General Certificate of Education
June 2007
Advanced Level Examination

MATHEMATICS **MS2A/W**
Unit Statistics 2A

Tuesday 5 June 2007 1.30 pm to 2.45 pm

For this paper you must have:
- an 8-page answer book
- the **blue** AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Time allowed: 1 hour 15 minutes

Instructions
- Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
- Write the information required on the front of your answer book. The *Examining Body* for this paper is AQA. The *Paper Reference* is MS2A/W.
- Answer **all** questions.
- Show all necessary working; otherwise marks for method may be lost.
- The **final** answer to questions requiring the use of tables or calculators should normally be given to three significant figures.

Information
- The maximum mark for this paper is 60.
- The marks for questions are shown in brackets.
- Unit Statistics 2A has a **written paper and coursework**.

Advice
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.

Answer **all** questions.

1 Two groups of patients, suffering from the same medical condition, took part in a clinical trial of a new drug. One of the groups was given the drug whilst the other group was given a placebo, a drug that has no physical effect on their medical condition.

The table shows the number of patients in each group and whether or not their condition improved.

	Placebo	**Drug**
Condition improved	20	46
Condition did not improve	55	29

Conduct a χ^2 test, at the 5% level of significance, to determine whether the condition of the patients at the conclusion of the trial is associated with the treatment that they were given. *(10 marks)*

2 The number of telephone calls per day, X, received by Candice may be modelled by a Poisson distribution with mean 3.5 .

The number of e-mails per day, Y, received by Candice may be modelled by a Poisson distribution with mean 6.0 .

(a) For any particular day, find:

(i) $\mathrm{P}(X = 3)$; *(2 marks)*

(ii) $\mathrm{P}(Y \geqslant 5)$. *(2 marks)*

(b) (i) Write down the distribution of T, the total number of telephone calls and e-mails per day received by Candice. *(1 mark)*

(ii) Determine $\mathrm{P}(7 \leqslant T \leqslant 10)$. *(3 marks)*

(iii) Hence calculate the probability that, on each of three consecutive days, Candice will receive a total of at least 7 but at most 10 telephone calls and e-mails. *(2 marks)*

3 David is the professional coach at the golf club where Becki is a member. He claims that, after having a series of lessons with him, the mean number of putts that Becki takes per round of golf will reduce from her present mean of 36.

After having the series of lessons with David, Becki decides to investigate his claim.

She therefore records, for each of a random sample of 50 rounds of golf, the number of putts, x, that she takes to complete the round. Her results are summarised below, where $\bar{x}$ denotes the sample mean.

$$\sum x = 1730 \qquad \text{and} \qquad \sum (x - \bar{x})^2 = 784$$

Using a z-test and the 1% level of significance, investigate David's claim. *(8 marks)*

4 Ten students each independently carried out the same experiment in order to measure, in $\mathrm{m\,s^{-2}}$, the value of g, the acceleration due to gravity, with the following results:

9.75 9.72 9.71 9.69 9.66 9.70 9.72 9.71 9.69 9.65

(a) Assuming that values from the experiment are normally distributed, with mean g, construct a 95% confidence interval for g. *(6 marks)*

(b) It was subsequently discovered that the equipment used in the experiment was faulty. As a consequence, each of the values above is $0.10\,\mathrm{m\,s^{-2}}$ less than the actual value.

Use this additional information to write down a revised 95% confidence interval for g. *(2 marks)*

Turn over for the next question

5 A discrete random variable X has probability distribution as given in the table.

$\boldsymbol{x}$	1	2	3	4
$\mathbf{P}(\boldsymbol{X}=\boldsymbol{x})$	p	p	p	$1-3p$

(a) Show that, for this to be a valid distribution, $0 \leqslant p \leqslant \frac{1}{3}$. *(3 marks)*

(b) (i) Find an expression, in terms of p, for $\mathrm{E}(X)$. *(1 mark)*

(ii) Show that $\mathrm{Var}(X) = 2p(7-18p)$. *(3 marks)*

(c) (i) Find the value of p for which $\mathrm{Var}(X)$ is a maximum. *(2 marks)*

(ii) Find the maximum value of the standard deviation of X. *(3 marks)*

6 The continuous random variable X has the probability density function given by

$$\mathrm{f}(x) = \begin{cases} 3x^2 & 0 < x \leqslant 1 \\ 0 & \text{otherwise} \end{cases}$$

(a) Determine:

(i) $\mathrm{E}\left(\dfrac{1}{X}\right)$; *(3 marks)*

(ii) $\mathrm{Var}\left(\dfrac{1}{X}\right)$. *(4 marks)*

(b) Hence, or otherwise, find the mean and the variance of $\left(\dfrac{5+2X}{X}\right)$. *(5 marks)*

END OF QUESTIONS