

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**  
**A2 GCE**

**4733**

**MATHEMATICS**

**Probability & Statistics 2**

**QUESTION PAPER**

**FRIDAY 22 JUNE 2012: Afternoon**

**DURATION: 1 hour 30 minutes**  
**plus your additional time allowance**

**MODIFIED ENLARGED**

**Candidates answer on the Printed Answer Book or any suitable paper provided by the Centre. The Printed Answer Book may be enlarged by the Centre.**

**OCR SUPPLIED MATERIALS:**

**Printed Answer Book 4733**  
**List of Formulae (MF1)**

**OTHER MATERIALS REQUIRED:**

**Scientific or graphical calculator**

**READ INSTRUCTIONS OVERLEAF**

## **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.**
- **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.**

## **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 In one day's production, a machine produces 1000 CDs. Explain how to take a random sample of 15 CDs chosen from one day's production. [2]**
  
- 2 (i) For the continuous random variable  $V$ , it is known that  $E(V) = 72.0$ . The mean of a random sample of 40 observations of  $V$  is denoted by  $\bar{V}$ . Given that  $P(\bar{V} < 71.2) = 0.35$ , estimate the value of  $\text{Var}(V)$ . [4]**  
  
**(ii) Explain why you need to use the Central Limit Theorem in part (i), and why its use is justified. [2]**
  
- 3 It is known that on average one person in three prefers the colour of a certain object to be blue. In a psychological test, 12 randomly chosen people were seated in a room with blue walls, and asked to state independently which colour they preferred for the object. Seven of the 12 people said that they preferred blue. Carry out a significance test, at the 5% level, of whether the statement "on average one person in three prefers the colour of the object to be blue" is true for people who are seated in a room with blue walls. [7]**

**4 In a rock, small crystal formations occur at a constant average rate of 3.2 per cubic metre.**

- (i) State a further assumption needed to model the number of crystal formations in a fixed volume of rock by a Poisson distribution. [1]**

**In the remainder of the question, you should assume that a Poisson model is appropriate.**

- (ii) Calculate the probability that in one cubic metre of rock there are exactly 5 crystal formations. [2]**
- (iii) Calculate the probability that in 0.74 cubic metres of rock there are at least 3 crystal formations. [3]**
- (iv) Use a suitable approximation to calculate the probability that in 10 cubic metres of rock there are at least 36 crystal formations. [5]**

**5 The acidity  $A$  (measured in pH) of soil of a particular type has a normal distribution. The pH values of a random sample of 80 soil samples from a certain region can be summarised as**

$$\Sigma a = 496,$$

$$\Sigma a^2 = 3126.$$

**Test, at the 10% significance level, whether in this region the mean pH of soil is 6.1. [11]**

**6 At a tourist car park, a survey is made of the regions from which cars come.**

**(i) It is given that 40% of cars come from the London region. Use a suitable approximation to find the probability that, in a random sample of 32 cars, more than 17 come from the London region. Justify your approximation. [7]**

**(ii) It is given that 1% of cars come from France. Use a suitable approximation to find the probability that, in a random sample of 90 cars, exactly 3 come from France. [4]**

**7 The continuous random variable  $X$  has probability density function**

$$f(x) = \begin{cases} kx^2 & 0 \leq x \leq a, \\ 0 & \text{otherwise,} \end{cases}$$

**where  $a$  and  $k$  are constants.**

**(i) Sketch the graph of  $y = f(x)$  and explain in non-technical language what this tells you about  $X$ . [3]**

**(ii) Given that  $E(X) = 4.5$ , find**

**(a) the value of  $a$ , [6]**

**(b)  $\text{Var}(X)$ . [3]**

**8 The random variable  $X$  has the distribution  $N(\mu, 8^2)$ . A test is carried out, at the 5% significance level, of  $H_0: \mu = 30$  against  $H_1: \mu > 30$ , based on a random sample of size 18.**

**(i) Find the critical region for the test. [4]**

**(ii) If  $\mu = 30$  and the outcome of the test is that  $H_0$  is rejected, state the type of error that is made. [1]**

**On a particular day this test is carried out independently a total of 20 times, and for 4 of these tests the outcome is that  $H_0$  is rejected. It is known that the value of  $\mu$  remains the same throughout these 20 tests.**

**(iii) Find the probability that  $H_0$  is rejected at least 4 times if  $\mu = 30$ . Hence state whether you think that  $\mu = 30$ , giving a reason. [3]**

**(iv) Given that the probability of making an error of the type different from that stated in part (ii) is 0.4, calculate the actual value of  $\mu$ , giving your answer correct to 4 significant figures. [4]**

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