful letter and 12 positive responses to the plain letter. The population proportions of positive responses to the colourful and plain letters are denoted by p_C and p_P respectively. Test the null hypothesis $p_C - p_P = 0.15$ against the alternative hypothesis $p_C - p_P > 0.15$ at the $2\frac{1}{2}$% significance level and state what Anna could report to her manager. **[6]**

4 The time interval, T minutes, between consecutive stoppages of a particular grinding machine is regularly measured. T is normally distributed with mean μ.
24 randomly chosen values of T are summarised by

$$\sum_{i=1}^{24} t_i = 348.0 \text{ and } \sum_{i=1}^{24} t_i^2 = 5195.5.$$

(i) Calculate a symmetric 95% confidence interval for μ. **[5]**

(ii) For the machine to be working acceptably, μ should be at least 15.0.
Using a test at the 10% significance level, decide whether the machine is working acceptably. **[6]**

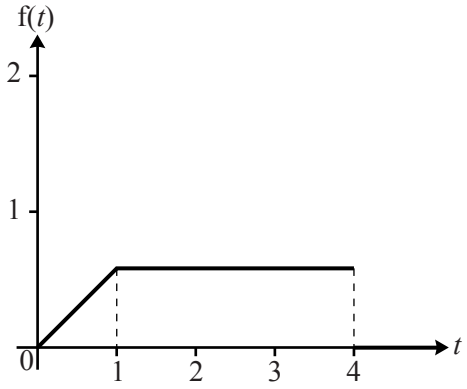
5 The discrete random variables X and Y are independent with $X \sim \text{B}(32, \frac{1}{2})$ and $Y \sim \text{Po}(28)$.

(i) Find the values of $\text{E}(Y - X)$ and $\text{Var}(Y - X)$. **[3]**

(ii) State, with justification, an approximate distribution for $Y - X$. **[3]**

(iii) Hence find $\text{P}(|Y - X| \geqslant 3)$. **[4]**

6



The diagram shows the probability density function f of the continuous random variable T, given by

$$\mathrm{f}(t) = \begin{cases} at & 0 \leqslant t \leqslant 1, \\ a & 1 < t \leqslant 4, \\ 0 & \text{otherwise}, \end{cases}$$

where a is a constant.

(i) Find the value of a. **[2]**

(ii) Obtain the cumulative distribution function of T. **[4]**

(iii) Find the cumulative distribution of Y, where $Y = T^{\frac{1}{2}}$, and hence find the probability density function of Y. **[7]**

7 A study was carried out into whether patients suffering from a certain respiratory disorder would benefit from particular treatments. Each of 90 patients who agreed to take part was given one of three treatments *A, B* or *C* as shown in the table.

Treatment	*A*	*B*	*C*
Number in group	31	25	34

(i) It is claimed that each patient was equally likely to have been given any of the treatments. Test at the 5% significance level whether the numbers given each treatment are consistent with this claim. **[6]**

(ii) After 3 months the numbers of patients showing improvement for treatments *A*, *B* and *C* were 14, 18 and 25 respectively. By setting up a 2 × 3 contingency table, test whether the outcome is dependent on the treatment. Use a 5% significance level. **[8]**

(iii) If one of the treatments is abandoned, explain briefly which it should be. **[2]**

THERE ARE NO QUESTIONS WRITTEN ON THIS PAGE